BHP Billiton Iron Ore

OREBODY 31

Closure Plan

ML244SA Section 16

Revision A

(draft for consultation)

FEBRUARY 2015

SUBMISSION DETAILS

Company Name:	BHP Billiton Iron Ore
Title of Project	Orebody 31
Document Title	Closure Plan
Document ID	MIN_JMB_ClosurePlan_Orebody31
Document Version No.	Draft – Rev A for technical consultation with the Department of Mines and Petroleum as per the direction of the Office of the Environmental Protection Authority
Catalogue No.	
Date of Submission	February 2015
Mineral Tenements:	AML7000244SA
Contact Details:	
Manager Environment	Ms Soolim Carney – Manager Environment – Operations, Iron Ore Business address: Level 37, City Square 125 St Georges Terrace Perth WA 6000 Mailing address: PO Box 7122 Cloisters Square Perth WA6850 Telephone: +61863213449
Registered Mine Manager	Mr Tim Day – Jimblebar General Manager Business address: City Square 125 St Georges Terrace Perth WA 6000 Mailing address: Executive Office PO Box 655 Newman WA 6753 Telephone: +61891268919
Tenement Holder	C/- WAIO Land Tenure Team PO Box 7474 Cloisters Square Perth WA 6850

Checklist

Mine Closure Plan Checklist		Y/N	Section	Comments
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company?		N/A (draft version)	
2	How many copies were submitted to DMP?		Electronic = 1	
Cover Page, Table of Contents				
3	Does the cover page include; • Project Title. • Company Name. • Contact Details (including telephone numbers and email addresses). • Document ID and version number. • Date of submission (needs to match the date of this checklist).		Cover page	
4	Has a Table of Contents been provided?		Contents	
Scope and Project Summary				
5	State why the Mine Closure Plan being submitted (as part of a Mining Proposal or a reviewed Mine Closure Plan or to fulfil other legal requirements).		Section 1.2	
6	Does the project summary include; • Land ownership details. • Location of the project. • Comprehensive site plan(s). • Background information on the history and status of the project.		Section 2	
Legal Obligations and Commitments				
7	Has a consolidated summary of register of closure obligations and commitments been included?		Section 7	
Data Collection and Analysis				
8	Has information relevant to mine closure been collected from each domain or feature (including pre-mining baseline studies, environmental and other data)?		Section 4	
9	Has a gap analysis been conducted to determine if further information is required in relation to closure of each domain or feature?		Section 7.5	
Stakeholder Consultation				
10	Have all stakeholders involved in closure been identified?		Section 5	
11	Has a summary or register of stakeholder consultation been provided, with details as to who has been consulted and the outcomes?		Section 5.4	

Mine Closure Plan Checklist		**Y/N**	**Section**	**Comments**
Final land use(s) and Closure Objectives				
12	Does the Mine Closure Plan include proposed end land use(s) and closure objectives?		Section 7	
13	Does the Mine Closure Plan identify all potential (or pre-existing) environmental legacies, which may restrict the post closure plan use (including contaminated sites)?		Section 7	
Identification of Management of Closure Issues				
14	Does the Mine Closure Plan identify all key issues impacting the mine closure objectives and outcomes?		Section 7	
15	Does the Mine Closure Plan include proposed management or mitigation options to deal with these issues?		Section 7	
16	Have the process, methodology, and rationale been provided to justify identification and management of all the issues?		Section 7	
Closure Criteria				
17	Does the Mine Closure Plan include an appropriate set of specific closure criteria and/ closure performance indicators?		Section 8	
Closure Financial Provisioning				
18	Does the Mine Closure Plan include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?		Section 9	
19	Does the Mine Closure Plan include a process for regular review of the financial provision?		Section 9	
Closure Implementation				
20	Does the reviewed Mine Closure Plan include a summary of the closure implementation strategies and activities for the proposed operations or for the whole site?		Section 10	
21	Does the Mine Closure Plan include a closure work programme for each domain or feature?		Section 10	
22	Have site layout plans been provided to clearly show each type of disturbance?		Section 2	
23	Does the Mine Closure Plan contain a schedule of research and trial activities?		Section 7.1	
24	Does the Mine Closure Plan contain a schedule of progressive rehabilitation activities?		Section 10.3	
25	Does the Mine Closure Plan include details of how unexpected closure and care and maintenance will be handled?		Section 10.5	
26	Does the Mine Closure Plan contain a schedule of decommissioning activities?		Section 10.4	
27	Does the Mine Closure Plan contain a schedule of closure performance monitoring and maintenance activities?		Section 11	

Mine Closure Plan Checklist		Y/N	Section	Comments
Closure Monitoring and Maintenance				
28	Does the Mine Closure Plan contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?		Section 11	
Closure Information and Data Management				
29	Does the mine closure plan contain a description of management strategies including systems, and processes for the retention of mine records?		Section 12	
30	Confidentiality			

Corporate Endorsement:

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

Name: ________________________ **Signed:** _______________________

Position: ______________________ **Date:** _________________________

NB: The corporate endorsement section must be given by tenement holder(s) or a senior representative authorised by the tenement holder(s), such as a Registered Manager or Company Director.

Contents

List of Appendices

List of tables

List of figures

Abbreviations

Abbreviation	Meaning
AMD	acid and metalliferous drainage
ANC	Acid Neutralising Capacity
ANRA	Australian Natural Resources Atlas
ANZMEC	Australian and New Zealand Minerals and Energy Council
BOCO	Base of complete oxidation
BOM	Bureau of Meteorology
CAP	Corporation Alignment Planning
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DER	Department of Environment Regulation
DMP	Department of Mines and Petroleum
DoW	Department of Water
EIL	Ecological Investigation Level
EMS	environmental management system
EPA	Western Australian Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
GLD	Group Level Document
IBRA	Interim Biogeographic Regionalisation for Australia
lcm	Loose cubic metres
LOR	Limit of Reporting
MCA	Minerals Council of Australia
MCP	Mine Closure Plan
NAF	non-acid forming
NAPP	net acid production potential

Abbreviation	Meaning
OSA	overburden storage area
PAF	potentially acid forming
RULSE	Revised Universal Soil Loss Ecosystem
S	Sulfur
SRE	short range endemic
WEPP	Water Erosion Prediction Project

1 Scope and purpose

1.1 Project background

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) proposes to develop and operate a new iron ore deposit at Orebody 31 (the Project), located approximately 40 kilometres (km) east of Newman in the Pilbara Region of Western Australia (Figure 1). The Project is located immediately east of the existing Orebody 18 Hub Mine on Mineral Lease 244SA (Table 1, Figure 2). The Orebody 18 deposit is reaching the end of its economic life, with available ore reserves expected to be depleted by 2019. Additional ore sources are required to provide sufficient blend feed in order to maintain the current level of iron ore production from the Eastern Pilbara mines. The Project is located immediately adjacent to the Orebody 18 Mine Hub, which provides opportunities to create integrated mine waste strategies.

The Project ore resource has been estimated at approximately 500 Million tonnes (Mt) and is anticipated to have an operating life of 30 years.

Table 1: Tenements underlying the Project area

Lease	Description	Grant date	Expiry date
ML244SA	Mineral Lease 244SA	7 April 1967	6 April 2030

1.2 Purpose of plan

This Mine Closure Plan (MCP) provides an overview of how the Project will be rehabilitated and closed in accordance with the Department of Mines and Petroleum (DMP)/Environmental Protection Authority (EPA) *Guidelines for Preparing Mine Closure Plans* (DMP/EPA Guidelines, 2011).

This MCP will be used by BHP Billiton Iron Ore and its contractors in the implementation of appropriate rehabilitation and mine closure strategies at the Project, inclusive of proposed modifications. Where there is any conflict between the provisions of this Mine Closure Plan and statutory requirements, the statutory requirements are to take precedence.

This MCP will be revised at intervals of not more than five years[1]. This revision timeline is consistent with the DMP/EPA Guidelines, and with Western Australian Iron Ore's (WAIO) strategic approach to closure planning across its Pilbara assets.

1.3 Relationship of this plan to other adjacent mines

The Project area is located adjacent to the Orebody 18 Mine Hub. The Orebody 18 Mine Hub is subject to a separate MCP which has recently been revised and will be submitted to the OEPA for review and endorsement.

Future reviews of the Orebody 18 Mine Hub and this MCP may be consolidated into a single plan based on the interdependence of the infrastructure and waste strategies for the deposits.

[1] [1] As agreed with DMP in consultation 29th January 2015 (Table 13)

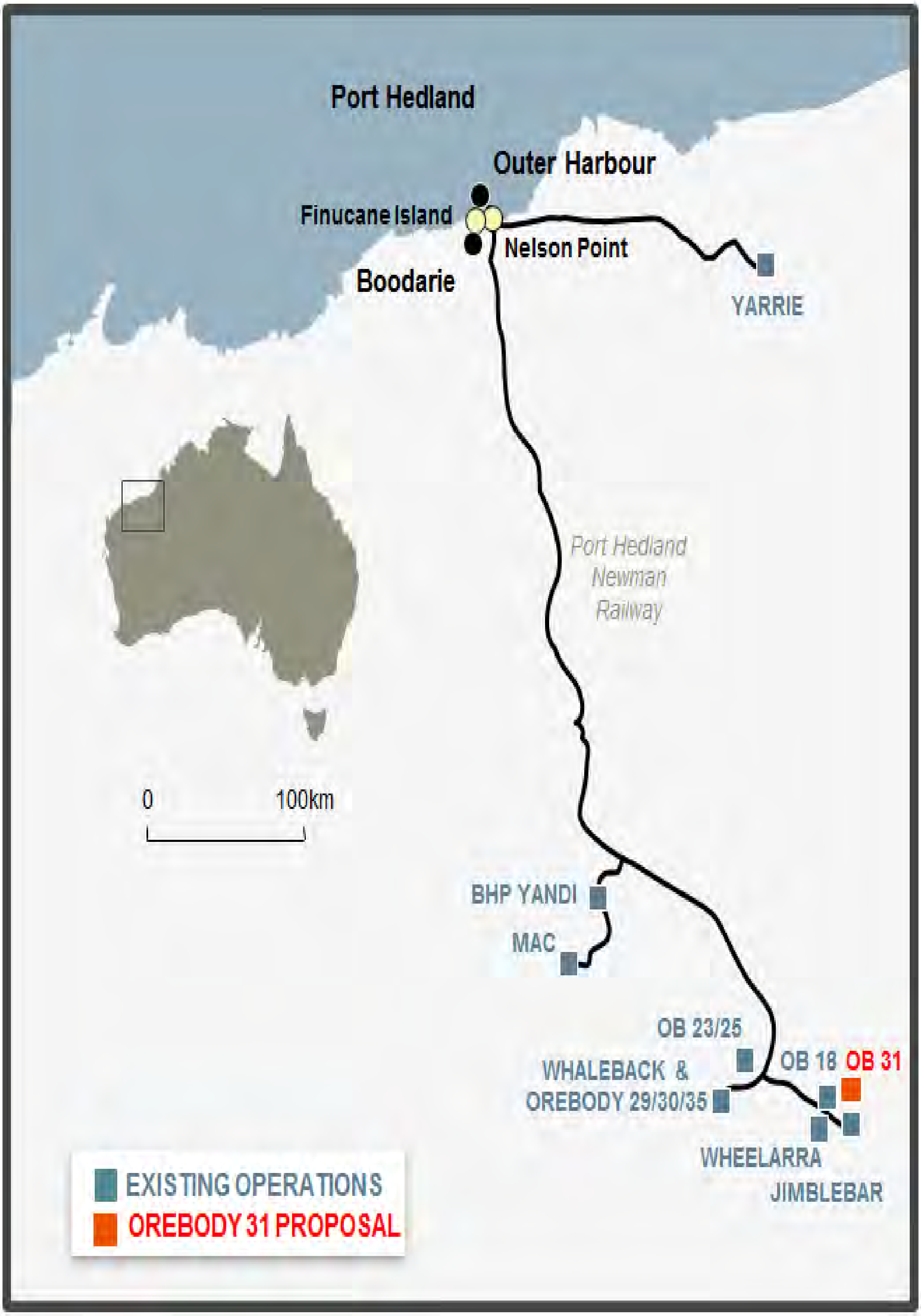
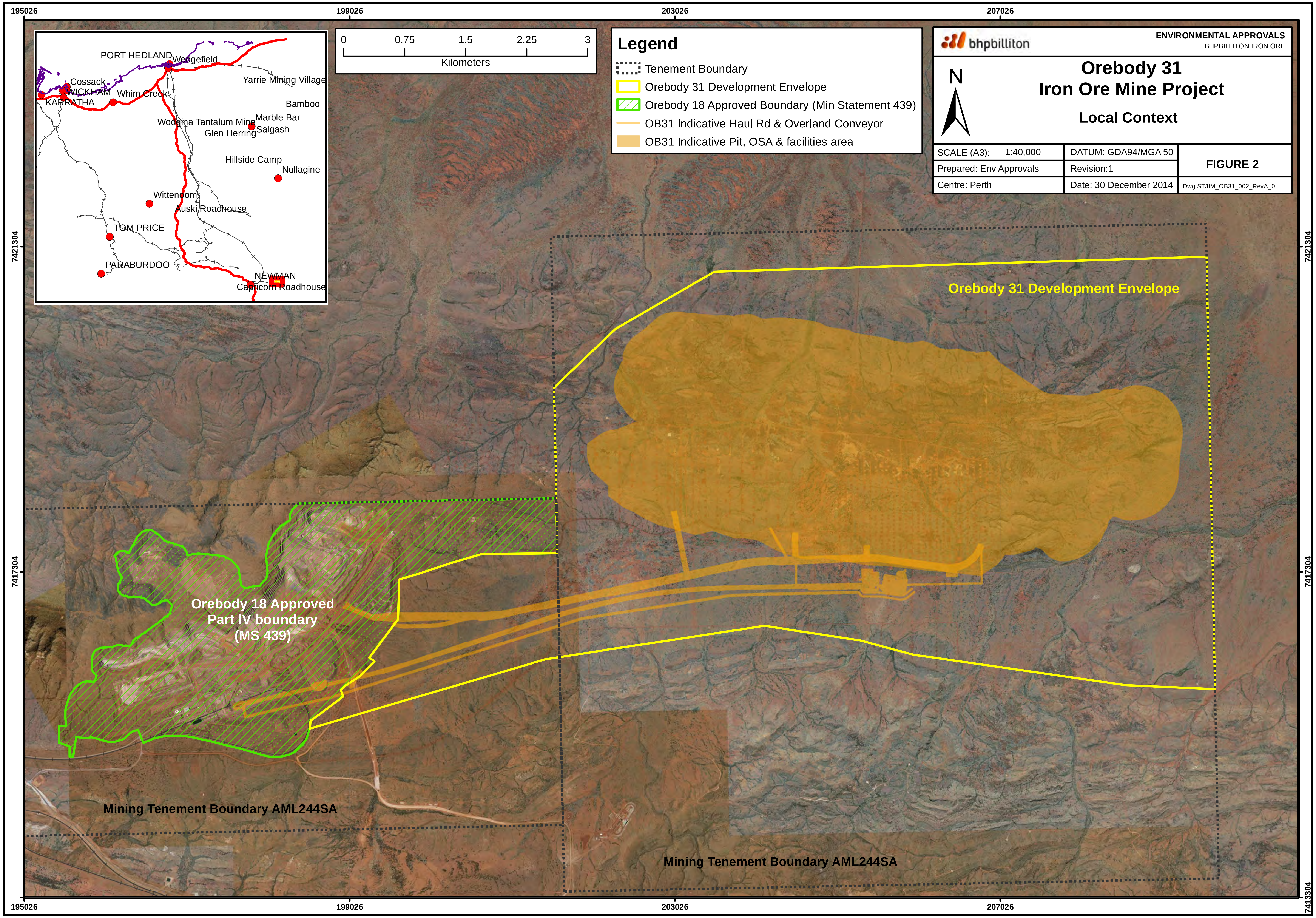


Figure 1: Orebody 31 Regional location


195026
199026
203026
207026
7421304
7417304
7413304
PORT HEDLAND
Wedgefield
Cossack
WICKHAM
KARRATHA
Whim Creek
Yarrie Mining Village
Bamboo
Wodgina Tantalum Mine
Marble Bar
Glen Herring
Salgash
Hillside Camp
Nullagine
Wittenoom
Auski Roadhouse
TOM PRICE
PARABURDOO
NEWMAN
Capricorn Roadhouse
0 0.75 1.5 2.25 3
Kilometers
Legend
Tenement Boundary
Orebody 31 Development Envelope
Orebody 18 Approved Boundary (Min Statement 439)
OB31 Indicative Haul Rd & Overland Conveyor
OB31 Indicative Pit, OSA & facilities area
bhpbilliton
ENVIRONMENTAL APPROVALS
BHPBILLITON IRON ORE
N
Orebody 31
Iron Ore Mine Project
Local Context
SCALE (A3): 1:40,000
DATUM: GDA94/MGA 50
Prepared: Env Approvals
Revision:1
Centre: Perth
Date: 30 December 2014
FIGURE 2
Dwg:STJIM_OB31_002_RevA_0
Orebody 31 Development Envelope
Orebody 18 Approved
Part IV boundary
(MS 439)
Mining Tenement Boundary AML244SA
Mining Tenement Boundary AML244SA

1.4 BHP Billiton Business Guidance

BHP Billiton is committed to environmental stewardship. The BHP Billiton Charter is the overarching document that articulates the corporate vision and values and what BHP Billiton stands for. The first value in the Company Charter is:

> *Sustainability: putting health and safety first, being environmentally responsible and supporting our communities.*

This commitment provides the starting point from where the mine closure and rehabilitation policy and procedures begin. The remaining values are integrity, respect, performance, simplicity and accountability.

A series of Group Level Documents (GLDs) that underpin the Charter have been developed, which describe the performance requirements and accountabilities for definitive business obligations, processes, functions and activities. Compliance with the GLDs ensures reputations are managed and minimum standards are met for all BHP Billiton operations.

The GLDs are the foundation for developing and implementing management systems. The GLDs considered relevant to Mine Closure include:

- Environment GLD.009 - establishes the performance requirements for the management of land, biodiversity, water, air, greenhouse gases, hydrocarbons and wastes; the latter including waste rock and tailings (BHP Billiton 2014);
- Risk Management GLD.017 - establishes the performance requirements for the assessment, control, monitoring and reporting of material risks that could impact the purpose and business plans. It includes risk rankings for both environmental and community aspects (BHP Billiton 2013a);
- Corporation Alignment Planning GLD.034 - represents an annual cycle of key activities (known as the CAP cycle) designed to focus the organisation on achieving Our Purpose and Our Strategy by facilitating robust debate, informed decision-making and the disciplined delivery of quality planning outcomes. Mine closure planning is specifically addressed in the annual cycle ensuring closure liabilities, risks and requirements are appropriately managed (BHP Billiton 2013b); and
- Major Capital Projects (Minerals) GLD.031 - defines the performance requirements for the initiation, development, execution, close out and transition to operations phases of minerals (including iron ore) major capital projects. It sets out the minimum study requirements for each of these phases including studies specifically related to closure and rehabilitation planning (BHP Billiton 2013c). From the Charter and GLDs flow various business level documents and procedures that provide a framework for the application of the corporate vision and values with respect to mine closure planning and rehabilitation. These include for example:
  - West Australian Iron Ore (WAIO) Rehabilitation Standard 0001074;
  - WAIO Closure Planning - Business Planning Procedure 0005144;
  - WAIO Acid and Metalliferous Drainage Management Standard 0096370;
  - BHP Billiton Iron Ore Environment, Land and Biodiversity Management 0044650 Version 001;
  - BHP Billiton Iron Ore Environmental Monitoring, Data Management and reporting Procedures 0045364 Version 1;
  - WAIO Mine Planning Standard STD-PLN-MPL-001;
  - Life of Mine Plan – Overburden Storage Area Design 0001259; and
  - WAIO Water Management Standard 002461 Version 001.

2 Project Summary

2.1 Ownership

The Project area is situated wholly within ML244SA (**Figure 2**) which is operated by BHP Billiton Iron Ore on behalf of the Mount Newman Joint Venture. The Mount Newman Joint Venture partners are as follows:

- BHP Billiton Minerals Pty Ltd (85%);
- Mitsui - Itochu Iron Pty Ltd (10%); and
- Itochu Minerals and Energy of Australia Pty Ltd (5%).

The contact details for BHP Billiton Iron Ore are:

BHP Billiton Iron Ore Pty Ltd

City Square

125 St Georges Terrace

PERTH WA 6000

Phone: 6321 6000

2.2 Project overview

BHP Billiton Iron Ore proposes to develop and operate a new mine at Orebody 31 with the intent to extract up to 30 Million tonnes per annum (Mtpa). The Project involves campaign mining of iron ore and overburden through conventional open cut mining methods.

The Project will be supported by existing infrastructure and facilities at the existing Orebody 18 Mine Hub and the Wheelarra Hill (Jimblebar) Mine Hub. This reflects BHP Billiton Iron Ore's 'Hub-based' approach whereby new deposits are developed immediately adjacent to existing operations and infrastructure. The positive outcome of this approach is smaller footprints for new expansions, which in turn, results in less rehabilitation requirements at the closure stages of the Project.

Overburden for the new Project will be stockpiled in approved Overburden Storage Areas (OSAs). In line with the BHP Billiton Iron Ore's aim of minimising footprints, where possible, overburden may also be placed back into the pit void/s within either the Project area or within adjacent Orebodies 17 and 18 to assist in achieving closure objectives for various deposits.

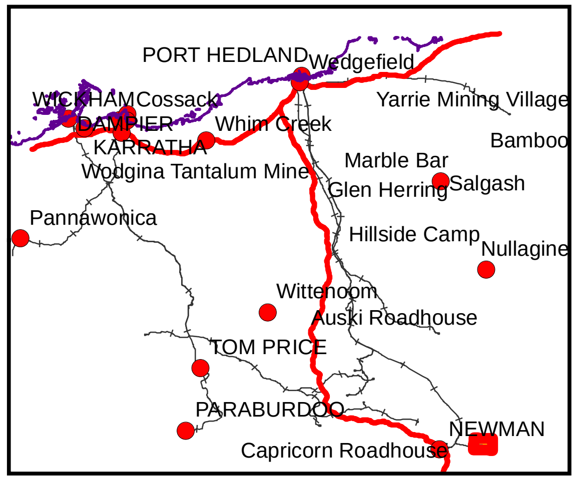
Topsoil, where recoverable, will first be removed and placed into stockpile areas for later use in rehabilitation. The likelihood of encountering small volumes of potentially acid-forming (PAF) material is probable given the lithologies underlying the Orebody 31 pit (i.e. Mount McRae Shale).

2.3 Closure domains

To facilitate effective mine closure planning, the Project mining operations have been divided into a number of physically distinct domains and features (Figure 3 and Table 2). The domains are comprised of features that have similar rehabilitation and closure requirements.

Description of clearing

Infrastructure and ancilliary	520 ha
Pit area	778 ha
Overburden storage areas	952 ha
Topsoil stockpiles (final location yet to be determined)	250 ha
Total:	2,500 ha



0 0.75 1.5 2.25 3
Kilometers

ENVIRONMENTAL APPROVALS
BHPBILLITON IRON ORE

N

Orebody 31 Iron Ore Mine Project

Project clearing domains

SCALE (A3): 1:40,000	DATUM: GDA94/MGA 50	FIGURE 3
Prepared: Env Approvals	Revision:0	
Centre: Perth	Date: 12 February 2015	Dwg:STJIM_OB31_004_RevA_0

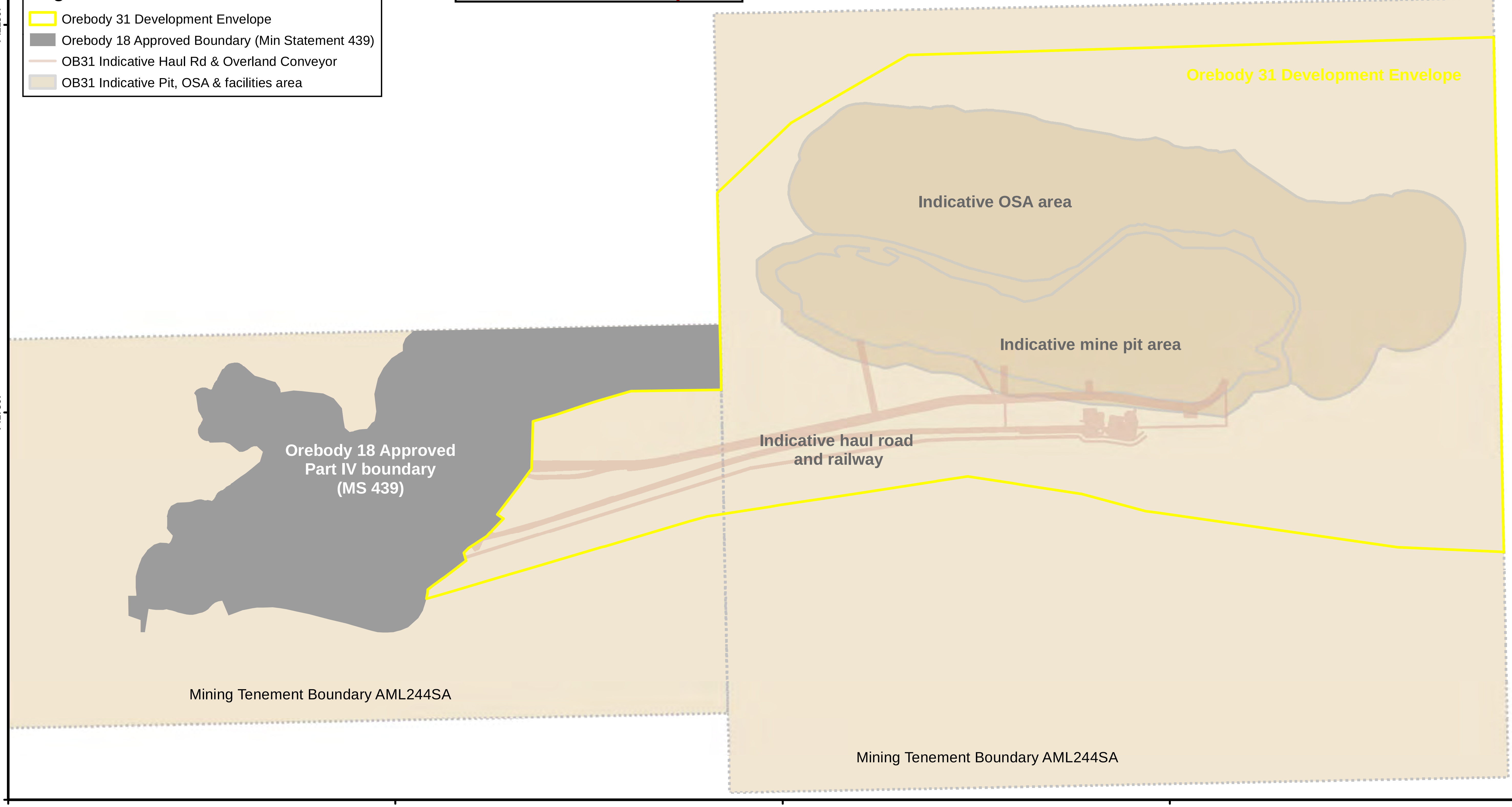


Table 2: Domains of the Project as categorised in the in the Proposal application document submitted to the Environmental Protection Authority (BHP Billiton Iron Ore, 2015)

Domain
Overburden Storage Areas*
Infrastructure and ancillary
Pit area (mine void)
Topsoil stockpiles (actual footprint yet to be determined)

*Based on worst-case scenario of no-back-fill.

3 Closure obligations and commitments

3.1 Legislative requirements

The management measures contained within this MCP have been developed with reference to State government rehabilitation requirements, policies and guidance statements, which are summarised below.

The *Environmental Protection Act 1986* (EP Act) provides for the establishment of the Office of the Environmental Protection Authority (OEPA) to support the EPA and has the objective of overseeing the prevention, control and abatement of pollution and environmental harm, and the conservation, preservation, protection, enhancement and management of the environment. The EPA considers mine closure and rehabilitation plans as part of the formal assessment for mining projects under Part IV of the EP Act.

EPA guidance notes and position statements relevant to mine closure include:

- DMP/ EPA Guidelines for Preparing Mine Closure Plans (2011).
- EPA Guidance Statement Number 6: Rehabilitation of Terrestrial Ecosystems (2006).
- EPA Guidance Statement Number 33: Environmental Guidance for Planning and Development (2008).
- EPA Position Statement Number 2: Environmental Protection of Native Vegetation in Western Australia (2000).
- EPA Position Statement Number 5: Environmental Protection and Ecological Sustainability of the Rangelands in Western Australia (2004a).
- EPA Position Statement Number 7: Principles of Environmental Protection (2004b).
- EPA Position Statement Number 8: Environmental Protection in Natural Resource Management (2005).

3.1.1 Ministerial Statement

A Proposal under section 38 of the EP Act is currently being referred to the EPA for assessment in February 2015. It is anticipated that this Mine Closure Plan will form part of the conditions of the Ministerial Statement.

3.1.2 Permits, licenses and regulatory approvals

The EP Act and subsidiary Regulations require permits and licences to be obtained prior to commencement of prescribed activities. These permits, licences and regulatory approvals may contain legally binding obligations relating to rehabilitation or closure. Prior to Project commissioning, an operating licence will be obtained for activities which may trigger a prescribed premise under the Environmental Protection Regulations 1987.

3.1.3 Mining Act 1978

The Project is not located within tenure granted under the *Mining Act 1978*, and therefore Sections 84 and 162 of the Act are not applicable.

3.1.4 Iron Ore (Mount Newman) Agreement Act 1964

The Project area is subject to the *Iron Ore (Mount Newman) Agreement Act 1964*.

The *Guidelines for Preparing Mine Closure Plans* (DMP and EPA, 2011) requires that mine closure be managed through Part IV of the EP Act on tenements subject to a State Agreement Act.

The State Agreement Acts essentially defer environmental compliance (including closure and rehabilitation) to the applicable environment legislation.

3.2 Closure guidelines and industry standards

BHP Billiton Iron Ore governs closure planning, on a corporate level, by GLD.034 Corporation Alignment Planning (BHP Billiton Iron Ore 2013b). The purpose of this document is to ensure closure planning is included in the Business Planning Processes from "Cradle-to-Grave".

This MCP has been prepared to satisfy the relevant components of BHP Billiton's Corporation Alignment Planning process, and finalised for external review in line with the DMP/EPA Guidelines. In addition, this MCP incorporates relevant aspects from other closure guidelines and industry standards. A list of relevant publications and a brief summary of their content is provided below.

- *Strategic Framework for Mine Closure.* This handbook was prepared by the Minerals Council of Australia (MCA), and the Australian and New Zealand Minerals and Energy Council (ANZMEC) in 2000. It outlines strategic framework concepts associated with stakeholder involvement, planning, financial provision, implementation, standards, and relinquishment. Examples of best practice are also included.
- *Mine Closure and Completion*. This document was prepared by the Department of Industry, Tourism and Resources in October 2006 as part of an Australian Government initiative Leading Practice Sustainable Development Program for the Mining Industry. The publication addresses sustainable development and closure, mine life phases, planning during the operational phase and mine completion and relinquishment, including case studies.
- *Managing Acid and Metalliferous Drainage*. This handbook is one within the Leading Practice Sustainable Development in Mining Series, and was prepared by the Department of Industry, Tourism and Resources in February 2007. It encompasses social, economic and environmental aspects of the various mining phases, addressing the decision making, regulatory framework, identification and prediction, risk, minimisation, control and treatment, monitoring and performance evaluation and management processes of acid and metalliferous drainage (AMD). Case studies are also included.
- *Mine Rehabilitation*. This handbook was published in October 2006 within the Leading Practice Sustainable Development in Mining Series by the Department of Industry, Tourism and Resources. It outlines sustainable development and mine rehabilitation, planning, operations, and closure, and includes case studies addressing these aspects of mine rehabilitation.

4 Collection and analysis of closure data

The following section provides a summary of details on the physical and biological environment within and surrounding the Project area including:

- local climatic conditions;
- local environmental conditions – topography, geology and hydrogeology;
- local and regional information on flora, fauna and subterranean fauna;
- local water resources details – type, location, extent, hydrology, quality, quantity and environmental values (ecological and beneficial uses); and
- soil and waste materials characterisation.

This information provides a basis to develop completion criteria and performance indicators for closure monitoring and performance.

The proposed preliminary closure management of the mining operations is based on understanding the surrounding environment and the outcomes of monitoring and research trials.

4.1 Interim Biogeographic Regionalisation of Australia

The Australian Natural Resources Atlas (ANRA) identifies 85 bioregions across Australia and 403 subregions. The BHP Billiton Iron Ore operations are located within the Pilbara region of WA in the Interim Biogeographic Regionalisation of Australia (IBRA).

The Pilbara region, which actively drains into the Fortescue, De Grey and Ashburton River systems is divided into four subregions; Chichester (*PIL 1*), Fortescue Plains (*PIL 2*), Hamersley (*PIL 3*) and Roebourne (*PIL 4*). The Project area lies within the Fortescue subregion.

4.2 Climate

The Project is located in the Pilbara region of Western Australia which has an arid climate and experiences regular cyclonic activity during November to March. Characteristic climatic features of the region include seasonally low rainfall with high temperatures, high evaporation rates and a high daily temperature range.

Climatic information described in this section has been sourced from the closest operating Bureau of Meteorology (BOM) station at Newman (BOM station number 007176).

