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 advise on aspect areas of significance or where in-house expertise is unavailable or unsuitable. Closure Planning Risk Assessments BHP Billiton Iron Ore involve people with a cross section of relevant knowledge and experience, including employees, contractors and other stakeholders. 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.

8.3 Identification of closure issues

A Closure Planning Risk Assessment was undertaken for the Eastern Ridge mining operations closure considering the current operations and proposed changes to current operations. 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 18 outlines the aspects identified as requiring specific attention in the Closure Planning process for the Eastern Ridge mining operations. This is based on the collection and analysis of closure data (Section 7) and a Closure Risk Assessment workshop, carried out internally by BHP Billiton Iron Ore. The full risk assessment and matrix is provided in Appendix E.

Responsibilities for closure risk mitigation and management are addressed in BHP Billiton internal processes and procedures. The Planning function (including; Mine Planning, Resource Modelling, Hydrology and Closure Planning teams) in conjunction with the Environment functions Rehabilitation and Biodiversity team lead integration of closure management requirements into the Eastern Ridge mining operations plans as part of the CAP process (as outlined in Section 1.4). Eastern Ridge Mines Operations are responsible for implementing the plans.

Table 18 Eastern Ridge mining operations closure and rehabilitation issues identified

Risk Factor	Risk Issue	Event	Uncontrolled Risk Ranking	Residual Risk Rating
Terrestrial Environmental Quality – AMD	Potential acid and saline drainage forming materials	AMD seepage from ex-pit OSA's to groundwater or surface water with negative impact on receptor(s)	High	Moderate
Terrestrial Environmental Quality - AMD	Potential acid and saline drainage forming materials	AMD Seepage from in-pit OSA's to groundwater with negative impact on receptors (s)	Moderate	Low
Terrestrial Environmental Quality - AMD	Potential acid and saline forming materials	AMD release from unsaturated pit wall rock. Seepage to GW. OR from saturated pit wall rock below water table following groundwater rebound. Seepage (percolation) to groundwater having negative impact on receptors.	Moderate	Low
Hydrology - Groundwater	BWT pit void	Groundwater quantity has negative impact on receptor(s)	Moderate	Low
Hydrology - Groundwater	BWT pit void	Groundwater quality has negative impact on receptor(s)	Moderate	Low
Landform - Pit Void	Landform instability (pit voids)	Final landform failure, beyond agreed abandonment structure, causing negative impact on surroundings post closure	Moderate	Low
Landform - Pit Void	Landform instability (pit voids)	Final pit wall failure exposing potential problematic rock (e.g. sulphide rocks)	Low	Low
Landform - OSAs	Landform instability (OSA)	Final landform failure causing negative impact on surroundings post closure	Moderate	Moderate
Sustainability	Revegetation establishment	Revegetation fails to establish and/or self-sustain	Moderate	Low
Sustainability	Standing water attracts fauna	Fauna attracted to pit lake/s resulting in death or injury	High	Low
Safety	Public access	Injury to public caused from accessing abandoned/ closed site (not relinquished)	High	Moderate
Hydrology - Surface Water	Creek capture	Creek overtops pit crest and erodes away the pit crest. All future events then drain into the pit.	Material	Low
Hydrology - Surface Water	Surface water quality and quantity	Surface water flow and quality offsite does not meet acceptable limits	High	Low
Hydrology - Surface Water	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.	High	Low
Heritage	Heritage	Cultural values are not replaced/preserved at the end of closure due to ineffective cultural materials management and lack of consultation.	Moderate	Low
Community	Community	Operations cease at Eastern Ridge resulting in the lack of community sustainability caused by economic reduction post mining.	Moderate	Moderate

The sections that follow provide an overview of proposed closure management of issues identified as having and uncontrolled risk rating of medium or high. Management measures 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 MCP.

8.4 Management of identified issues

8.4.1 Acid and metalliferous drainage

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.

BHP Billiton Iron Ore is committed to managing and mitigating AMD risk using a structured approach, consistent with global leading practice guidelines including International Network for Acid Prevention (INAP) (2012) 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; Appendix F). The overall strategy for AMD management is illustrated in Figure 24 with considerations across the full mine life cycle.

The approach as shown in Figure 24 is risk based approach, 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 24 informs Stages 2 through 5 inclusive of OSA design as shown in Figure 24. The information also informs the decision making process for pit closure and mine void management.

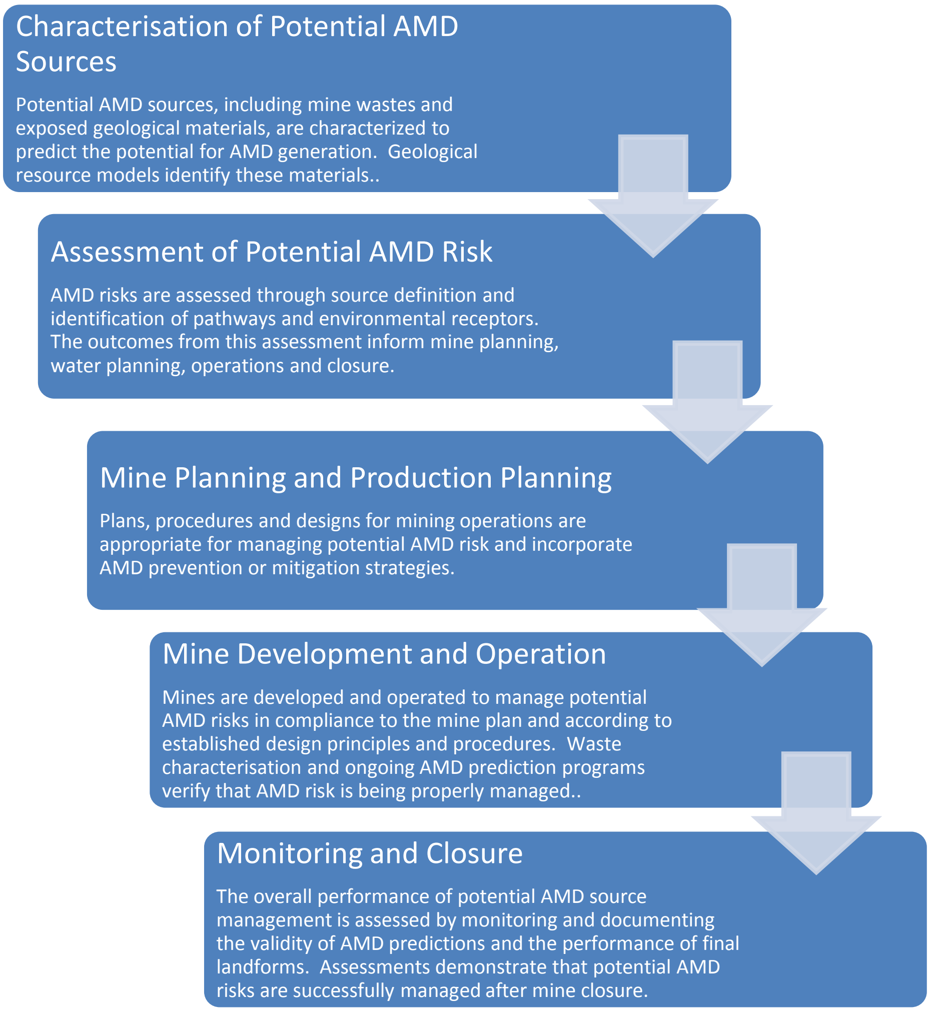

Figure 24: The AMD Management Process

Specifically BHP Billiton utilises the following tools to model and assess AMD risk.

- Exploration Phase Waste Characterisation Sampling
- Static and Kinetic Geochemical Waste Characterisation
- AMD Risk Assessment
- 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 subaquously or a combination of options can be applied. These are evaluated on a site specific basis following the completion of appropriate material characterisation, risk assessment and modelling.

Based on the findings of the AMD risk assessments undertaken for Eastern Ridge Hub (Section 7.2.3) overall, there is a low risk of AMD from OSA's and a low to negligible risk of AMD from stockpiles. There is a low risk of AMD from pit walls, however there are isolated hot spots of PAF in Orebody 23, Orebody 25 Pit 3 and small percentages in Orebody 24 and Orebody 25 West pits. Orebody 32 has low to negligible risk of AMD, and no specific management measures are required. The AMD Management Standard will continue to be applied including continued waste characterisation and review of AMD risk as this deposit is further advanced.

The following specific management measures will be applied.

Mine waste:

For all deposits at the Eastern Ridge mining operations, the process flow for managing PAF material from mine planning through to operations is illustrated in Figure 25. Designated locations for PAF encapsulation are identified as part of the mine planning process, and should PAF be confirmed through the Mine Geology blast hole drilling, the short term mine plan will direct the PAF to the designated location.

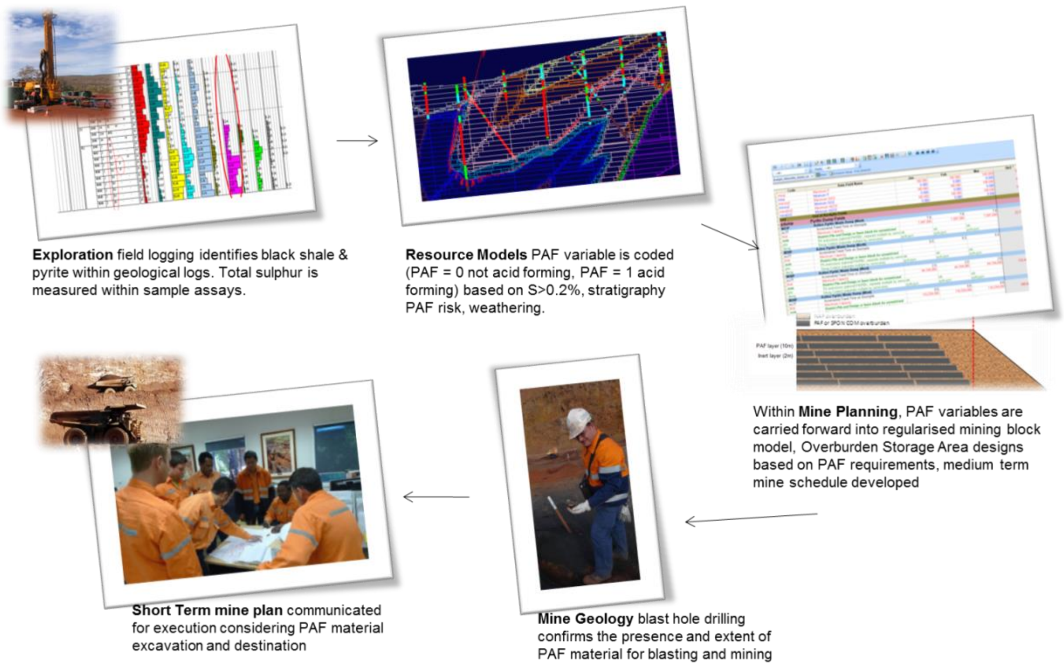

Figure 25: PAF Management process flow (BHP Billiton Iron Ore ELearning tool).

There is 60,000T of PAF material, which has been confirmed and managed through the Mine Geology blast hole drilling to date. The PAF material has and will continue to be placed in the existing PAF containment cell integrated within the Orebody 25 SW OSA (Figure 26). This cell is designed and constructed in accordance with leading practice guidance to limit oxygen and water ingress. Additional PAF cells may be included as the operations progress.

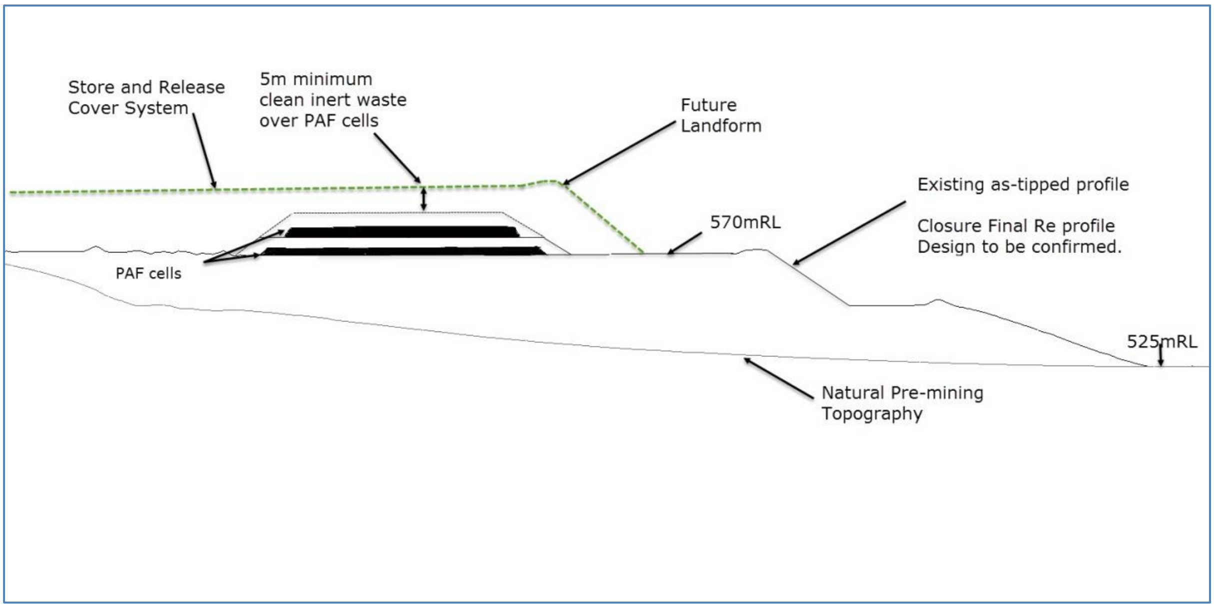

Figure 26: PAF material containment cell integrated with Orebody 25 SW OSA

Other options such as blending PAF materials with neutralising material prior to disposal, in order to neutralise the stored acidity on re-wetting may be considered in the future. Below water table disposal is not planned for Orebody 25 Pit 3 or Orebody 23. It may be considered for the remaining mine voids at Eastern Ridge mining operations in the future.

Wall Rock and Mine voids:

Water quality assessments identified the risk to receptors from a pit lake at Orebody 23 and/or Orebody 25 Pit 3 as moderate. Considering cumulative risks associated with Homestead creek capture, groundwater and AMD, Orebody 23 and Orebody 25 Pit 3 will be backfilled with geochemically inert waste to above the pre-mining water table (to the pit crest along Homestead Creek).

Upon inundation, oxygen supply to the backfill would be reduced to very low levels and oxidation of wall rock will essentially cease. Readily soluble solutes contained in the backfill placed below the final water table (i.e generated prior to inundation) would be released to the groundwater within the former mine void following inundation. After inundation, residual sulfide minerals would no longer react and generate solutes. Solute generation would be expected to continue in reactive materials (backfill and wall rocks) that remain above the water table. Geochemically Inert waste will be used to reduce the total potential for solute release. The life of mine waste strategy has confirmed that adequate volumes of geochemically inert waste (e.g. waste from the Dales Gorge and Joffre lithological groups) are available and are scheduled to facilitate this closure strategy.

During the transition period from operations to closure (when groundwater level may be influenced by surrounding operations dewatering) solute transport beyond the mine void is a potential risk, however continuous dilution and flushing during large hydrologic events (e.g. cyclones) is expected to limit the transport of elevated solutes levels to the Ethel Gorge TEC. During the transition period, recovery of the groundwater table will be managed through aquifer recharge (if required) to reduce the accumulation of solutes and subsequent flushing of solute spikes. Conceptual modelling and mass balance calculations have been completed to predict groundwater quality within the mine void following closure. Additional hydrogeochemical modelling can be used to support prediction regarding solute dilution during the transition.

The base case mine void closure strategy for Orebody 25 West and Orebody 24 is pit void (pit lake forming). This strategy will be reviewed over life of mine to ensure any emerging residual AMD risks are addressed. Options include:

- Avoiding exposure of PAF in final pit walls.

- Backfill to above pre-mining water table.
- Covering exposed PAF with 10-20m of NAF or ANC material (Dependent on groundwater recovery level).

The Strategy will be informed by the ongoing geochemical waste characterisation and studies program outlined in Section 8.5.

Monitoring and contingency planning:

A Trigger Action and Response Plan is under development for OB23 and OB25 pit 3 to identify groundwater quality change thresholds requiring a response action during the later stages of operation and closure execution to mitigate any potential impact. Monitoring is in place within OB25 pit 3 and OB23 and regionally (See Section 10.1) to measure any groundwater quality change arising from mining. Mitigating controls available include passive attenuation treatment through locally sourced calcrete waste materials, known through local sampling and laboratory testing to exhibit neutralisation capacity. Monitoring and evaluation of change in ground water hydrology will be undertaken in accordance with the Principals of The Pilbara Water Resource Management Plan and supporting Eastern Pilbara Water Management Plan (BHP Billiton Iron ore 2015c).

Coding PAF material:

PAF material has historically been identified in geological and mine planning block models based on total sulfur content and degree of weathering, and the focus has been on material known to have a high acid generating potential (i.e., unweathered black shales). Improvements are being made to procedures for identifying and coding PAF and other material that may contribute to AMD in geological and mine planning block models. These improvements are possible based on the collection of extensive geochemical characterisation data and learnings from preliminary AMD risk assessments and research studies. This will result in the more accurate documentation of AMD risk and facilitate improvements in tracking and managing mined waste material as well as residual risks from material exposed in pit voids.

Based on the current state of knowledge AMD risk for the Eastern Ridge mining operations closure and rehabilitation will be managed as per Table 19.

Table 19: Management actions, tools and improvement activities for managing AMD at the Eastern Ridge mining operations

Management Actions (physical actions undertaken during operational and during closure phase to enable closure outcomes)	Orebody 23, Orebody 25 Pit 1 and3: Backfill of the BWT pit to AWT with geochemically inert waste. Management of cumulative impact period during operations through managed aquifer recharge (if required) to reduce accumulation of solutes and spikes being flushed. Orebody 24 and Orebody 25 West: base case strategy pit void remains (pit lake forms). Mine void closure strategy to be reviewed over life of mine to ensure any emerging residual AMD risks are addressed. Options include: a) Avoiding exposure of PAF in final pit wall b) Backfill to above pre-mining water table c) covering exposed PAF with 10-20m of NAF or ANC material (dependent of GW recovery level)
Tools (processes, procedures, plans used to guide and inform the planning of management actions)	• AMD Management Standard • Conformance to mine plan. Verification of OSA compliance to 'as dumped design' • Research and Development (store and release, and other programs). • Life of Mine waste strategy informed by the closure plan. • PAF coding included within Resource Model carried through to Mining Model • Eastern Ridge AMD Risk Assessment • OSA Design Manual • Monitoring of risk indicators (visual inspection of waste dumps, surface water sampling, groundwater sampling).

Improvement Activities (further studies based on knowledge gaps)	• Develop TARP for Orebody 23 and Orebody 25 to enable timely response to water quality risks as they arise before and during the backfill process. • Understand final exposures throughout the life of mine for Orebody 24, Orebody 25 West and Orebody 32 to develop mine waste closure strategy that addresses residual AMD risk. • Improvements in modelling of waste geochemistry and coding (moving towards NAPP modelling) in block models for identifying materials with potential AMD risk. • Geochemical waste characterization studies including: - Additional sampling and analysis of waste from Orebody 23, Orebody 24 Orebody 25 Pit 3, Orebody 25 West and Orebody 32. - Carbon speciation test work - Acid buffering characteristic curves - Mineralogical assessment (quantitative X-ray diffraction) - Supplemental leach tests - Kinetic testing using AMIRA free draining columns - Saturated column test work • Hydrogeochemical modelling to validate predictions regarding solute dilution and attenuation during transition period from operations to closure. • Review the AMD risk assessment for Orebody 32 following update of the Geological model with more extensive data.

8.4.2 Groundwater

The risk associated with the closure of mine pits, should they be left as open voids at the completion of below water table mining, is they will result in the development of pit lakes that reach equilibrium on a balance of pit inflows and evaporation, which have the potential to impact local and regional groundwater and surface water resources. Public safety also requires consideration.

BHP Billiton Iron Ore uses Hydrogeological Conceptual and Predictive Modelling to inform closure planning. Additionally BHP Billiton Iron Ore uses the historical monitoring data to validate and update the hydrogeological conceptual and predictive models. BHP Billiton Iron Ore has over thirty years of groundwater monitoring data for Ophthalmia Dam and over ten years of data for the Eastern Ridge mining operations area. Groundwater flow modelling 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 has been updated and validated throughout the life of mine as more data has become available. This has informed closure strategies landform design from conceptual through to detailed, thereby reducing risk and increasing confidence. In particular, the initial assumption prior to mining was that dewatering of Orebody 23 and Orebody 25 Pit 3 would lead to a drawdown in the local and regional groundwater levels have been revised. Ongoing monitoring has shown that water level recovery at Orebody 23, Orebody 25 Pit 3 and within the Ethel Gorge area is relatively quick due the high recharge rates associated with direct infiltration through Ophthalmia Dam and Homestead and Shovelanna Creeks. Full recovery of water levels is estimated to occur within approximately 40 years.

The outputs from this work have guided closures strategies, provided input to hydrogeochemical assessments (Section 7.8) and informed environmental impact assessments using the source, pathway, and receptor approach.

A summary of the results of the technical assessments (details provided in Section 7) show how each of the Eastern Ridge mine pits will recover post-closure (Table 20). This summary describes the likely post-closure recovery in an uncontrolled environment (impact assessment), the proposed management action and the expected residual risk.