4.2.1 Rainfall and evaporation

Rainfall in the Pilbara is highly variable with annual evaporation exceeding rainfall by as much as 2,500mm per year. Highest rainfall events are typically associated with cyclonic activity and thunderstorms, which are common in the Pilbara region with approximately 20 to 30 occurring per year. In 2013, the Newman area received approximately 322.8mm of rain with approximately 156.4mm of this occurring in January and December (BOM, 2014). The annual mean rainfall was 325.8mm for the period 1971 to 2013.

The highest daily rainfall event occurred in December 1999 with approximately 214 mm recorded, with the second highest daily rainfall event occurring in January 1973 with approximately 138 mm recorded (BOM, 2014).

4.2.2 Temperature

Temperatures are generally high, with average maximum monthly temperatures at Newman ranging between 23°C in June to 39°C in January. Average minimum monthly temperatures at Newman range from 6°C in July to 25°C in January. The hottest temperature experienced at Newman was 47°C in January 1998.

4.2.3 Climate change impacts

The predicted annual and seasonal temperature and rainfall changes for the Project area have been obtained using the Commonwealth Scientific and Industrial Research Organisation (CSIRO) OzClim system for the medium climate sensitivity and the A1B emission scenario for years 2030 and 2070, shown in Table 3 and Table 4 (CSIRO 2012).

The current climate change prediction information suggests a wide range of potential scenarios, for example, annual rainfall in 2070 may vary from 1990 by -50 mm to -25 mm. Rehabilitation strategies which take into consideration the effects of climate change are addressed in Section 7.

Table 3: Predicted Seasonal and Annual Temperature Increase (Relative to 1990) for the Project area

Season	2030 (°C)	2070 (°C)
Annual	1.0 to 2.0	3.0 to 4.0
Summer	1.0 to 2.0	3.0 to 4.0
Autumn	1.0 to 2.0	3.0 to 4.0
Winter	1.0 to 2.0	3.0 to 4.0
Spring	1.0 to 2.0	3.0 to 4.0

Table 4: Predicted Seasonal and Annual Rainfall Change (Relative to 1990) for the Project area

Season	2030 (mm)	2070 (mm)
Annual	-25 to 0	-50 to -25
Summer	-20 to -10	-30 to -20
Autumn	-10 to 0	-10 to 0
Winter	0 to 10	-10 to 0
Spring	-10 to 0	-10 to 0

4.3 Overburden characteristics

Overburden materials at BHP Billiton Iron Ore sites are characterised at a high level based on their geological, geochemical, and physical characteristics. This characterisation process allows BHP Billiton Iron Ore to identify waste types and manage their disposal appropriately, including segregation and selective disposal of PAF overburden. This approach is consistent with the *Mine Closure and Completion guideline* (Department of Industry, Tourism and Resources, 2006) and *Managing Acid and Metalliferous Drainage Handbook* (Department of Industry, Tourism and Resources, 2007).

4.3.1 Geological overview

The stratigraphy of the orebody within the Project area is mainly of the Hamersley Group, which is a 2.5km thick sequence of predominantly deep water chemical sediments with lesser turbidites and intrusives. Lithologies include banded iron formation (BIF), hemipelagic shales, dolomite, chert, tuff and turbiditic volcanics. Historical drilling in the Project area has encountered stratigraphy from Mt Sylvia Formation through to the upper units of the Joffre Member of the Brockman Iron Formation.

The main geologic formations in the Hamersley Group include:

- Marra Mamba Iron Formation;

- Wittenoom Formation;
- Mt. Sylvia Formation;
- Mt. McRae Shale Formation;
- Brockman Iron Formation; and
- Tertiary sediments.

Figure 4 illustrates the stratigraphic units which have been recorded in the Hamersley area.

Historical drilling in the Project area encountered stratigraphy from Mt Sylvia Formation through to the upper units of the Joffre Member of the Brockman Iron Formation. The FY12 drilling program intersected a full stratigraphic sequence extending from the Bee Gorge Member of the Wittenoom Formation through to the Boolgeeda Iron Formation at the top of the Hamersley Group and Kungarra Formation of the Turee Creek Group.

The following stratigraphic units have been recorded in the Project area to date.

Wittenoom Formation

The Wittenoom Formation comprises the West Angela, Paraburdoo and Bee Gorge Members. Lithology of the West Angela Member varies across the Pilbara Province and ranges from interbedded dolomite and shaley dolomite in the west to interbedded shales and chert with rare dolomite beds in central and western parts. This variability is believed to reflect either the degree of weathering and alteration of the original dolomite (e.g. Blockley *et al*. 1993) or a true depositional facies change. Manganese appears to be present especially where the underlying Mount Newman BIF is altered or enriched.

The Paraburdoo Member consists of a well bedded crystalline dolomite with interbedded chert and shale. Its thickness is not well understood but varies between approximately 120m at Mesa Gap OB34, just south of the Project area, to 500m at South Alligator (Kepert 2001).

The Bee Gorge Member comprises high energy turbiditic sediments with interbedded dolomite, shales and chert and several tuff beds. The average thickness varies in between 140m and 210m (Simonson *et al* 1993).

Mt Sylvia Formation and Mt McRae Shale

The Mt. Sylvia Formation is a 50-60m thick sequence comprising interbedded shale, chert and BIF. The top of the formation is marked by Bruno's band which consists of a 5-10m thick interval of dark well micro banded BIF.

The Mt McRae Shale is subdivided into three facies units according to the BHP Billiton Iron Ore classification. These units consist of massive carbonate and cherts at the bottom and pyritic carbonaceous shales and chert at the top. The total thickness of the three units is 30-40m.

Brockman Iron Formation

The Brockman Iron Formation is 120-180m thick and comprises the Dales Gorge, Whaleback Shale, Joffre and Yandicoogina Shale Members. The Dales Gorge Member is subdivided into four units each of which consists of interbedded well micro banded BIF and shale bands. Subdivision is based on the relative frequency of the BIF and shale bands with D1 and D3 containing more shale bands and D2 and D4 comprising more frequent BIF intervals. The Whaleback Shale Member comprises 30-50m of fissile shales with chert mesobands. The most prominent marker bed is the Central Chert Band which is up to 3m thick.

The Joffre Member is an up to 250m thick sequence of interbedded BIF and shale with 6 subunits. J1 is a shale rich basal unit which grades into a more monotonous J2 BIF with occasional thin shale bands. J3 and J5 have several thick interbedded shale units, where J4 is has more BIF, J6 is an up to 120m of thick monotonous sequence of chert rich BIF.

The Yandicoogina Shale Member comprises interbedded shales and cherts and is intruded by frequent dolerite sills.

Weeli Wolli Formation and Woongarra rhyolite

The Weeli Wolli Formation is up to 300m thick and consists of alternating beds of red or black micro banded BIF, red chert and tuffaceous shale with abundant dolerite intrusions.

The Woongarra Rhyolite consists of three subunits. The lowermost unit is a massive rhyolite and is overlain by BIF, dolerite and shale (the median raft complex). The upper unit consists of a massive and porphyritic rhyolite and is capped by 10-20m of interbedded tuff and chert.

Boolgeeda Iron Formation

The Boolgeeda Iron Formation overlies the Woongarra Rhyolite and is the uppermost Formation of the Hamersley Group. It is distinctly different from other BIFs in the Hamersley Group in that it does not display mesobanding and comprises predominantly black fine grained black and flaggy iron formation. The Formation is approximately 200m thick and comprises upper and lower units of interbedded BIF and shales, and a central BIF zone. The transition from Boolgeeda to Turee Creek is gradual as can be seen in the upper unit at Duck Creek Syncline contains glacial diamictite and siltstone and contact to the Kungarra Formation of the Turee Creek Group is gradational. At Hardey Syncline the Boolgeeda Iron Formation is 150m thick and grades from the uppermost BIF unit upward into laminated siltstone of the lower Kungarra Formation.

Turee Creek Group

Kungarra formation is the lowermost unit of the Turee Creek Group and at Hardey Syncline comprises turbiditic fine sandstone and shale interpreted as distal turbidites.

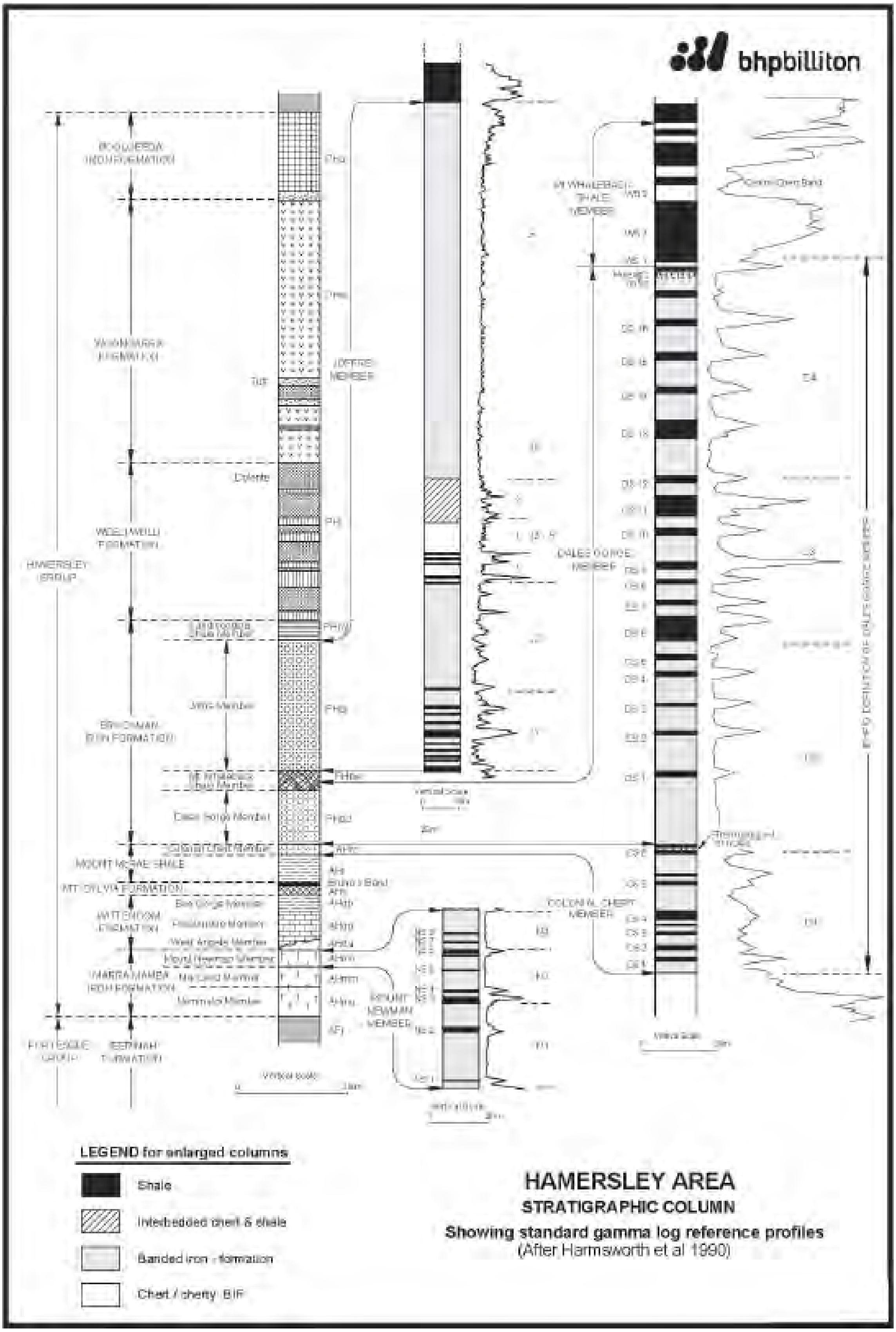


Figure 4: Stratigraphy of the Hamersley Group (Harmsworth *et al*., 1990)

4.3.2 Volume and availability

Based on the current mine design the Project is anticipated to produce in the order of 290 M loose cubic metres (lcm) of waste material. An overburden balance has been estimated for the Project in Table 5.

Table 5: Anticipated overburden availability

Schedule/Balance Element (Site Overburden Balance)	**Estimated Total Quantity (M lcm)**
Indicative LOM overburden volume	290 M lcm

Management of overburden is addressed in Section 7.4.4.

4.3.3 Acid and Metalliferous Drainage Geochemistry

BHP Billiton Iron Ore has developed procedures for classifying PAF material that can be a contributing source of AMD. BHP Billiton Iron Ore classifies PAF overburden according to the sulfur (S) content, stratigraphy, degree of oxidation, and other geochemical testing to characterize potential acid generation or metals release.

In accordance with the WAIO AMD Management Standard, a geochemical characterisation and Preliminary AMD risk assessment was undertaken for the Project by Earth Systems in October 2014 (Earth Systems, 2014).

This assessment incorporated information supplied by BHP Billiton Iron Ore, which included:

- waste characterisation data;
- geological data;
- mine planning designs;
- spatial data for the Project area;
- data relevant to identification of AMD migration pathways; and
- data relevant to identification of environmental and social receptors.

For the purposes of the Preliminary AMD Assessment the classification system, referred to as the NAPP (net acid production potential) model was used. The NAPP classification evaluates the balance between acid generating and acid neutralising potential of a sample. The relevant assay data and designs were input into 3-dimensional modeling software to compute a 3-Dimensional Block Model for the Project. Where material was assessed as having a NAPP>3kgH2SO4/t[2] it was classified as PAF. A range of alternatives method was used to highlight the relative difference in the PAF overburden mass balance with and without consideration of rock Acid Neutralizing Capacity (ANC).

The alternative methods applied were:

- NAPP cut off of 6kg H2SO4/t (corresponding to rock containing 0.2%S); and
- Total S cut-off of 0.2%wt S with no consideration of ANC.

[2] This is considered a conservative cut-off for this preliminary assessment, based on the limited availability of static geochemical testwork data.

Potential sources of PAF were identified as:

- overburden/waste; and
- wall rock.

The NAPP model data were then used to quantify the distribution (statistical and spatial) of any PAF overburden and wall rock materials that have the potential to generate AMD. Indicative annual AMD generation rates were calculated based on pyrite oxidation rates for similar geologic materials elsewhere in the Pilbara.

To identify potential AMD pathways and environmental and social receptors, a workshop was held involving representatives from Earth Systems consultants and BHP Billiton Iron Ore.

Predicted Wall Rock

The Preliminary AMD Risk Assessment identified the following potential sources of AMD in relation to wall rock:

- Based on drilling and subsequent analysis, the Mount McRae Shale makes up almost 20% of the wall rock zone of the Orebody 31 pit.
- NAPP for the Mount McRae Shale ranged from -67 to 48 kilograms (kg) H2SO4/t, with approximately 3-4% of the Mount McRae Shale wallrock blocks having NAPP of greater than 3 kg H2SO4/t and hence classified as PAF. This resulted in PAF classification using conservative criteria. A NAPP value of 3 kg H2SO4/t is equivalent to 0.2%wt S with no consideration of ANC.
- Several blocks within the BIF Dales Gorge Member and Mt Sylvia Formation were also classified as PAF. PAF wall rock blocks are predominantly located in one zone along the south eastern pit wall.
- PAF blocks within the wall rock zone assumed for this assessment amount to approximately 1,500,000 t, with an average Total Sulfur content of 0.95 wt%. Assuming a pyrite oxidation rate (POR) of 0.3 wt%FeS2/year, the AMD potential from the wall rock, if allowed to oxidise under atmospheric conditions, is estimated at 100-150 tonnes H2SO4-eq per year.

Predicted waste

The Preliminary AMD Risk Assessment identified the following potential sources of AMD in relation to mined waste:

- The bulk of the overburden is dominated by BIF (69%) and Alluvial Deposits (22%). Mount McRae Shale accounted for approximately 3% of the overburden (approximately 10 Mt).
- Only 32,000 t of overburden was classified as PAF based on the NAPP value of greater than or equal to 3 kg H2SO4/t. This represents approximately 0.01% of the total overburden mass.
- The PAF material was dominated by Mount McRae Shale (82% of the PAF material). The rest of the PAF material was associated with BIF - Dales Gorge Member.
- All PAF classified material is from below the groundwater level.
- The average Total Sulfur concentration for PAF classified overburden blocks was 0.55 wt%S.

A sensitivity analysis of the modelling was undertaken, which concluded that:

- Using NAPP cut-off value of 6 kg/H2SO4 results in approximately 50% less material classified as PAF.
- Using a Total Sulfur cut off of 0.2%wtS, significantly more material is classified as PAF (1.6Mt) as no consideration is given to the ANC of material. Most (1.3Mt) of the PAF

classified material relates to material above the groundwater level, where the sulfur is likely to be present in the form of non-acid generating sulfate materials.

- Based on sensitivity analysis the quantum of PAF material is anticipated to be between 30,000-300,000t.

Drilling results indicate that the PAF material is located in the south-eastern corner of the Orebody 31 pit. Based on the most recent mine plan, it is estimated that the PAF material will be exposed during the later stages of the mine schedule. This provides an opportunity for BHP Billiton Iron Ore to further refine and adapt a range of management measures during the life of the mine prior to exposing any PAF.

Overburden rock types, their tonnages, relative proportions (by mass as a proportion of the total overburden mass) and PAF classified proportions are provided in Table 6 and illustrated in Figure 5.

Table 6: Potential Project overburden tonnages, relative proportions (by mass) and PAF mass balance on a NAPP cut-off value of 3 kg H_2SO_4/t to differentiate between PAF and NAF materials (as adapted from Earth Systems, 2014)

Lithology	Estimated tonnage*	Proportion relative to total overburden	PAF classified overburden**			
			Tonnage	Proportion relative to mass of lithology	Proportion relative to mass of total overburden	Proportion above groundwater level^
Tertiary Alluvials	65,567,763	22%	-	-	-	-
Weeli Wolli	13,421,219	5%	-	-	-	-
BIF, Shale Member	39,345,440	13%	-	-	-	-
BIF, Joffre Member	71,726,302	24%	-	-	-	-
BIF, Whaleback Shale	57,292,045	20%	-	-	-	-
BIF, Dales Gorge Member	34,900,145	12%	948	0.02%	0.000%	0%
Mt McRae	9,935,572	3%	15,472	0.26%	0.01%	0%
Mt Sylvia	1,094,552	0.4%	-	-	-	-
Wittenoom	55,190	0.02%	-	-	-	-
Total	**293,338, 230**	**100%**	**16,420**	**0.28%**	**0.01%**	**0%**

* Estimated by summation of block mass based on density, block dimensions and ore-classification attributes in provided from the mine model current at the time of writing.
** Blocks with a calculated NAPP ≥ 3 kg H_2SO_4/t.
^ Groundwater level status (above/below) derived directly from each block attribute in the mine model.

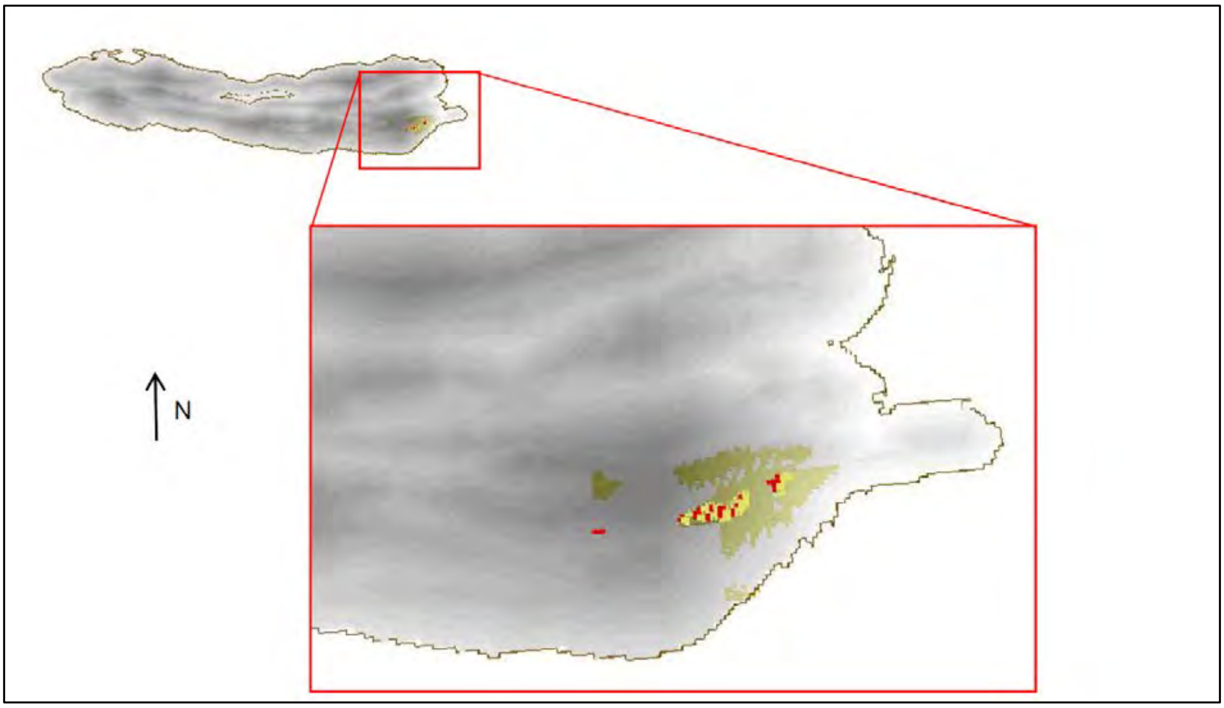


Figure 5: Plan view of the OB31 pit shell (depth delineated by grey colour-scale) and PAF classified blocks. In-pit PAF overburden blocks are shaded in red. Wallrock PAF blocks (nominally 30m below the pit shell) are shaded in yellow. PAF rocks are defined as those with NAPP ≥ 3 kg H_2SO_4/t (as adapted from Earth Systems, 2014).

Potential sources of AMD following closure for the Project

Studies (Earth Systems, 2014) assessed the potential AMD sources, pathways and environmental receptors relevant to closure. These are summarised in Table 7. The assessment considered the risk of impacts based on no management of PAF i.e. the worst-case scenario, and the residual risk with PAF management in place.

Table 7: Potential AMD sources, pathways and environmental and social receptors for the Project following closure (as adapted from Earth Systems, 2014)

Potential AMD sources	AMD transport pathway	Environmental and social receptors
H_2SO_4 from PAF overburden stored in ex-pit OSA's Accumulated AMD from PAF overburden stored in-pit Accumulated AMD from PAF from wall rock	Surface run-off Expression of seepage Percolation into groundwater Controlled or uncontrolled discharge of pit lake water	Surface water ecosystems (Jimblebar Creek) Groundwater quality (for reuse) Terrestrial flora and fauna utilising impacted surface waters Subterranean fauna Social receptors

Studies (Earth Systems, 2014) have suggested that at mine closure, the following may occur:

- With ex-pit PAF storage, it was possible for the mine waste to generate acidic conditions (10-20t H_2SO_4/year AMD), the consequence of which would be insignificant to minor. With AMD risk mitigation measures in place the likelihood of acid generation was assessed to be reduced to unlikely.
- With in-pit PAF storage below the groundwater rebound level, it was possible for a pulse of AMD to occur upon groundwater rebound. With AMD risk mitigation measures in place the likelihood reduced to unlikely and the consequence being minor.
- With in-pit PAF storage above the groundwater rebound level, it is possible for ongoing release of AMD, the consequence of which would be limited. With risk mitigation measures in place the likelihood reduces to unlikely and the consequence reduced to insignificant.
- Release of a pulse of AMD from pit wall rock below final groundwater rebound is possible at groundwater rebound with the consequence moderate. With AMD risk mitigation measures in place the likelihood reduces to unlikely and the consequence would be minor.
- Ongoing release of AMD from the unsaturated pit wall rock above the final groundwater rebound level is possible, with the consequence being minor. With AMD risk mitigation measures in place the likelihood reduces to unlikely.

Management for AMD materials across BHP Billiton Iron Ore's Pilbara sites is outlined at a high-level in the WAIO AMD Management Standard (see Section 7.4.1 for further detail). Further work proposed to close potential knowledge gaps in regards to AMD is outlined in Section 7.5.

4.3.4 Physical characteristics

The majority of mineralisation within the Project occurs within the Joffre Member of the Brockman Iron Formation, which shows more resistance to erosion than other formations within the Hamersley Group.

The relative abundance and location of overburden stratigraphic units has been carried out. The Brockman Iron Formation wastes dominate the total overburden (as previously listed in Table 6). In particular, the Joffre Member and the Whaleback Shale units are present in high proportions.

Broader material characterisation and field trials across BHP Billiton Iron Ore operations have been undertaken on waste types from both the Brockman and Marra Mamba formations and the associated stratigraphic units to further understand the erosion characteristics (Landloch 2012, 2013, 2013b).

Analysis has included physical modelling including rainfall simulation and overland flow undertaken within laboratory conditions using predicted rainfall events based on local rainfall data. Laboratory methods including rainfall simulation and overland flow over a range of gradients have been undertaken resulting in quantification of:

- Interrill erodibility (Ki);
- Rill erodibility (KR);
- Critical Shear (tc); and
- Effective Hydraulic conductivity (Ke).

The data has then been used in numerical modelling to assess how well a specific waste rock type (or blends of waste types) behaves under surface flow conditions. Numerical modelling tools of Water Erosion Prediction Project (WEPP) model and SIBERIA landform evolution model and the Revised Universal Soil Loss Equation (RUSLE) have been used.

Outcomes of the tests show variability in the parameters derived as illustrated in Figure 6.

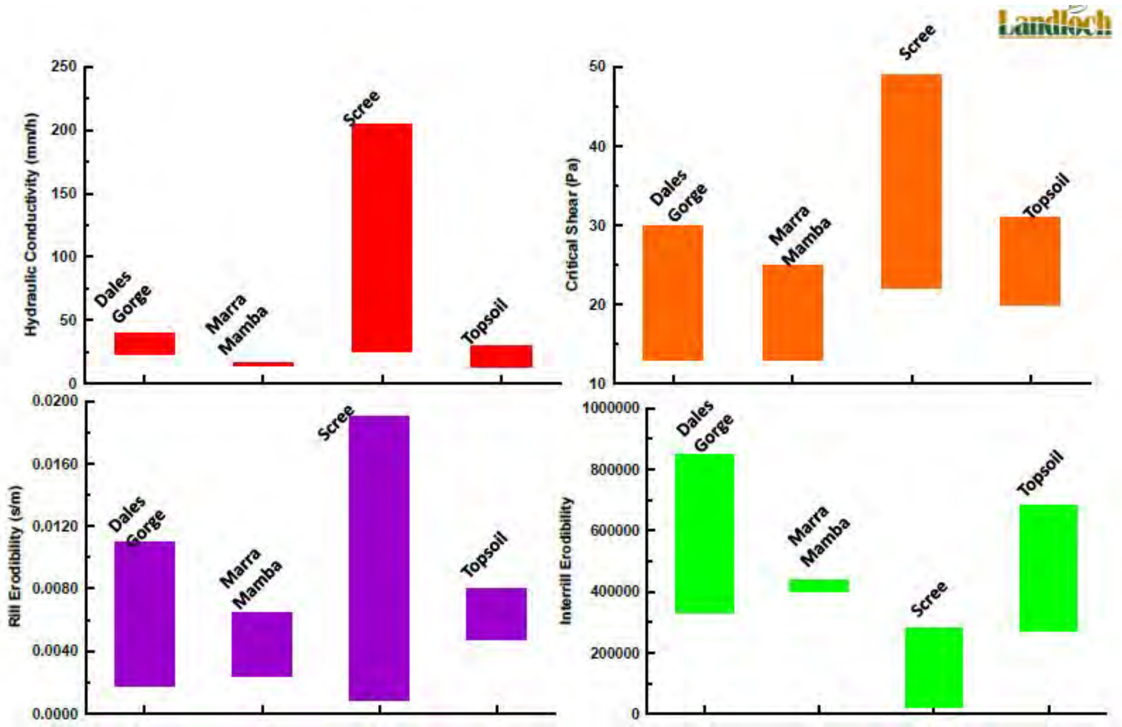


Figure 6: Variability in WEPP erodibility parameters for wastes and soils BHP Billiton Iron Ore operations

SIBERIA modelling has analysed the performance of alternative landform design options including:

- design profiles (linear slopes, concave slopes and bench and berm designs);
- landform heights and angles; and
- waste types including mixes (i.e. rockier material, growth media).

Outcomes of modelling corroborate that erosion is a function of the rock size distribution (well graded), slope grade and height. The application of concave slopes and augmentation of additional rock percentage to poorer performing waste material both successfully increased performance. The material characterisation work associated with the Brockman waste types has shown that the material is significantly less susceptible to surface erosion than other Marra Mamba overburden materials.

Management of overburden physical characteristics is addressed in Section 7.4.4. Further work proposed to close knowledge gaps in regards to waste physical characteristics is outlined in Section 7.5.

4.4 Slope stability and seismicity

A probabilistic seismic hazard assessment was conducted on selected BHP Billiton Iron Ore operations in the Pilbara in early 2012 (Meynink Engineering Consultants, 2012). The assessment was based on area seismic sources as no evidence of recent fault activity was recognised close to the BHP Billiton Iron Ore operations in the Pilbara during the preliminary neotectonic observations. The observations show that an inferred segmented fault system appears to run across the site; however, there is no indication of recent fault activity. In the Australian context, the Peak Ground Acceleration values estimated from this study correspond to a low to moderate seismic hazard.

4.5 Landforms and land systems

Land systems across much of the grazing and pastoral lands of WA were surveyed, described and categorised during a series of surveys conducted by the Department of Agriculture. The Project lies within the Pilbara Region, which was surveyed in the period between 1995 and 1999, by Van Vreeswyk *et al.* (2004), with the results published in Technical Bulletin No. 92. The descriptions of the land systems below are consistent with those described in Technical Bulletin No. 92.

The following land systems are located within the Project area:

- **Newman land system:** Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands. This land system accounts for 49.13% of the Project area;
- **Boolgeeda land system:** Stony lower slopes and plains below hill systems supporting hard and soft Spinifex grasslands and Mulga shrublands. This land system accounts for 41.58% of the Project area;
- **McKay Land System:** Hills, ridges, plateaux remnants and minor breakaways of sedimentary and meta sedimentary rocks, relief up to 100 m. This land system accounts for 0.86% of the Project area; and
- **Washplain land system:** Hardpan plains supporting groved Mulga shrublands. This land system accounts for 8.43% of the Project area.

A landform design and opportunities assessment has been undertaken for the Orebody 18 Mine Hub and the Project area (ERM, 2014).

The analysis of analogue sites (**Figure 7**) supported the application of BHP Billiton Iron Ore standard landform design practice and parameters, integrating design controls for local surface water drainage (e.g. slope crest bunding) and material stability.