Table 20: Summary of hydrological technical impact assessments at Eastern Ridge mining operations

Pit	AWT / BWT	Impact Assessment – Quantity	Impact Assessment – Quality	Void Closure Strategy	Residual Risk Assessment - Quantity	Residual Risk Assessment – Quality
Orebody 23	BWT	Pit void is adjacent to Homestead creek. Groundwater levels will rebound quickly following cessation of dewatering.	Pit void has hot spots of PAF exposed on the south pit wall.	Backfilll to pit above water table [1]	Backfill of pit void will re-establish a through flow and groundwater levels are expected to rebound to close to pre-mining levels within 40 years of backfill.	Backfill of the pit void and rebound of the water level will saturate the exposed PAF resulting in limited ability for oxidisation and mobilisation.
Orebody 25 Pit 3	BWT		Pit void has hot spots of PAF exposed on the pit wall.	Backfill to above water table [1]		
Orebody 25 Pit 1	BWT	Groundwater levels will rebound quickly following ceasation of dewatering.	Low potential for AMD from pit walls	Backfill to above water table		
Orebody 24	BWT	Pit void creates localised groundwater sink, with limited impact on the surrounding regional groundwater levels	Low risk of PAF; no PAF hotspots within the pit void walls have been identified. Potential for AMD generation post-closure is limited.	Leave as pit void – pit lake may form [2]	The pit void is expected to for a pit lake. Groundwater assessments show a localised groundwater sink, with limited impact on the surrounding regional groundwater levels.	No PAF hotspots within the pit void walls have been identified. As such, the potential for AMD generation post-closure is limited.
Orebody 25 West	BWT			Leave as pit void – pit lake/s may form [2]		
Orebody 32	AWT	No impact to groundwater levels.	Low risk of PAF; No impact to groundwater quality.	Leave as pit void	AWT mining only, therefore not pit lake or potential impact on groundwater resources.	

[1] to pit crest adjacent to Homestead Creek to manage surface water risk.

[2] Mine voids closure strategy will be reviewed as further assessments are undertaken over the life of mine.

The base-case closure strategy for Orebody 24 and Orebody 25 West Joffre pits will be permanent voids, these have the most potential for significant effect on groundwater levels in the Eastern Ridge mining area. Final lake levels in these pits are reached quickly (within 10 years), however the recovery of the entire groundwater system is longer (particularly within vicinity of Homestead Borefield) with water level equilibrium and corresponding groundwater flow regime (discussed in Section 7.8) being established after about 200 to 300 years. Resulting pit lakes are likely to become saline due to evaporation concentration of salts. However, the pit lake scenario shows that only a local groundwater sink is created, in which the final pit lake water level is lower than the regional water table and therefore groundwater discharges to the pit lake containing the poor quality water within the pit (discussed in Section 7.8).

The technical assessments (discussed in Section 7.8) determined that the risk from cumulative groundwater drawdown along the major length of Homestead Creek supporting *Eucalyptus victrix* is determined to be low, while the risk for the localised section of Homestead Creek immediately west of Orebody 25 West supporting *Eucalyptus camaldulensis* subsp. *refulgens* is determined to be moderate (Onshore Environmental 2015).

Impacts to tree health are expected during operations, if at all, and no evidence of negative impact to tree health has been observed from existing operations (Astron, 2015). As such, impacts are not expected to the health of the riparian vegetation post-closure, and therefore no management actions are required.

The ultimate groundwater levels in Ethel Gorge show that with complete backfilling of Orebody 23 and Orebody 25 Pit 3 there is no residual drawdown predicted to occur long term in Ethel Gorge. As such, no additional management post-closure is required to manage this risk.

The impacts associated with the presence of PAF material within the deposits of the Eastern Ridge mining operations was further explored in the Preliminary AMD Risk Assessments conducted by SRK (2015a, b) and is discussed further in Section 7.2. Management of PAF is discussed in Section 8.4.1.

Based on the current state of knowledge for the Eastern Ridge mining operations, groundwater closure and rehabilitation risk will be managed as per Table 21.

Table 21 Management actions, tools and improvement activities for groundwater at Eastern Ridge mining operations

Management Actions (physical actions undertaken during operational and during closure phase to enable closure outcomes)	• Closure Management consistent with the objectives of the EPWRMP. • Mine void closure strategy for Orebody 23 and Orebody 25 Pit 1 and 3: backfill to AWT with inert waste. • Mine void closure strategy for Orebody 25 West (Joffre pit) and Orebody 24 and Orebody 32 Pit void remains. Impact assessment does not show that any further actions are required, as potential risk of impact is localised.
Tools (processes, procedures, plans used to guide and inform the planning of management actions)	• EPWRMP (BHP Billiton Iron Ore, 2015c). • WAIO AMD Management Standard (BHP Billiton Iron Ore, 2013). • Eastern Ridge AMD Risk Assessment (Appendix E). • Conceptual Hydrogeological model. • Numerical Hydrogeological model inform pit closure strategy (backfill, backfill material, through flow) • Monitoring of groundwater levels, via regional monitoring network. • Monitoring of risk indicators for AMD (visual inspection of waste dumps, surface water sampling, groundwater sampling). • Conformance to mine plan checks and balances. Verification of OSA compliance to 'as dumped design'. • Research and development (store and release, and other programs). • Life of Mine waste strategy informed by the closure plan. • PAF coding included within Resource Model carried through to Mining Model. • OSA Design Manual.
Improvement Activities (further studies based on knowledge gaps)	• Mine waste scheduling to ensure inert waste placement for Orebody 25 Pits 1 and 3 and Orebody 23 backfill. • Orebody 25 West and Orebody 24 mine void closure design (informed by surface water and further pit lake water quality studies) to meet safety requirements for pit voids. • Better understanding of the Ethel Gorge stygofauna community. • Develop Trigger Action and Response Plan (TARP) for Orebody 23 and Orebody 25 to enable timely response to water quality risks as they arise before and during the backfill process. • Understand final PAF exposures throughout the life of mine for Orebody 24 and develop mine waste closure strategy that addresses residual AMD risk.

	• Further studies will be completed to determine the mine void closure strategy (including consideration of backfill) to manage groundwater risks as outlined in Section 8.5.

8.4.3 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.

The design of surface water management works to meet operational needs will include consideration of closure requirements. These designs will then be revisited five years prior to the closure of the site as a whole where closure design will be developed. Closure designs for individual pits or domains will be prepared prior to closure of the site, in line with the CAP cycle. The development of this design near to the end of the pit life will permit closure design to benefit from the data captured through the operational period as well as the increased certainty around final landforms.

The surface water management post closure will focus on ensuring long term stability of Homestead Creek and Fortescue River and their tributaries in the vicinity of the mined pits, as well as ensuring the long term stability of site OSAs. The closure design will consider:

- surface water runoff from OSAs;
- natural creek sections adjacent to pits; and
- diversion/realignment sections.

The drainage from the OSAs and any upstream catchments will be managed to ensure landforms are stable in the long term. The final shaping of OSAs is further discussed in Section 8.4.4.

Capture of Homestead Creek into a pit could result in:

- surface water not reaching downstream environment, including Fortescue Marsh and Ethel Gorge TEC.
- potential loss of riparian vegetation, dependant on surface water flows (Homestead Creek).
- homestead Creek provides freshwater flows to Ethel Gorge TEC and the Fortescue Marsh. Capture to pit would significantly diminish freshwater re-charge to protected area.

There is the potential for loss of surface water to the downstream environment from Orebody 25 West Haul Roads which will be constructed across minor tributaries to Homestead Creek during operations and Orebody 32 several small drainage lines are being diverted during operations.

There is the potential for the abandonment bund to be located within the creek channel due to government requirements that provide direction in relation to the location of the Abandonment bund. The pit crest of Orebody 23, Orebody 25 Pit 3, Orebody 25 West and Orebody 32 are within 100m of Homestead Creek.

Backfill of Orebody 23 and Orebody 25 Pit 3 will be designed to mitigate the potential for creek capture into these pit voids. The backfill will also mitigate the need for an abandonment bund for these pits. Further details of the design of the backfill of these pits are provided in Section 9.2.

Consultants are currently completing hydrological and hydraulic modelling of Homestead Creek and major tributaries to assess impacts on Orebody 32 and Orebody 25 West pits at closure. This review will include development of concept options to prevent creek capture at closure. This work will also address the potential for loss of surface water to the downstream environment from Orebody 25 West haul roads. Relevant options will be included in site plans and in the future MCP for the site.

For Orebody 32, if the diversion is required post closure, then the principal diversion design objective is that there should be no legacy resulting from long-term permanent encroachments / diversion. This would require adjustment to the diversion channel to either increase the bed grade, or lower the channel into the terrain to contain the two-year ARI flow with the same bed grade. Both of these options would require more cut through higher ground of the north-western side of the pit. Final landform designs and flood protection solutions are still to be finalised. Studies undertaken to date, described in Section 7.8, will inform the closure designs.

The natural creek areas next to the pits will include flood protection bunds for protection during operation, where required. The flood protection works required for closure will be designed and constructed to achieve stable, maintenance free draining landforms and may be different to the operational flood bunds. The options which would be considered include additional rock armouring, changes to the elevation and slope of protection bunds and stream management to locally reduce velocities at critical locations.

In waterway sections which are diverted for mining operations, the initial diversion design will consider closure requirements. The systems will be designed to achieve comparable hydraulic and geomorphological characteristics to the original creek systems. Seepage from the creek base and interaction with groundwater will be studied and measures incorporated to reduce seepage where appropriate. The design Average Recurrence Interval (ARI) for the diverted creek sections will be selected on a case by case basis. Consideration will be made to the fate of flood events in excess of the design ARI to ensure that the system is stable in the long term. This consideration may include the use of spill out structures to divert an increasing proportion of the flow above the design ARI event into mine voids. Design features of spill out structures may include heavy rock armouring and include features such as launching aprons, baffles and weirs to improve stability.

Based on the current state of knowledge surface water for Eastern Ridge mining operations, closure and rehabilitation will be managed as per Table 22.

Table 22: Management actions, tools and improvement activities for surface water at Eastern Ridge mining operations

Management Actions (physical actions undertaken during operational and during closure phase to enable closure outcomes)	• Orebody 23 and Orebody 25 Pit 3 will be backfilled to the pit crest to manage the likelihood of creek capture and mitigate the need for an abandonment bund. • Flood protection solutions designs, such as engineered flood levees, to manage likelihood of creek capture for Orebody 25 West (Pits adjacent to Homestead Creek) and Orebody 32. • Orebody 32 diversions need to be appropriately designed for closure to ensure a permanent flow path is sustained post-closure.
Tools (processes, procedures, plans used to guide and inform the planning of management actions)	• Design of integrated landforms across all domains taking account of the post-closure surface water regime as detailed in Section 7.8. • Surface water modelling, including studies undertaken to determine the local surface water drainage requirements and detailed design criteria for flood bunding to meet closure requirements. • Surface water assessments inform infrastructure design. • OSA Design Manual. • Master Area design review process to verify that closure design guidance has been incorporated. • Flood protection design and final landform design, especially of areas adjacent to creek and drainage lines, for closure (appropriate specifications e.g., design life). • Surface water monitoring network (water quantity and quality).
Improvement activities (further studies based on knowledge gaps)	• Complete hydrological and hydraulic modelling of Homestead Creek and major tributaries to assess impacts on Orebody 32 and Orebody 25 West pits at closure and inform closure options. • Prepare flood protection design, such as engineered flood levee, of Orebody 32 and Orebody 25 West (pits adjacent to Homestead Creek and drainage lines), for closure. • Develop design principles and details for structures remaining post mining that will be exposed to surface drainage (bunds, diversion channels, flood protection structures etc.). • Final landform design, especially of areas adjacent to creek and drainage lines.