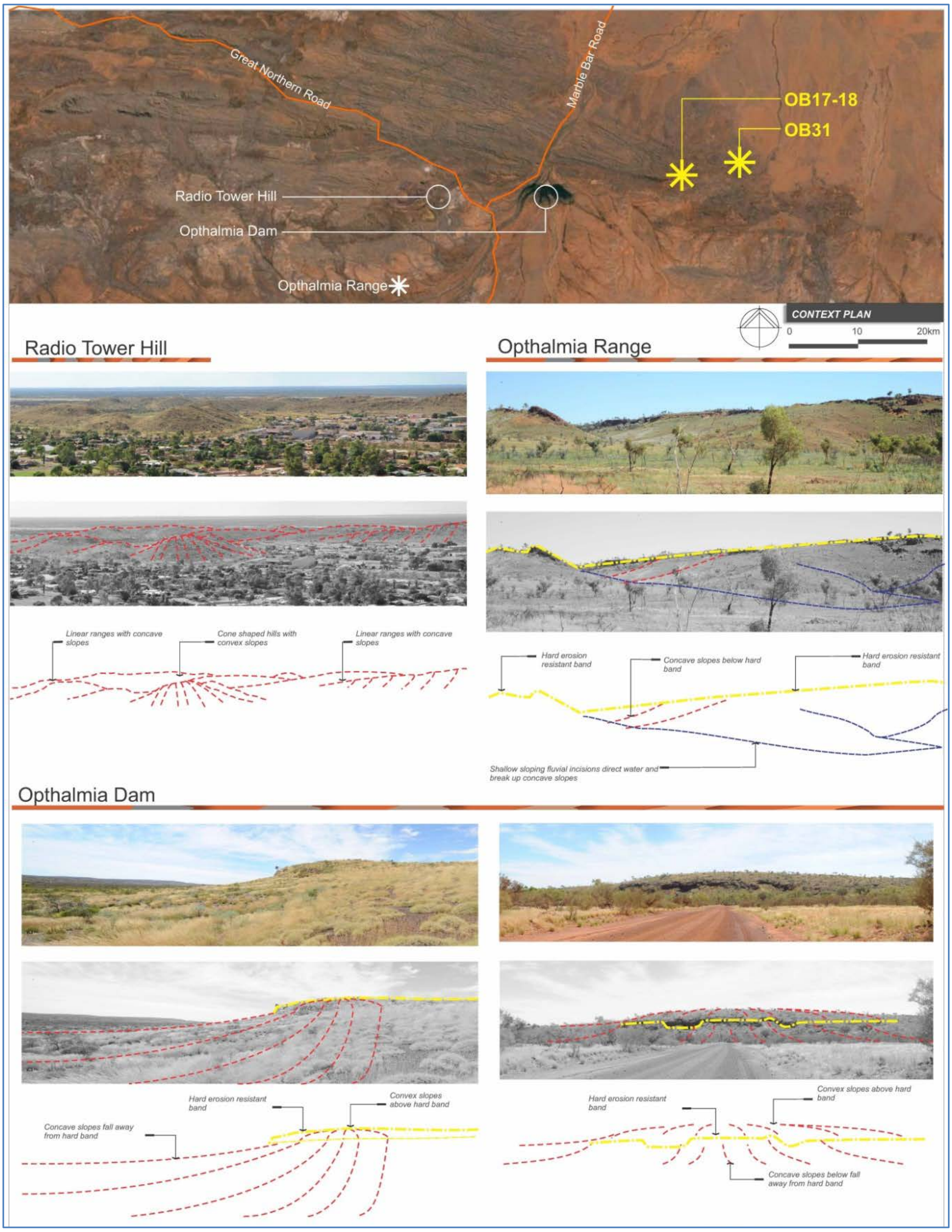


Figure 7: Orebody 18 Mine Hub and the Project area landform analogue sites

4.6 Soil characteristics

Soils of the Pilbara region have been defined and mapped at a scale of 1:2,000,000 by Bettenay *et al*. (1967). The following two soil units occur within the Project area (Figure 8), based on mapping by Bettenay, Churchward and McArthur (1967):

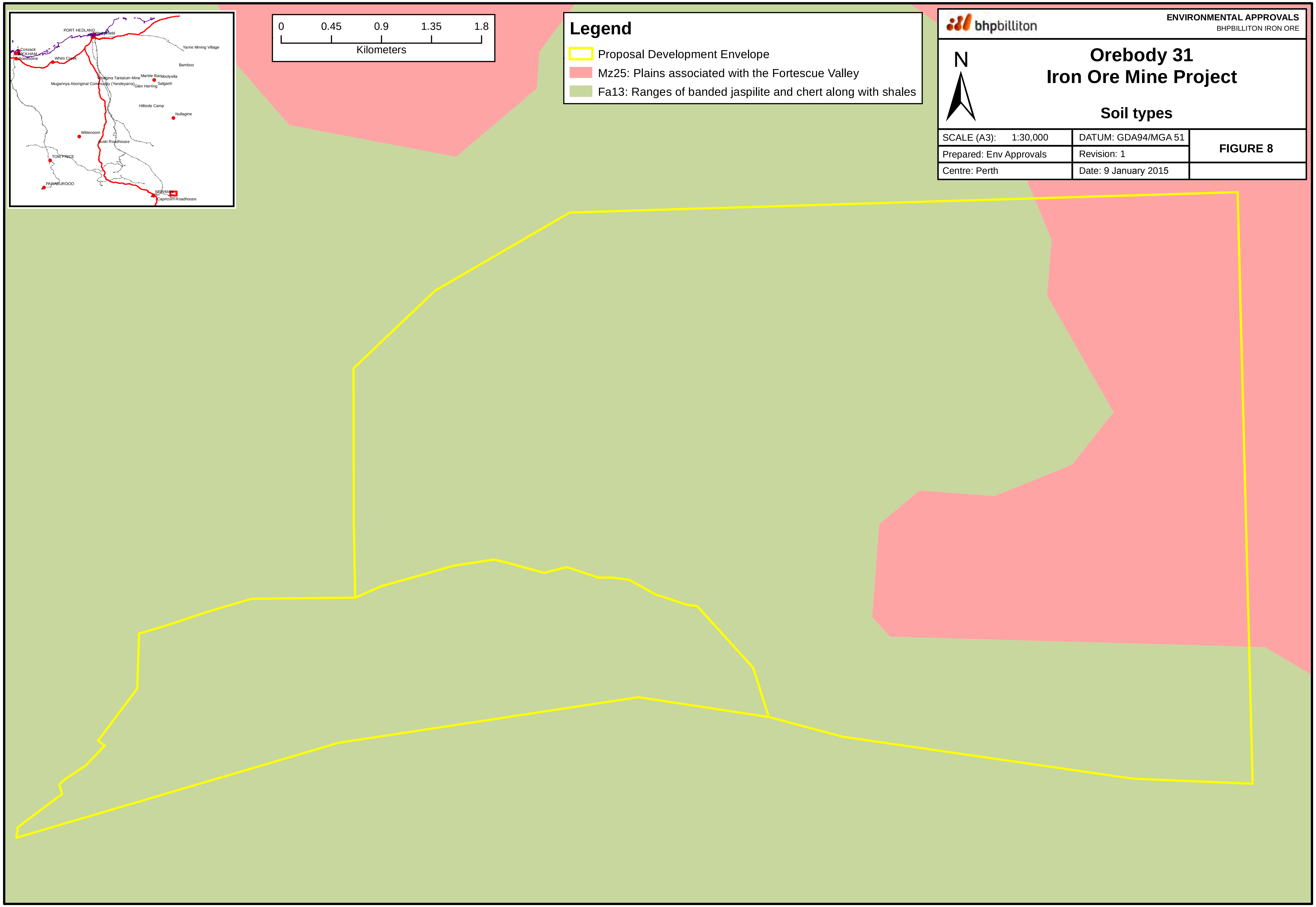
- Fa13: Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are (Dr2.33, Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains.
- Mz25: Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines.

A Soil and Landforms Survey has recently been carried out within the Project area by MWH (2015). As part of this survey, six soil-landform associations were identified. These include:

- three ‘flat’ soil-landform associations:
  - gravel/carbonates;
  - gypsiferous;
  - drainage;
- two ‘mid-slope’ soil-landform associations:
  - gravelly;
  - rocky; and
- (one) ‘low-rise’ soil-landform association.

The surface soils assessed from the Project area were broadly characterised as follows:

- typically classed as ‘sandy loams’ or ‘sandy clay loams’;
- generally contained a high percentage of coarse material;
- predominantly moderately aggregated in structure;
- exhibited partial clay dispersion upon severe disturbance;
- not prone to hard setting;
- ‘moderate’ to ‘moderately rapid’ drainage class;
- ‘low’ to ‘moderate’ water holding capacity;
- neutral pH;
- typically non-saline (‘flat - gypsiferous’ sites were extremely saline and not suitable for use in rehabilitation works);
- typically low in organic carbon and moderate in plant-available nutrients;
- non-sodic; and
- typically below the limit of reporting (LOR) and/or the Ecological Investigation Levels (EILs) for total metal concentrations.


ENVIRONMENTAL APPROVALS
BHPBILLITON IRON ORE
bhpbilliton
Orebody 31
Iron Ore Mine Project
Soil types
N
SCALE (A3): 1:30,000
DATUM: GDA94/MGA 51
FIGURE 8
Prepared: Env Approvals
Revision: 1
Centre: Perth
Date: 9 January 2015
Legend
Proposal Development Envelope
Mz25: Plains associated with the Fortescue Valley
Fa13: Ranges of banded jaspilite and chert along with shales
0 0.45 0.9 1.35 1.8
Kilometers
PORT HEDLAND
Yarrie Mining Village
Bamboo
Nullagine
Hillside Camp
Wittenoom
TOM PRICE
PARABURDOO
NEWMAN
Capricorn Roadhouse

BHP Billiton Iron Ore recently provided MWH with conceptual designs illustrating indicative mine pit, OSAs and infrastructure / ancillary facilities boundaries for the purposes of predicting stockpile footprints within the Project area. Table 8 presents potential topsoil and subsoil resource inventories for the Project area.

Table 8: Potential topsoil and subsoil resources inventory for the Project area (as adapted from MWH, 2015)

Soil-landform association (SLA)	Total Study Area		Disturbance footprint (OSAs, pit and infrastructure corridor)					
	Area of SLA (ha)	%	Area of SLA (ha)	%	Topsoil stripping depth (m)	Approx. topsoil volume (m^3)	Subsoil stripping depth (m)	Approx. subsoil volume (m^3)
Flat - gravel / carbonates	2,287	56	619	33	0.15	928,500	0.9	5,571,258
Flat - gypsiferous	126	3	126	7	Not recommended for use as a rehabilitation resource			
Flat - drainage line	71	2	7	<1	0.1	10,591	0.9	63,550
Scree slopes (mid-slopes and low rises)	1,571	39	1,091	58	0.1	1,636,500	0.9	9,819,603
Area already disturbed	-	-	29	2	-	-	-	-
	4,055	**100**	**1,872**	**100**	**-**	**2,575,591**	**-**	**15,454,411**
					Approx. area required to stockpile topsoil	**103 ha**	**Approx. area required to stockpile subsoil**	**310 ha**

The topsoil and subsoil stockpile footprint figures included in Table 8 represent the ‘worst-case’ maximum footprint required and do not take into consideration the repeat use of the same footprint as soil is continuously stockpiled and re-collected as part of progressive rehabilitation programmes at the Project throughout the life of the mine. In addition, some disturbances may not warrant sub-soil stripping.

The suitability of soils as growth media is also being assessed at other BHP Billiton Iron Ore sites as part of the WAIO Growth Media Atlas Study. This research includes sampling analogue sites and existing topsoil stockpiles to define chemical, physical and fertility ranges. Furthermore, different waste materials are also being investigated to define their suitability to be utilised as alternative growth media. This includes sampling of waste materials that are *in situ* across proposed rehabilitation areas, and the sampling of any materials that are to be imported and utilised as surface armour. This research is ongoing as new topsoil stockpiles are created and rehabilitation areas are proposed.

Management of soils is addressed in Section 7.4.4. Further work proposed to close knowledge gaps in regards to soil characteristics is outlined in Section 7.5.

4.7 Surface water

A surface water impact assessment has been carried out by RPS Aquaterra (2014) to understand the existing surface water drainage flows and catchment areas within and around the Project area. Pre-mining surface water catchments within and surrounding the Project area are shown in Figure 9.

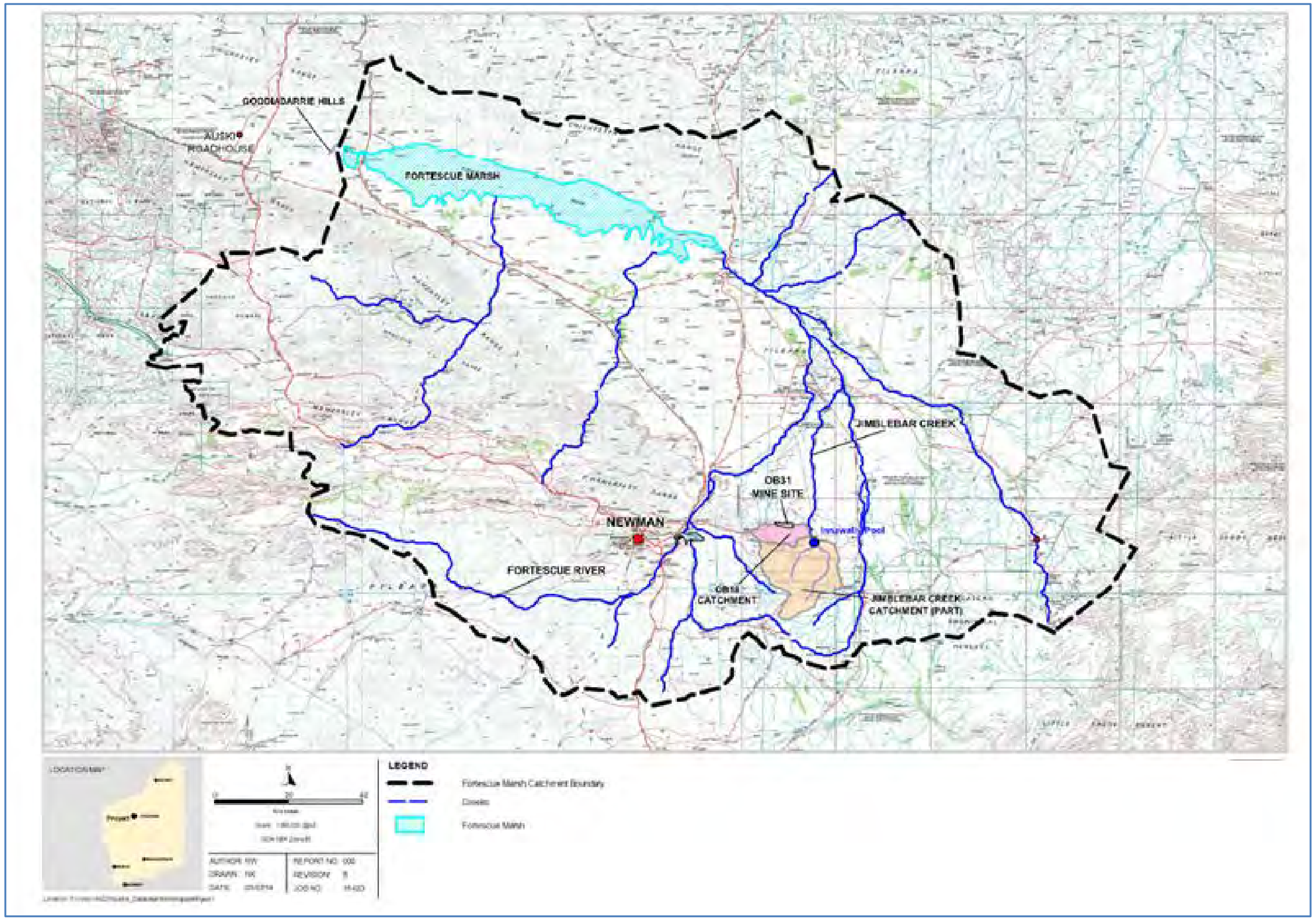


Figure 9: Surface water catchments within and surrounding the Project area (RPS, 2014)

Hydrological Environment – Regional

Fortescue River Upper Catchment

The Project area is located in the upper portion of the Fortescue River Catchment, which ultimately drains into the Fortescue Marsh.

The Fortescue Marsh is an extensive intermittent wetland extending approximately 104,800 ha within a total catchment area of approximately 2,979,100 ha. Although the Project area is located within the greater Fortescue Marsh catchment area, it is not located within the Fortescue Marsh management area boundary identified in the EPA's Strategic Advice to the Minister for Environment titled: *Environment and water assessments relating to mining and mining-related activities in the Fortescue Marsh management area* (EPA, 2013d).

The water regime of Fortescue Marsh consists of surface water run-off from the catchment and evaporative loss (EPA, 2013d). Surface water enters the Marsh during rainfall events and cyclonic activity via the surrounding landscapes and tributaries. Through the evaporation process, the loss of water results in an accumulation of salts and results in wetland water quality alternating between fresh, saline and hypersaline (EPA, 2013d). Groundwater below the marsh is believed to be saline to hypersaline (Aquaterra, 2009).

Jimblebar Creek

The Project area is located adjacent to Jimblebar Creek which is considered a major ephemeral tributary of the Fortescue River. Approximately 40 km to the north of the mines, Jimblebar Creek runs into the Fortescue River and ultimately, drains into the Fortescue Marsh approximately 80 km north of the mines. Surface water quality around the Jimblebar area and adjacent creek systems is fresh (RPS Aquaterra, 2009).

Local groundwater characteristics

The salinity of the groundwater within the Project area varies between fresh to brackish, with total dissolved solids (TDS - a measure of salinity) recorded during drilling ranging from 400 mg/L to 0.4 to 2,200 mg/L. TDS values generally increase with depth, especially after ~50m below the water level. The TDS of water in the Orebody 31 aquifers varies between 600 mg/L and 1,200 mg/L, while that in the Mt Sylvia Formation and Bee Gorge Member along the southern margin of the Stage 1 pit varies between 1,800 and 2,200 mg/L.

Local surface water characteristics

The surface water quality around the Jimblebar area (including the Project area) and adjacent creek systems is considered fresh with typically <500mg/L and pH 6-8 (neutral) (Aquaterra, 2014).

Surface Water Hydrology – local

Known surface water bodies in the vicinity of the Project area include Innawally Pool (approximately 10 km south east of the Project area) and Ophthalmia Dam (approximately 30 km west of the Project area).

The Ophthalmia Dam, which was installed in 1981, was installed to impound surface water along the upper Fortescue for subsequent replenishment into the underlying and downstream aquifers which support the Ophthalmia Borefield. Historical data collected from the dam shows that the salinity ranges are generally between 1,000 and 2,500 mg/L. Surplus water from the Project is proposed to be discharged into the Ophthalmia Dam in the first instance. Although the discharged water has the potential to slightly increase salinity in the Ophthalmia Dam, it is anticipated that the salinity rates will remain within historical ranges and there should be no long-term impact post closure.

Innawally Pool is considered a perched water feature owing to regional groundwater levels under the Wheelarra Hill ridgeline being at a depth of around 50m below the base of the Pool. When full, the pool is 1 km long and up to 40m wide (RPS Aquaterra, 2014). Run-off from the Project area will enter Jimblebar Creek approximately 5 km downstream from Innawally Pool and will therefore, not be affected by the Project during or post-mining. Surplus water from the Project will also be discharged into the unnamed creek which flows into the Jimblebar Creek. However, this surplus water discharge is proposed to be discharged on a short-term seasonal basis, during wet season between November and March. It is not anticipated that there will be any impacts post closure following cessation of short-term seasonable discharge.

Current surface water flow

The Project area is located adjacent to the dryland water course flowing into Jimblebar Creek. The creek is dry outside of seasonal rainfall events. The catchment is confined by relatively steep rocky ridges on each side and slopes from RL565 m in the west to about RL500 m at the Jimblebar Creek confluence, with a typical bed slope of 0.3%.

Within the centre of the Project area, the area naturally drains south into the adjacent valley and then into the Jimblebar Creek. A small portion of the central area with the Project area drains into the north and eventually into Jimblebar Creek downstream. The adjacent operations at the Orebody 18 Mine Hub are also located within the same catchment.

Potential disruption to surface water flows

The interruption of surface water flow patterns through the construction of a new open pit, new OSAs, stockpiles and associated supporting infrastructure may have the potential to either reduce or increase surface water runoff volumes within the Project area.

Runoff volumes from some infrastructure areas (e.g. roofs, hardstands, access roads) may increase, whereas from other infrastructure development areas (e.g. ponds, stockpiles) runoff volumes may be reduced. Overall, the runoff volumes from infrastructure and stockpile areas are anticipated to remain similar following implementation of the Project (RPS Aquaterra, 2014).

No creek diversions are proposed as part of the Project, however, during operation, a Flood Bund will be constructed between the southern side of the pit and the northern side of the unnamed creek. This Flood Bund will be rehabilitated following closure.

4.8 Groundwater

A range of technical studies have been carried out to inform an Orebody 31 Hydrogeological Impact Assessment study (BHP Billiton Iron Ore, 2015). The technical studies, modelling and impact assessment have sought to understand the hydrogeological properties of the aquifer, determined the geology underlying the orebody and determined the hydraulic relationship between the various aquifer units and structural features.

Local aquifer

The main local aquifer within the Project area is the Brockman orebody aquifer. This aquifer extends for some distance along the strike but is eventually bounded by unmineralised Brockman. To the north and south, the orebody aquifer is bounded by lower permeability BIF and shales of the Weeli Wolli Formation (hanging wall) and Mount McRae Shale (footwall). The orebody appears to be hydraulically constrained within these lower permeability units. However, elevated airlift yields have been recorded in bores targeting the footwall (Mount McRae Shale). These high airlift yields appear to be related to a series of faults which have the potential to provide hydraulic connection through to the orebody aquifer and/or regional aquifers.

Groundwater elevations range between 495 and 498 mRL within the Orebody 31 aquifer, with a steep 40m hydraulic change observed between the Brockman (Orebody 31) and Weeli Wolli Formation / Woongarra Volcanics (aquitards) to the north (~460mRL). This suggests limited flow from the Project area to the north.

Aquifer recharge

Recharge to the aquifer system in the Project area occurs mainly by infiltration and rainfall run-off but may also occur by some minor groundwater throughflow from the Shovellana Creek valley. Overall, rainfall recharge to outcropping/subcropping orebody aquifers is anticipated to vary between 1-2%of mean annual rainfall. Recharge to the regional aquifer system may be very slow due to the large depth to the regional water table.

Inter-orebody connectivity

Generally, there is a low north-westerly hydraulic gradient along the detrital valley, extending through the Project area to the Wheelarra Fault with groundwater level ranges between 501 mRL (Orebody 18) to 496 mRL (Wheelarra Fault). Across the Orebody 31 mine deposit, the hydraulic gradient is flat to slightly eastwards, towards the Wheelarra Fault with groundwater elevations ranging from around 498 mRL in the west to 496 mRL at the Wheelarra fault, east of the Project area. Regional groundwater measurements indicate limited flow from the Project area to the north.

Reduction in aquifer levels

Dewatering associated with the Project will result in lowered aquifer levels within and surrounding the Project area. The maximum extent of drawdown within and surrounding the Project area is presented in Figure 10. At the time of closure, groundwater drawdown in the pit area is predicted to be approximately 160m deeper than existing baseline levels. The radial extent of the drawdown outside of the indicative pit area is predicted to extend 22 km into the regional aquifer.

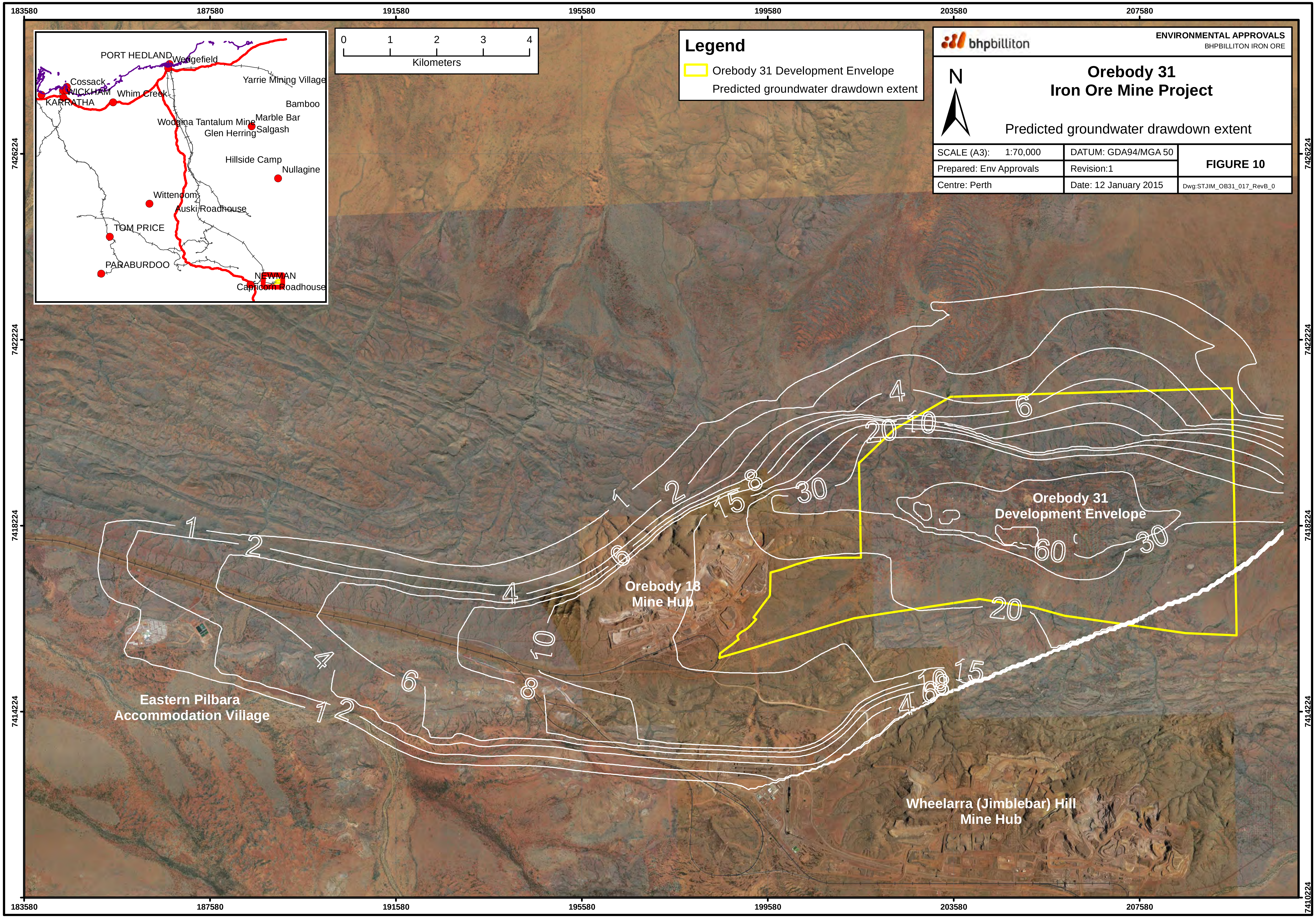
Hydrological legacy after mine closure

Post-closure modelling has been carried out to assess the long term hydrological impact of different closure management options for the Project. The focus of this work is the hydrological impact particularly relating to pit void management. As discussed previously, the Orebody 31 deposit is approximately 70% below the water table. Once the orebody is mined out the pit void extends well below the pre-mining water table.

A Project numerical model was used to determine the long term hydrological change using three different closure management options including:

- completely infilled pit void to 5 m above the pre-mining water level;
- partial back fill void; and
- an empty void with the development of a pit lake.

These three options are illustrated in Figure 11.



ENVIRONMENTAL APPROVALS
BHPBILLITON IRON ORE
bhpbilliton
Orebody 31
Iron Ore Mine Project
Predicted groundwater drawdown extent
N
SCALE (A3): 1:70,000
DATUM: GDA94/MGA 50
FIGURE 10
Prepared: Env Approvals
Revision:1
Centre: Perth
Date: 12 January 2015
Dwg:STJIM_OB31_017_RevB_0
Legend
Orebody 31 Development Envelope
Predicted groundwater drawdown extent
0 1 2 3 4
Kilometers
PORT HEDLAND
Wedgefield
Cossack
WICKHAM
KARRATHA
Whim Creek
Yarrie Mining Village
Bamboo
Wodgina Tantalum Mine
Marble Bar
Glen Herring
Salgash
Hillside Camp
Nullagine
Wittenoom
Auski Roadhouse
TOM PRICE
PARABURDOO
NEWMAN
Capricorn Roadhouse
Orebody 31
Development Envelope
Orebody 18
Mine Hub
Eastern Pilbara
Accommodation Village
Wheelarra (Jimblebar) Hill
Mine Hub
183580
187580
191580
195580
199580
203580
207580
7426224
7422224
7418224
7414224
7410224
1
2
4
6
8
10
15
20
30
60

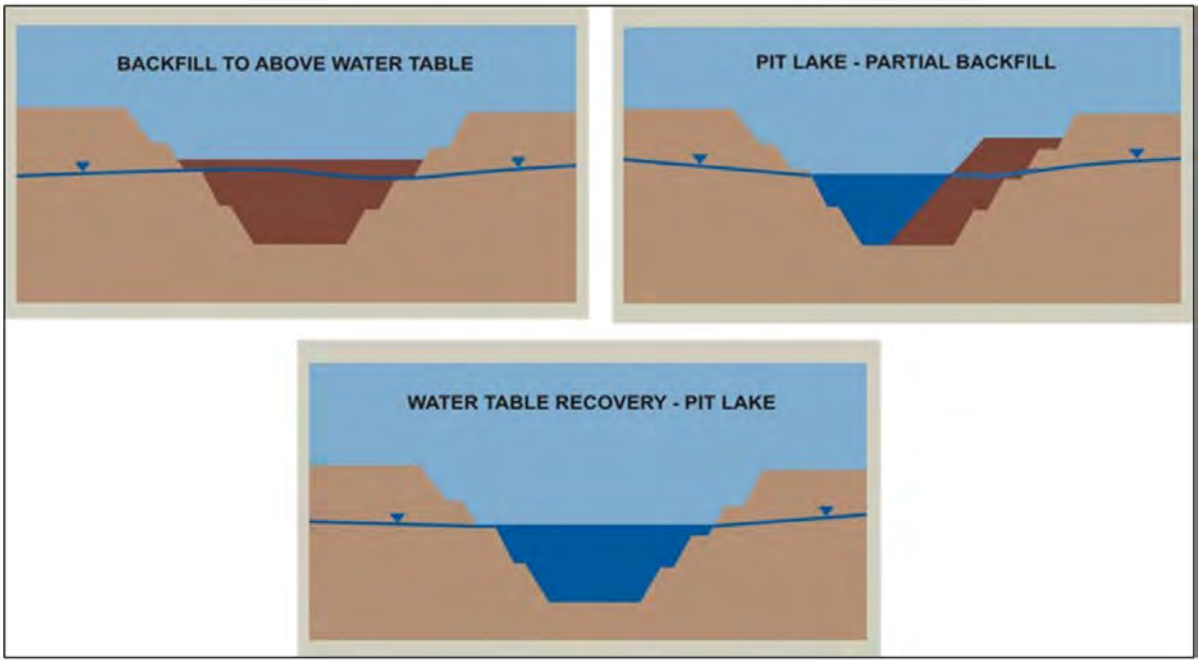


Figure 11: Schematic representation of the three pit closure scenarios assessed for the Project

For the purposes of modelling post-closure groundwater levels, each of the closure management options were implemented from 2048 following the cessation of dewatering at the Project (refer to **Figure 12**). For the backfilled void (assuming backfilled material of equivalent hydraulic parameters as the ore body aquifer) the water levels rebound to pre-mining level after an extended period of time as flow from the regional aquifer and recharge replenishes the storage of the backfilled void. For the empty void, a pit lake develops at a rate governed by the rate of groundwater and surface inflows and loss via direct evaporation. Under the open void scenario rebound to the pre-mining water level is unlikely due to the ongoing evaporative loss from the pit lake.

The modelling predicted these dynamics, with the infilled void rebounding 100 m within 50 years of the cessation of dewatering with full recovery of water levels to pre-mining levels taking hundreds of years. The partially backfilled void rebounded 55 m within 20 years of closure with a steady state water level achieved after 70 years. For the pit lake scenario, water levels recover rapidly in the first 20 years following dewatering; however, the rate of rebound decreases significantly to a steady level of 420 mAHD (70 m below the pre-mining level). Each of the closure management options present different long term hydrological states. The completely backfilled void recreates the pre-mining hydraulic gradient with through flow occurring to the north and north east. The pit lake and partial backfill options creates a regional groundwater sink, due to the steady state level lower than the regional water table, groundwater discharges to the pit lake where evaporation occurs.

Each closure option present different potential hydrological legacy conditions. The backfilled void recreates a pre-mining hydrological condition; however, increases the risk of downstream impact through the potential transport of any potential acid metaliferious drainage associated with mine waste (outside the scope of this assessment). Conversely, the pit lake does not recreate a pre-mining hydraulic condition with the pit void being a regional groundwater sink. The risk of downstream impact is low due to the reversal of hydraulic gradient with the fate and transport of AMD being likely localised to the pit lake.

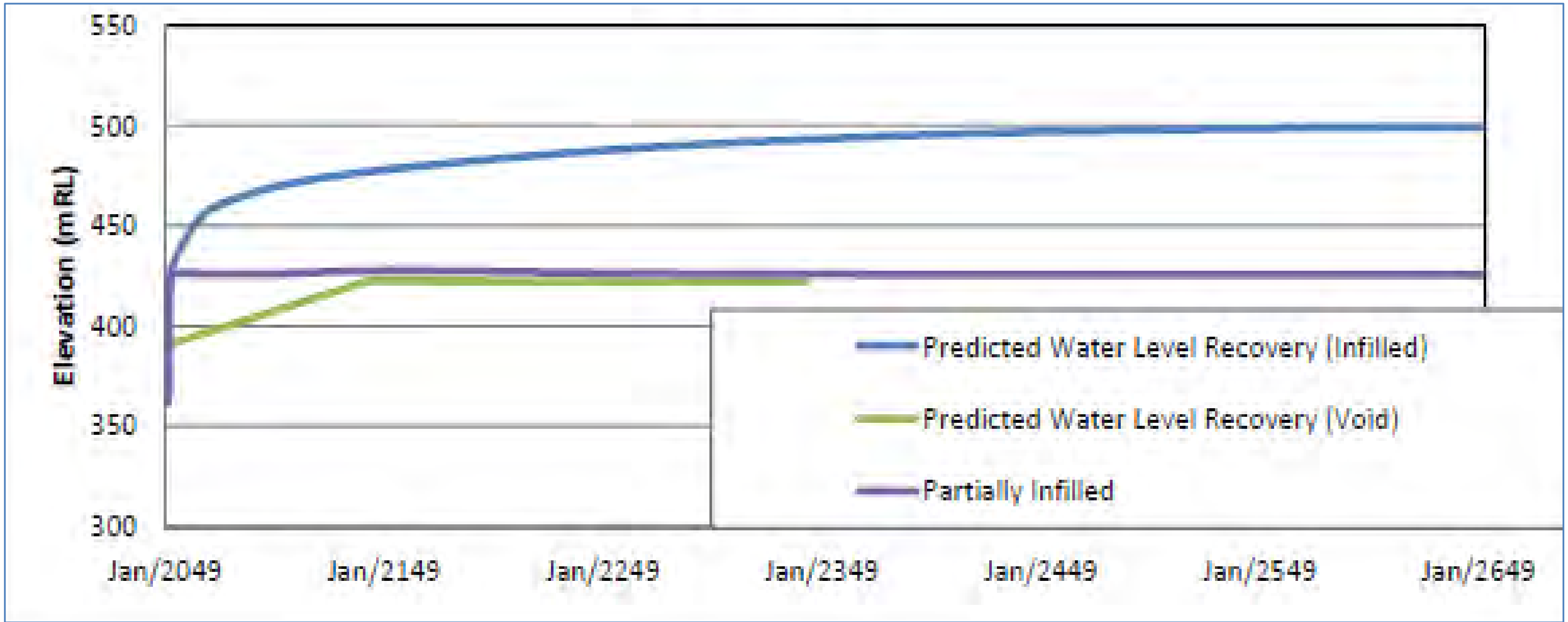


Figure 12: Predicted groundwater level recovery at the Project area following completion of mining

4.9 Vegetation

4.9.1 Regional flora and vegetation

Broadly, the Project area lies on the southern fringe of the Pilbara bioregion as defined by the IBRA (Thackway and Cresswell, 1995). The Pilbara bioregion is further divided into four sub regions, and the Project area lies in the Hamersley and Fortescue Plains sub regions. The Hamersley sub region forms the southern section of the Pilbara Craton (Kendrick, 2001a). This sub region is characterised by mountainous areas of Proterozoic sedimentary ranges and plateaux, dissected by gorges. The vegetation of the sub region is dominated by *Eucalyptus leucophloia* over *Triodia* hummock grassland on skeletal soils atop mountains and slopes, while swathes of Mulga woodland occur over hard and soft grasses on fine-textured soils of the plains and valleys (Kendrick, 2001a).