	• Undertake flood protection design for closure (appropriate specifications e.g., design life) once final landform design signed off. • Further studies will be completed to address the knowledge gaps identified in Section 8.5

8.4.4 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.

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.

Management of erosion is the primary tool for achieving a sustainable landform. The design objective applied is to create slopes on which riling 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 (following Landloch 2013).

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 inform 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 programs. 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.

In line with the *Guidelines for Preparing Mine Closure Plans 2015* (DMP and EPA, 2015), 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 (as previously illustrated in Figure 4);

- OSAs;
- Infrastructure;
- Mine voids (above and below watertable); and
- Roads and rail.

8.4.4.1 Overburden Storage Areas

Final landform designs (including location) of the out-of-pit OSAs are informed by surface water assessments, waste characterisation and modelling of erosion potential as outlined in Section 8.4.3 and 7.2.4. 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 10.

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.

During mine operations “as dumped designs” and mine pit designs are developed to ensure the footprint and overall scale is within environmental and operational constraints. Preliminary Closure Landform Designs for domains approaching closure (Orebody 25 and Orebody 23) as outlined in Table 23. Final closure design will be confirmed (as required) through 3D landform evolution modelling (SIBERIA) once the detailed design has been completed.

Figure 27, Figure 28 and Figure 29 provide an illustrative overview of Orebody 25 from current operations to post-rehabilitation and Figure 30 illustrates Orebody 23 preliminary closure landform designs.

Table 23: Overburden Storage Areas at Eastern Ridge mining operations

Feature	Status	Considerations	Landform Design Features
Orebody 25 Central OSA	Dumping complete. Preliminary Closure Design (Figure 28)	Mine waste dump from 1999 to 2014, inert waste material from Orebody 25 Pit 3. Brockman Waste. Visual analysis of surface material indicates upper lifts are unsuitable for closure landform due to erosion characteristics. Some areas of western face previously re-profiled show good erosion resistance. Analysis of available local stockpiles and future mining operations demonstrates availability of suitable sheeting material to achieve erosionally resistant landform with linear slopes. Suitability of sheeting material as growth media has been confirmed, fertiliser may be required. Landloch (2013 and 2015a).	Remove/re-profile top 3 lifts, south and eastern faces. Excess material to be utilised in backfill of adjacent Oreody 25 pit 3. Linear slopes 15 degree re-profile. Batter height ~20deg. Intermediate berm for surface water management (200yr ARI design capacity). Crest berm with 'store and release' on OSA top lift for surface water management. Sheeting as required with competent erosion resistant waste rock (minimum 500mm thickness).
Orebody 25 North West OSA	Dumping complete. Preliminary Closure Design (Figure 28)	Mine waste dump from 2001 to 2006, inert waste material from Orebody 25 Pit 1. Brockman Waste. Sampling and analysis of surface material indicates material unsuitable for closure landform due to erosion characteristics. Analysis of available local stockpiles and future mining operations demonstrates availability of suitable sheeting material to achieve erosionally resistant landform with linear slopes. Suitability of sheeting material as growth media has been confirmed, fertiliser may be required. Landloch (2013 and 2015b)	Design profile to be confirmed (potentially linear slope 15 degree). Batter height 30m Crest berm with 'store and release' on OSA top lift for surface water management Sheeting as required with competent erosion resistant waste rock (minimum 500mm thickness).
Orebody 25 North East OSA	Dumping complete. Initial re-profiling commenced. Preliminary Closure Design (Figure 28)	Mine waste dump from 2001 to 2003, inert waste from Orebody 25 Pit 3. Brockman waste. Surface material on the northern (partially re-profiled slope) is not suitable for closure landform due to erosion characteristics. Analysis of available material from upper benches, local stockpiles and future mining operations demonstrates availability of suitable sheeting material to achieve erosionally resistant landforms with linear slope of 40m high and 20 deg. Suitability of sheeting material as growth media has been confirmed,	Linear slopes 20 degree re-profile Batter height ~40m No intermediate berm Crest berm with 'store and release' on OSA top lift for surface water management Sheeting as required with competent erosion resistant waste rock (minimum 500mm thickness). Integration of southern slope with OB25 pit crest with

Feature	Status	Considerations	Landform Design Features
		fertiliser may be required. Landloch (2013 and 2015a).	consideration of visual impact.
Orebody 23 West OSA	Dumping complete Preliminary Closure Design (Figure 30)	Mine waste dump from 2001 to 2011, waste from Orebody 23. Brockman Waste. Low potential for AMD (SRK, 2015b). Erosion performance of the as dumped material over a number of years (37deg linear slope, 10m high) demonstrates suitability of material for closure landform surface.	Linear slopes 15 degree re-profile Lift heights ~10m Intermediate berm for surface water management (200 year ARI design capacity) Crest berm with 'store and release' on OSA top lift for surface water management. Cut and fill required to achieve closure landform design, excess to be utilised in adjacent pit backfill.
Orebody 23 Low Grade Stockpile	Low grade Stockpile As dumped design	May be processed prior to closure. Material confirmed as erosion resistant, suitable for closure landform sheeting. Landloch (2015)	NA
Orebody 25 Low Grade Stockpile	Low grade Stockpile As dumped design	May be processed prior to closure. Material confirmed as erosion resistant, suitable for closure landform sheeting. Landloch (2015)	NA
Orebody 25 South West OSA	Active OSA As dumped design	Includes PAF cell within inert waste containment. Currently holds ~60,000T of PAF waste.	Closure re-profile to be informed by further physical waste characterisation of surface materials. Design to ensure PAF cell minimum cover (5m). Crest berm with 'store and release' on OSA top lift to minimise infiltration and for surface water management.
Orebody 24 East 2 OSA	Active OSA As dumped design – partially filled	Brockman waste. Further characterisation will be undertaken approaching closure	NA
Orebody 32 OSA	As dumped concept only	OSA likely to contain Marra Mamba waste	NA
Orebody 25 West OSA	As dumped concept only	OSA likely to contain Brockman waste	NA

Figure 27: Orebody 25 as at 2015

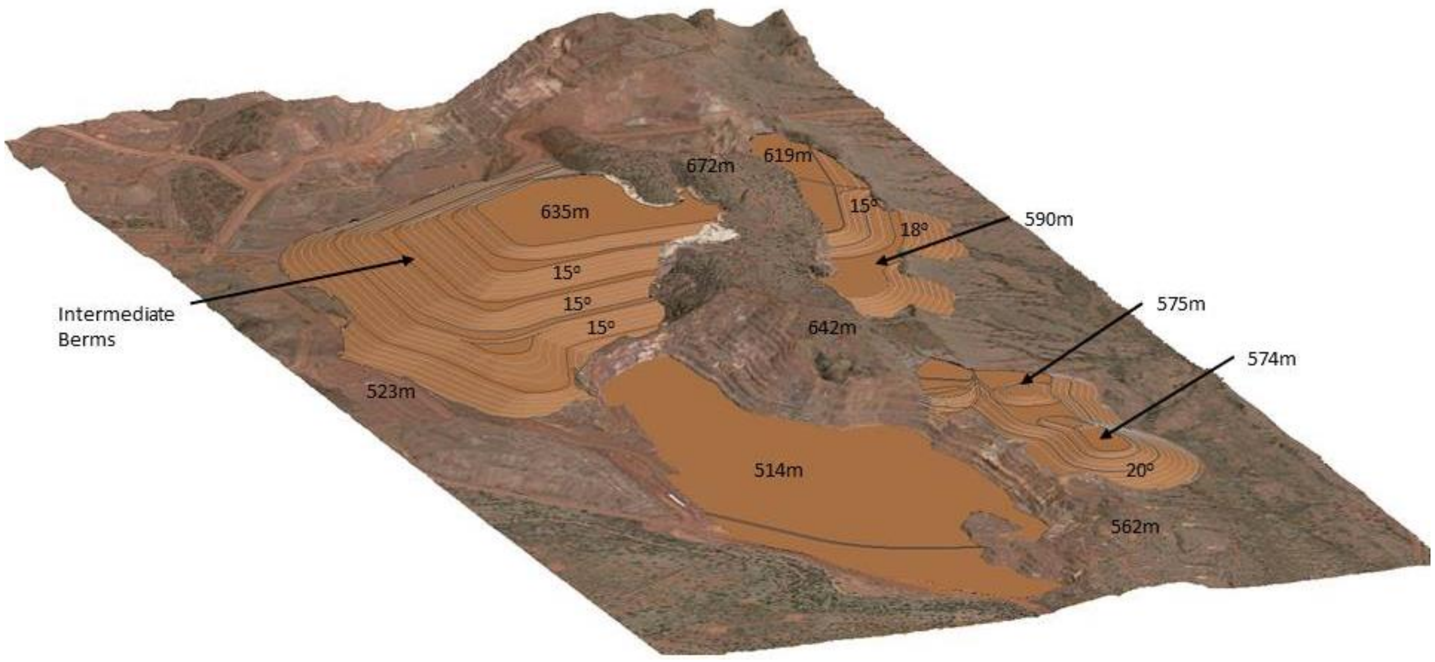

Figure 28: Closure Landform preliminary designs; Orebody 25 Pit 3, Central OSA, North East OSA, North West OSA

Figure 29: Orebody 25 post closure artist's impression (360 Environmental, 2015)

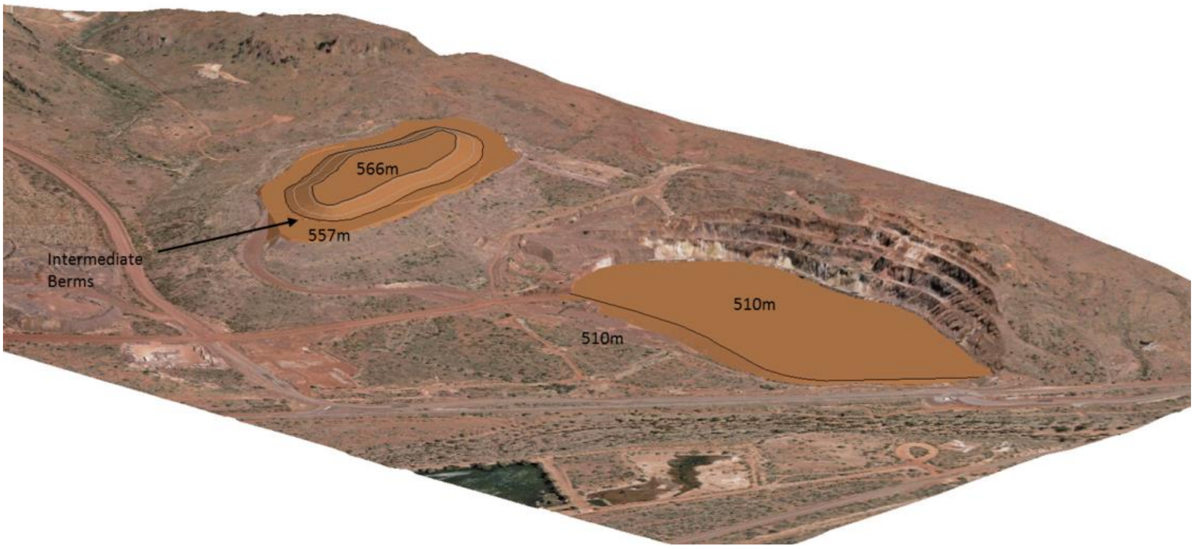

Figure 30: Orebody 23 Pit and OSA preliminary closure landform designs

8.4.4.2 Mine Voids

Across the Eastern Ridge mining operations 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. In regards to pit voids, current blasting practices used to reduce the potential for pit wall failure post-closure include the use of trim shots.