The Fortescue Plains sub region contains the Fortescue Marsh, which is listed in the Directory of Important Wetlands in Australia (Environment Australia, 2001) and is a proposed Ramsar site (DEC 2009). Outside the Marsh, this sub region is characterised by River Red Gum (*Eucalyptus camaldulensis*) woodlands fringing drainage lines and deeply incised gorge systems (Kendrick, 2001a).

4.9.2 Flora within the Project area

Thirty-two flora and vegetation surveys have been carried out either within the Project area or within a 25 km radius of the Project area. Of the 32 studies, six have been fully or partially completed within the Project area.

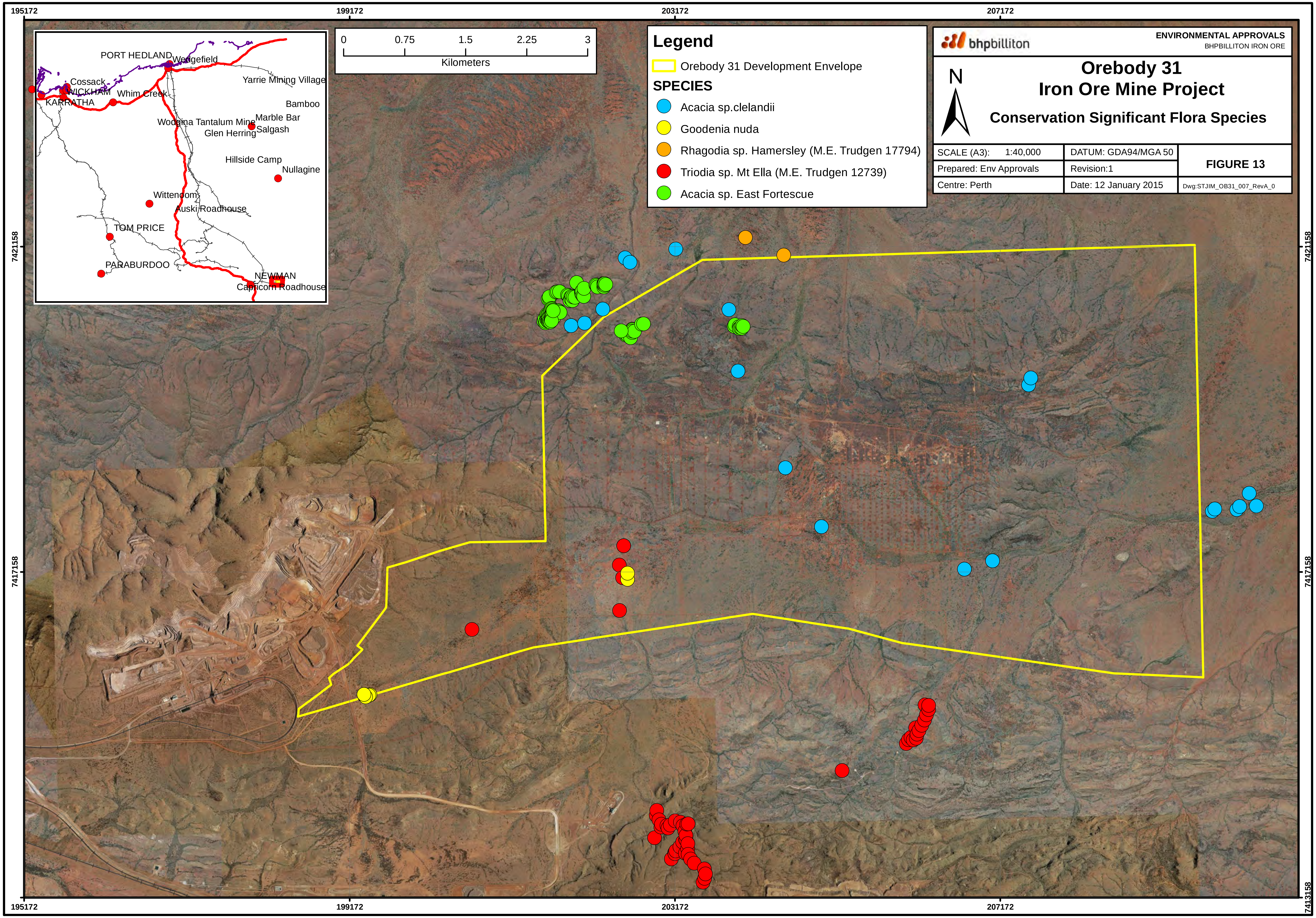
4.9.3 Conservation significant flora within the Project area

Onshore (2014b) have identified four conservation significant flora occurring within the Project area, including two Priority flora, one taxon of interest, and one significant range extension (Figure 13). These include:

- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (Priority 3);
- *Goodenia nuda* (Priority 4);
- *Acacia sp. East Fortescue* (J. Bull & D. Roberts ONS A 27.01) (Priority 1); and
- *Acacia clelandii* (significant range extension).

4.9.4 Threatened or declared rare flora

No threatened or Declared Rare Flora listed under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) or the *Wildlife Conservation Act, 1950* (WC Act) were recorded in the Project area.



195172
199172
203172
207172
7421158
7417158
7413158
PORT HEDLAND
Wedgefield
Yarrie Mining Village
Cossack
WICKHAM
Whim Creek
KARRATHA
Bamboo
Marble Bar
Woodgina Tantalum Mine
Glen Herring
Salgash
Hillside Camp
Nullagine
Wittenoom
Auski Roadhouse
TOM PRICE
PARABURDOO
NEWMAN
Capricorn Roadhouse
0
0.75
1.5
2.25
3
Kilometers
Legend
Orebody 31 Development Envelope
SPECIES
Acacia sp.clelandii
Goodenia nuda
Rhagodia sp. Hamersley (M.E. Trudgen 17794)
Triodia sp. Mt Ella (M.E. Trudgen 12739)
Acacia sp. East Fortescue
bhpbilliton
ENVIRONMENTAL APPROVALS
BHPBILLITON IRON ORE
N
Orebody 31
Iron Ore Mine Project
Conservation Significant Flora Species
SCALE (A3): 1:40,000
DATUM: GDA94/MGA 50
FIGURE 13
Prepared: Env Approvals
Revision:1
Centre: Perth
Date: 12 January 2015
Dwg:STJIM_OB31_007_RevA_0

4.9.5 Groundwater dependent vegetation

Groundwater-dependent ecosystems are ecosystems which have their species composition and their ecological processes largely determined by groundwater. Groundwater-dependent ecosystems relevant to the Project area are considered to consist of localised groundwater dependent vegetation (GDV) at a species and vegetation association level.

The majority of the Project area contains groundwater levels of between 35 metres below ground level (mbgl) and up to 95 mbgl. GDV require groundwater depths of less than 20m to survive (Onshore, 2014b), therefore this area would not support GDVs. A small part of the Project area (restricted to the south-eastern section of the proposed mine area) contains groundwater depths within 20 mbgl. Onshore (2014b) assessed this area in detail and determined that a medium drainage line supporting the vadophytic tree species, *Eucalyptus victrix,* exists in this area. Similar corresponding vegetation associations that support the vadophytic tree species *Eucalyptus victirx,* were also recorded at the north-west sector of the Project area and also south outside the Project area. The majority of these areas occur where groundwater levels were greater than 20 mbgl. As such, there should be no impact on these species post-closure.

4.9.6 Weeds and Declared Plants

Within the Project area, Onshore (2014b) has identified three weed species. None of these are listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). These include:

- **Bidens bipinnata* (Beggar's Ticks);
- **Cenchrus ciliaris* (Buffel Grass); and
- **Malvastrum americanum* (Spiked Malvastrum)

No 'declared pests' listed under the *Biosecurity and Agriculture Management Act 2007* and associated Regulations have been recorded within the Project area.

4.10 Fauna

Six vertebrate fauna surveys have been carried out over various parts of the Project area. These are:

- Orebody 18 Biological Assessment Survey (ecologia Environmental, 1995);
- Mesa Gap Biological Survey (GHD, 2008);
- Orebody 18 Fauna Assessment Phase II (ENV, 2007);
- Wheelarra Hill North Fauna Assessment (ENV, 2012);
- Orebody 31 Vertebrate Fauna Survey (Biologic, 2014b); and
- Orebody 17 and 18 Vertebrate Fauna Habitats (Biologic, 2013).

A total of 194 vertebrate fauna species have been recorded during the surveys which overlap the Project area, consisting of 25 native mammal species (plus seven introduced species), 81 bird species, 78 reptile species and three amphibian species. An additional 76 species comprising nine native and two introduced mammals, 44 birds, 17 reptiles and four amphibians are likely to occur in the area.

4.10.1 Conservation significant fauna

Six fauna species of conservation significance have been recorded to date within the Project area (Biologic, 2014a). These are listed in Table 9, illustrated in Figure 14 and discussed below.

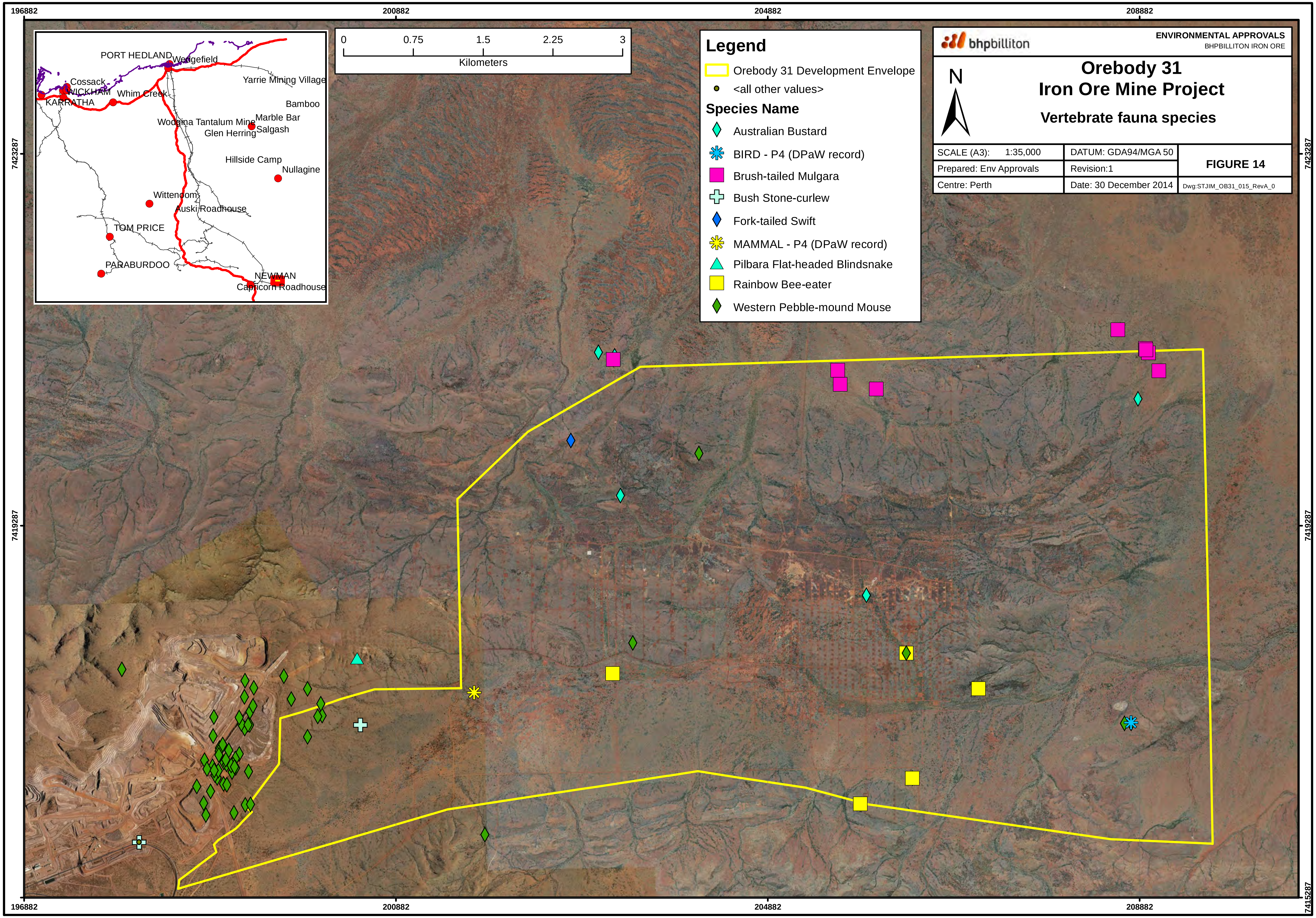
Table 9: Fauna species recorded within the Project area

	Species Name	Conservation Significance Ranking
Mammals	Brush-tailed Mulgara (*Dasycercus blythi*)	Listed as Priority 4 by the WA Department of Parks and Wildlife (DPaW)
	Western Pebble-mound Mouse (*Pseudomys chapmani*)	DPaW Priority 4
Birds	Australian Bustard (*Ardeotis australis*)	DPaW Priority 4
	Bush Stone-Curlew (*Burhinus grallarius*)	DPaW Priority 4
	Rainbow Bee-eater (*Merops ornatus*)	Listed as Migratory under the *Environment* EPBC Act and on Schedule 3 of the WC Act
	Fork-tailed Swift (*Apus pacificus*)	EPBC Act Migratory, WC Act Schedule 3

Biologic (2014b) identified five major vertebrate fauna habitats within the Project area relevant to vertebrate fauna. These are:

- Minor Drainage Line;
- Sand Plain;
- Crest/Slope;
- Drainage Area; and
- Gorge/Gully.

Of these, the Sand Plain and Gorge/Gully were considered to be of high importance because this habitat provides potential breeding, shelter and/or foraging habitat for a number of conservation significant fauna.



196882
200882
204882
208882
7423287
7419287
7415287
0
0.75
1.5
2.25
3
Kilometers
PORT HEDLAND
Wedgefield
Yarrie Mining Village
Cossack
WICKHAM
KARRATHA
Whim Creek
Bamboo
Wodgina Tantalum Mine
Marble Bar
Glen Herring
Salgash
Hillside Camp
Nullagine
Wittenoom
Auski Roadhouse
TOM PRICE
PARABURDOO
NEWMAN
Capricorn Roadhouse
Legend
Orebody 31 Development Envelope
<all other values>
Species Name
Australian Bustard
BIRD - P4 (DPaW record)
Brush-tailed Mulgara
Bush Stone-curlew
Fork-tailed Swift
MAMMAL - P4 (DPaW record)
Pilbara Flat-headed Blindsnake
Rainbow Bee-eater
Western Pebble-mound Mouse
bhpbilliton
ENVIRONMENTAL APPROVALS
BHPBILLITON IRON ORE
N
Orebody 31
Iron Ore Mine Project
Vertebrate fauna species
SCALE (A3): 1:35,000
DATUM: GDA94/MGA 50
FIGURE 14
Prepared: Env Approvals
Revision:1
Centre: Perth
Date: 30 December 2014
Dwg:STJIM_OB31_015_RevA_0

4.10.2 Subterranean fauna

Bennelongia (2014a) carried out a baseline study within the Project area and surrounds to record, describe and determine the conservation status of the number of troglofauna and stygofauna species present. The following summarises the results of baseline surveys.

Troglofauna

During troglofauna baseline surveys, Bennelongia (2014a) collected a total of 17 species consisting of 12 orders.

Stygofauna

The indicative area of groundwater drawdown (and subsequent post closure recovery) for the Project extends beyond the proposed Project boundary and approximately 22km to the west. All recordings from all surveys within the areas of drawdown were reviewed.

In the indicative area of groundwater drawdown greater than or equal to 2m, 11 stygofauna species belonging to seven higher level taxonomic groups have been collected through various surveys.

Impacts to subterreanean fauna resulting from the Project (including the post-closure groundwater recovery period) are not anticipated to be significant and are not anticipated to warrant specific post-closure management actions.

4.10.3 Short range endemic species

Six potential SRE species were found within recent SRE surveys in the Project area (Biologic, 2014c). These are listed below:

- two selenopid spiders, *Karaops* 'ARA003-DNA' and *K*. 'ARA004-DNA';
- the pseudoscorpion, *Xenolpium* 'PSE079'; and
- three isopods, *Buddelundia* '10NM', *B.* '49', and Buddelundiinae 'WN'.

Impacts to SRE post-closure are not anticipated to be significant and are not anticipated to warrant specific post-closure management actions.

4.11 Site contamination

There are no known or suspected contaminated sites within the Project area.

4.12 Visual amenity

Eleven viewpoints or potential sensitive receptor sites have been identified (360 Environmental, 2014) for the Project area based on a risk of impact and site significance matrix. These were then visited and surveyed in the field. Of these sites, seven were determined to be of a higher value and as such, were further assessed during the impact assessment phase as key sites. All the sites are listed in Table 10.

The Project area is not located adjacent to any public roads and as such, will not be subject to tourists/visitors passing through. The area also has a unique topographical setting (the ore resource is located in a valley, surrounded by ridges). As such, many of the above potential key receptor sites showed little to no alterations in viewsheds as a result of the proposed development (360 Environmental, 2014).

The seven potential high-value sensitive tourist / visitor receptor sites were identified and analysed for potential impacts (including an eighth sensitive receptor – the Great Northern Highway which is considered to be a scenic drive rather than a specific location). The highest potential impact to a view shed was anticipated to be 1.11% with many of the sites anticipating no impact to viewsheds at all.

Table 10: Viewpoints surveyed in the Visual Landscape Impact Assessment (as adapted from 360 Environmental, 2014)

Site No.	Site Name	Potential key site	Potential Visual Risk
1	Radio Tower Hill, Newman	Yes	Low-negligible: the Project area is not expected to be visible from this site.
2	Opthalmia Dam Picnic Area	Yes	Negligible: the location of the site in relation to the project area results in no direct views. Distance may also result in low indirect impacts.
3	Opthalmia Dam Wall	Yes	Low: some possibility of indirect impacts from particulate matter emanating from the Project area, between Wheelarra and Shovellana Hill, although the Orebody 18 and Wheelarra Hill (Jimblebar) Mine Hub have a markedly higher contribution to impact to this site.
4	Round Hill	Yes	Low: the Project area is located in excess of 25 km from the site. Some particulate matter may be visible, but impacts may be minor.
5	Trugallenden Pool	No	
6	Innawally Pool	No	
7	Kalgan Pool	Yes	Low-negligible: the Project area is nestled within a creek bed surrounded by gorges.
8	Marble Bar Road – Rest Stop 1	Yes	Low: distance to the Project area and vegetation cover makes direct impacts from the Project likely to be very low.
9	Marble Bar Road – Rest Stop 2	Yes	Low: distance to the Project area and vegetation cover makes direct impacts from the Project likely to be very low.
10	Marble Bar Road – Rest Stop 3	No	
11	Jinerabar Pool	No	
12	Great Northern Hwy and Marble Bar Road	Yes	Low: vegetation screening, high travel speeds, low elevation, large distance and the presence of the Ophthalmia Range on either side of the road sections closes to the Project area results in low risk of overall impact.

4.13 Cultural heritage

The Project area is situated entirely within the Nyiyaparli [WC05/6] Native Title Claim (NTC).

As a commitment of the Comprehensive Agreement between the *Nyiyaparli People* and BHP Billiton Iron Ore, representatives from both parties meet through the Implementation Committee on a six monthly basis. This is a forum that seeks to share relevant information, and to resolve any concerns, between BHP Billiton Iron Ore and the *Nyiyaparli People*, including matters related to heritage and environment[3].

Comprehensive archaeological and ethnographic surveys have been undertaken. As a result of the surveys, heritage sites have been recorded at different locations within the proposed Project boundary. Out of respect for the wishes of traditional owners, the locations of the recorded Aboriginal heritage sites are not shown in this MCP.

BHP Billiton Iron Ore is aware of the location and extent of all known Aboriginal heritage sites within the footprint covered by the Mine Closure Plan, and will avoid all Aboriginal heritage sites where practicable. If any site cannot be avoided, BHP Billiton Iron Ore will apply for consent to use the land under Section 18 of the *Aboriginal Heritage Act 1972*.

Proposed operations within the Project area have the following potential impacts on Aboriginal heritage sites:

- damaging sites during mining operations and construction of Project infrastructure;
- collecting or excavating artefacts from heritage sites;
- damaging sites by off-road use of vehicles; and
- trespassing on sites.

4.14 Local land use

Socio-economic setting

Mining is considered the main land use in the Newman area. BHP Billiton Iron Ore owns and operates a number of mining operations around the Newman area which are known as the Whaleback Hub, the Eastern Ridge Hub and the Wheelarra Hill (Jimblebar Hub). The hubs consist of the following grouped deposits/mines:

- Whaleback Hub (current operations - Whaleback, Orebody 29, Orebody 30 and Orebody 35);
- Eastern Ridge Hub (current operations - Orebody 23, Orebody 24 and Orebody 25); and
- Jimblebar Hub (current operations – Jimblebar, Wheelarra, Orebody 18 and the proposed Orebody 31 Project).

Post-mining land use is further discussed in Section 6.3.

Newman Township and surrounding areas

The nearest regional centre is the Newman Township, which is located approximately 40 km to the west of the Project area. It provides accommodation and services for mine employees and contractors.

[3] See consultation register (Table 14)

Mining around Newman generates significant revenues and provides strong economic stimulus to the Pilbara region and WA. Community infrastructure at Newman includes medical and hospital facilities, banks, an airport, post office, sporting facilities and schools.

According to the Australian Bureau of Statistics (ABS, 2013), between 2006 and 2011, the East Pilbara region in Western Australia had both the highest growth in population and the highest turnover – that is, people moving into and out of the region.

The Shire of East Pilbara estimates the current population to be around 8,000, comprising approximately 5,000 permanent residents and 3,000 'Fly-in-Fly-out' (FIFO) workers residing in mine accommodation camps within or in close proximity to the Newman Township (Shire of East Pilbara, 2014).

Nearby tourist attractions

The following locations are popular tourist attractions in the vicinity of Newman:

- Karijini National Park (approximately 200 km west of Newman);
- Karlamilyi (Rudall River) National Park (approximately 300 km north east of Newman);
- Ophthalmia Dam, a popular swimming and recreation spot (fishing and sailing) (approximately 20 km out of Newman);
- Kalgan Pool/Creek (approximately 20 km out of Newman);
- Wanna Munna rock are and pool site (approximately 30 km out of Newman);
- Silent Gorge (approximately 12 km out of Newman); and
- Weeli Wolli Springs (approximately 100 km out of Newman).

Tourists are also attracted to areas surrounding the Newman Township between July and September each year to view Spinifex grass flowering (360 Environmental, 2014).

4.15 Key considerations

BHP Billiton Iron Ore has undertaken an assessment of the potential closure impacts of each of the 'factors' from the EPA's *Environmental Assessment Guideline 8 for Environmental Factors and Objectives* (EPA, 2013a). This assessment is provided in Table 11.

Table 11: Assessment of closure and rehabilitation considerations for each of the relevant EPA factors for the Project

EPA Factors	Closure and rehabilitation planning summary
Flora and vegetation	Baseline information will inform rehabilitation.
Landforms	Waste Characterisation and analogue landforms to inform rehabilitation.
Subterranean Fauna	No specific post closure management required.
Terrestrial Environmental	Acid and Metaliferous Drainage impacts on groundwater, surface water and soil quality have been assessed as a moderate to low risk. Geochemical waste characterisation will

Quality	inform management.
Terrestrial fauna	Baseline information will inform rehabilitation.
Hydrological Processes	Post closure groundwater recovery and long term groundwater level to inform mine void closure strategies. Post closure surface water flow changes not anticipated to be significant. Management of runoff from final landforms to be considered in landform design.
Inland Waters Environmental Quality	Post closure groundwater quality (including potential pit lake) to inform mine voids closure strategy. Post closure surface water quality change not anticipated to be significant. Management of runoff from final landforms to be considered in landform design.
Air Quality	No specific post closure management required.
Heritage	Baseline information will inform rehabilitation.
Amenity	Potential visual impact is not considered significant due the unique location of the Proposal in a valley between ridgelines. Analogue landforms will inform landform design.
Human Health	No specific post closure management required.

5 Stakeholder consultation

5.1 Objectives

BHP Billiton Iron Ore's WAIO Stakeholder Engagement Management Plan states that wherever the Company operates it will:

> *Engage regularly, openly and honestly with our host governments and people affected by our operations, and take their views and concerns into account in our decision making.*

BHP Billiton Iron Ore recognises the importance of engaging with relevant stakeholders. The ability to build relationships and work collaboratively and transparently with our host communities is critical to the Company's long-term success. BHP Billiton Iron Ore has established a comprehensive consultation programme to support ongoing, effective dialogue with stakeholders potentially impacted by, or interested in, the implications of the Company's operations. This approach is consistent with BHP Billiton Iron Ore's Charter that states a commitment to supporting communities and the BHP Billiton Code of Business Conduct that articulates how this underpins how the Company does business:

"*Our ability to build relationships and work collaboratively and transparently with our host communities is critical to our long-term success. Our aim is to be the company of choice, valued and respected by the communities in which we operate. We do this by engaging regularly, openly and honestly with people affected by our operations, and by taking their views and concerns into account in our decision-making*."

BHP Billiton Iron Ore is currently undertaking an ongoing consultation programme relating to its Project operations with government agencies (both state and local), non-government organisations and land-users that have expressed interest in, or are directly impacted by a proposed Project. The objectives of the programme are to:

- provide information and the opportunity to comment to government agencies and other stakeholders who may potentially be interested in activities (including closure and rehabilitation) associated with the Project;
- identify the key issues and concerns of government agencies and other stakeholders in regards to the design and management of activities (including closure and rehabilitation) associated with the Project;
- discuss objectives for the development of the Project and its ultimate rehabilitation and closure;
- periodically provide updated information and results of the development and closure planning process to government agencies and other stakeholders as more information comes to hand; and
- allow for adjustments to the design and/or management of any proposed activities to accommodate concerns or issues raised by government agencies and other stakeholders, where relevant.

As part of the broad consultation programme for the Project, BHP Billiton Iron Ore consults with identified stakeholders on closure related issues during each project phase (pre-approval, operations, rehabilitation and post closure) to ensure that legal requirements, risks and internal and external stakeholder expectations for closure at the Project are taken into account at an appropriate time and as far as practicable.

5.2 Consultation

The WAIO Stakeholder Engagement Management Plan provides the framework for the communication of results from the ongoing closure planning process.

In line with DMP/EPA 2011 BHP Billiton Iron ore considers the key stakeholders to be post-mining owners or managers and relevant regulators. The current focus of the Project closure consultation is primarily with the key stakeholders associated with the planning and approval of the Project.

As the Project progresses, closure specific consultation will increase with broader stakeholder groups such as those listed below.

State Government agencies:

- Department of Environment and Regulation;
- Department of Parks and Wildlife;
- Department of Mines and Petroleum;
- Department of State Development;
- Department of Planning;
- Department of Water;
- Office of the Environmental Protection Authority;
- Environmental Protection Authority;
- Department of Indigenous Affairs;
- Department of Health;
- Heritage Council of WA; and
- Department of Regional Development and Lands: Office of Pilbara Cities.

Shires, Local Governments and politicians:

- Shire of East Pilbara;
- Pilbara Development Commission;
- Newman Chamber of Commerce and Industry;
- Local Member for the Pilbara – Hon. Brendan Grylls;
- Minister for Mines and Petroleum – Hon. Bill Marmion;
- Minister for Water – Hon. Mia Davies;
- Minister for Regional Development – Hon. Terry Redman; and
- Minister for Environment and Heritage – Hon. Albert Jacob.

Local and regional groups:

- Newman Community Consultative Group;
- Wildflower Society of WA;
- Tourism Operators;
- Greening Australia; and
- Conservation Council of WA.

Land owners and managers:

- Traditional Landowners;
- Other mining companies, Atlas, Rio Tinto Iron Ore, Fortescue Metals Group;
- Project Employees; and
- Project Contractors.

5.3 Consultation program

An indicative stakeholder consultation programme for the Project in line with the overall WAIO plan is shown in Table 12.

Table 12: Stakeholder Consultation Programme – next five years

Stage	Stakeholder(s)	Date	Purpose	Activity	Communications
Pre-referral of a Proposal to Government and prior to implementation of approved Project	Traditional owners *Nyiyaparli*	Q1 and Q2 2015	Consult	Meeting	Advise of the intention to refer a Proposal to Government and seek comments on Project
Pre-referral of a Proposal to Government and prior to implementation of approved Project	Shire of East Pilbara	Prior to Referral	Inform	Correspondence	Advise key stakeholders that the Project is referred to Government.
Pre-referral and during assessment of Project Referral	OEPA	Consultation has commenced and will continue following submission of the Referral during assessment	Consultation	Meetings and correspondence	Outline Project scope and seek preliminary feedback on the environmental impact assessments carried out, as well as proposed management / mitigation measures. Seek feedback on assessment process.
Pre-referral	Department of Water	Already commenced in 2014 and will continue throughout Q1 and Q2 of 2015	Technical consultation	Site visits (occurred in 2014), meetings and correspondence	Seek technical review of potential impacts to surface water and groundwater quality and quantity which may arise from the Project and BHP Billiton Iron Ore's proposed management and mitigation measures.

Stage	Stakeholder(s)	Date	Purpose	Activity	Communications
Pre-referral	Department of Parks and Wildlife	Already commenced in 2014 and will continue throughout Q1 and Q2 of 2015	Technical consultation	Meetings and correspondence	Seek technical review of potential impacts to identified signification species which may arise from the Project and BHP Billiton Iron Ore's proposed management and mitigation measures.
Pre-referral	Department of Mines and Petroleum	Already commenced in 2014 and will continue throughout Q1 and Q2 of 2015	Technical consultation	Meetings and correspondence	Seek technical review of this MCP.

5.4 Consultation undertaken to date

BHP Billiton Iron Ore's locally based Community and Indigenous Affairs team are active members of the Newman community and through continued community engagement they have established:

- supportive working relationships between BHP Billiton Iron Ore and the Newman community;
- an environment conducive to productive dialogue;
- an understanding of key issues and concerns of the community in relation to developments in the area; and
- an avenue to share key project information as it becomes available.

Table 13 describes the key issues discussed with stakeholders and comments received relating to mine site rehabilitation and closure during consultation undertaken to date.

BHP Billiton Iron Ore will continue ongoing dialogue on closure with all selected stakeholders over the lifetime of the mine in line with the WAIO Stakeholder Engagement Management Plan.

Table 13: Summary of consultation carried out with stakeholders to date regarding closure

Orebody 31 Iron Ore Mine Project – Stakeholder Engagement Register 2014					
Date	**Description of Engagement**	**Stakeholders**	**Stakeholder comments/issue**	**Proponent response and/or resolution**	**Stakeholder Response**
27 February 2014	Overview of the preliminary environmental impacts, conclusion of the impact assessment process for the Project and discussion regarding rehabilitation and closure mechanisms	OEPA (Sally Bowman, Peter Walkington)	Sought an understanding of project scope and key characteristics	Outlined preliminary key factors and timeframe for remainder of EIA studies and anticipated submission timeframe	Acceptable
23 July 2014	Update on environmental impact assessment results and proposed Project footprint.	OEPA (Sally Bowman, Matt Spence, John Guld)	The OEPA queried potential to reduce proposed clearing of Good-to-Excellent vegetation. Proposed discharge to creek was discussed. The OEPA enquired about the management strategy for this.	The Proposed clearing allocation has been reduced by 25% to meet API LOA requirements and to address recently published Offsets requirements. A Surplus Water Management Plan will be drafted and submitted with the referral supporting document.	Acceptable
27 January 2015	Discussion regarding revised assessment process for API-A proposals, requirements for pre-referral technical consultation with regulators, new species of Acacia recorded within Project area and discharge to creek volumes and timeframes.	OEPA (Sally Bowman, Matt Spence, John Guld)	The OEPA queried timeframe and proposed technical consultation with regulators	Pre-referral timeframe was discussed. Referral supporting document to clearly document proposed surplus water discharge to Jimblebar Creek will only be seasonal and short-term.	Acceptable
31 July 2014	Discussion regarding a proposed MCP for Orebody 31 and a revised MCP for the Orebody 18 Mine Hub. Opportunities exist for synergies across the operations	DMP (Danielle Risbey)	The DMP concurred that it makes sense from a closure planning and implementation perspective, to consider	Further meetings will be held as the draft plans progress	Ongoing

Orebody 31 Iron Ore Mine Project – Stakeholder Engagement Register 2014					
Date	**Description of Engagement**	**Stakeholders**	**Stakeholder comments/issue**	**Proponent response and/or resolution**	**Stakeholder Response**
	particularly in terms of waste management.		waste from a regional perspective.		
3 December 2014	Regarding rehabilitation across all current and future BHP Billiton Iron Ore hubs.	DMP (Danielle Risbey)	Discussion of progress to date on achievements and challenges in the development of Ecological Completion Criteria and alignment on new target date for defining agreed draft criteria possibly 2020.	Progress to be reported in the BHP Billiton Iron Ore Annual Environmental Review documents annually.	Ongoing
29 January 2015	General update on closure planning for Orebody 18 Mine Hub, Eastern Ridge and proposed Orebody 31 deposit.	DMP (Danielle Risbey)	Discussion concerning Orebody 31 focused on the new EPA assessment process and requirement for technical consultation of a draft MCP with DMP prior to formal submission of a Referral to the EPA.	Technical briefing on key closure aspects (AMD and Hydrological impacts). Integrated Closure Strategy with OB18 hub and adaptive management approach to mine void closure. DMP agreed to an update cycle of five years given the long life of project. DMP acknowledged there is an opportunity to integrate the existing Orebody 18 Mine Closure Plan with this MCP in future.	Further meeting proposed in February 2015
Regular briefings with the most recent being 7 October 2014	To provide an update on scope and timing of the Orebody 31 Proposal referral and State Agreement Proposal.	Department of State Development (DSD)	No concerns.	N/A	

Orebody 31 Iron Ore Mine Project – Stakeholder Engagement Register 2014					
Date	**Description of Engagement**	**Stakeholders**	**Stakeholder comments/issue**	**Proponent response and/or resolution**	**Stakeholder Response**
30 January 2015	To provide the *Nyiyaparli* representatives with a presentation overview of the Project scope and proposed Project timeframes.	*Nyiyaparli* (traditional owners)	Sought to understand environmental impacts of the Project, in particular, water.	Ongoing dialogue will continue over the lifetime of the mine in line with the WAIO Stakeholder Engagement Management Plan.	Dialogue will be ongoing.

6 Post mining land use and closure objectives

In line with BHP Billiton's Charter, we demonstrate environmental responsibility by minimising environmental impacts and contributing to enduring benefits to biodiversity, ecosystems and other environmental resources (BHP Billiton 2013d).

6.1 Closure and Rehabilitation Standards

BHP Billiton Iron Ore employs its Closure and Rehabilitation Regional Management Strategy in association with relevant standards and procedures (WAIO Rehabilitation Standard and WAIO Closure Provision Procedure) across its Pilbara operations. The Closure and Rehabilitation strategy provides the overarching framework for the development of the mine closure strategy and supporting closure provision. The Rehabilitation Standard provides the overarching framework for successful restoration of areas impacted by BHP Billiton Iron Ore operations in the Pilbara.

The Standards provide a consistent approach for closure and rehabilitation across BHP Billiton Iron Ore's WAIO operations.

6.2 Objective and guiding principles

The BHP Billiton Iron Ore's closure and rehabilitation objective is to:

> *Develop a safe, stable, non-polluting and sustainable landscape that is consistent with key stakeholder agreed social and environmental values and aligned with creating optimal business value.*

The strategic objective recognises the landscape sustainability focus within the broader consideration of the surrounding social and environmental values. The importance of key stakeholders'[4] expectations and of optimising business value (i.e., cost, reputation, risk and liability) in decision making is also recognised.

To guide the development and implementation of mine closure and rehabilitation for the Pilbara operations, BHP Billiton Iron Ore has established a set of guiding closure principles which are applied consistently across all operations:

The current Guiding Closure Principles for BHP Billiton Iron Ore Pilbara operations are as follows:

- Final land use: Stakeholder consultation including government, NGOs and community undertaken in the development of post-mining end land use objectives and site specific completion criteria toward site relinquishment.
- Land management: Is compatible with a 'whole-of-lease' sustainable management approach, so that rehabilitated areas can be integrated into local land management practices, and management requirements (e.g. maintenance of access tracks, fire) are not greater than those of areas prior to mining, or where extra management actions may be required, a mechanism has been put in place for addressing these.
- Safety: There will be no unsafe areas where members of the general public could inadvertently gain access. Unauthorised public access risk will be managed through the implementation of controls in accordance with regulatory requirements and consideration of industry guidance.
- Landforms: Physically interface appropriately with adjacent features, considering natural hydrological linkages and ensuring surface landform stability. Visual impact assessment, mine

[4] Key stakeholders refers to post-mining land owners or managers and relevant regulators (DMP and EPA, 2011)

waste characterisation (physical, geochemical) hydrology and hydrogeological predictive modelling and surface landform stability assessment will inform final landform design (including overburden storage areas, tailings storage facilities, pit void walls and pit lakes) to achieve the closure objective.

- Mine Planning: Closure and rehabilitation requirements are integrated into mine plans (directional and delivery horizons) to achieve optimum business value and the guiding principles.
- Ecosystem Sustainability: Areas demonstrated to be sustainable, resilient, and capable of meeting objectives relating to agreed final land use in terms of flora, vegetation, fauna, and surface and groundwater hydrology.
- Water: Manage the range of potential hydrological changes (groundwater, surface water and/or soil moisture) resulting from operations impacting on receiving receptors to an acceptable level post closure.
- Decommissioning: Infrastructure decommissioning and removal is undertaken (where transfer to another party is not agreed). This may include below ground structures and services as applicable to manage post-mining impact.
- Contaminated sites: Prevent and manage contaminated sites in accordance with regulatory requirements.

The Objective and Guiding Closure Principles provide the foundation for developing site specific Completion Criteria for the Project as outlined in Section 8.

The objectives and guiding principles adopted across BHP Billiton Iron Ore's Pilbara operations (as outlined above) will be applied to the Project.

6.3 Final land use

As stated in the guiding closure principles, the post mining land use will be determined through stakeholder consultation. In advance of the final post mining land use being agreed for OB31, BHP Billiton Iron Ore will assume a native ecosystem, capable of supporting low intensity grazing as the *provisional* post mining land use. The provisional land use provides an interim target to which closure and rehabilitation planning can work towards. Notwithstanding, the most likely final land use for the lease area is shown in Table 14. The likely post mining land uses are considered in mine planning, operations and rehabilitation.

Table 14 Provisional final land use by site feature[5]

Domain	Post closure land use
Pit area (mine void)	Areas not currently planned to support a specific post-closure land-use due to ingress/egress restrictions. Further assessment required as design of mine voids management measures (including in pit OSAs) progresses.
Overburden Storage Areas	Areas will support native grasslands.
Infrastructure and ancillary	Areas will support native grasslands.
Former topsoil stockpile areas	Areas will support native grasslands.

[5] Refer to Section 10.4.

7 Identification and management of closure issues

The successful planning and execution of sustainable closure and rehabilitation in the Pilbara requires a holistic, long term view of landscape scale outcomes coupled with progressive operational level activities that implement or preserve options toward meeting the outcomes. The closure planning process over the life of the Project is illustrated in Figure 15, with the closure planning 'wedge' illustrating the progressive reduction in uncertainty.

A key driver for the holistic regional approach to closure and rehabilitation is the regional scale and long life span of BHP Billiton Iron Ore's proposed future mining footprint within the Pilbara. This driver necessitates the use of a regional approach adaptable over time, as opposed to considering individual mines in isolation. The regional approach, by its very nature, provides an avenue to consider potential post closure cumulative impacts including visual amenity, water, land use, and biodiversity/ecosystem function.

BHP Billiton Iron Ore's adaptive management approach includes updating specific mine closure plans to account for closure risk, liability and stakeholder requirements as informed by the outcomes of the Corporation Alignment Planning process.

BHP Billiton Iron Ore applies a suite of modelling and assessment tools to guide the application of management approaches to address closure issues. Monitoring programmes provide data and information to support and inform the progressive development of the mine closure strategy for a site.

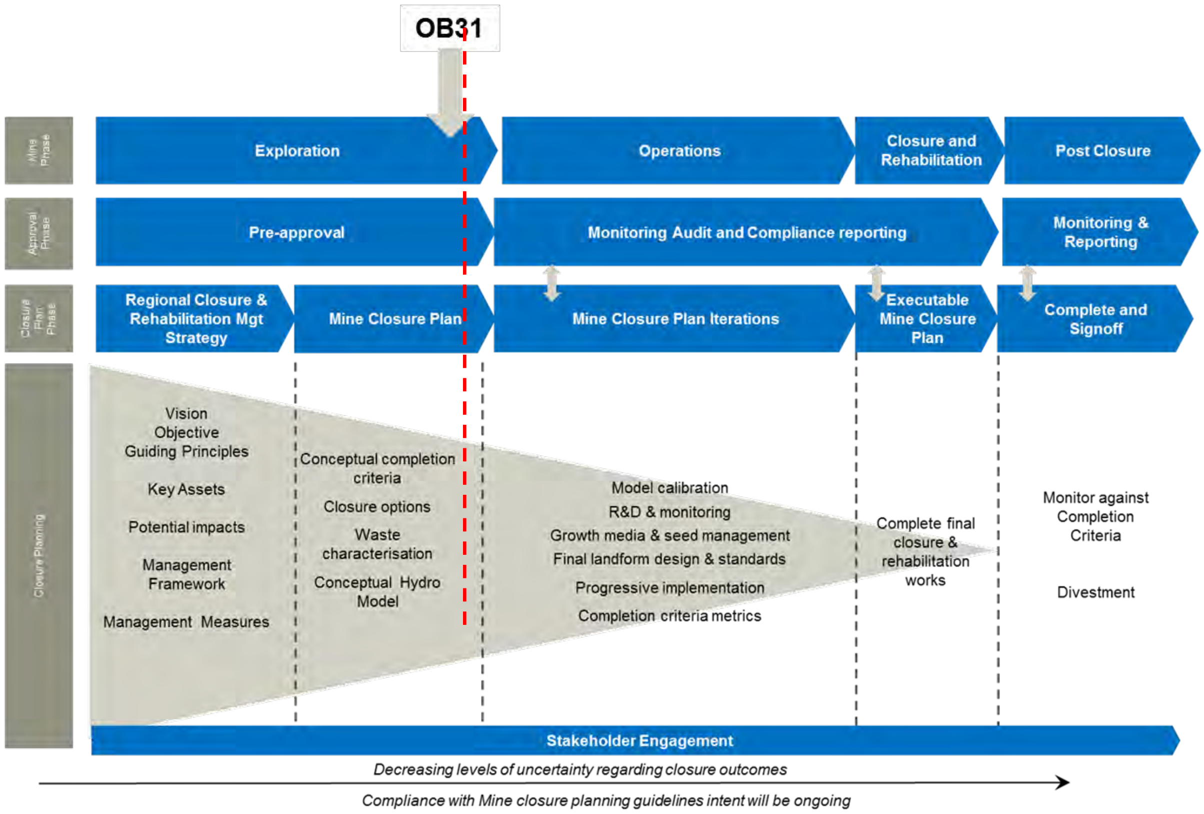


Figure 15: Closure planning over the Project mine life cycle

7.1 Adaptive management

The concept of adaptive management is a structured, procedural, iterative approach to decision making. By its very nature, adaptive management employs an inherent capacity to incrementally improve confidence through the re-integration of data into the forward planning process, thereby reducing risk. Therefore, in circumstances where potential impacts cannot be entirely avoided, the adaptive management approach allows for an evaluation of the preferred mitigation controls employed, such that they are progressively improved and refined, or entirely alternate solutions adopted.

BHP Billiton Iron Ore recognises that learning is at the heart of adaptive management. Models, research and development, and experience as they relate to closure and rehabilitation are the basis of learning. Management approaches can be subsequently informed through the cause-and-effect feedback mechanism under the adaptive management framework.

It is recognised that observation of outcomes alone is insufficient as a feedback mechanism, as interactions in complex systems can be iterative, dynamic, and discontinuous as external circumstances change and internal behaviour crosses systemic thresholds. Continuous testing and refinement of models, research and plan implementation against new data and new hypotheses is therefore a core component of any effective adaptive management strategy.

BHP Billiton Iron Ore's application of adaptive management to closure and rehabilitation involves regularly assessing performance and adjusting management practises to facilitate continuous improvement.

This adaptive management approach will apply to the operations and associated closure issues, and takes into consideration the results of rehabilitation and trials from BHP Billiton Iron Ore's other Pilbara operations and best practice rehabilitation techniques used elsewhere in the mining industry.

7.1.1 Rehabilitation trials and research

As part of BHP Billiton Iron Ore adaptive management approach rehabilitation trials and research across the Pilbara operations are utilised to inform closure and rehabilitation planning.

BHP Billiton Iron Ore has undertaken progressive rehabilitation at a number of its Pilbara operations, which enable learnings from one project area to be applied to new areas through an adaptive management approach. Rehabilitation development monitoring is undertaken to assess initial rehabilitation, revegetation establishment, development over time, and determine whether completion criteria (see Section 8) have been met.

The outcomes of monitoring, research and trials are reported in further detail in the Annual Environmental Reports. Additional ongoing external research programmes, including the Restoration Seed Bank Initiative through the Botanic Gardens and Parks Authority, contribute to improving rehabilitation success across BHP Billiton Iron Ore's Pilbara operations.

Assessment of rehabilitation monitoring results assists with defining these improvements and provides input to the development of robust ecological completion criteria metrics. The rehabilitation monitoring programme and ongoing assessment of results from this programme enables the adaptive management approach which will continue to be used throughout the life of the Project.

In addition to BHP Billiton Iron Ore's rehabilitation research, the adaptive management approach maintains rehabilitation planning flexibility to accommodate changes in method or technology which are developed more broadly in the mining, closure and rehabilitation industry.

7.2 Risk Management

Risk Management is an integral component of the BHP Billiton Iron Ore's Closure planning process. Risk management is undertaken to qualitatively and quantitatively guide the selection of closure options, assess specific risks and identify controls for the design and execution of closure projects.

In accordance with BHP Billiton Iron Ore's Corporate Alignment Planning process (GLD.034, BHP Billiton 2013b) risk assessments are conducted for all of BHP Billiton's operations in order to prioritise and manage risks consistent with Australian Risk Management Standard AS/NZS ISO 31000:2009 Risk Management – Principles and Guideline.

The primary objective of BHP Billiton's risk assessment and management system is to minimise risk in all aspects of its operations; including closure planning. The risk assessment process and the development of a risk profile are undertaken in accordance with:

- BHP Billiton GLD.017 - Risk Management; and
- The WAIO Health Safety and Environment risk management procedure.

In the closure context risk management processes include three main types of risk assessment:

- Closure Planning Risk Assessment (health, safety, environment, legal, community, financial): a predominantly qualitative assessment (including stakeholder consultation) to identify mine closure risks and opportunities associated with closure and management strategies to preserve, maintain or enhance values or beneficial uses. These assessments also include consideration of post closure event risks (i.e. failure).
- Scientific Risk Assessments: Scientific source, pathway and receptor risk assessment for environmental, ecological or human health risk. Involving technical specialists in quantitative assessment based on scientific data and information. For example AMD Risk Assessments and Ecological Risk Assessments.
- Construction/Workplace Risk Assessments: As a closure project reaches execution, risk management is used to guide the effective management of risk in the execution phase.

Closure Planning Risk Assessments are undertaken against closure scenarios to optimise the outcome. Mitigating unacceptable risks to a tolerable level may involve the development of control options against each of the risk factors, including the commissioning of additional technical studies and/or research. Such a process is iterative and is aimed at providing, on balance, the most appropriate closure outcome given the key risk drivers. Closure risks are reviewed on a regular basis and are recorded and maintained in a closure risk register.

For example Initial Closure Planning Risk Assessments identify risk issues with controls often directed to further investigations/study programmes which may include scientific risk assessments. Outcomes of the studies and investigations subsequently provide increased knowledge moving to controls directed to specific closure strategies and design features for the mine site. Subsequently as the Mine Closure Strategy is developed the risk assessments progressively mature with the increase in knowledge and information over the life of the mine.

Stakeholders and specialists may be called upon to provide advice on aspect areas of significance or in instances where in-house expertise is unavailable or deemed unsuitable. BHP Billiton Iron Ore will involve people with a cross section of relevant knowledge and experience, including employees, contractors and other stakeholders to undertake Closure Planning Risk Assessments Evaluation of identified risks is undertaken by the level of management that is consistent with the significance of the closure risk. Scientific Risks Assessments are undertaken by specialists in the relevant field.

7.3 Preliminary identification of closure issues

A Closure Planning Risk Assessment was undertaken for the Project closure, considering integration with the adjacent Orebody 18 Mine Closure Hub, the Project mine life and potential future utilisation of pit voids. The assessment workshop assessed event risks which may impact on achieving the guiding closure principles. Participants included stakeholders within BHP Billiton Iron Ore with expertise in technical closure disciplines. Table 15 outlines the aspects identified as requiring specific attention in the Closure Planning process for the Project. This is based on the collection and analysis of closure data (Section 4) and the Closure Risk Assessment workshop.

Table 15: Closure and rehabilitation risk issues

Guiding principle	Issues	Uncontrolled Risk rating	Residual Risk rating[6]
Final Land use	Rehabilitation /closure inadequate for provisional post mining land use (low intensity grazing)	10-Moderate	3-Moderate
Safety	Injury to public as a result of inadvertent access to closed site (closure landforms include high faces and potential pit lake)	30-High	1-Low
Landforms	Pit void stability failure exposing problematic rock material.	1-Low	0.3-Low
	Landform surface failure causing negative impact on receptors	10-Moderate	1-Low
Ecosystem Sustainability	Revegetation fails to establish and/or self-sustain	3-Moderate	1-Low
Hydrology	Surface water flows downstream impacted by creek overtopping pit crest.	10-Moderate	0.03-Low
	Groundwater quality or quantity has negative impact on receptors (liberation of geochemical contaminants, potential pit lake development)	10-Moderate	1-Low
Contaminated Sites	Potential AMD from OSA's and pit walls	10-Moderate	1-Low
Decommissioning	Not assessed – infrastructure based at OB17/18		
Land Management	See final land use		

[6] Based on preventative and mitigating controls (as outlined in Section 7.4) existing and planned as part of the Project

Management measures (Section 0) will be refined progressively (in line with the adaptive management approach). The Closure Risk Assessment will be reviewed and updated prior to the next revision of this Closure Plan.

7.4 Management of identified issues

7.4.1 Acid and metalliferous drainage (AMD)

AMD is a consideration for mine closure if concentrated levels of acidic, metalliferous or saline drainage enter waterways. Drainage that contains elevated concentrations of sulfuric acid, salts or toxic metals can present a risk to aquatic life, riparian vegetation, ground and surface water or users of these e.g. stock and humans. If the AMD risk is not managed during the life of the mine it may arise post closure. In WAIO operations potential sources of AMD include overburden storage areas, exposed pit walls and other disturbances.

Strategic approach

BHP Billiton Iron Ore is committed to managing and mitigating AMD risk using a structured approach, consistent with global leading practice guidelines including INAP (2009) and DTIR (2007). Management for AMD materials across BHP Billiton Iron Ore’s Pilbara sites is outlined at a high-level in the WAIO AMD Management Standard (BHP Billiton Iron Ore 2013). The overall strategy for AMD management is illustrated in Figure 16 with considerations across the full mine life cycle.

The approach as shown in Figure 16 is risk based, refined with increasing geochemical knowledge of the mine waste material, and this knowledge is integrated into the closure plan. Specifically, the characterisation stage (Stage 1) as shown in Figure 16 informs Stages 2 through 5 inclusive of OSA design. The information also informs the decision making process for pit closure and mine void management.

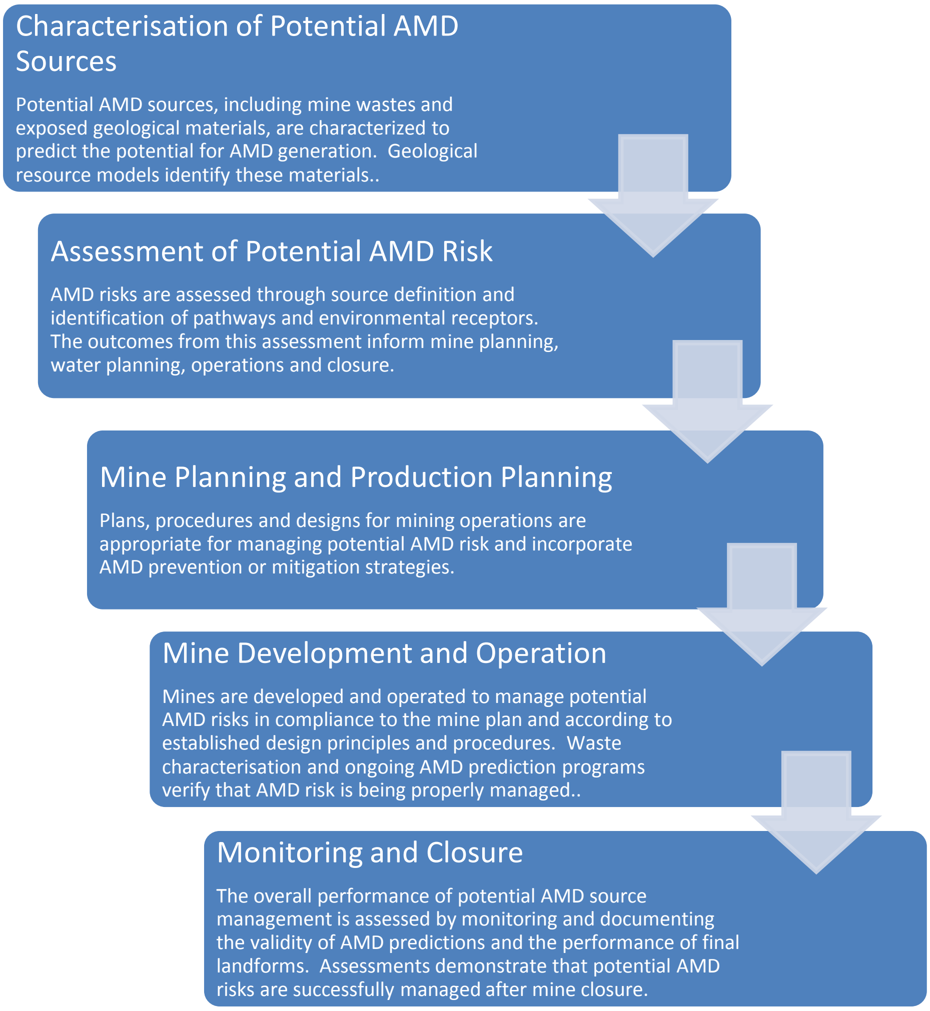


Figure 16: The AMD management process

Specifically, BHP Billiton Iron Ore utilises the following tools to model and assess AMD risk:

- exploration phase waste characterisation sampling;
- static and dynamic geochemical waste characterisation;
- AMD Risk Assessment; and
- hydrogeochemical predictive modelling.

There are a variety of mine waste management and mitigation options available for higher risk stratigraphies that have AMD generation potential. Material can be encapsulated, co-disposed with inert or acid neutralising material, disposed sub-aqueously or a combination of options can be applied (Figure 17). These are evaluated on a site specific basis following the completion of appropriate material characterisation, risk assessment and modelling.

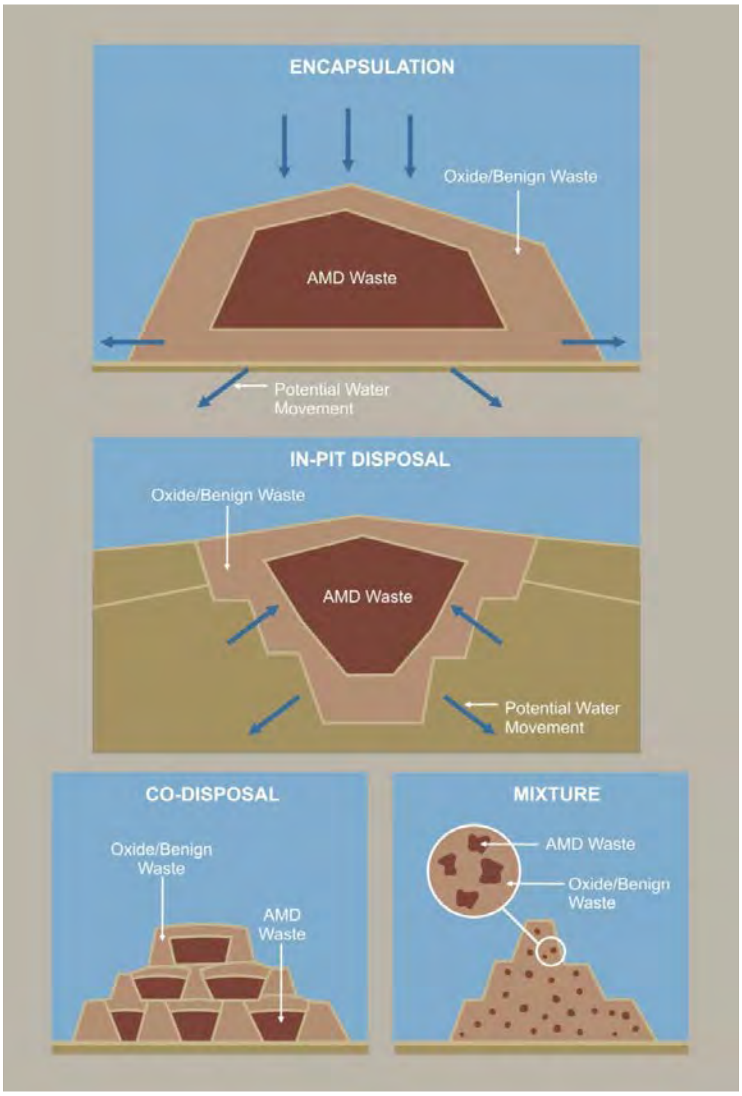


Figure 17: PAF waste management strategies (following DITR, 2007)

Based on the findings of the Project AMD risk assessment (Section 4.3.2) the potential for AMD generation from PAF material is expected to be low.

The majority of the rock types at the Project are suitable for general placement in the out-of-pit overburden storage areas and in-fill storage areas with the exception of any PAF overburden encountered during the remaining mine life.

The process flow for managing PAF from the mine planning through to operations is illustrated in Figure 18.

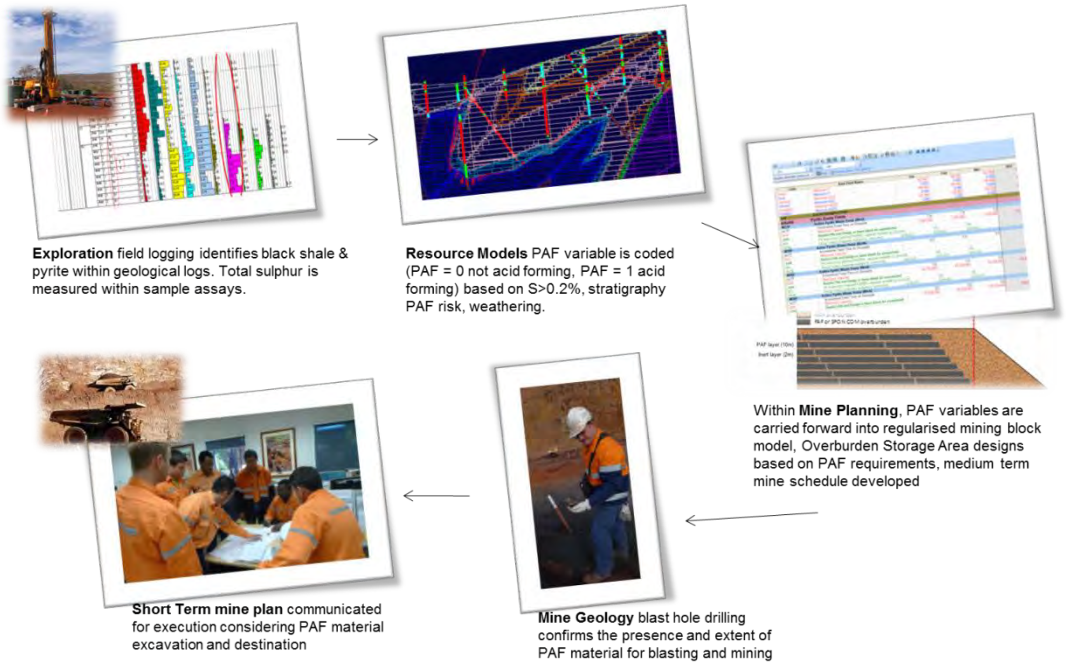


Figure 18: PAF Management process flow (BHP Billiton Iron Ore PAF Management ELearning tool)

Based on the current state of knowledge for the Project, AMD closure and rehabilitation issue will be managed as follows:

- identification and management in accordance with the AMD Management Standard (BHP Billiton Iron Ore, 2013); and
- further studies will be completed in accordance with the AMD Management Standard and as outlined in Section 7.5 to further guide closure planning.

7.4.2 Groundwater

Where mining occurs below the water table residual mine voids have the potential to impact local and regional groundwater and surface water resources. Public safety will also require consideration.

Strategic approach

BHP Billiton Iron Ore undertakes Hydrogeological Conceptual and Predictive Modelling to inform closure planning. This is consistent with the operations approach to water management as outlined in the Pilbara Water Resource Management Strategy (BHP Billiton Iron Ore, 2013). Groundwater flow modelling (commensurate with the extent of below water table mining) is undertaken to predict the range of possible outcomes for pit voids post closure, which guides further technical studies and site-specific closure plans to focus on key uncertainties. Groundwater flow models provide predictions for water level recovery rates and equilibrium levels for the pit void options available at closure.

The initial conceptual model is updated and validated throughout the life of mine as more data becomes available. As with hydrological modelling, such updates and validations would inform closure strategies landform design from conceptual through to detailed, thereby reducing risk and increasing confidence.

The outputs from this work guides closures strategies, provide input to hydro-geochemical assessments (Section 4.3.3) and inform environmental impact assessments using the source, pathway, receptor approach.

Project considerations and management

There are three alternative mine void closure strategies for OB31;

- completely infilled pit void to 5 m above the pre-mining water level,
- partial back fill void, and
- an empty void with the development of a pit lake.

Based on the findings of the closure hydrogeological assessments, and as previously discussed, each closure option presents different potential hydrological legacy conditions. The backfilled void recreates a pre-mining hydrological condition; however, increases the risk of downstream impact through the potential transport of any potential acid metalliferous drainage associated with mine waste. Conversely, the pit lake does not recreate a pre-mining hydraulic condition with the pit void being a regional groundwater sink. The risk of downstream impact is low due to the reversal of hydraulic gradient with the fate and transport of AMD being likely localised to the pit lake. The closure void management strategy will be developed over the life of mine informed by further technical studies to ensure closure objectives and principles are met.

Based on the current state of knowledge for the Project, groundwater closure and rehabilitation issue will be managed as follows:

- Further studies will be undertaken as outlined in Section 7.5 to determine the preferred mine void closure strategy.

7.4.3 Surface water

The surface water system at closure will be designed to meet the closure principle of no significant impact on baseline surface water quality and flow regimes in nearby waterways. Key considerations will include an assessment of the likelihood that mine voids will 'capture' creek lines, or that major climatic events will result in damage to surface water controls (including those on constructed landforms) that may in turn impact future groundwater/surface water interactions and hence, long term water balances.

Strategic approach

The design of surface water management works to meet operational needs will include consideration of closure requirements. These designs will then be revisited the life of the Project and also prior to the closure of the site when closure design will be finalised.

The management of surface water on OSAs may be addressed with:

- Store and release cover systems: To maintain water on or within the closure landform;
- Water shedding profiles: Such as concave slopes to drain surface water to surrounding drainage networks; or
- Defined drainage chutes: Providing a defined drainage line transferring surface drainage off the closure landform to surrounding drainage networks.

The management of surface water drainage in the broader rehabilitated area can be addressed using a number of alternatives, including:

- Avoiding drainage line intersection: Through mine pit and OSA location selection during operations, creek and significant drainage lines may be avoided. The Project OSAs have been located to avoid the need to divert the main stream line;
- Reinstate over backfilled pits: Drainage lines including creeks may be reconstructed over backfilled pits enabling reconnection to downstream systems; and
- Intercept (discharge to pit or local capture): Drainage lines intersected by closure features may be permanently realigned to discharge to backfilled mine pits or pit lakes. Alternatively,

the interception may result in local capture and associated evaporation, seepage or ponding. Considerations include fate of the captured water, potential for surface water recharge of the groundwater system and stability of the impacted landforms to changes in surface water flows.

The selection and design of these alternatives will be made over the life of mine with consideration of on material, geochemistry, environmental values and hydrology.