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.

Safety bunds will be established around the final pit walls. The bunds will be constructed as per the DMP recommended practice. The bunds will be a minimum 2 m high with a base width of minimum 5 m and constructed at least 10 m away from the edge of the area known to contain potentially unstable rock mass as per recommended practice (DoIR 1997).

The final landform design for the pit crest adjacent to Homestead Creek at Orebody 25 Pit 3 establishes a large elevated landform, which acts as a surface water bund (to prevent creek capture).

The mine void closure strategy for the Eastern Ridge mining operations is currently as listed in Table 24.

Table 24: Mine void closure strategy for the Eastern Ridge mining operations

Mine Void	AWT / BWT	Closure Strategy
Orebody 23	BWT	Backfill to +5m above pre-mining water table with geochemically inert waste, to pits crest adjacent to Homestead creek. Preliminary closure design Figure 30.
Orebody 25 Pit 1	BWT	Backfill to +5m above pre-mining water table.
Orebody 25 Pit 3	BWT	Backfill to +5m above pre-mining water table with geochemically inert waste, to pits crest adjacent to Homestead creek.

		Preliminary Closure Design (Refer to Figure 28)
Orebody 24	BWT	Based case: leave as pit void (potential pit lake), strategy to be confirmed through further studies over the life of mine.
Orebody 25 West	BWT	Base case: leave as pit void (potential pit lake/s) to be confirmed through further studies over the life of mine.
Orebody 32	AWT	Leave as pit void (no pit lake)

8.4.4.3 *Infrastructure, roads and rail*

In accordance with the State Agreement Act, prior to removing the rail rolling stock, equipment and removable buildings, BHP Billiton 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 of the Eastern Ridge mining operations 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 (BHP Billiton Iron Ore, 2011b).

Based on the current state of knowledge the final landform design for Eastern Ridge mining operations closure and rehabilitation will be managed as per Table 25.

Table 25: Management actions, tools and improvement activities for final landforms at Eastern Ridge mining operations

Management Actions (physical actions undertaken during operational and during closure phase to enable closure outcomes)	• Construct final landforms (as outlined in Table 23), informed by ongoing waste characterisation, erosion potential modelling and integrated landform considerations • For mine voids that will not be backfilled the final pit design will include abandonment bunds. • Mine void closure strategies to be implemented as outlined in Table 24.
Tools (processes, procedures, plans used to guide and inform the planning of management actions)	• Waste characterization and erosion potential modelling • Surface water hydrology assessments (considers upstream catchment, sediment load, downstream receptors). • Geological model (highlights fault zones). Geotechnical pit model informs pit design. • Survey (final blast wall design against actual pit wall).
Improvement Activities (further studies based on knowledge gaps)	• Detailed closure landform designs (integrating all domains) to be developed based on outcomes of technical studies and assessments. • Ongoing characterisation of waste is required to refine the mine model and inform final landform designs. • Final landform design confirmed through 3D landform evolution modelling (SIBERIA) once the detailed design has been completed. • Review of historical performance to inform regular review and update of

	relevant procedures / practices • Validation of design assumptions during operational life of mine. • Detailed slope stability analysis to inform final abandonment bunds location for pit faces and mine pits remaining post closure. • Further studies will be completed to address the knowledge gaps identified in Section 8.5

8.4.5 Sustainability

The revegetation program 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 characterisation as outlined in Section 7.2) is critical for the successful establishment of vegetation and compliance with the relevant completion criteria (see Section 6). 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 topsoil and alternative growth media for rehabilitation is being investigated as part ongoing rehabilitation works across WA Iron Ore with the resulting data being collated in the Growth Media Atlas . This ongoing study seeks to not only establish the quantity and quality of current stockpiled material but also identify alternative growth media materials within waste rock stockpiles 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 agreed post-mining land use. The plant species included in revegetation programs are identified from the Eastern Ridge baseline survey and 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.

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 unmined 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 pool.

Based on the provisional final land use (Section 5.3) revegetation at the Eastern Ridge mining operations 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 mine area prior to mining (BHP Billiton Iron Ore, 2008).

During rehabilitation works suitable material will be identified for use in the creation of landforms that mimic those of surrounding areas, with natural drainage lines being restored where practicable. Specialised fauna habitats will be established if available resources can be identified, however there are currently no plans to disturb new areas to source these materials.

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

Based on the current state of knowledge, the rehabilitation of disturbed areas of the Eastern Ridge mining operations will be undertaken consistent with the Rehabilitation Standard and as per Table 26.

Table 26: Management actions, tools and improvement activities for rehabilitation of disturbed areas at the Eastern Ridge mining operations

Management Actions (physical actions undertaken during operational and during closure phase to enable closure outcomes)	• 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)
Tools (processes, procedures, plans used to guide and inform the planning of management actions)	• WAIO Rehabilitation Standard (Controlled Document ID 0001074) • Growth Media Management Procedure (SPR-IEN-LAND-009).
Improvement Activities (further studies based on knowledge gaps)	• Locations which may be available for a minimum of five years for rehabilitation/landform trials will be investigated • Genetic material collected from *Eremophila magnifica* subsp. *veluntina* (Priority 3) will also be considered as part of revegetation activities. • Continued development of the Growth Media Atlas to inform rehabilitation projects • Further studies will be completed to address the knowledge gaps identified in Section 8.5

8.5 Closure improvement

Section 8.4 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 Eastern Ridge mining operations Section 7 discusses the baseline knowledge that BHP Billiton Iron Ore currently has regarding the Eastern Ridge mining operations and also discusses the knowledge gaps which have been identified. Table 27 summaries these activities to fill gaps in the existing knowledge base and further define the closure methodology.

Table 27: Eastern Ridge mining operations closure improvement activities.

Technical Area	Knowledge gap or Risk[7]	Proposed Improvement activity	Indicative timing[8]
Government and stakeholder consultation	Risk of impact to the community (community sustainability caused by economic reduction) following cessation of operations at Eastern Ridge.	Consultation will continue to be undertaken with identified stakeholders in line with the broader Stakeholder Consultation Programme.	Ongoing
Completion Criteria	Conceptual criteria without metrics.	Ecological Completion Criteria: • Review and refine completion criteria taking into consideration improved knowledge to develop more measurable metrics.	2018
	Conceptual criteria without metrics.	Other criteria: • Review and refine completion criteria taking into consideration improved knowledge to develop more measurable metrics.	ongoing
Sustainability			
Climate	No knowledge gaps have been identified.		
Progressive Rehabilitation	Risk of revegetation failure	Locations which may be available for a minimum of five years for rehabilitation/landform trials will be investigated	Ongoing
Rehabilitation of Priority Flora	There is a current knowledge gap as to the known success in rehabilitation using *Eremophila magnifica* subsp. *velutina* material.	Genetic material collected from *Eremophila magnifica* subsp. *veluntina* (Priority 3) will also be considered as part of revegetation activities.	Ongoing
Soils	Limited information available on baseline soil mapping.	Continued development of the Growth Media Atlas to inform rehabilitation projects	Ongoing
Landforms			
Waste characterisation	Waste characterisation modelling and analysis.	Ongoing characterisation of waste is required to refine the mine model and inform final landform designs.	Ongoing
Stability	Detailed slope stability analysis for pit faces and mine pits remaining post closure.	Detailed slope stability analysis to inform final abandonment bunds location for pit faces and mine pits remaining post closure.	Less than 5 years to domain closure
Landform design	Validated performance of final landform designs over design life.	Final landform design confirmed through 3D landform evolution modelling (SIBERIA) once the detailed design has been completed.	Less than 5 years to domain closure
		Validation of design assumptions during operational life of mine	Ongoing
		Review of historical performance to inform regular review and update of relevant procedures / practices.	Less than 5 years to closure
	Detailed closure landform designs (integrating all domains).	Detailed closure landform designs (integrating all domains) to be developed based on outcomes of technical studies and assessments.	Less than 2 years to closure
Hydrology			
Hydrogeology	Risk of impact to groundwater quality associated with PAF material exposure and interaction with groundwater post-closure (geochemical understanding of the site) .	Mine waste scheduling to ensure inert waste placement for Orebody 25 Pit 1 and 3 and Orebody 23 backfill.	2016/2017
		Orebody 25 West and Orebody 24 mine void closure design (informed by surface water and further pit lake water quality studies) to meet safety requirements for pit voids.	Less than 2 years to domain closure
		TARP for Orebody 23 and Orebody 25 to enable timely response to water quality risks as they arise before and during the backfill process.	2016/2017

[7] Note: If a knowledge gap exists, the relevant risk has not been stated. All relevant risks are listed in Table 20.

[8] Reviewed annually as part of the CAP cycle.