Project considerations and management

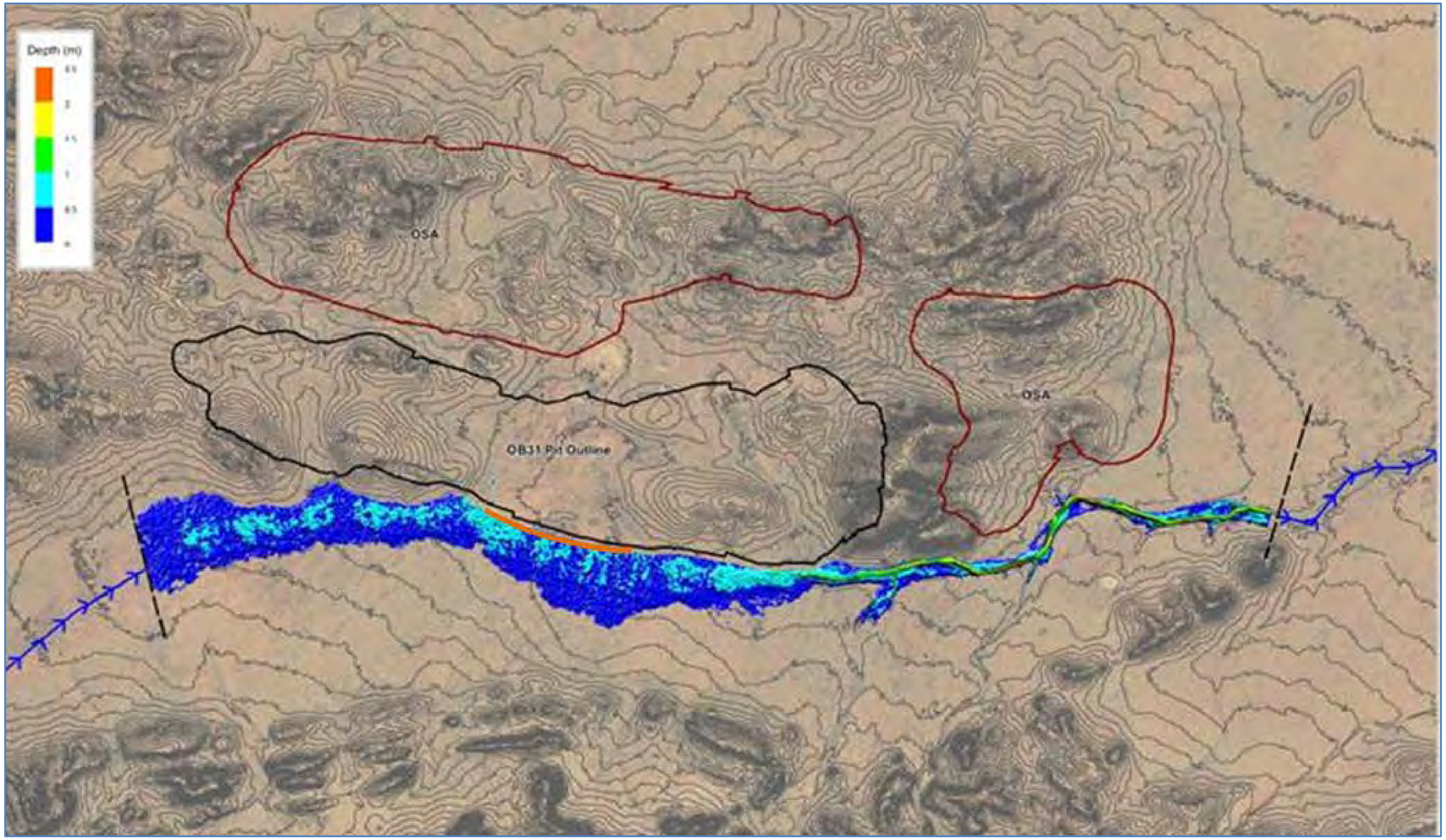
Immediately south of the Orebody 31 pit, there is an unnamed minor drainage line which flows in an easterly direction towards Jimblebar Creek.

Based on anticipated 100 year flood level data, modelling indicates that a bund will be required to be constructed along the drainage line where it intercepts the southern boundary of the indicative Orebody 31 pit footprint. The bund will be constructed during operations and will remain in situ following closure of the Project. Figure 19 illustrates the 100 year flood extent for the Project based on modelling carried out by RPS.

Based on the current state of knowledge for the Project, surface water closure and rehabilitation issue will be managed as follows:

- Further studies will be undertaken as outlined in Section 7.5 to determine the local surface water drainage requirements and detailed design criteria for flood bunding to meet closure requirements.

Figure 19: Surface water management conceptual arrangement post closure (proposed flood bund illustrated in orange)



7.4.4 Landforms

The development of the post mining landform design is an iterative process, integrating all the closure domains. Critical to the transfer of the operational domains, particularly OSAs, to a successful and sustainable landform design is a fundamental understanding of the chemical and physical properties of the soil and/or waste material used to construct the final landform. In particular, the surface materials must be appropriate to withstand erosive forces and sustain vegetation growth in the long term. Inherent in this consideration is the water and nutrient holding capability of the growing media. Similarly, its chemical properties must have low AMD and dispersivity / sodicity risk.

Strategic approach

BHP Billiton follows the adaptive management framework, with the mine plan and closure landform designs evolving over the life of mine as constraints information and knowledge becomes available as a function of time. The opportunities to minimise the size of the overburden storage areas by increasing the amount of overburden material used to infill final voids (as void areas become available and/or as resources are mined out) will continue to be explored as part of ongoing operational planning

Management of erosion is the primary tool for achieving a sustainable landform. The design objective applied is to create slopes on which rilling will be minimal or absent. Such slopes will have little potential to become heavily gullied, and any interill erosion that occurs will be relatively insignificant to potential rates of erosion by rilling that could develop on long steep, slopes. If riling and gullying is avoided, the slope should be sustainable.

BHP Billiton Iron Ore undertakes a suite of work to inform and guide the landform design process including:

- **Resource Sterilisation Assessment:** Is an assessment of resource or potential mineralisation beneath an area typically selected for proposed OSA construction. Drilling, surface mapping, geological modelling and/or resource modelling data are typically used to identify and quantify any mineral resources within the area that may become 'sterilised' or economically unviable to mine if the proposed closure strategy proceeds. This assessment also applies to pit voids where backfill is proposed as part of the operations and/or closure strategy. It would add to the spatial dataset to assist with OSA positioning at the conceptual stage.
- **The Resource Block Model:** Contains geological resource information for planned and operational mines. The model contains amongst other things the relevant stratigraphies and geochemical properties of the rock mass allowing for the identification of ore and waste material. Examination of the resource model and associated drilling would be undertaken prior to closure being considered to ensure that a high level of certainty is held on sterilisation of the orebody.
- **Waste Characterisation:** A critical component of a sustainable landform is the physical and geochemical nature of the waste material used in landform construction. To this end, waste characterisation would form a suitable material for use on final slopes, with any inappropriate material being buried within the OSA or mine void as appropriate.
- **Mine Plan Optimiser:** Mine planning software would be used to assist in generating an optimal pit design based on financial and geotechnical parameters, assuming an appropriate risk level. The mine planning software is also used to schedule multiple deposits based on optimal maximised net present value (in considerations of operational and environmental constraints). Schedules provide the necessary information to develop optimal waste strategies and are an iterative process. This informs waste production rates which would subsequently inform waste volumes and therefore, OSA design.
- **Numerical Erosion Potential Modelling:** Environmental surface erosion modelling can be undertaken as part of the detailed OSA design stage to evaluate the predicted rates and

locations of erosion on a final landform. This process is supported by numerical inputs obtained from the material characterisation programmes. This activity supports planning considerations around final landform design and waste scheduling objectives.

- **Physical Erosion Potential Modelling:** The physical hydraulic examination of mine waste that forms the outer surfaces of OSA landforms is undertaken to determine the key erosion characteristics of the waste material. This is undertaken within laboratory conditions using predicted rainfall events using local rainfall data. It provides validated data for the numerical modelling on how well a specific waste rock type behaves in surface flow conditions, and would inform detailed OSA design considerations regarding stable slope angles and material use. In addition field trials are utilised where appropriate to validate laboratory findings.

For mine void closure several landform options are available as shown previously in Figure 11.

Landforms created from OSAs can be located within a mine void (in-pit OSAs) or outside the mine void footprint (ex-pit OSAs). At closure, OSAs are re-profiled into a final landform through rehabilitation earthworks. To maximise the longevity of OSA final landform, the technical studies, modelling and analysis tools discussed above inform the detailed design. Figure 20 shows a selection of alternatives that may be adopted, including:

- In-pit OSA: Utilising the mine void to permanently store waste material;
- Buttress OSA: Creating an extension to an existing landform; and
- Free-standing OSA: Creating new landforms.

Options for surface profiles, which vary based on the surface waste material characteristics and hydraulic condition, include:

- Bench and Berm Profiles: Using a stepped profile to manage the slope length and associated surface water flow path. Store and release drainage designs may be used to manage surface water;
- Concave Profiles: Creating hydraulic conditions on the landform surface that reduce the slope gradient in stages from the crest to toe of the slope to manage the surface water flow velocity as it drains down the batter; and
- Linear Profiles: continuous slope with uniform angle from crest to toe.

For each option, the key dimensions of height (H) of the OSA, slope length (L), slope angle, and berm width are determined by the waste characteristics of the external face and surface water catchment (Refer Figure 20).

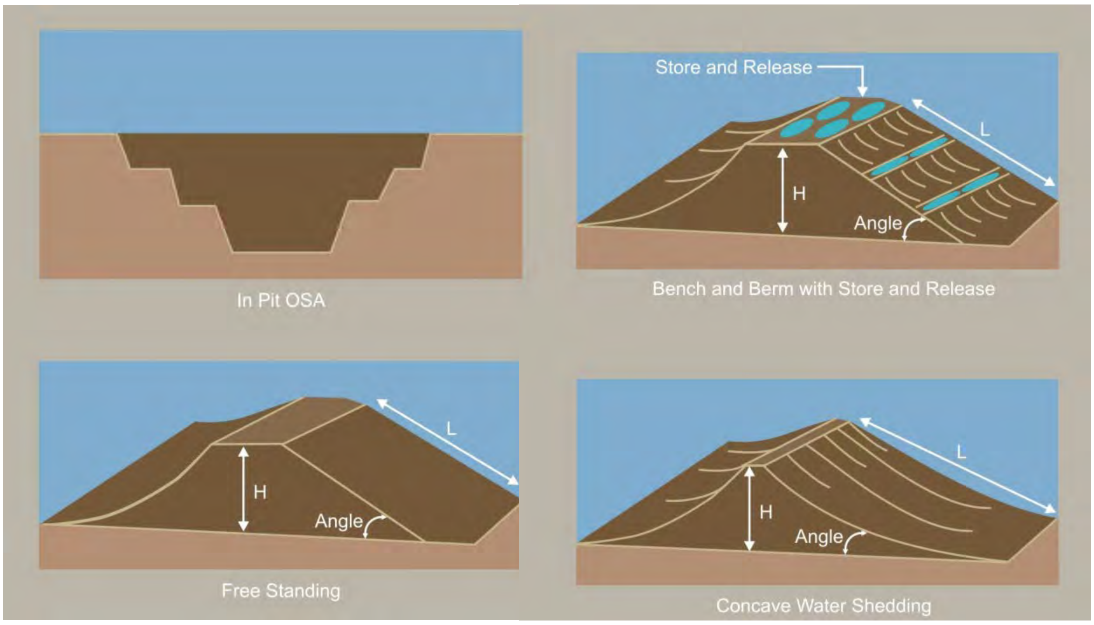


Figure 20: Waste landform conceptual options

The management of physically unstable waste is addressed through the waste landform design process with available management measures including:

- Encapsulation: Place unstable material on the inside of OSAs where exposure to erosive forces will be avoided;
- Armour with suitable material: Utilise erosion-resistant waste material on the outer face of the OSA as part of the closure landform earthworks; and
- Slope length and gradient control: Design the OSA slopes and height to ensure the erosive forces do not exceed the material characteristics' ability to resist erosion. A key consideration in this option is the surface water management from the top of the OSA (see Figure 21).

Design decisions regarding the application of these measures include material characteristics, surface water management, outcomes of erosion potential modelling, disturbance footprint, visual impact and integration with the adjacent landforms (natural and closure features).

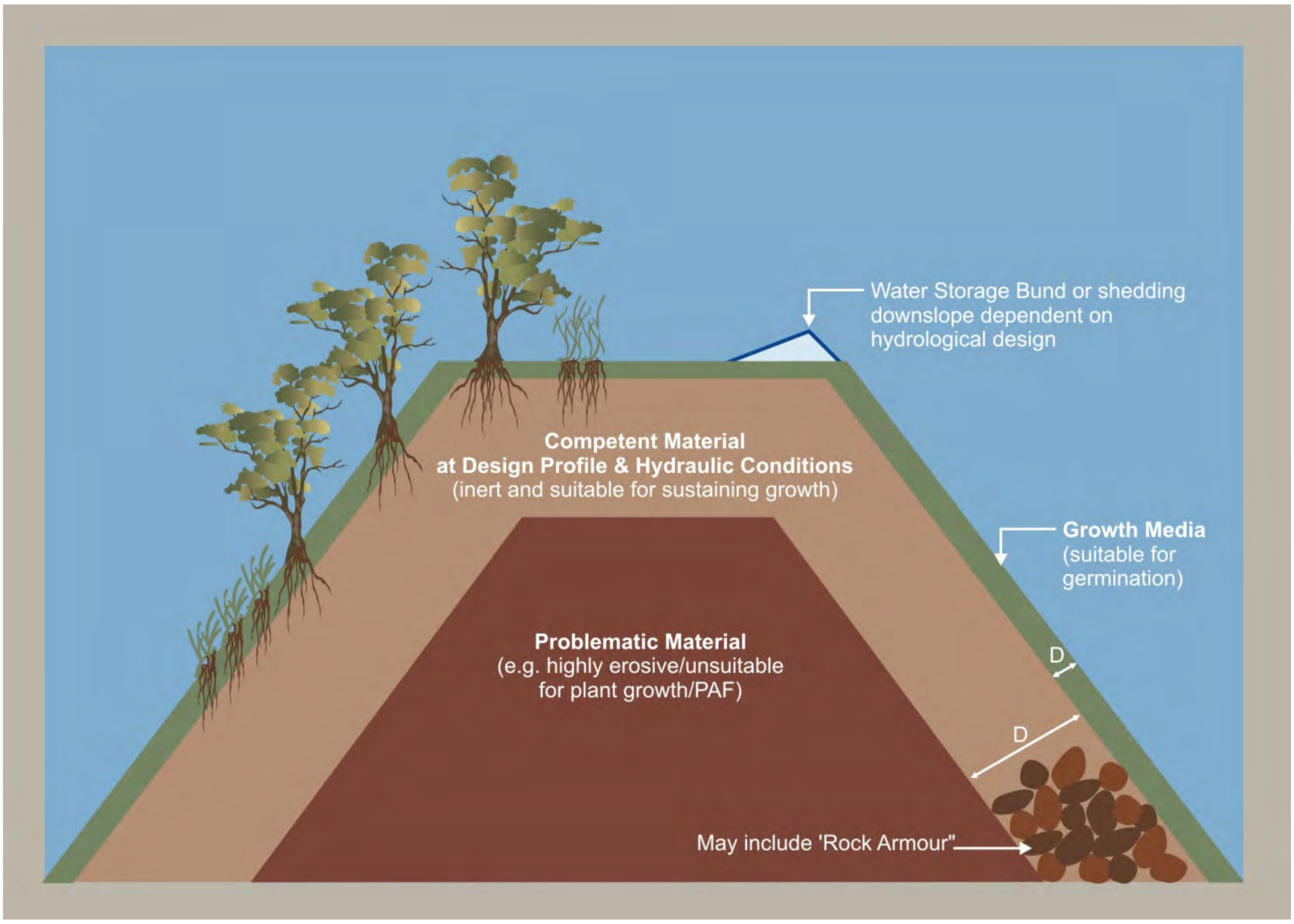


Figure 21: Integrated waste landform concept

The management of surface water on OSAs may be addressed with:

- Store and release cover systems: To maintain water on or within the closure landform;
- Water shedding profiles: Such as concave slopes to drain surface water to surrounding drainage networks; or
- Defined drainage chutes: Providing a defined drainage line transferring surface drainage off the closure landform to surrounding drainage networks.

Geotechnical and hydrological assessments will be used to inform the pit design and reduce stability issues, with surveys being undertaken to check final pit walls against designs.

Project considerations and management

A Landform and Visual Impact Assessment has been carried out for the Project (360 Environmental, 2014) and has have demonstrated that direct impacts on landscape character and visual amenity are anticipated to be relatively low.

The opportunity to minimise the size of the overburden storage areas by increasing the amount of overburden material used to infill final voids (as void areas become available and/or as resources are mined out) is a key characteristic of the Project mine plan. The following options are being considered specifically in relation to reducing the OSA footprint associated with the Project and adjacent Orebodies 17 and 18:

- **Option 1** – transferring all overburden from the Orebody 31 pits direct to new OSAs at Orebody 31;

- **Option 2** – transferring some overburden from the Orebody 31 pits direct to the existing Orebody 17 depleted pits and the remaining amount to OSAs at Orebody 31; and
- **Option 3** – progressively transferring some overburden from the Orebody 31 pits back into the depleted pit areas of Orebody 31 and the remaining amount to OSAs at Orebody 31.

The opportunities to minimise the size of the overburden storage areas by increasing the amount of overburden material used to infill final voids (as void areas become available and/or as resources are mined out as part of the Project and at the adjacent Orebody 18 Mine Hub) will continue to be assessed to manage the water level and AMD risk in line with the regional closure management approach.

Based on the current state of knowledge for the Project, landform closure and rehabilitation issue will be managed through undertaking further studies as outlined in Section 7.5 to determine the preferred landform closure strategy.

7.4.5 Sustainability

Strategic approach

The revegetation strategy will be designed to establish native vegetation that blends with the surrounding areas and will provide habitat and foraging areas for native fauna, while taking into consideration any constructed landform and the waste material characteristics within the potential root zone.

The establishment of a robust soil profile (based on waste material characterisation as outlined in Section 7.4.4) is critical for the successful establishment of vegetation and compliance with the relevant completion criteria (see Section 8). Prior to use in rehabilitation, topsoil is stripped and stored (if required) in accordance with the procedures outlined BHP Billiton Iron Ore's Growth Media Management Procedure (SPR-IEN-LAND-009).

The use of alternative growth media for rehabilitation is being investigated as part of the Growth Media Atlas. This study will establish the quantity and quality of current stockpiled material in addition to identifying alternative growth media materials within OSAs that can be utilised for rehabilitation activities.

The Rehabilitation Standard requires that revegetation be conducted so as to establish plant species that will support the approved post-mining land use. The selection of plant species used in revegetation is to be selected from the revegetation species lists generated for each domain from the baseline survey, and includes a range of typical vegetation assemblages suited to the post-mined landform. The use of local vegetation assemblages in rehabilitation areas will contribute to improving habitat value and encourage colonisation by a wide range of fauna.

Based on the available climate change predictions, BHP Billiton Iron Ore considers that the most appropriate rehabilitation revegetation approach is to design landforms and select native species based on the current climatic conditions. If there were to be an effect on rehabilitated landforms and revegetation from climate change, those changes would reasonably be expected to be gradual and would be experienced across the entire region, including adjoining unmined areas. By revegetating based on the current climatic conditions the mine will blend in with the surrounding vegetation, regardless of the effect of climate change (i.e. any future changes would affect undisturbed and rehabilitated areas equally). Major differences between regional and post-mined vegetation will be managed by ensuring sufficient diversity of species within rehabilitated sites, so that the natural adjustments to a changing climate will be accommodated within the local species gene pool.

Project considerations and management

Dependent on the provisional final land use (Section 6.3) revegetation at the Project will use local provenance native seed (from the local area, but as a minimum from within 100 km consistent with vegetation associations and native species recorded in the mine area prior to mining (BHP Billiton Iron Ore, 2008). At the time of writing, additional targeted surveys are being planned to gather more information on the newly discovered species *Acacia sp. East Fortescue* (J. Bull & D. Roberts ONS A 27.01) (Priority 1). OSAs are currently being redesigned to bring the proposed impact down to less than 14% of all known records. Following the results of the proposed targeted surveys, this proposed impact may be further reduced. Future revisions of this MCP will reflect the results of the proposed targeted surveys and these Project considerations will be updated.

Development of specialised habitats for conservation level fauna recorded in the Project area pre-development will be considered during rehabilitation works. The following broad habitat types may be considered, in line with species identified to date in the Project area:

- Western Pebble-mound Mouse *Pseudomys chapmani* have been recorded within 'Crest/Slope' habitat within the Project area.
- Mulgara *Dasycercus* sp. have been recorded within the 'Sand Plain' habitats within the Project area.
- Rainbow Bee-eater *Merops ornatus,* Fork-tailed Swift *Apus pacificus* may utilise all habitats within the Project area and may also nest within the riparian areas.
- Short-range endemic species such as *Karaops* species (*Karaops* 'ARA008-DNA' and *Karaops* 'ARA004-DNA') were recorded wtihin rocky habitats/microhabitats in the Project area and *Xenolphium* PSE079 was predominantly found in sparse leaf litter on moderate to low stony slopes. Baseline surveys indicate that the species favours moderately open, low sloping habitats, where is a combination of rocky substrates and sparse to moderate leaf litter from *Eucalyptus* or Mulga trees.

Revegetated landforms (as part of progressive rehabilitation) will be monitored to determine adequacy of habitat structure, recolonisation of landforms and success of revegetation.

Summary

Based on the current state of knowledge, the rehabilitation of disturbed areas within the Project area during and post-operations will be undertaken consistent with the Rehabilitation Standard and include;

- Rehabilitation earthworks in accordance with the BHP Billiton Iron Ore's Earthworks for Rehabilitation Procedure (SPR-IEN-LAND-010).
- Growth media management in accordance with the BHP Billiton Iron Ore's Growth Media Management Procedure (SPR-IEN-LAND-009).
- Local provenance native seed (from the local area, but as a minimum from within 100 km of site within the Pilbara Biogeographic Region) as per the BHP Billiton Iron Ore's Seed Management Procedure (SPR-IEN-LAND-011).
- Further studies will be undertaken to advance rehabilitation planning as outlined in Section 7.5.

7.5 Closure improvement

Section 0 provided an overview of closure issues, modelling and assessment and management initiatives which BHP Billiton Iron Ore will undertake to progress Closure Planning during the life of the Project. Table 16 summarises the activities to fill gaps in the existing knowledge base and further define the closure methodology.

Table 16: Project closure improvement activities

Knowledge gap	Proposed activity	Indicative timing
Waste characterisation	Undertake further waste characterisation, modelling and analysis to refine the Waste Class classification.	Ongoing
Landform design	Develop the conceptual and detailed closure management and design tools (including application timing) to identify the optimal closure overburden storage area design and mine void outcomes.	Ongoing with progressive rehabilitation and less than 5 years to closure.
	Develop integrated waste strategy across The Orebody 18 Mine Hub and the Project area to inform OSA and mine void infill requirements (informed by results for further AMD and hydrogeological assessments)	2020
	Detailed closure landform designs (integrating all domains) to be developed based on outcomes of technical studies and assessments.	Less than 2 years to closure
Hydrogeology	Undertake hydrodynamic trial to resolve key hydrological uncertainties	2015/16
	Review and update the Project conceptual model (based on outcomes of hydrodynamic trial 2015/16).	2016
	Re-calibrate numerical model (based on hydrodynamic trial) to refine and validate the predictions.	2017
	Review and update conceptual model and numerical model as more data becomes available	ongoing
	Modelling mitigation measures (using the updated numerical model) to offset any identified groundwater changes at the receptors.	Ongoing
Surface Water Hydrology	Develop design principles and details for structures remaining post mining that will be exposed to surface drainage including flood bunds.	2 years prior to re-alignments
	Where overburden storage areas encroach in the flood zones, additional	When triggered

Knowledge gap	Proposed activity	Indicative timing
	studies will be completed to determine the 100 year Average Recurrence Interval (ARI) flood event.	
	Further develop the parameters and design objectives to ensure that surface water drainage requirements are included at the various stages of planning and execution.	Ongoing
AMD	Targeted geometric testing of key lithologies to increase understanding of the potential for AMD-generation.	Ongoing
	Hydro-geochemistry assessment of alternative mine void closure strategies (based on updated hydrological model and geochemical characterisation)	2018
	Update the AMD Risk Assessment with additional analytical data and update in-pit block model.	Ongoing
	On the basis of ongoing AMD studies assess the need to update the Project AMD classification and management system.	Ongoing
Soils	WAIO Growth Media Atlas to identify suitable growth media for use in rehabilitation	Annually
Land use	Final land use planning study to be undertaken. Key Stakeholders to agree and endorse the final land use for the Project area.	Within 2 years of closure
Decommissioning Plans	Develop detailed decommissioning plans for site infrastructure.	Within 3 years of closure
Government and stakeholder consultation	Consultation will continue to be undertaken with identified stakeholders in line with the broader Stakeholder Consultation Programme.	Ongoing
Completion Criteria	Ecological Development of ecological criteria based on analysis of rehabilitation monitoring results from executed rehabilitation across BHP Billiton Iron Ore Operations.	2020
Progressive Rehabilitation	Locations which may be available for a minimum of five years for rehabilitation/landform trials will be planned as they become available in the annual planning cycle.	Ongoing

8 Completion criteria

Completion criteria are the measures against which implementation of closure objectives and guiding principles can be assessed. As closure objectives and guiding principles cover a broad spectrum of outcomes, so must the completion criteria for example; final land use, safety, landform, sustainability, hydrology, decommissioning, contaminated sites and land management.

BHP Billiton Iron Ore will continue to work with regulators and stakeholders to refine the completion criteria for the Project mining operations in order to produce robust measures of closure completion.

8.1 Basis for development

Working completion criteria for the Project operations have been developed with reference to the following sources of information:

- Relevant guidelines and codes of practice issued by the Australian and WA Governments, which currently includes:
  - Guidelines for Preparing Mine Closure Plans (EPA/DMP 2011);
  - Rehabilitation of Terrestrial Ecosystems (EPA 2006); and
  - Department of Resources, Energy and Tourism's Leading Practice Sustainable Development Program for the Mining Industry Handbooks on Mine Closure, Mine Rehabilitation, Biodiversity Management, and Performance Assessment – Monitoring and Auditing.
- Key guidelines on mine site closure and rehabilitation issued by industry and international councils that are relevant to the Project area, including:
  - the Strategic Framework for Mine Closure (Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) 2000);
  - the Planning for Integrated Mine Closure Toolkit (International Council on Mining and Minerals (ICMM) 2008);
  - International Council on Mining and Minerals (ICMM) - Good Practice Guidance for Mining and Biodiversity (2006); and
  - Minerals Council of Australia (MCA) - Enduring Value, the Australian Minerals Industry Framework for Sustainable Development (2005).

Development of the completion criteria for the Project will integrate a number of key components related to the establishment, monitoring and management of rehabilitation including:

- rehabilitation objectives, including ecological completion criteria, must be achievable and based on the findings of relevant monitoring and research programmes;
- rehabilitation performance will be measurable using accepted monitoring and performance indicators;
- rehabilitation must be sustainable under the designated post-mining land use;
- progressive rehabilitation initiated during early mine design stages, involving material chemical and physical characterisation to inform the design of overburden storage areas and plan dumping and rehabilitation operations;
- the principle of progressive signoff will be adopted where applicable, to facilitate the development of rehabilitation to acceptable standards. Criteria that change over time will not be applied retrospectively;
- specific features that do not reflect typical land uses for the area (such as mine void pit lakes) will be subject to independent environmental risk audits;

- long-term management operations following mining/closure/signoff (e.g. maintenance of access tracks, fire) to be no greater than those of areas prior to mining, or where extra management actions may be required, a mechanism has been put in place for addressing these; and
- ensuring operational criteria reflect key stages of the mining operation, including planning, operations, early establishment, development, and closure.

8.2 Approach

Assessment of rehabilitation against completion criteria will be applied throughout the various stages of rehabilitation planning, operations and management. Assessment of rehabilitation success during the early years of ecosystem development ensures that corrective actions can be carried out if necessary without disturbing older rehabilitation, and while mining operations are still nearby. However, it should be noted that for older rehabilitation, it may not be possible to assess some (perhaps many) of the operational and establishment criteria. For these areas, assessment of rehabilitation success will need to focus on the development stage.

Completion criteria standards and milestones will be formally reviewed with Closure Plan updates (nominally every five years for the Project) where necessary they will be revised by mutual agreement between BHP Billiton Iron Ore, key stakeholders and regulatory authorities to adopt any significant advances in cost-effective rehabilitation techniques. More frequent review can take place over the next five to ten years where improvement opportunities are identified through research and development programmes.

This process has been refined in consultation with regulators with initial discussions on the development of ecological completion criteria with the Department of Minerals and Petroleum (DMP) held in March 2013, outlining the proposed approach and agreeing on the target of having draft ecological criteria in 2018. While considerable work has been undertaken including a detailed analysis of all rehabilitation monitoring data (to be finalised in 2015), delays in fully executing planned rehabilitation projects have resulted in a delay to measuring early establishment criteria for most land disturbance domains. Following a recent progress meeting with the DMP (December, 2014. Table 17), the target date for establishing draft ecological criteria has been revised to 2020. Criteria have been defined based on successive stages of closure:

- **Stage 1 Planning**: Describes criteria that must be met to confirm that the necessary planning and operating procedures have been developed and agreed with regulators and other stakeholders.
- **Stage 2 Rehabilitation Operations**: Describes criteria that must be met to confirm that rehabilitation operations have been implemented according to the above agreed planning and operating procedures. The assessment method for this will be by reviewing and auditing rehabilitation plans and records, and site inspections as required. Note that for older existing rehabilitation a simplified approach to setting agreed criteria may be developed.
- **Stage 3 Early Establishment Rehabilitation**: Assesses whether completed rehabilitation has established with no early problems (e.g. erosion, exposed dispersive material) apparent. The early establishment assessment provides confidence that vegetation is establishing and developing, and identifies where corrective work may be required. Assessment is initially by site inspection, followed by broad scale vegetation establishment monitoring. Note that for older existing rehabilitation, it may not be possible to determine whether some revegetation criteria have been met; nevertheless, rehabilitation records should help determine likely stability and performance.
- **Stage 4 Rehabilitation Development**: Determines whether the rehabilitation is developing appropriately towards the designated final land use and has reached or exceeded various development standards and milestones. Assessment is by site inspections, monitoring (both detailed monitoring of typical rehabilitation, and broad scale monitoring of other sites), and research projects where required.

- **Stage 5 Closure:** Addresses final closure stage management and land capability issues.

8.3 Development of criteria

Closure and rehabilitation objectives are based on the land uses applicable to the particular area, in recognition of the fact that the land is altered fundamentally from its pre-existing condition. The completion criteria are designed to confirm that the objectives have been met. They provide both BHP Billiton Iron Ore and government with clear direction for the planning, establishment and management of mine rehabilitation at the site. They also provide a detailed understanding of the desired state of lands influenced by mining operations, at the time when any obligation for ongoing financial input or legal responsibilities by the mining companies effectively ceases, i.e. at signoff.

The purpose of the completion criteria is to ensure areas will display similar self-sustaining characteristics of surrounding areas and give Government regulators confidence that, to the maximum possible extent, they can be managed in the long term according to the intended land use (or uses), using normal management practices without the input of additional resources.

Completion criteria will continue to be developed by BHP Billiton Iron Ore over the next five years to integrate findings from ongoing research and development programs including landform trials, improved knowledge on the ecosystem development derived from rehabilitation monitoring programs and greening initiatives. Future revisions of the criteria will focus on developing measurable metrics based on site specific data.

The completion criteria for the Project mining operations are presented in Table 17. For clarity, column headings are defined as follows:

- **Criterion Objective:** The purpose or objective of the particular criterion.
- **Criterion Standard or Milestone:** An agreed standard or level of performance which demonstrates successful closure of a site for that particular objective.
- **Verification Procedure**: How BHP Billiton Iron Ore will demonstrate that the criterion has been met. This will generally require either reporting in the Annual Environmental Report when a specific criterion is met, or production of a separate rehabilitation monitoring report addressing one or more criteria, e.g. development of vegetation.
- **Domain:** Areas of similar operational land uses and closure requirements. Additional information relating to closure implementation for each closure domain is provided in Section 10.

Table 17: Project completion criteria

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
1. Final Land use				
1.1 Final Land Use	Agreed final land use has been determined in consultation with relevant stakeholders.	All	End land use for the area is considered likely to revert to low intensity cattle grazing or the inclusion in some form of natural conservation area, however this would be determined in consultation with stakeholders and approved by the administering authority during the life of the mine. Specific rehabilitation objectives have been developed to ensure that, when met, areas will fulfil the post-mining land use requirements.	▪ Land use and objectives are documented in the Mine Closure Plan as reviewed and agreed by the stakeholder groups mentioned.
2. Safety				
2.1 Safety	There are no unsafe areas where members of the general public could gain inadvertent access.	All	All hazards that could endanger the safety of any person or animal have been identified and eliminated where practical. All residual safety and health hazards have been identified and controlled in accordance with regulatory requirements and consideration of industry guidance.	▪ All relevant DMP guidelines have been met. ▪ All sites are safe to access as determined following site inspection by a Mines Safety Inspector.
2.2 Landform Safety	Final landforms are safe.	All	Landforms have been constructed to conform to DMP guidelines for structural stability, with no significant slumping or failure of constructed slopes or berms. No hazards to humans or wildlife have developed thorough erosion,	▪ Report on landform construction methods, and any additional maintenance works undertaken. ▪ Rehabilitation inspections (including undertaken on maintenance earthworks) confirm earthworks have met final

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
			subsidence, AMD or otherwise. Inspections of the rehabilitated landforms have been conducted to monitor their stability over time, with monitoring conducted after each significant rainfall season.	landform designs. ▪ Rehabilitation monitoring results (including erosion monitoring) ▪ Report on performance in relation to design criteria and DMP guidelines. ▪ Inspections of the rehabilitated landforms have been conducted to monitor their stability over time, with monitoring conducted after each significant rainfall season.
3. Landforms				
3.1 Visual Amenity	Visual amenity of constructed landforms is compatible with that of local Pilbara landforms.	All except mine voids	Within the constraints imposed by aspects such as the physical nature of the materials available, tenement boundaries, and proximity to streams, landforms have been constructed to blend into the surrounding landscape and are similar to the existing regional landforms.	▪ Report on rehabilitation works confirms landform construction undertaken according to BHP Billiton Iron Ore relevant procedure. ▪ Rehabilitation inspections confirm earthworks have met final landform designs.
3.2 Waste Characterisation	Materials with poor physical or chemical properties do not compromise rehabilitation (landforms stability and revegetation)	Anywhere problem materials present	An overburden storage plan for any new overburden storage area is developed and incorporated into the life of mine plan prior to the commencement of ex-pit dumping activities. All overburden placement in new overburden storage areas has been undertaken in accordance with this plan. Mine waste material likely to provide a poor growth medium (e.g. dispersive and incompetent material), has been placed appropriately in the overburden storage	▪ Waste characterisation report available for review. ▪ Report on landform construction methods. ▪ Rehabilitation inspections confirm earthworks have met final landform designs.