Technical Area	Knowledge gap or Risk[7]	Proposed Improvement activity	Indicative timing[8]
		Understand final PAF exposures throughout the life of mine for Orebody 24 and develop mine waste closure strategy that addresses residual AMD risk.	Ongoing
	Risk of solute (elevated salinity) migration form backfill material to Ethel Gorge TEC	Hydrogeochemical modelling to validate predictions regarding solute dilution and attenuation during transition period from operations to closure.	Less than 2 years to domain closure
Surface Water Hydrology	Better definition of the mine development plans for the pit and OSA areas to enable final designs for surface water.	Develop design principles and details for structures remaining post mining that will be exposed to surface drainage (bunds, diversion channels, flood protection structures etc.).	2018
		Final landform design, especially of areas adjacent to creek and drainage lines.	Less than 2 years to domain closure
		Undertake flood protection design for closure (appropriate specifications e.g., design life) once final landform design signed off.	Less than 2 years to domain closure
	Surface water assessment for other pits that may be impacted by Homestead Creek flooding e.g. Orebody 32 and Orebody 25 West, to inform closure design requirements.	Complete hydrological and hydraulic modelling of Homestead Creek and major tributaries to assess impacts on Orebody 32 and Orebody 25 West pits at closure and inform closure options.	Within next 5 years
		Prepare flood protection design, such as engineered flood levee, of Orebody 32 and Orebody 25 West (pits adjacent to creek and drainage lines), for closure.	Within next 5 years
Inland Environmental Quality			
AMD	Geochemical data gaps exist relating to understanding variability in material properties to improve confidence in predictions regarding the behaviour of waste rock and pit wall rock, and provide a basis for waste management designs.	Understand final exposures throughout the life of mine for Orebody 24, Orebody 25 West and Orebody 32 to develop mine waste closure strategy that addresses residual AMD risk. Improvements in modelling of waste geochemistry and coding (moving towards NAPP modelling) in block models for identifying materials with potential AMD risk. Geochemical waste characterization studies including: • Additional sampling and analysis of waste from Orebody 23, Orebody 24 Orebody 25 Pit 3, Orebody 25 West and Orebody 32. • Carbon speciation test work • Acid buffering characteristic curves • Mineralogical assessment (quantitative X-ray diffraction) • Supplemental leach tests • Kinetic testing using AMIRA free draining columns • Saturated column test work	Ongoing
	Fate of potential AMD in the context of regional flows.	Fate and transport modelling, if warranted based on risk	As needed.
	Limited geological data available for Orebody 32.	Review the AMD risk assessment for Orebody 32 following update of the Geological model with more extensive data.	Within next 5 years
Potentially Contaminated sites	Contamination assessments are incomplete for known and suspected contaminated sites.	Contamination assessments will be undertaken for any potential contaminated site, in accordance with the requirements of the DER and relevant technical guidelines. Prepare and implement remediation plan, as appropriate.	Ongoing
Final Land Use and Decommissioning			
Land use	Final-land use yet to be confirmed (provisional use is currently low-intensity grazing).	Final land use planning study to be undertaken. Stakeholders to agree and endorse the final land use for the Eastern Ridge mining operations.	Within 5 years of closure
Decommissioning Plans	No detailed decommissioning plans	Develop detailed decommissioning plans for site infrastructure.	Within 3 years of closure

9 Closure implementation

Taking into account the identified closure issues and acknowledging the further studies, investigations and design work that will occur during the life of the mine this section describes how the Eastern Ridge mining operations will be rehabilitated and closed in a manner that satisfies the objectives and guiding principles, 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 Closure and Rehabilitation Standard.

Rehabilitation of disturbed areas will be conducted progressively during the mine life with complete closure of the mine not expected to occur until 2055.

9.1 Standard closure and rehabilitation strategies

BHP Billiton Iron Ore has developed and will implement 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. This rehabilitation standard is used across BHP Billiton Iron Ore's Pilbara mine sites and other areas where appropriate. Rehabilitation and revegetation of the final mine landforms and infrastructure and support facilities will be conducted in accordance with the Rehabilitation Standard. A description of each 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.

9.1.1 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 5. 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 8.1).

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 (see Section 8.4.4)).

Surface water management may include the construction of compacted crest bund around the perimeter of the overburden storage area to prevent surface water runoff onto the slopes of the overburden storage area. The faces of the slopes are designed and constructed as weathering. Concave slope profiles may be used to facilitate water-shedding.

9.1.2 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 Eastern Ridge 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 to maximise water infiltration and enhance revegetation success; and

- selective placement of logs or smaller woody debris and/or boulders (if available) 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.

9.1.3 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. A large diversity of plant species used in rehabilitation must be maximised in order to improve habitat value and encourage colonisation by fauna.

Based on the provisional post mining land use, revegetation at Eastern Ridge mining operations will use local provenance native seed (sourced from within 100 km of site within the Pilbara Biogeographic Region) consistent with vegetation associations and native species recorded in the mine area prior to mining (BHP Billiton Iron Ore, 2008c). The Eastern Ridge mining operations seed list is provided at Appendix G. Genetic material collected from *Eremophila magnifica* subsp. *veluntina* (Priority 3) will also be considered as part of revegetation activities.

The BHP Billiton Iron Ore Seed Management Procedure describes the seed purchasing strategy, standards and overall seed management requirements including the process to develop a seed mix and determine rates. Through BHP Billiton Iron Ore adaptive management approach (refer Section 8.4.5) seed mixes and seeding rates will continue to be improved and informed by ongoing monitoring results, and research such as the Restoration Seed Bank Initiative.

Where monitoring results indicate vegetation establishment may not meet required standards, (vegetation density, species diversity and plant age heterogeneity), additional maybe undertaken.

Two rainfall periods occur at Eastern Ridge mining operations – 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.

9.1.4 Cultural 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 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 (BHP Billiton Iron Ore 2008b).

The primary mechanism for protection of cultural heritage sites identified as being significant at the Eastern Ridge mining operations will be avoidance of identified sites. Any post closure issues (including ongoing management) relevant to these sites will be discussed with the *Nyiyaparli People* through the stakeholder engagement process (Section 4).

9.1.5 Site contamination

Site contamination as a result of activities during 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 assessment will be managed in accordance with Department of Environment and 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 9.1.2 and 9.1.3.

9.1.6 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.

9.2 Closure strategies for specific domains

Closure strategies for each domain have been discussed previously in Section 8.4.4.

9.3 Progressive 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 Eastern Ridge Five Year Rehabilitation Mine Plan is developed annually as part of the CAP process, outlined in Section 1.4. It identifies areas available for final landform earthworks and rehabilitation within the five year period.

The main components of the progressive rehabilitation programme are described in the Rehabilitation Standard 0001074 and reported annually within the Annual Environmental Report.

9.4 Implementation schedule

Table 28 provides an overview of the proposed schedule of closure works, including progressive rehabilitation of identified closure domains over the life of mine. It should be noted that closure dates for selected domains have not been determined, and will depend on the following the completion of the long-term plan for the Eastern Ridge mining operations. The implementation schedule will be further refined as closure planning progresses.

Table 28: Eastern Ridge mining operations implementation schedule

Domain	Feature	Mining complete) [1]	Preliminary Closure Design [1]	Final Closure Design [1]	Rehabilitation Execution [1,2]
OSA	Orebody 25 Central OSA	Complete	Complete	2015/16	2017 to 2021
	Orebody 25 North West OSA	Complete	Complete	2015/16	2016/17
	Orebody 25 North East OSA	Complete	Complete	2015/16	2016/17
	Orebody 23 West OSA	Complete	Complete	2015/16	2016/17
	Orebody 25 South West OSA	2019/20	2017	2018	2019/20
	Orebody 24 East 2 OSA	2020-2026	Opportunities for progressive rehabilitation over life of mine. Final design and rehabilitation >2020		
	Orebody 32 OSA	2025	Opportunities for progressive rehabilitation over life of mine. Final design and rehabilitation >2020		
	Orebody 25 W OSA	2022	Opportunities for progressive rehabilitation over life of mine. Final design and rehabilitation >2020		
Infrastructure	Orebody 24 Infrastructure	2045-2055	Opportunities for progressive rehabilitation over life of mine. Final design and rehabilitation >2020		
	Orebody 5 Infrastructure	2045-2055	Opportunities for progressive rehabilitation over life of mine. Final design and rehabilitation >2020		
Mine void	Orebody 23 Pit	Complete	Complete	2016/17	2020
	Orebody 25 Pit 3	2019	Complete	2016/17	2017 to 2021
	Orebody 25 Pit 1	2020	Opportunities for progressive infill over life of mine. Final design and rehabilitation >2020		
	Orebody 24 Pit	2022-2026	Opportunities for progressive infill over life of mine. Final design and rehabilitation >2020		
	Orebody 25 West pits	2022	Opportunities for progressive infill over life of mine. Final design and rehabilitation >2020		
	Orebody 32 Pit (AWT)	2025	Opportunities for progressive infill over life of mine. Final design and rehabilitation >2020		
	[1] Timing reviewed annually with long term mine plan [2] Scope as per Section 8.4.4				

9.5 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 8), 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 11 provides an understanding of the current closure liability, with present closure obligation costs representing an unplanned or unexpected closure scenario.

10 Closure monitoring and maintenance

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 against established criteria 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 in 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 8.1).

10.1 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. Previous rehabilitation monitoring used Ecosystem Function Analysis. A review of the BHP Billiton Iron Ore Pilbara rehabilitation monitoring system was undertaken during 2011. This resulted in the establishment of a three stage monitoring process:

- Rehabilitation Establishment Assessment, three 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 Landscape Function Analysis, erosion monitoring and quadrat vegetation monitoring using existing monitoring transects. It is applied to maturing rehabilitated areas. Rehabilitation Development Monitoring methodology was followed for the first time in 2011, with positive results in quantifiable vegetation measures that will assist in the development of completion criteria.
- 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.

As part of BHP Billiton's Adaptive Management, the approach to rehabilitation monitoring is currently under review to ensure that the information collected is appropriate to demonstrate progress towards meeting completion criteria; and to provide opportunity to examine the use of technological advances which may provide more accurate data at a landform scale.

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

10.2 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.

10.3 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 recent 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), possibly associated with the age of the rehabilitation areas.

The requirement for undertaking fauna assessments in rehabilitation areas including if required appropriate methodology for fauna monitoring (approach/frequency/key performance indicators) will continue to be investigated as part of the development of ecological completion criteria (Section 6.3).

Refer to Section 10.7 for details regarding monitoring of the Ethel Gorge TEC habitat.

10.4 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 31) 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 Eastern Ridge mining 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.