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
			areas.	
3.3 Landform Stability	Constructed landforms are structurally stable.	All	Post-mining landforms have been constructed according to guidelines and procedures outlined in this MCP and the Project Mine EMP (in prep.). Detailed landform design standards include: ▪ Residual pit voids have been left as run-of-mine where geotechnically stable ▪ A compacted bund has been constructed along the crest of the overburden storage areas to reduce surface water runoff from overburden storage area slopes and minimise potential erosion impacts. The bund constructed is approximately 1.5 m high and 5 m wide ▪ Earthworks consist of reshaping the slope, ideally to between 15° and 18°; however, the type of material used will ultimately determine slope stability and therefore final gradient.	▪ Report on rehabilitation works at construction confirms all DMP Guidelines have been met and sites constructed according to BHP Billiton Iron Ore relevant procedures. ▪ Rehabilitation inspections confirm earthworks have met final landform designs.
3.4 Surface Stability	The constructed soil surface is stable and showing no signs of significant erosion.	All	Post-mining landforms have been designed and constructed taking into account waste characteristics (physical and chemical). Slope surfaces are stable, with no dispersive material on the surface ; rock armouring is present as required; and no areas are exposed to the risk of significant	▪ Report on landform construction methods, and any additional maintenance works undertaken. ▪ Rehabilitation inspections (including undertaken on maintenance earthworks) confirm earthworks have met final landform designs. ▪ Visual assessment and monitoring,

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
			erosion which may be defined as having: ▪ channelised flow resulting in extensive active gullies; ▪ failure of banks, berms or bunds; and ▪ evidence of ongoing significant sheet erosion (including large accumulation of silt at base of slope, exposed subsoil, poor seedling establishment)	taking into account slope, available materials and vegetation cover, and relevant research projects on surface stability of comparable rehabilitated landforms. ▪ Rehabilitation monitoring results (including erosion monitoring) indicate gullies and rills are stabilising.
3.5 Landform Surface	Landform surface material promotes water infiltration and reduces erosion and crusting.	All (excl. mine voids and PAF encapsulation OSA's)	Surface treatments (including ripping) undertaken to rehabilitated surfaces to maximise water infiltration, to reduce erosion potential, and support establishment of vegetation	▪ Report on landform construction methods. ▪ Rehabilitation inspections confirm earthworks have met final landform designs.
4. Sustainability				
4.1 Sustainability	Rehabilitation is sustainable and the land capability and groundwater are suitable for the agreed end land use	All where relevant	Monitoring, research data and site inspections indicate that the rehabilitation will be sustainable and will continue to fulfil rehabilitation objectives relating to the agreed final land use in terms of flora, vegetation, fauna, and surface and groundwater hydrology.	▪ Documented in relevant monitoring, research reports and site inspections.

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
4.2 Resilience	Vegetation is sustainable and resilient to likely impacts such as fire, drought and grazing (where applicable, if managed according to agreed guidelines).	Overburden storage[7]e areas	Monitoring and/or research results have shown that recruitment of native perennial species is occurring or is likely to occur on the site (e.g. evidence of flowering, fruiting, soil seed bank or second generation seedlings). Research trials in rehabilitation representative of the same age and technique have demonstrated its ability to regenerate following burning (in terms of key parameters such as cover, richness and density); rehabilitation has reached the age where plants are likely to tolerate fire or regenerate/reseed. Monitoring has shown that the rehabilitation can survive one or more seasons of low rainfall.	▪ Review of progress and performance of Rehabilitation Development Monitoring results, and related rehabilitation monitoring procedures. ▪ Monitoring results reported in Annual Environmental Report. ▪ Research findings from trials on representative rehabilitated areas investigating post-disturbance recovery of revegetation.
4.3 Growth Media	A suitable growth medium has been constructed to facilitate plant establishment and growth.	All where revegetation is planned	Material placed on the outer surface of landforms takes into consideration the growth media characteristics. The depth and characteristics of newly constructed landforms surface soils and subsoils are suitable for plant growth in terms of their structure, water holding capacity, and lack of materials that might affect plant growth or survival (i.e. they are suitable for establishing target vegetation communities and supporting	▪ Topsoil reconciliation database information available. ▪ Review of baseline soil report (where available) and site waste characterisation report. ▪ Report on landform construction methods. ▪ Rehabilitation inspections confirm earthworks have met final landform designs.

[7] Simplified assessment and milestones needed for other domains including borrow pits, infrastructure corridors, road and rail.

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
			the agreed final land use). Soil stripping has been undertaken as per Section 10.2.2 in this Mine Closure Plan; and following the relevant BHP Billiton Iron Ore Rehabilitation Standards and Procedures. Topsoil stockpiles have been managed as per the EMP and the relevant plans and databases have been prepared, updated and maintained. Where available, topsoil has been used to provide a suitable medium for plant establishment and a source of propagules.	▪ Rehabilitation monitoring results provide feedback to determine suitability of growth medium.
4.4 Provenance	Vegetation is locally endemic.	All	Revegetation at the Project will use local provenance native seed from the local area or the Pilbara IBRA region consistent with vegetation associations and native species recorded in the Project area prior to mining	▪ Site Rehabilitation Report including seed mix summary. ▪ Seed Database. ▪ Rehabilitation monitoring results.
4.5Vegetation Development	Vegetation is suited to the agreed final land use.	All with revegetation	Established vegetative cover should be self-sustaining and similar to the surrounding undisturbed vegetation in terms of species diversity and plant density. Monitoring of rehabilitated areas has been undertaken until it can be demonstrated that the landscape and vegetation is progressing towards a self-sustaining state. Rehabilitation Development stage density or cover target to be developed.	▪ Monitoring of rehabilitation development vegetation using BHP Billiton Iron Ore Rehabilitation Monitoring Procedures. ▪ Monitoring results reported in Annual Environmental Report. ▪ Report on performance in relation to rehabilitation methods, using site inspection and rehabilitation monitoring sites to assess whether criteria have been met.

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
4.6 Weeds	Potential for rehabilitation to meet the agreed post-mining use is not limited by the presence of weeds.	All with revegetation	All requirements of the Weed Management Plan have been implemented. No Declared Pests (as defined under the *Biosecurity and Agriculture Management Act 2007*) are present in greater abundance than baseline surveys indicate. Weed abundance does not exceed that in areas representative of the agreed final land use. Populations of environmental weeds have been monitored and controlled; weed abundance does not exceed that in areas representative of the agreed final land use. All Declared Pests and environmental weeds recorded in the rehabilitation have been effectively managed.	▪ Review weed monitoring and control undertaken to ensure compliance with the BHP Billiton Iron Ore Weed Management Plan. ▪ Report on weed monitoring and control records. Measurement of weed abundance compared to representative reference sites, using cover or counts (as appropriate according to the species). ▪ Monitoring and visual inspection of vegetation establishment and representative reference areas.
4.7 Fauna Recolonisation	There is evidence that local native fauna are colonizing the rehabilitation	All where opportunities exist	In accordance with the Rehabilitation Standard, the creation of habitat features similar to those found in the Project area prior to mining, will be created, wherever practical. Habitat creation initiatives include, but are not limited to the following: ▪ Creation of rock piles in OSAs and/or mine void areas to provide potential habitat opportunities for reptiles and mammals; ▪ Creation of rocky cliff features, which may include small hollows	▪ Rehabilitation inspections confirm earthworks have met final landform designs. ▪ Fauna habitat assessment using site inspection and evaluation of vegetation monitoring results. ▪ Vertebrate fauna surveys using standard methods have been undertaken and reviewed in representative rehabilitation areas. ▪ Vertebrate pest species have been controlled as required.

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
			and cracks suitable for reptiles and mammals; and ▪ Return of vegetation debris, logs and rocks to areas which have been disturbed to provide microhabitats for recolonising fauna. Vegetation includes locally endemic species of known importance to fauna. Vertebrate fauna surveys have been conducted in representative rehabilitated areas; these demonstrate that local bird, mammal and reptile species are recolonising in typical rehabilitated sites. Signs of fauna recolonisation are apparent. Vertebrate pests (rabbit, dingo, donkey, goat and cat) have been controlled where necessary.	

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
5. Hydrology/Hydrogeology				
5.1 Surface Hydrology	Rehabilitation drainage patterns have been established and impacts on natural surface water flows minimised.	All where relevant	There are no significant, physical off-site impacts. Baseline surface water quality and flow regimes in Shovelanna Creek, Fortescue River and Jimblebar Creek have been maintained, and monitoring results reported in the Annual Environmental Report (BHP Billiton Iron Ore, 2014); Sediment traps installed downslope of the overburden storage areas have been inspected and maintained in order to control downstream sedimentation which may occur whilst slopes are revegetating (e.g. in the first ten to 20 years of revegetation). Surface water quality should fall within guidelines for specific-end land use (e.g. stock watering requirements).	▪ Documents reviewed and signed off as required. ▪ Surface water sampling results from within Shovelanna Creek, Fortescue River and Jimblebar Creek maintained below BHP Billiton Iron Ore's nominated trigger values for surface water quality. Monitoring results reported in the Annual Environmental Report. ▪ Site inspection to verify no unplanned impacts on surrounding natural drainage patterns.
5.2 Groundwater	Mining-related impacts on groundwater levels, quality and soil moisture) have been minimised.	All where relevant	There are no significant, physical off-site impacts at key receptors as a result of BHP Billiton Iron Ores operations. Baseline conditions[6] for groundwater regime (levels, quality and soil moisture). Water resource quality is managed within predetermined criteria based on ANZECC 2013. Acceptable levels defined as closure thresholds in OB31 EMP.	Review compliance through the Regional monitoring programme against BHP Billiton Iron Ore's nominated trigger values as defined in OB17/18 EMP and ultimately the Central Pilbara Water Resource Management Plan when adopted. Monitoring results reported in the AER and Annual Aquifer Review (as required).

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Verification Procedure
6. Decommissioning				
6.1 Infrastructure	Infrastructure has been decommissioned and removed where transfer to a third party is not agreed.	All where infrastructure exists	Agreement has been reached with Government regarding whether any infrastructure is required to remain post-mine closure. Infrastructure not required has been removed (and recycled/reused where practicable) and the site rehabilitated.	▪ Site inspection and documentation of infrastructure removal and rehabilitation operations.
7. Contaminated Sites				
7.1 Contaminated Sites	Contaminated sites have been documented and addressed	All where relevant	All commitments relating to the identification and management of contaminated sites, as per the *Contaminated Sites Act 2003* have been fulfilled.	▪ Report documenting compliance with specific requirements.
8. Land Management				
8.1 Land Management	Long-term management requirements have been addressed.	All	At the time mine closure is considered complete, site land management requirements will be no greater than those of areas prior to mining (or comparable unmined areas); alternatively, where additional management actions are required, these will be identified in agreement with Regulators, and BHP Billiton Iron Ore will make adequate provisions so that this additional management can be undertaken.	▪ Reports into sustainability and long-term management requirements identified in the monitoring and research carried out as per Criterion 4.

9 Financial provisioning for closure

BHP Billiton Iron Ore has corporate systems that financial provisions for the expected closure and rehabilitation cost of environmental disturbance (representing a present obligation) are recognised at the annual reporting date. As the extent of disturbance increases over the life of an operation, the provision is increased accordingly. Costs included in the provision encompass all closure and rehabilitation activities expected to occur progressively over the life of the operation, at the time of closure and during the post closure period (e.g. monitoring). This includes all expected indirect costs, such as project management costs, statutory reporting fees and technical support costs.

The financial provision preparation is undertaken in accordance with GLD.034 Corporate Alignment Planning, GLD.004 Accounting Interpretations and GLD.031 Capital Cost Estimation.

In some cases, substantial judgements and estimates are involved in forming expectations of future activities and the amount and timing of the associated cash flows. These expectations are formed based on existing environmental and regulatory requirements or, if more stringent, Company standards or policies giving rise to a constructive obligation.

Flexibility within the method via adjustments to the estimated amount (expected value) and timing of future closure and rehabilitation budgets are accommodated as additional information is derived within the closure planning process. Factors influencing those changes include:

- Revisions to estimated mine life;
- Developments in technology;
- Additional technical studies being completed that influence closure decisions;
- The results of research and development trials;
- Regulatory requirements and environmental management strategies;
- Changes in the estimated extent and costs of anticipated activities; and
- Movement in economic input assumptions (interest rates, inflation).

BHP Billiton Iron Ore maintains documentation regarding closure costing assumptions to support the closure financial provision estimates. The provision process and outcomes are subject to internal and external audit on an annual basis.

Where the closure obligation involves a range of possible outcomes range analysis is employed to provide a financial range for each.

For the Project, the provision is made up of:

- Overburden storage areas, stockpile and general land disturbance rehabilitation;
- Pit void closure (abandonment bund etc.);
- Infrastructure removal;
- Post closure monitoring costs; and
- Human Resource allowances.

10 Closure implementation

This section describes how the Project will be rehabilitated and closed in a manner that satisfies closure objectives, draft completion criteria, and in accordance with the DMP/EPA guidelines. Closure implementation strategies defined below are based on experience across BHP Billiton Iron Ore's Pilbara Operations and on the BHP Billiton Iron Ore Rehabilitation Standard.

Rehabilitation of disturbed areas will be conducted progressively during the mine life in accordance with the implementation conditions of a Ministerial Statement, with complete closure of the mine not expected to occur until 2048.

10.1 Standard closure and rehabilitation strategies

BHP Billiton Iron Ore has developed and implemented the Rehabilitation Standard 0001074 which covers all procedures relevant to rehabilitation works including Rehabilitation Planning, Growth Media, Earthworks for Rehabilitation, Audit and Inspect, Seed Management, Rehabilitation Data Management and Rehabilitation Monitoring. The Rehabilitation Standard is used across BHP Billiton Iron Ore Pilbara mine sites and other areas where appropriate. Rehabilitation and revegetation of the Project final mine landforms, infrastructure and support facilities will be conducted in accordance with the Rehabilitation Standard. A description of each section of the Rehabilitation Standard is provided in the subsections below.

The approach to closure implementation for rehabilitation and decommissioning of the key components of the Operation are discussed in the following paragraphs.

10.1.1 Earthworks

The BHP Billiton Iron Ore Earthworks for Rehabilitation Procedure describes the rehabilitation earthworks required across BHP Billiton Iron Ore Pilbara mining operations to meet closure objectives stated in Section 6.2. It has been prepared to provide a consistent methodology based on previous rehabilitation success and identified issues. The results of rehabilitation monitoring are assessed for performance and are used to adjust and refine this methodology in accordance with BHP Billiton Iron Ore adaptive management approach (Section 7.1).

Rehabilitation earthworks aim to re-profile the land surface to create landforms that are consistent with the surrounding landscape, within the constraints imposed by the physical nature of the materials, in accordance with the stated closure objectives.

Earthworks consist of reshaping the slope to a profile suited to the nature of the material used (determined by waste characterisation studies and modelling of erosion potential (Section 7.4.4)).

Surface water management may include the construction of compacted bund approximately 2 m high and 12 m wide along the crest of the overburden storage area to prevent surface water runoff down the slopes of the overburden storage area. Concave faces may be used to facilitate water-shedding.

10.1.2 Surface treatment

A number of surface treatments may be used, depending on the size and nature of the rehabilitated area. The proposed surface treatments for rehabilitation areas at the Project have been developed to satisfy the stated closure objectives and may consist of one or more of the following:

- deep ripping of compacted surfaces;
- selective application of topsoil material (or alternative growth media) to provide a medium to support plant growth;
- surveyed contour ripping or scarifying of surfaces following the application of soils to maximise water infiltration and enhance revegetation success; and

- selective placement of logs or smaller woody debris and/or boulders (if available) across the re-profiled surface and/or constructing rocky cliff features (where potential exists) to provide additional habitat areas for fauna species recorded prior to mining.

The Growth Media Management Procedure provides general information on soils of the Pilbara region and methods for soil stripping, stockpiling and use in rehabilitation.

Direct placement of topsoil onto rehabilitation areas is preferable. If direct placement is not possible, soil should be stockpiled in low mounds, ideally no more than 3 m high to maintain biological activity. Compaction of the topsoil stockpiles should be minimised by building from the edge (rather than the top of the stockpile) and stripped plant material should be collected and stored with the topsoil to encourage revegetation. Revegetating the stockpiles will also minimise dust, erosion and weed establishment.

10.1.3 Revegetation

The Rehabilitation Standard requires that revegetation be conducted so as to establish plant species that will support the approved post-mining land use. The selection of plant species used in revegetation is linked to the appropriate landforms and species lists as identified in the baseline flora and vegetation surveys. Species lists for the relevant domains are generated for each site as part of planning works, and typically include a range of typical vegetation assemblages suited to the post-mined landform. The diversity of vegetation types used in rehabilitation must be maximised in order to improve habitat value and encourage colonisation by a wide range of fauna.

Revegetation at the Project will use local provenance native seed (from the local area, but as a minimum from within 100 km of site within the Pilbara Biogeographic Region) consistent with vegetation associations and native species recorded in the Project area prior to mining.

The BHP Billiton Iron Ore Seed Management Procedure describes the types of seed species mixes and seeding rates that BHP Billiton Iron Ore uses at its Pilbara mining operations. This mix can be adapted to suit the particular characteristics of the site through BHP Billiton Iron Ore adaptive management approach (Section 7.1). The procedure also lists appropriate seed vendors which collect seed which meets the standards set by the Seed Management Procedure.

To promote vegetation density and species diversity, additional seeding (in subsequent years) may be conducted if required.

Two rainfall periods occur at the Project area – one from January to March and the other from May to August. The most reliable rainfall period occurs from January to March. Accordingly, revegetation activities will be completed during November and December where practicable.

10.1.4Cultural heritage

There is the potential for closure works to impact on sites of cultural significance via direct or indirect disturbance (e.g. erosion). All activities that require land disturbance, including during decommissioning and rehabilitation, will be authorised by BHP Billiton Iron Ore via the Project Environmental Aboriginal Heritage Review (PEAHR) procedure. For each planned disturbance area, the following details are addressed in the PEAHR form:

- a summary of the proposed disturbance activities;
- a plan showing the location of the proposed works;
- the anticipated environmental, land access and Aboriginal heritage impacts; and
- specific management measures where necessary.

The primary mechanism for protection of cultural heritage sites identified as being significant at the Project will be avoidance of identified sites. Any post closure issues (including ongoing management) relevant to these sites will be discussed with the relevant Nyiyaparli People through the stakeholder engagement process (Section 5).

10.1.5 Site contamination

Site contamination as a result of activities during mine site operation has the potential to compromise environmental values and result in non-compliance against relevant completion criteria. In areas where the potential for soil contamination is identified they will be managed in accordance with Department of Environment Regulation requirements including sampling/analysis and remediation/management.

Remaining surfaces will be reshaped to conform to surrounding landforms, with surface treatment and revegetation implemented as outlined in Section 10.1.2 and 10.1.3.

10.1.6 Dust emissions

Dust has the potential to be emitted during decommissioning and bulk earthworks activities during closure. Dust control measures will be implemented during closure e.g. regular watering of unsealed roads, exposed surfaces and active earthwork areas. Upon closure dust generation from the rehabilitated surfaces is expected to be similar to other nearby natural landforms.

10.2 Closure strategies for specific domains

In line with the Guidelines for Preparing Mine Closure Plans (DMP/EPA, 2011), BHP Billiton Iron Ore has adopted a domain model for closure implementation; identified domains are defined as those areas of similar operational land uses and subject to similar closure strategies. Implementation strategies have been informed by the standard rehabilitation strategies outlined in the previous section and the management measures outlined in Section 0, to mitigate the key closure risks/issues.

Closure domains have been identified for the Project:

- mine voids;
- overburden storage areas;
- infrastructure; and
- roads and rail.

An integrated closure landform design will be developed as discussed in Section 7.4.4.

10.2.1 Mine voids

As outlined in Section 7.4.4 mine void closure alternatives are shown in Figure 20.

BHP Billiton Iron Ore commits to infill the Project mine voids where practical depending on operating constraints. The mine plan waste schedule will be progressively re-visited based on mine planning constraints and updated throughout the life of mine, informed by the outcomes of the closure studies

10.2.2 Overburden storage areas

Final landform designs of the out-of-pit overburden storage areas will be informed by waste characterisation and modelling of erosion potential. The final shape of the overburden storage areas will be designed to maintain surface stability and minimise erosion by managing surface water runoff. The final landform design will be executed in accordance with the earthworks strategies under the Rehabilitation Standard 0001074. BHP Billiton Iron Ore will monitor the stability and revegetation success of the rehabilitated overburden storage areas during the mine life. Monitoring of rehabilitation is discussed in Section 11.

Any low grade ore that is encountered will be placed adjacent to the overburden storage areas, as it is likely that low-grade ore will be both added and removed depending on ore blending requirements. Market demand will determine how much, and when it is viable to process the low grade material. No separate stockpile for low grade will be established. In the event that this material is not blended with the high grade ore, BHP Billiton Iron Ore will re-profile these areas into the overburden storage areas.

10.2.3 Infrastructure

In accordance with the *State Agreement Act*, prior to removing any equipment and removable buildings, BHP Billiton Iron Ore will notify the State in writing giving the option for the State to purchase the infrastructure subject to valuation. Other stakeholders including adjacent landholders will also be consulted regarding infrastructure decommissioning as part of the post mining land use consultations. In the event the State or other stakeholders do not take up the infrastructure ownership, decommissioning plans will be prepared to guide the decommissioning, demolition and removal of all fixed site assets.

BHP Billiton Iron Ore's office buildings and minor equipment will be removed from site. At closure the infrastructure associated with dewatering the Project pits ahead of mining will be removed; the water bores will be capped in accordance with the requirements of the relevant government administering authority.

Following the removal of infrastructure, road and rail facilities re-profiling of the land surface, additional surface treatments and revegetation works will be implemented in accordance with the standard rehabilitation procedures described in the Rehabilitation Standard 0001074.

10.2.4 Road and rail

Roads and tracks

Bitumen will be removed from sealed roads and disposed to an appropriate landfill. Road and track surfaces will be deep ripped and reprofiled where required. It is unlikely that roads or tracks will require seeding as they are typically narrow corridors that can be recolonised naturally following earthworks.

Haul roads that have not been progressively rehabilitated during the mine life will be reprofiled (including removal of portions of haul road embankment where necessary) to blend in with surrounding topography. Where necessary, road surfaces will be reprofiled to allow free drainage and minimise interference with surface flows.

Following re-profiling of the land surface, additional rehabilitation works will be implemented in accordance with the procedures described in Section 10.1.2.

10.2.5Linear infrastructure corridors (pipelines)

Following the cessation of all mining activities (which may utilise the Project processing facilities), all infrastructure associated with power lines and pipelines will be removed unless otherwise agreed with the administering authority and other relevant stakeholders.

At the conclusion of mining, all power generating and supply infrastructure will be decommissioned and removed from site unless otherwise agreed with the administering authority and other relevant stakeholders. This will include the breaking up of concrete footings and slabs for placement within areas of general backfill or burial in-situ below the rehabilitated surface (to a minimum depth of 1.5 m).

Following the removal of power generating and supply infrastructure the land surface will be re-profiled to blend with surrounding topography. Additional rehabilitation works will be implemented in accordance with the procedures described in Section 10.1.2.

10.3Progressive rehabilitation

Progressive rehabilitation and ongoing performance assessment will be carried out in areas where mining operations have been completed and further disturbance is unlikely.

The majority of the landform development will be carried out as a normal part of overburden removal and placement during the mining operations. Some final shaping of landforms will be needed to establish drainage lines and place selected materials in the required positions to protect those drainage lines against erosion. Topsoil and other alternative growth media recovered during mine development will then be placed on the final landform.

The rehabilitation programme will aim to re-establish local native vegetation that is appropriate to the environmental characteristics of the final mine landforms and the agreed final land use in accordance with the site closure objectives.

The main components of the progressive rehabilitation programme are described in Section 10.1 and reported annually within the Annual Environmental Report. Planning for rehabilitation is undertaken annually in the development of the Five Year Rehabilitation Plan (BHP Billiton Iron Ore, 2013).

A washdown/quarantine procedure for all machinery operating on-site will be used in order to minimise the introduction and spread of declared weed species whilst rehabilitation activities are undertaken.

10.4 Implementation schedule

The Life of Mine is anticipated to be approximately 30 years depending on mining rate. A progressive rehabilitation and closure implementation schedule will be developed and updated over the life of mine with preliminary guidance provided in the next Mine Closure plan update.

10.5 Unplanned or unexpected closure

BHP Billiton Iron Ore is required to review a range of risks associated with the closure of its facilities annually as assessed using the risk processes described in GLD.017 Risk Management (BHP Billiton, 2013). One of these risks is unexpected or unplanned closure. In the event that unplanned or unexpected closure occurs, the site will be decommissioned and rehabilitated in line with the objectives and strategies outlined in this document. In the absence of more detailed information (as planned in Section 7), the overall objective under this scenario will be to make landforms such as overburden storage areas secure and non-polluting following decommissioning and decontamination activities, with application of topsoil prioritised for these areas.

Annual cost provisioning for closure in line with the closure cost estimating methodology outlined in Section 9 provides an understanding of the current closure liability, with present closure obligation costs representing an unplanned or unexpected closure scenario.

11 Closure monitoring and maintenance

11.1 Monitoring programme overview

Across its Pilbara mining operations, BHP Billiton Iron Ore has implemented monitoring programmes to evaluate the performance of rehabilitated mine landforms and to assess whether they have either met the site completion criteria or are showing satisfactory progress towards meeting these criteria. These programmes will be expanded as new areas of the mine are rehabilitated, and will be refined based on monitoring results and rehabilitation success.

Ecological monitoring post closure will be in accordance with the Rehabilitation Standard (0001074) and the Rehabilitation Monitoring Procedure (SPR-IEN-LAND-012). An important component of leading practice rehabilitation is the use of monitoring and research to track the progress of rehabilitation, and ensure continuous improvement through adaptive management:

- monitoring procedures shall be used to assess whether initial establishment has been successful, rehabilitation is developing satisfactorily and is ready for signoff; and
- research activities shall be undertaken where knowledge gaps or deficiencies in rehabilitation progress occur.

Monitoring events will be undertaken in line with the process outlined within this section, with the outcomes informing rehabilitation strategies, facilitating refinement in completion criteria and directing maintenance and remedial action plans consistent with the adaptive management approach (Section 7.1).

11.1.1 Rehabilitation monitoring methodology

Progressive rehabilitation and ongoing performance assessment will be carried out in areas where mining and related operations have been completed and further disturbance is unlikely. Monitoring procedures will be used to assess whether initial establishment has been successful, rehabilitation is developing satisfactorily, and is ready for signoff.

The BHP Billiton Iron Ore Pilbara rehabilitation monitoring system consists of a three stage monitoring process:

- Rehabilitation Establishment Assessment, 3 to 24 months of age. Rehabilitation Establishment Assessment provides feedback on the stability and erosion of rehabilitation areas and an assessment of vegetation establishment.
- Rehabilitation Development Monitoring, Years 3, 5, 7, 9, 12, 15. Rehabilitation Development Monitoring is an in-depth assessment of rehabilitation involving erosion monitoring and quadrat vegetation monitoring along a fixed transect.
- Rehabilitation Landform Appraisal, Years 3, 7, 12 and thereafter if required. Rehabilitation Landform Appraisal provides a summary of the status of large scale rehabilitated landforms and areas not covered by Rehabilitation Development Monitoring.

Assessing whether a particular area has met all criteria will require compilation of all relevant site records of rehabilitation operations, monitoring data, photographic records and summarising these in a short report. Assessment procedures used against particular criteria will generally fall into one of three categories:

1. Using ‘operational criteria’ to confirm that operations have been carried out according to agreed Ministerial Statements, and any other commitments and procedures;
2. Determining whether agreed criteria milestones and standards have been met as measured using monitoring procedures, visual inspection and other methods as appropriate; and

3. Using more detailed trials and research investigations in typical rehabilitated areas to determine whether more in-depth criteria, such as those relating to sustainability following burning, have been met.

Should ongoing monitoring indicate potential non-compliance with established closure criteria the appropriate maintenance and/or remedial work will be undertaken. Further monitoring will be subsequently undertaken on repaired areas to demonstrate compliance with relevant criteria.

To ensure quality control is maintained at all stages of the rehabilitation processes (e.g. execution of rehabilitation works, maintenance and monitoring), activities will be completed in line with BHP Billiton Iron Ore's suite of procedures which provide guidance on aspects such as:

- rehabilitation audit and inspection;
- rehabilitation data capture; and
- rehabilitation monitoring.

11.1.2 Weed Monitoring

BHP Billiton Iron Ore weed management procedures describe the weed monitoring to be conducted, in addition to measures used to prevent the introduction and spread of weeds and the ongoing effectiveness of weed control measures.

Post-mining control measures and monitoring programmes (and completion criteria) will be developed and/ or refined during the mine life in consultation with the relevant authorities. Approved changes to the monitoring programmes and completion criteria will be documented in the Annual Environmental Report and revisions of the BHP Billiton Iron Ore weed management procedures.

11.1.3 Fauna monitoring of rehabilitation areas

Assessment of rehabilitation is often focussed on revegetation success and few studies on whether rehabilitated areas in the Pilbara provide suitable habitat for fauna have been undertaken to date. A study of re-colonisation of rehabilitated mine sites in the Pilbara by Outback Ecology (2012) found that fauna assemblages were 'broadly comparable' to reference sites, however, some species may be absent due to ecological barriers (Outback Ecology 2012). The appropriate methodology for fauna monitoring across BHP Billiton Iron Ore Pilbara Operations including approach/frequency/key performance indicators will be undertaken and executed initially in 2015.

11.1.4 Regional water monitoring network

The Regional Monitoring Network has been installed as an operational and catchment scale monitoring programme that collects important information for compliance reporting and to improve the capacity to estimate receptor response to changing hydrological conditions and natural climatic variations and stresses.

The Regional Monitoring Network (Figure 22) is used to develop the understanding of the Baseline Conditions (prior to BHP Billiton Iron Ore operations) and Current Conditions (with BHP Billiton Iron Ore operations), to define the natural variance in hydrological conditions, to underpin the adaptive management and modelling process and to be consistent with the threshold variables being used to assess significance of impacts to receiving receptors. The Regional Monitoring network and mine monitoring for the Project area operations will continue to be used to support and inform closure assessments, enabling progressive improvement in understanding and confidence in the achievement of the stated closure objectives related to the hydrological regime.

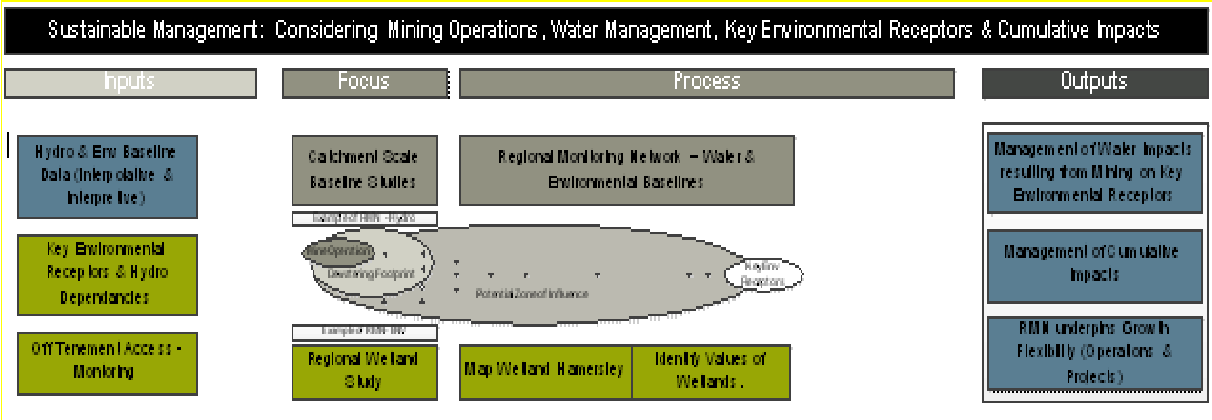


Figure 22: Regional Monitoring Network overview

The data used in the modelling includes not only the Regional Monitoring Network surface and groundwater data, but also hydrology, hydrogeological and environmental technical studies of Baseline Conditions.

The Regional Monitoring Network is currently functioning across each of BHP Billiton Iron Ore's hub areas, and it will be strategically expanded and tele-remoted to build on BHP Billiton Iron Ore's ability to:

- Enable an improved understanding of hydrogeological, hydrological and ecological baseline characterisation, conceptualisation and flow controls.
- Determine impact: positive, negative or no effect from BHP Billiton Iron Ore operations.
- Establish effects of long term water abstraction and flow modification.
- Predict groundwater footprint based on drawdown via modelling, conductivity, specified yield, pump tests and operational dewatering.
- Record natural conditions, climate variability and characterise control or reference sites.
- Evaluate the interdependency between water and environment systems.
- Collect long term trending and monitoring data.
- Assess the likelihood of impact from BHP Billiton Iron Ore and third-party operations.
- Identify, define and monitor receptors and values.
- Enable environmental impact early warning triggers and thresholds to be developed for receptors.

The Regional Monitoring Network – Hydrological will enable time-variant data collection from various hydrological systems, including:

- Groundwater aquifers water levels and quality.
- Surface water drainage features and creeks flow volumes.
- Soil moisture content.
- Spring discharges, seepages, waterholes and marsh zones.
- Weather and climatic conditions.

The data from the Regional Monitoring Network - Ecological will be supplemented by data collected on:

- Vegetation assemblages.
- Determine significant biodiversity, flora and fauna values.
- Tree health monitoring, including lead indicators such as leaf moisture, sap flow and trunk/stem growth gauges or satellite / aerial photography based vegetation condition.
- Hydrological dependence of receiving receptors on surface water, groundwater or soil moisture.

11.1.5 AMD monitoring

AMD monitoring will be integrated with the regional monitoring network (Section 11.1.4) as required based on progressive refinement of the assessment of AMD risk following mine closure.

The risk of AMD generation and release is directly related to the concern that the chemical quality of local and regional water resources could be degraded. Surface water and groundwater monitoring are the primary methods for assessing water quality impacts from AMD. In addition, the following activities can be conducted to monitor AMD potential:

- The integrity of landforms that are constructed to prevent AMD generation and release will be inspected.
- Inspections for AMD discharge to surface water.
- Chemical monitors can be installed in landforms containing potential AMD generating material to assess changing conditions over time.
- Long duration kinetic testing can be conducted in laboratories to verify assumptions about the chemical behaviour of the geological materials.

The application of these methods to the Project will be determined as the understanding of AMD risk is refined.

11.1.6 Surface water monitoring

In addition to the Regional Monitoring Network (Section 11.1.4), inspections of drainage surfaces and erosion control measures will be carried out as soon as possible after periods of heavy rainfall to assess structural integrity of surface hydrological features such as rehabilitated overburden storage areas. Follow up monitoring will occur progressively throughout the closure monitoring period.

If failures are identified appropriate maintenance/remedial actions will be determined and implemented.

11.1.7 Groundwater monitoring

In addition to the Regional Monitoring Network (Section 11.1.4), additional monitoring deemed necessary to support the closure and rehabilitation assessment will be determined over the life of the Project operations with any changes to the programme reported in the Annual Environmental Report.

11.1.8 Off-site Impacts and landform stability monitoring

As part of the general monitoring of the site visual inspections will be conducted to identify obvious off-site impacts. Visual inspections will be undertaken in conjunction with the public safety inspections.

Rehabilitated landforms will be inspected after significant rainfall to assess stability and to monitor for areas where unacceptable erosion has occurred. Where necessary, maintenance works will be undertaken to improve performance.

11.1.9 Public safety monitoring

During operations and after mine closure, periodic inspections will be conducted to determine the condition of the safety bunds (and any other safety measures) erected around the open pits and a record kept of those inspections. Where the integrity of the bunds has been compromised to the extent that inadvertent public access could occur, maintenance will be conducted.

11.2 Reporting

The progress and performance of; rehabilitation monitoring sites, any new rehabilitation activities conducted, research and development activities and progress towards developing completion criteria at the Project mining operations will continue to be reported on an annual basis through the Annual Environmental Report, which covers all of BHP Billiton Iron Ore's Pilbara operations. Rehabilitation details reported in the Annual Environmental Report will include a summary of the rehabilitation monitoring results for the reporting period, maintenance/remedial actions completed or planned and the area and nature of any new rehabilitation that has been undertaken on-site. Any rehabilitation activities planned for the future reporting period will continue to be reported as environmental initiatives on an annual basis. Reporting results will also be made available to the relevant authorities on request.

12 Data management

BHP Billiton Iron Ore will collect, store and manage closure data in line with its existing data management procedures.

The Closure Plan and related information will be managed by BHP Billiton Iron Ore. All data will be stored in a central and readily accessible location in accordance with existing BHP Billiton Iron Ore standards and procedures. After lease relinquishment BHP Billiton Iron Ore will transfer the Closure Plan and all associated information to the DMP for its files.

BHP Billiton Iron Ore will progressively update this Closure Plan over time to capture and summarise current closure planning information associated with:

- closure planning prior to cessation of operations;
- implementation of the closure programme of works; and
- the post closure monitoring and reporting period.

A full review of this Mine Closure Plan will occur at intervals of five years.

BHP Billiton Iron Ore will communicate closure planning progress to the regulators via existing Annual Environmental Reporting channels. BHP Billiton Iron Ore will update the Closure Plan as knowledge gaps are filled and closure plans are refined.

13 References

360 Environmental (2014) Orebody 31 Landscape and Visual Impact Assessment. Report prepared for BHP Billiton Iron Ore Pty Ltd.

Aquaterra (2009). Hydrogeological Assessment for Jimblebar Iron Ore Project. Report prepared for BHP Billiton Iron Ore Pty Ltd.

Australian and New Zealand Environmental and Conservation Council (ANZECC) (2013) National Water Quality Management Strategy. Guidelines for Groundwater Quality Protection in Australia

Australian Bureau of Statistics (2013) Perspectives on Regional Australia: Population Growth and Turnover in Local Government Areas, 2006 - 2011

Bennelongia (2014a) Subterranean Fauna Survey at Orebody 19 and 31. Report prepared for BHP Billiton Iron Ore Pty Ltd.

Bettenay, Churchward and McArthur (1967) Atlas of Australian Soils: Meekatharra-Hamersley Range Area, Sheet 6, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia

BHP Billiton Iron Ore (2014) Annual Environment Report.

BHP Billiton Iron Ore (2014) Orebody 31 Iron Ore Project Environmental Referral Supporting Information Document. BHP Billiton Iron Ore, Perth, Western Australia

BHP Billiton Iron Ore (2014a) Orebody 31 Hydrogeological Impact Assessment. BHP Billiton Iron Ore, Perth, Western Australia

BHP Billiton Iron Ore (2014b) Eastern Pilbara Water Resource Management Plan. BHP Billiton Iron Ore, Perth, Western Australia

BHP Billiton Iron Ore Pty Ltd (2013) Five Year Rehabilitation Plan (Mines)

BHP Billiton Pty Ltd (2013a) Group Level Document .017 Risk Management. Version 4.1

BHP Billiton Pty Ltd (2013b) Group Level Document .031 Major Capital Projects. Version 4.0

BHP Billiton Pty Ltd (2013c) Group Level Document .034 Corporation Alignment Planning. Version 4.0BHP

BHP Billiton Pty Ltd (2013d) Our BHP Billiton Iron Ore Charter. BHP Billiton Iron Ore, Perth, Western Australia

BHP Billiton Pty Ltd (2014) Group Level Document .009 Environment. Version 5.1

Biologic (2014b) Orebody 31 Vertebrate Fauna Survey. Report prepared for BHP Billiton Iron Ore Pty Ltd.

Biologic (2014d) Orebody 31 Short Range Endemic Invertebrate Survey. Report prepared for BHP Billiton Iron Ore Pty Ltd.

Blockley, J.G. , Tehnas, I.J. , Mandyczewsky, A. , Morris, R.C. 1993 Proposed stratigraphic subdivisions of the Marra Mamba Iron Formation and the lower Wittenoom Dolomite, Hamersley Group, Western Australia. Geological Survey of Western Australia. Report 34 p47-63

Bureau of Meteorology (BOM) (2014) Monthly Climate Statistics. Summary Statistics Newman Aero. http://www.bom.gov.au/climate/averages/tables/cw_007176.shtml

CSIRO (2013). OzClim - Exploring Climate Change Scenarios for Australia. Retrieved February 04, 2014, from CSIRO: http://www.csiro.au/ozclim/register.do

Department of Environment and Conservation (2009) Resource Condition Report for Significant Western Australian Wetland: Fortescue Marshes. Department of Environment and Conservation, Perth, Australia.

Department of Industry Tourism and Resources (2006) Mine Rehabilitation Handbook — Leading Practice Sustainable Development Program for the Mining Industry. Department of Industry, Tourism and Resources, Canberra.

Department of Industry Tourism and Resources (2007) Managing Acid and Metalliferous Drainage. Department of Industry, Tourism and Resources, Canberra.

Department of Mines and Petroleum and Environmental Protection Authority (2011) Guidelines for Preparing Mine Closure Plans 2011.

Earth Systems (2014) Preliminary Acid and Metalliferous Drainage Risk Assessment for the Orebody 31 Deposit. Report prepared for BHP Billiton Iron Ore Pty Ltd.

Environment Australia (2001) A Directory of Important Wetlands in Australia, Third Edition, Environment Australia, Canberra, Australian Capital Territory

Environmental Protection Authority (2013a) Environmental Assessment Guideline 8 for Environmental Factors and Objectives. June 2013

Environmental Protection Authority (EPA) (2013b). Environmental Protection Bulletin No.19: EPA involvement in mine closure. Published by Environmental Protection Authority, Western Australia

Harmsworth, R.A., Kneeshaw, M., Morris, R.C., Robinson, C.J., Shrivastava, P.K., 1990. BIF-derived iron ores of the Hamersley Province. In: Hughes, F.E. (Ed.), Geology of the Mineral Deposits of Australia and Papua New Guinea. The Australasian Institute of Mining and Metallurgy, Melbourne, pp. 617–642.

Kendrick, P. (2001) A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. Pilbara 3 (PIL3 – Hamersley Subregion). Department of Conservation and Land Management.

Kepert, D. A. (2001) The mapped stratigraphy and structures in the Mining Area C region: an eclectic synthesis of geological mapping – 1994-2001 ("The Black Monolith"). BHP Billiton Iron Ore, Perth, Western Australia

Landloch Pty Ltd (2012) Erosion potential of Erosion Plots at Mining Area C Landloch Pty Ltd (2012).

Landloch Pty Ltd (2013a) Development of Erosionally Stable Final Batter Shapes final batter Shapes. Marra Mamba Ore bodies

Landloch Pty Ltd (2013b) Design of Stable Final landform batter Slope, Mining Area C, E east & E Central OSAs. Report Prepared for BHP Billiton Iron Ore.

Meynink Engineering Consultants (2012) Probabilistic Seismic Hazard Assessment of BHPBIO Pilbara Operations, Western Australia. Report prepared for BHP Billiton Iron Ore

MWH (in prep.) Orebody 31 Landforms and Soil Impact Assessment

Outback Ecology (2012) Successful re-colonisation, by vertebrate and invertebrate fauna, of rehabilitated mining areas in Western Australia's Pilbara Region: a case study. Presentation at Society for Ecological Restoration Australasia Conference, November 2012.

RPS Aquaterra (2014) Orebody 31 Surface Water Environmental Impact Assessment. Report prepared for BHP Billiton Iron Ore

Simonson, B.M., Hassler, S.W., Schubel, K.A. (1993) Lithology and proposed revisions in stratigraphic nomenclature of the Wittenoom Formation (Dolomite) and overlying formations, Hamersley Group, Western Australia. Geological Survey of Western Australia. Report 34 p65-79

Thackway, R. and Cresswell, I.D. (1995) An Interim Biogeographic Regionalisation for Australia: A Framework for Setting Priorities in the National Reserve System Cooperative Program. Australian Nature Conservation Agency, Canberra.

The International Network for Acid Prevention (INAP) (2009). Global Acid Rock Drainage Guide (GARD Guide).http://www.gardguide.com.

Van Vreeswyk, A.M.E., Payne, A.L., Leighton, K.A. and Hennig, P. (2004) An Inventory and Condition Survey of the Pilbara Region, Western Australia. Technical Bulletin No. 92. Department of Agriculture, Perth

Appendix A: BHP Billiton Iron Ore Closure and Rehabilitation Research and Trials

Table A1: Summary of Findings - Rehabilitation Performance at BHP Billiton Iron Ore's Pilbara Operations

Site	Description of Findings from Rehabilitation Performance
General	Scalloping has been demonstrated to be effective on competent waste materials on slopes below 20°, at slopes higher than 20° or where materials are not competent, erosion tends to be more pronounced. When using scalloping as a rehabilitation technique, the scallops must be 'interlocked' to minimise erosion and optimise the success of revegetation. The construction of bunds on the top of overburden storage areas around the perimeter is essential as it prevents water from flowing down the slopes and minimises erosion potential. Material that has a higher sulphidic content can impact on the success of revegetation. It has been found that using inert waste material as a cover can minimise the impact of sulphidic material. When applying topsoil it is preferable that it be incorporated (keyed-in) into the subsurface material to minimise surface erosion. Contour ripping has been effective at slopes below 20°; however the contours must be surveyed accurately to minimise failure of rip lines. Backfilling pits with waste material minimises visual impacts of the operations and reduces the need to disturb land for new out-of-pit overburden storage area areas. Increased revegetation success has been observed when seeding has occurred prior to the main wet season (i.e. before January).
Mt Whaleback and Orebody 29/30/35	Previous trials have found that revegetation performance generally increases with greater depth of topsoil application (i.e. there would be an ideal topsoil depth which would be dependent on the species).
Jimblebar - Wheelarra Hill, OB18	Prior to 2004, qualitative rehabilitation monitoring at the Wheelarra Hill mine showed some areas encountered problems due to plants being of the same age. By adjusting the rehabilitation method used, BHP Billiton Iron Ore has demonstrated that this issue can be overcome by undertaking additional seeding in subsequent years. Operational experience has indicated that due to the unpredictable rainfall in the Newman area, seed application should, where practicable, be timed to coincide with major rainfall events. Preliminary rehabilitation monitoring results indicate that rehabilitated stockpiled fines are capable of supporting local native species and are exhibiting growth on a trajectory that would suggest that a sustainable ecosystem will develop over time. The batters of the rehabilitated stockpiled fines have not performed well in terms of stability. These batters were generally profiled to a final slope of 20°, and were directly seeded and contour ripped. High litter development appears to be associated with higher densities of *Triodia* spp. on the rehabilitated stockpiled fines. Higher infiltration and nutrient cycling values recorded in the Landscape Function Analysis monitoring

Site	Description of Findings from Rehabilitation Performance
	programme also appear to be correlated with the high litter content of topsoil.
Marillana Creek (Yandi)	Monitoring of overburden storage area surfaces confirmed significantly advanced rates of recovery in rehabilitated areas with topsoil (i.e. greater than 25% foliar cover) when compared with rehabilitated areas without topsoil (i.e. less than 10% foliar cover). It was also determined that topsoil should be spread at a depth of 50 mm to 60 mm to achieve optimum use of available topsoil resources. Promotion of soil harvesting and progressive rehabilitation has led to high success rates for rehabilitation. As a result of Yandi's soil harvesting, it has been possible for all rehabilitation areas to date to have topsoil applied. Operator ability has been identified as a key factor in successful rehabilitation. Rehabilitation operators where possible are preferentially selected based on their understanding and interest in environmental requirements to generate optimal rehabilitation results.
Yarrie/Nimingarra	Operational experience has indicated that due to the unpredictable rainfall in the Goldsworthy area, seed application should, where practicable, be timed to coincide with major rainfall events. Surface treatment trials are being undertaken to assess stability and revegetation success using no rip and minimal rip treatments, and are incorporated into progressive rehabilitation works.
Mt Goldsworthy	Due to a lack of rehabilitation planning in the early stages of mine development, Mount Goldsworthy has a topsoil deficit. This highlights the need for life of mine planning for rehabilitation, in particular soil recovery and storage. Scalloping has been used effectively on rehabilitated slopes at Goldsworthy. Due to the coarse blocky waste material scalloping has been able to be used effectively on slopes up to 25°.

Table A2: Summary of active rehabilitation research

Subject	Research Summary
Seed Management	Pilbara Seed Atlas: a five year research project involved with the development of practical recommendations for the collection, processing, storage, germination, and efficient use of seeds in mine-site restoration in collaboration with researchers from the Botanic Gardens and Parks Authority. Restoration Seed Bank: initiative is a five-year partnership between BHP Billiton Iron Ore (WA), the University of Western Australia, and the Botanic Gardens and Parks Authority to improve the existing 'restoration supply chain' from seed collection, cleaning, drying, storage, treatment, distribution, germination, establishment and monitoring, verification and reporting.
Growth Media	Yarrie/Nimingarra: Topsoil deficit has been identified as an issue for future rehabilitation works. As a result, BHP Billiton Iron Ore is conducting a trial to use shallow lateritic material as future growth media on rehabilitated landforms. Yarrie/Nimingarra: Growth media trails utilising in-situ waste materials are being incorporated into progressive rehabilitation works Growth Media Atlas: to enable successful establishment of vegetation in rehabilitated areas by assessing existing topsoil stockpiles for the chemical,

Subject	Research Summary
	physical and plant growth properties; and identify suitable alternative growth media materials that could be made available for rehabilitation.
Fire Ecology	Jimblebar, Wheelarra Hill, OB18, Marillana Creek (Yandi): BHP Billiton Iron Ore is investigating fire ecology (i.e. response of ecosystems following fire) by monitoring areas which have been burnt. Findings from this investigation will be used to determine the possibility of using fire as a rehabilitation tool and to better manage fire affected areas.
Surface treatments	Yarrie/Nimingarra: Trial to assess the stability and revegetation success using alternative surface treatments to 'moonscaping', such as contour ripping, and the creation of contour banks. Yarrie/Nimingarra: Surface treatment trials are being undertaken to assess stability and revegetation success using no rip and minimal rip treatments, and are incorporated into progressive rehabilitation works. Area C: Rock armour trial undertaken to assess varying surface treatments and armour treatments on minimising surface erosion.

Table B3: Summary of Findings – Waste Rock Management at BHP Billiton Iron Ore's Pilbara Operations

Subject	Research Summary
Neutralising Mineral Reactions for Control of Acid Completed 2004	Investigation of ARD control including mineral reaction control and hydrogeologic control through cover design, assessment and prediction of short and long-term mineral reactivity in waste deposits, measurement of the reactivity of minerals with long-term neutralising capacity. Included a case study of Mt Whaleback. Research partners: AMIRA International, University of South Australia, Env. Geochemistry International, Levay & Co. Env. Services Findings: Identified ARD passivation mechanisms and methods for assessing the reactivity of minerals.
Evaluation of ARD Passivation Treatments Completed 2013	Confirmation and definition of ARD passivation mechanisms leading to a methodology for implementation at mining sites using readily available materials. Included a case study of Mt Whaleback. Research partners: AMIRA International, University of South Australia, Env. Geochemistry International, Levay & Co. Env. Services Findings: Improved understanding of pyrite oxidation control and test methods. Identified alternative treatment options for long term ARD control. Extension of the project is planned for long-term acid rock and tailings drainage mitigation through source control.
Acid generating characterisation of stored waste rocks and current impact upon the surface environment, Mt Goldsworthy Iron Ore Mine Completed 2009	Masters research project investigated Overburden Storage Area (OSA) waste rock material and AMD release at Mt Goldsworthy. Research Partner: Environmental Inorganic Geochemistry Group (EIGG) at Curtin University Findings: Identified the occurrence and characteristics of acid generating waste rock on the surface of OSAs and their affects on vegetation. The work is being extended in a PhD research project.
Environmental impact of the storage of lignite waste rocks from the Jimblebar iron ore mine, Newman, Western Australia 2013	Study of Tertiary lignites (young, immature, low grade coal deposits) that may pose risks of combustion and AMD formation if they contain pyrite or other metal sulphide minerals. Research partner: EIGG at Curtin University Findings: Identified the geochemical and mineralogical nature of the rock types, their sulphide contents, and capacity to release acidic, metal laden drainage. Informs proper management and storage of the waste rock material
Investigation into the Rapid Oxidation Potential for Pyrite Containing Mt McRae Shales from Mt Whaleback Completed 2013	Investigation and recommendation of options for treatment of PAF wastes to remove long term liabilities. Research Partners: Umwelt Australia, University of Western Australia, ChemCentre Findings: A desktop study has been completed that reviewed chemical, biological and physical treatment options. Identified possible laboratory and pilot scale trials that could be conducted.
Pit Lake Disposal of Pyritic Shale	Conducted a desktop study of potential subaqueous disposal of shale. Included review of several case studies and examples that have been described in the

Subject	Research Summary
Completed 2013	literature where pit lakes have been used for the pit lake storage of sulphidic waste material, including waste rock and mine tailings. Considered implications for pit lake waste rock disposal at Mt Whaleback. Research Partners: Umwelt Australia, ChemCentre Findings: A key finding from the literature review is that pit lakes are considered to be an effective location for the long term storage of acid generating materials. This information will inform long-term management of Mt Whaleback pyritic waste and other potentially problematic mine waste deposits.

Table B4: Summary of active Waste Rock research

Subject	Research Summary
Acid Rock Drainage Cover Research Programme at Mt. Whaleback and Yarrie mine sites	Cover system field trials have been monitored at the Mt Whaleback site and Yarrie site since 1997. The trials evaluate performance of cover systems of varying thickness that primarily utilise the moisture store-and-release concept. Research partners: O'Kane Consultants.
Mechanisms of acid release from waste rock piles containing pyritic carbonaceous shale, Mt Goldsworthy Mine	PhD research project. Detailed study with the overall goal of elucidating not only the full extent of acid-generating potential but also comprehending the kinetics of the geochemical alteration and AMD production. Comparisons will be drawn with other iron ore minesites across the Pilbara region where shale is encountered to assess implications for waste rock management and closure. Research partner: EIGG at Curtin University
Analysis for selenium content of iron mining waste rock in the Pilbara	Investigation of the difficulties in producing accurate and reliable analysis for Se in geological materials and application of the optimised procedures to environmental samples encountered in BHP's iron ore operations. Research partner: EIGG at Curtin University
Investigation into PAF Waste and Shale Reactivity Iron Ore Mines in the Pilbara	Isothermal reactor and ARD testing of reactive pyritic shale samples to investigate spontaneous combustion reactivity and ARD potential. Evaluation of the associated management strategies. Research Partner: University of Western Australia

Appendix B: Orebody 31 Closure Risk Assessment Matrix

OB31 Closure Register

	Risk Identification and Analysis				Risk Control Strategy		Uncontrolled Risk			Residual Risk Rating		
Risk No.	**Risk Issue**	**Event**	**Causes**	**Impacts/Outcomes**	**Preventive Control Strategy (existing and planned as part of project)**	**Mitigating Controls (existing and planned as part of project)**	**Sev**	**Like**	**Ranking**	**Sev**	**Like**	**RRR**
1	Potential acid and saline forming materials	Acid, saline and metals released to the environment with negative impact on receptor(s)	a) Waste containing PAF waste material stored in a uncontrolled manner that will allow release of AMD. b) Poor source (AMD, saline etc) identification. c) Mine plans (governing PAF exposure and OSA construction) not followed. d) The geological, resource and mining models lacks the detail location and volume of PAF material. e) Mine plans change without consideration to AMD management. f) AMD material is left exposed in the pit walls. g) Erosion exposes PAF located behind pit wall surface (fracking). h) Changes in climate (increased rainfall) make previous OSA and pit design standards ineffective. i) Lack of control of low quality water. j) Closure of facilities used to manage AMD during operations.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) e) Cultural Heritage: Negative impact on areas of significant cultural and or heritage f) Health and safety of people adversely affected. g) Community values adversely affected. h) Future regulatory approval delays i) Unable to relinquish site. j) Non-compliance leading to procesecution and litigation and associated consequences.	a) AMD Management Standard. b) Site PAF Management Procedures and including waste dump design criteria (if applicable). c) Waste Rock Management Committee. d) PAF Management (expit) Research & Development (store and release, and other programs). e) Implementation of mine closure plan and associated management plans. f) Life of Mine waste strategy informed by the closure plan. g) Conformance to mine plan checks and balances. h) Monitoring of risk indicators (visual inspection of waste dumps, surface water sampling, groundwater sampling).	a) Monitoring of risk indicators (visual inspection of waste dumps, surface water sampling, groundwater sampling). b) Interception and treatment of water. c) Remediation of OSAs and pit walls.	10	1	10	3	0.1	1
2	BWT pit void	Groundwater quality or quantity has negative impact on receptor(s)	a) Liberation of geochemical contaminants (metals, PAF, salts) from exposed pit wall, floor and/or backfilled rock material. b) Inadequate knowledge or assessment of backfilled waste characteristics causing contaminant leaching. c) Contaminated surface water (ARD, metals etc.) introduced to pit during cyclonic rainfall events. d) Inadequate capture of regional water baseline data for predictive assessment. e) Hydrogeological model unable to predict adverse closure outcomes. f) Closure criteria not explicitly defined. g) Groundwater management controls not adequate in long term. h) Not properly defining pathways for impacts.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) e) Cultural Heritage: Negative impact on areas of significant cultural and or heritage f) Health and safety of people adversely affected. g) Community values adversely affected. h) Future regulatory approval delays i) Unable to relinquish site. j) Legal Non-compliance	a) East Pilbara Water Resource Management Plan: Environmental receptors identified, valued and documented. b) Mine Closure Plan, c) Mine void closure strategy using neutralising material to mitigate pit void water quality if required. d) Monitoring of risk indicators (visual inspection of waste dumps, surface water sampling, groundwater sampling), e) Treatment of walls and floor - dependentof outcomes of further analysis (sealing)	a) Treatment of pit void water. b) Monitoring of risk indicators (visual inspection of waste dumps, surface water sampling, groundwater sampling).	10	1	10	3	0.1	1
3	Landform instability (pit voids)	Final pit wall failure exposing potential problematic rock (e.g. sulphide rocks)	a) Inadequate geotechnical understanding of rock strength characteristics and faulting. b) Poorly managed hydraulic gradients within walls during watertable rebound. c) Accelerated weathering along geological failure planes not considered within final wall design. d) Poor surface water drainage management to meet final landform designs (expit or inpit). e) Poor final wall control (blasting, energy transfer into final wall). f) Ground subsidence.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) e) Cultural Heritage: Negative impact on areas of significant cultural and or heritage f) Health and safety of people adversely affected. g) Community values adversely affected. h) Future regulatory approval delays i) Unable to relinquish site. j) Legal Non-compliance	a) Geological model (highlights fault zones). b) Geotechnical pit model informs pit design. c) Survey (final blast wall design against actual pit wall). d) Surface hydrology assessment (considers upstream catchment, sediment load, downstream receptors). e) Backfill strategy to address geotechnical issues. f) Validation of design assumptions during operational life of mine.		1	1	1	1	0.03	0.3
4	Landform instability (OSA)	Final landform failure causing negative impact on surroundings post closure	a) Final landform OSA design is structurally flawed. b) The material used to construct the final landform is not suitable for external placement to provide stable landform. c) Final landform design is not suited to the material from which it is constructed. d) The final landform is not constructed according to the design. e) Climatic changes occur in excess of design criteria. f) Unplanned placement of waste material. g) Opportunistic placement of waste material inconsistent with LOM (e.g. short haul). h) Insufficient landform performance monitoring and feedback into design process or final landform objectives.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) water (i.e. sedimentation) e) Cultural Heritage: Negative impact on areas of significant cultural and or heritage f) Health and safety of people adversely affected. g) Community values adversely affected. h) Future regulatory approval delays i) Unable to relinquish site. j) Legal Non-compliance	a) Master Area signoff by qualified staff (engineers, geologists, scientists) b) Historical performance to inform current procedures/practices. c) Landform construction monitoring for compliance with design. d) Landform stability monitoring. e) Closure Plan (stakeholder agreed completion criteria). f) Landform design research and development to inform development of landform design criteria guidelines g) Mine design, source to destination scheduling. e) Waste characterisation and erosion potential modelling informing final landform design	a) Review design and rework to mitigate causes.	30	1	10	10	0.1	1

5	Revegetation establishment	Revegetation fails to establish and/or self-sustain	a) Viable correct provenance seed unavailable for seeding at completion of earthworks. b) Limited seed available in growth media applied to project area. c) Poor or no germination / establishment following seeding. d) Landform failure e) Prolonged periods of draught during crucial growth phases. f) Excessive weed infestation displaces native species. g) Closure criteria (landform design, species) not defined and agreed upon by stakeholders. h) Growth media not suitable for establishing and sustaining native vegetation. i) Surface hydrology not considered within landform designs. j) Rehabilitation earthworks not executed to standard or as defined in the project work pack. k) AMD discharge from containment structures.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) e) Cultural Heritage: Negative impact on areas of significant cultural and or heritage f) Health and safety of people adversely affected. g) Community values adversely affected. h) Future regulatory approval delays i) Unable to relinquish site. j) Legal Non-compliance	a) WAIO Rehabilitation Strategy. b) WAIO Rehabilitation Standard and seed management protocols. c) Growth Media Atlas and growth media trials. d) Weed management program. Botanic Gardens and Park Authority: Restoration Seed Bank: to address the long term management of seed collection, storage, and germination strategies. e) Mine closure plan. f) Development of agreed ecological completion criteria.	a) Rehabilitation monitoring program b) Progressive rehabilitation within 5YR mine planning. c) Annual topsoil reconcilation.	3	1	3	1	1	1
6	Public access	Injury to public caused from accessing abandoned/ closed site (not relinquished)	a) Pit abandonment bunds not or poorly constructed. b) Access control poorly constructed and not maintained. c) Information signs not clear (i.e. not multilingual, not maintained). d) Community closure engagement process poorly planned and executed. f) Inadequate infrastructure removal planning and/or execution to plan (tanks, voids, sumps). g) Completed pits within an operating site not appropriately safeguarded. h) Proximity to populated centres. i) Leaving behind attractive features (pit lakes, high walls, tyre dumps, scrap metal yards) not planned for public access.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) e) Cultural Heritage: Negative impact on areas of significant cultural and or heritage f) Health and safety of people adversely affected. g) Community values adversely affected. h) Future regulatory approval delays i) Unable to relinquish site. j) Legal Non-compliance	a) Consultation with East Pilbara Shire b) Control signage and gates/fences c) Regular inspection d) Closure Plan e) Abandonmentbund design (to be installed at closure) f) Infrastructure (as an attraction) will be removed as per Closure Provision. g) DMP Closure Guide.	a) Review defficiencies and address.	30	1	30	30	0.3	9
8	Pit captures the creek	Creek overtops pit crest and erodes away the pit crest. All future events then drain into the pit.	Inadequate bunding	Surface water would not reach downstram environment. The bund needs to be appropriately engineered to ensure it does not fail/overtop for the design event.	Well designed and constructed flood protection bunding that complies with government mine closure requirements. Minor creek relocation if required.	No additonal required	10	1	10	10	0.03	0.03
9	Construction of abandonment bund and interaction with protection bund.	Abandonment bund is located within creek channel or on south side of creek requiring creek diversion.	Legislated guidelines give a required location which may push the bund into this zone.	Abandonment bund if located within the floodzone would require armouring and would in effect become the flood protection bund. This bund would need to be set back sufficiently from the pit to avoid the capture of the creek by the pit if the pit slumps. The bund needs to be appropriately engineered to ensure it	Well designed and constructed abandonment/flood protection bunding that complies with government mine closure requirements. Minor creek relocation if required.	No additonal required	10	1	10	10	0.03	0.03
12	Heritage	Cultural values are not replaced/preserved at the end of closure due to ineffective cultural materials management and lack of consultation.	a) Heritage sites have been impacted under Section 18 of the heritage act in order to accommodate the mine and cultural material salvaged at the request of traditional owners. At the completion of mining these sites cannot be restored due to ineffective cultural material mangement and lack of consultation.	a) Ineffective management can result in damage to the relationship with traditional owners and non compliance with internal procedures and external agreements (e.g CMMP and Nyiyaparli Comprehensive Agreement)	a) Cultural Materials Management Plan; b) Nyiyaparli Comprehensive Native Title Agreement; c) Sustainable Heritage Strategy; d)mine closure plan	(a) Ongoing consultation with Nyiyaparli concerning mine closure and storage and repatriation of cultural materials	3	1	3	3	0.01	0.03
13	Community	Operations cease at OB31 resulting in the lack of community sustainability caused by economic reduction post mining.	a) Mine/infrastructure plan restricting access to local 4WD tracks, dewatering/discharge to Opthalmia Dam (recreation spot), b) Rehabbilitation/closure inadequate for pastoral needs and instability of OSA/pit walls and pit lakes (public access and safety)	a) Restricting access to local 4WD tracks, b) Impacts to Opthalmia Dam – too much/not enough water (recreation spot), c) Pastoral station financial impact and public safety – overall impact would be Community dissatisfaction and potential safety/financial concern.	a) Stakeholder Engagement Plan, b) Incorporating access tracks into design, c) Opthalmia long term water strategy, d) Safety management taking into considertion for closure plan/design.	a) Stakeholder Engagement Plan, b) Having alternative access tracks built, c) Safety management including fencing/signage etc of the closed site.	10	1	10	3	1	3