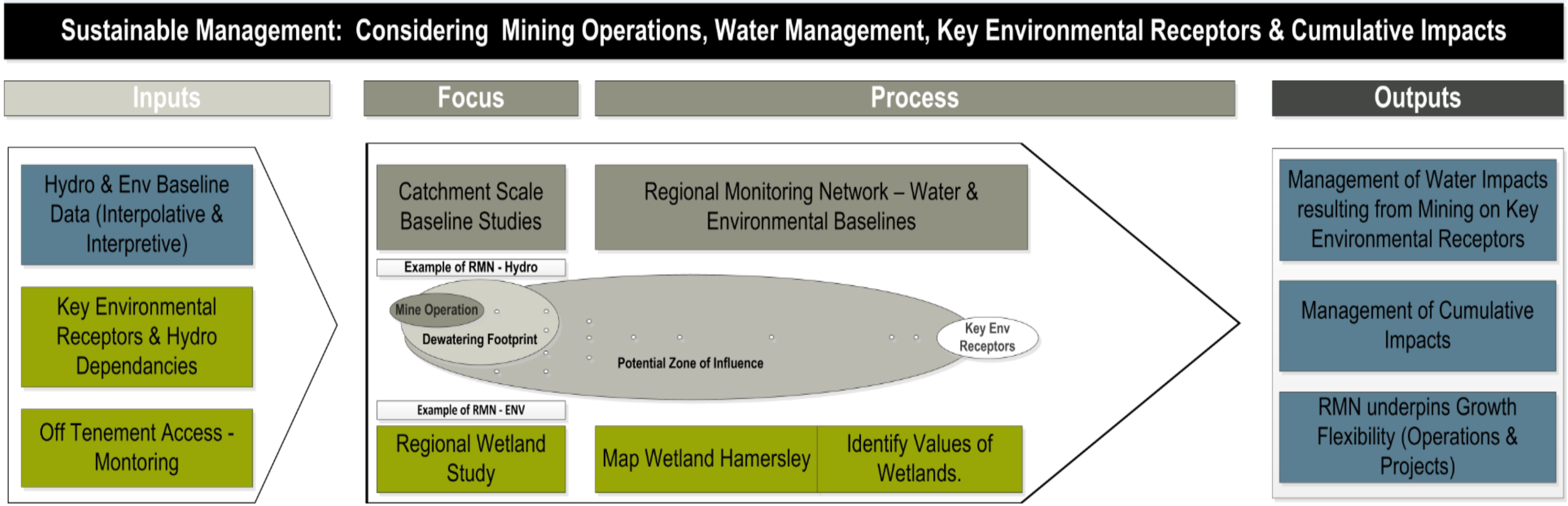

Figure 31: Regional Monitoring Network overview

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 future groundwater change.
- 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 depth to water, soil moisture, leaf water potential, canopy condition, understorey condition.
- Hydrological dependence of receiving receptors on surface water, groundwater or soil moisture.

10.5 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.

A TARP is under development for Orebody 23 and Orebody 25 pit 3 to identify groundwater quality change thresholds requiring a response action to mitigate any potential risk impact. Monitoring is in place within Orebody 25 pit 3 and Orebody 23 and regionally (See Section 10.7) to measure any groundwater quality change arising from mining.

10.6 Surface water monitoring

In addition to the Regional Monitoring Network (Section 10.1.4), 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.

10.7 Groundwater monitoring

Complementary to the Regional Monitoring Network (Section 10.4), groundwater monitoring is carried out by Eastern Ridge mining operations according to requirements of the 5C groundwater licence process and EPA Part IV commitments. This monitoring program is set out in the Groundwater Operating Strategy (GWOS) for Eastern Ridge which describes monitoring types, frequency and locations. This monitoring program provides insight into any changes in the surrounding aquifers, in particular the aquifers that host the adjacent TEC. Groundwater levels and chemistry are measured within the mine site and in the surrounding area.

Monitoring of the Ethel Gorge Aquifer Stygobiont Community has been ongoing since 2005. The diversity of core endemic species recorded in the 2015 program is consistent with previous programs and indicates that there has not been a decline in the stygobiont community at Ethel Gorge (MWH 2015). Based on the results of the monitoring program and the minimal proposed changes in water levels, the predicted drawdown at Ethel Gorge Aquifer Stygoniont Community resulting from below water table mining is unlikely to pose additional threat to stygofauna species (Bennelongia 2015a).

The Ophthalmia supply borefield is located immediately to the east of Eastern Ridge along the Homestead Creek and Fortescue River valleys. This borefield is also governed by a GWOS that contains a monitoring program complimentary to the Eastern Ridge program. Results of these monitoring programs are reported to the DoW annually along with cumulative abstraction and discharge volumes. Aspects of both monitoring programs are combined to provide an integrated view of the aquifer systems.

Additionally, the EPWRMP provides an overarching monitoring and management program that is focused on the protection of the Ethel Gorge TEC. Monitoring zones have been established that reflect the main sources of influence on the Ethel Gorge aquifer (see Figure 32) which include inflows from adjacent river valleys, Ophthalmia Dam and surplus water inputs from surrounding mines and any closure related activities. Monitoring associated with the EPWRMP is designed to compare changes in the water level and quality against thresholds that protect key receptors in the system, namely the Ethel Gorge stygobiont community and riparian vegetation associated with the creeks. Under the EPWRMP changes in aquifer condition outside the nominated ranges will trigger management responses designed to mitigate impacts at key receptors.

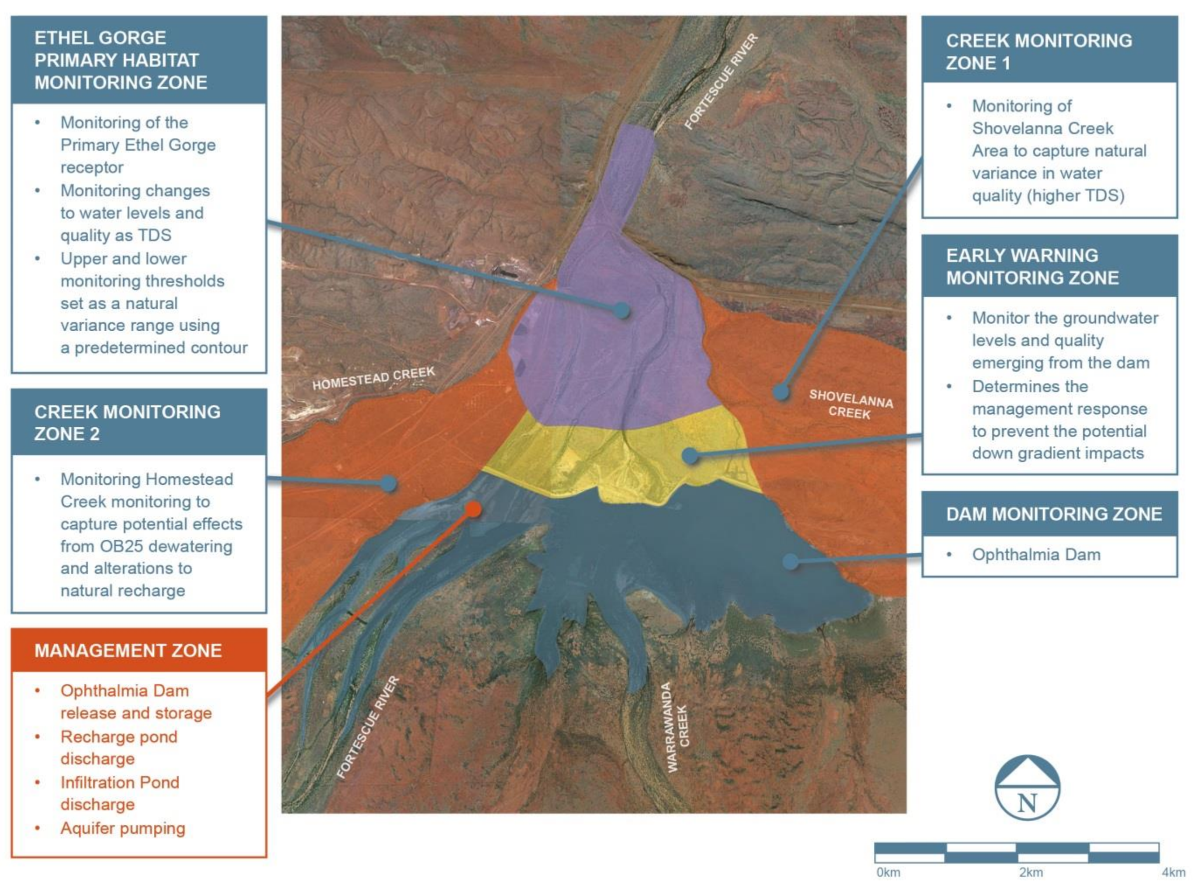

Figure 32: Ethel Gorge Monitoring zones (BHP Billiton Iron Ore, 2015c)

10.8 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.

10.9 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.

10.10 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 Eastern Ridge 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 AER 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.

11 Financial provisioning for closure

BHP Billiton Iron Ore will ensure 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.

Adjustments to the estimated amount and timing of future closure and rehabilitation cash flows are a normal occurrence in light of the substantial judgements and estimates involved. Factors influencing those changes include:

- revisions to estimated mine life;
- developments in technology;
- 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 sufficient closure input assumption documentation to support the closure model financial provision outcomes. The provision process and outcomes are subject to internal and external audit on an annual basis.

For the Eastern Ridge mining operations, 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
- manning forecasting and requirements.

12 Data management

BHP Billiton Iron Ore will collect, store and manage closure data in line with its existing data management procedures, including the WAIO-wide Rehabilitation Data Capture Work Instruction (001006).

The MCP 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 MCP and all associated information to the DMP for its files.

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

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

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 MCP as knowledge gaps are filled and closure plans are refined.

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14 Appendices

Appendix A: Eastern Ridge mining operations Closure and Rehabilitation Obligations and Commitments

Site	Condition / Key Characteristic / Proponent Commitment	Number	Title	Wording of current condition	Justification of how covered by the Mine Closure Plan
Orebody 25	Condition	10-1	**Decommissioning and Final Rehabilitation**	The proponent shall rehabilitate and decommission the new project areas in accordance with the Decommissioning and Rehabilitation Plan provided in the Environmental Protection Statement (November 2005) document or subsequent revisions which meet the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.	BHP Billiton Iron Ore is seeking a new contemporary Decommissioning and Rehabilitation condition to replace this wording through the *Eastern Ridge Revised Proposal* (BHP Billiton Iron Ore, 2015a), to be formally referred to the EPA in December 2015.
Orebody 25	Condition	10-2	**Decommissioning and Final Rehabilitation**	The proponent shall review and revise the Decommissioning and Rehabilitation Plan, in consultation with the Water and Rivers Commission, the Department of Industry and Resources and the Department of Conservation and Land Management, as required, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority. The objective of this plan is to ensure that closure planning and rehabilitation are carried out in a coordinated, progressive manner and are integrated with development planning, consistent with the Australian and New Zealand Minerals and Energy Council / Minerals Council of Australia Strategic Framework for Mine Closure (2000), current best practice, and the agreed land uses. Each revision of the Decommissioning and Rehabilitation Plan shall set out procedures and measures to: 1. manage over the long term ground and surface water systems affected by the open pits and waste rock dumps; 2. rehabilitate all disturbed areas to a standard suitable for the agreed end land use(s); 3. backfill Pit 3, to at least five metres above the pre-mining groundwater table so as to manage impacts on groundwater quality and subterranean fauna; 4. identify contaminated areas, including provision of evidence of notification and propose management measures to relevant statutory authorities; and 5. develop management strategies and/or contingency measures in the event that operational experience and/or monitoring indicate that a closure objective is unlikely to be achieved.	BHP Billiton Iron Ore considers that this MCP meets the intent of the updated *Guidelines for Mine Closure Plan 2015* (DMP and EPA 2015) and the relevant best practice documents which are outlined in the guidelines. BHP Billiton Iron Ore is carrying out consultation with the DMP, DOW, DPAW, the OEPA and others as per Section 4.2 of this MCP. Within this MCP: 1. Is addressed in Section 8.4.2 Groundwater (Table 22) and Table 24 (Surface Water). 2. Is addressed in Section 5.3 Final Land Use and Section 8.4.4 Landforms 3. Is addressed in Section 8.4.2 Groundwater (Table 22). 4. Is addressed in Section 7.9 Contaminated Sites (Table 19) lists known/suspected contaminated sites 5. Is addressed in Section 8.1 Adaptive Management
Orebody 25	Condition	10-3	**Decommissioning and Final Rehabilitation**	The proponent shall make revisions of the Decommissioning and Rehabilitation Plan required by condition 10-2 publicly available.	BHP Billiton Iron Ore considers that this is acceptable for the final version of this MCP.
Orebody 25	Commitment	3	**Mining Below Water Table**	Backfill all mine voids at Orebody 25 which progress below watertable to above the pre-mining watertable. Timing: Prior to mine closure	In this MCP, this is addressed in *Section 8.4.2 Groundwater*, specifically, Table 22.
Orebody 25	Commitment	4	**Potentially Acid Forming Overburden**	In the event that potentially acid-forming overburden is to be mined, the proponent will develop and implement management measures which minimise the potential for the material to generate acid rock operations drainage. If required, develop, in consultation with DoiR, management measures to be incorporated in the Project Environmental Management Plan. Timing: During operations	In this MCP, this is addressed in *Section 8.4.1Acid and Metalliferous Drainage*.
Orebody 24	Condition	8-1	**Acid and Metalliferous Drainage**	Prior to ground-disturbing activities, the proponent shall provide a report with a detailed risk assessment, using national and international standards (as noted below), for any potential Acid and Metalliferous Drainage (as defined in Section 2.1 of the Managing Acid and Metalliferous Drainage, February 2007 developed by the Australian Government) within the area of the Proposal as defined in Figure 2 to identify: 1. the extent of the potential acidity and metal contamination hazard associated from related mining activities in the area of the proposal; and 2. the potential environmental receptors that could be impacted on exposure to this hazard.	In this MCP, this is addressed in Section 7.2.3 and Section 8.4.1 Acid and Metalliferous Drainage. Specifically with regard to Orebody 24, this condition was met prior to ground disturbance and evidence provided to the EPA.

Orebody 24	Condition	8-2	**Acid and Metalliferous Drainage**	Prior to the mining of any material with the potential to generate Acid Metalliferous Drainage, the proponent shall have in place long-term prevention, monitoring, contingency and remediation strategies for the management of any potential Acid and Metalliferous Drainage to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority on advice of the Department of Environment and Conservation and the Department of Mines and Petroleum.	BHP Billiton Iron Ore considers that this MCP document, collectively presents its long-term prevention, monitoring, contingency and remediation strategies for the management of any potential PAF for consultation with, and the ultimate endorsement of, the CEO of the OEPA and in consultation with the DMP. Specifically, *Section 8.4.1 Acid and Metalliferous Drainage,* provides detail.
Orebody 24	Condition	8-3	**Acid and Metalliferous Drainage**	The proponent shall undertake static and kinetic geochemical testing for potential Acid and Metalliferous Drainage as part of the long-term monitoring strategies required by condition 8-2 using national and international standards to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority.	In this MCP, this is addressed in *Section 7.2.3 Acid and Metalliferous Drainage.*
Orebody 24	Condition	8-4	**Acid and Metalliferous Drainage**	The proponent shall report the results and assessment of efficacy of the long-term prevention, monitoring, contingency and remediation strategies required by condition 8-2 as part of the compliance assessment report required by condition 4-6 to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority. Note: the national and international standards are the Managing Acid and Metalliferous Drainage, February 2007 developed by the Australian Government, Department of Industry Tourism and Resources, and the Global Acid and Metalliferous Drainage (GARD) Guide, December 2008, developed by the International Network for Acid Prevention (INAP).	In this MCP, this is addressed in *Section 10 Closure Monitoring and Maintenance.*
Orebody 24	Condition	9-1	**Decommissioning and Rehabilitation**	The proponent shall implement the proposal in accordance with the Decommissioning and Rehabilitation Plan provided as Appendix B of Orebody 24/25 Upgrade Project, Environmental Protection Statement (March 2010) or subsequent revisions.	BHP Billiton Iron Ore considers that this MCP is a "subsequent revision".
Orebody 24	Condition	9-2	**Decommissioning and Rehabilitation**	The proponent shall review and revise the Decommissioning and Rehabilitation Plan required by condition 9-1 at intervals not exceeding 5 years until condition 9-5 is have been met to the requirements of the Chief Executive Officer of the Office of the Environmental Protection Authority on advice of the Department of Environment and Conservation and the Department of Mines and Petroleum.	This is addressed in *Section 1.1 Purpose of Plan*, where it states that: *"This MCP will be revised at intervals of five years. This revision timeline is consistent with the Guidelines for Preparing Mine Closure Plans 2015, and with Western Australian Iron Ore's (WAIO) strategic approach to closure planning across its Pilbara assets".*
Orebody 24	Condition	9-3	**Decommissioning and Rehabilitation**	The proponent shall ensure that decommissioning and rehabilitation completion criteria are developed during implementation of the proposal, included in the Decommissioning and Rehabilitation Plan required by condition 9-1 and updated as required by condition 9-2.	In this MCP, this is covered in *Section 6 Completion Criteria*, specifically, Table 7, where completion criteria have been drafted for the Eastern Ridge mining operations.
Orebody 24	Condition	9-4	**Decommissioning and Rehabilitation**	The proponent shall ensure that rehabilitation required by condition 9-1 achieves the following outcomes within 5 years following the cessation of productive mining in the area of the proposal: 1. The project area shall be non-polluting and shall be constructed so that its final shape, stability, surface drainage, resistance to erosion and ability to support local native vegetation are comparable to non-disturbed natural landforms within 100 km of the proposal. 2. Native vegetation areas disturbed through implementation of the proposal, shall be progressively rehabilitated with vegetation composed of native plant species of local provenance (defined as seed or plant material collected within 100 kilometres of the proposal). 3. Areas not currently supporting native vegetation shall be revegetated to the original land use or a use approved by the Chief Executive Officer of the Office of the Environmental Protection Authority. 4. The percentage cover of living vegetation in all rehabilitation areas shall be comparable to non-disturbed natural vegetation within 100 km of the proposal. 5. No new species of weeds (including both declared weeds and environmental weeds) shall be introduced into the area as a result of the implementation of the proposal. 6. The coverage of weeds (including both declared weeds and environmental weeds) within the rehabilitation areas shall be no greater than the average of three suitable reference sites on nearby land, with reference sites to be chosen in consultation with the Department of Environment and Conservation.	In this MCP, these requirements are addressed in *Section 6 Completion Criteria*, specifically, Table 7.

Orebody 24	Condition	9-5	**Decommissioning and Rehabilitation**	Rehabilitation activities shall continue until such time as the requirements of conditions 9-1 and 9-2 are demonstrated by inspections and reports to have been met for a minimum of five years, to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority on advice of the Department of Environment and Conservation and of the Department of Mines and Petroleum.	In this MCP, this is covered in *Section 10.1 Rehabilitation Monitoring Methodology*.
Orebody 25	Key Characteristic		**Hard Rock Mining**	Hard rock mining below the watertable in approved Pit 1 area and Pit 3 area. Backfilling of pits 1 and 3 to above the original ground water leveL.	This is addressed in *Section 8.4.2 Groundwater,* specifically, Table 22.
Orebody 23	Proponent Commitment	No. 7	**Development of a Life of Project Environmental Management Plan**	BHP Iron Ore will prepare, to a timetable agreed with the Department of Environmental Protection, and implement a Life of Project Environmental Management Plan (EMP) for the Orebody 23 Project. The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated as required. The EMP will address and BHP Iron Ore will commit to practice guidelines and management programs for the following environmental factors: 1. surrounding environment; 2. vegetation and topsoil management; 3. overburden storage; 4. surface water; 5. groundwater; 6. flora; 7. fauna; 8. aboriginal heritage; 9. noise; 10. dust; 11. waste and hazardous materials; **12. rehabilitation;** **13. decommissioning;** 14. contracting; and 15. continuous improvement.	The current *Orebody 23 Environmental Management Plan* (BHP Billiton Iron Ore, 2008) states 'at least 12 months prior to the cessation of mining, a final closure plan will be developed for review by the Department of Environmental Protection and implemented'. BHP Billiton Iron Ore considers that this MCP addresses this requirement.

Appendix B: Correspondence from BHP Billiton Iron Ore to the Office of the Environmental Protection Authority regarding Mine Closure Plan documents for the Eastern Ridge mining operations

Provided on CD

Appendix C: Relevant supporting technical studies applicable to this Mine Closure Plan

Provided on separate CD – this information is commercially sensitive and not for public release

Appendix D: BHPBIO Closure and rehabilitation Research and Trials

Table D1: 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, Orebody 18	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 (or planting) 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 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

Site	Description of Findings from Rehabilitation Performance
	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 D2: Summary of active rehabilitation research

Subject	Research Summary
Seed Management	Pilbara Seed Atlas: BHP Billiton Iron Ore in collaboration with the Science Directorate of the Botanic Gardens and Parks Authority (Kings Park) completed the seven year Pilbara Seed Atlas research project. The 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. A key outcome of the project was the compilation of a seed-use manual and plant identification guides for use by rehabilitation practitioners in the Pilbara. Restoration Seedbank (RSB) initiative: a five year partnership established in June 2013 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. A Think Tank was held which involved local and international experts and representatives from BHP Billiton Iron Ore convening to examine the latest research in seed technology, review the latest in rehabilitation practices and discussed possible solutions for improving native plant establishment in rehabilitation. As part of this research a Controlled Environment Facility (CEF) has been constructed onsite at Mt Whaleback. The CEF is designed to exclude natural rainfall events and allow for the manipulation of simulated rainfall via irrigation. Experimental plots under the CEF will trial different growth materials and a range

Subject	Research Summary
	of technologies designed to improve seed germination, emergence and early seedling establishment. The RSB initiative will equip conservation, pastoral and mining stakeholders to manage and restore degraded or disturbed areas of the Pilbara and other similar landscapes in Australia.
Growth Media	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, physical and plant growth properties; and • identifing suitable alternative growth media materials that can be made available for rehabilitation, including where necessary providing ameleorants to waste rock materials.
Fire Ecology	Jimblebar, Wheelarra Hill, OB18, Marrillana Creek (Yandi), Mooka: BHP Billiton Iron Ore is investigating fire ecology (i.e. response of ecosystems following fire) by monitoring burnt areas. Findings from this investigation will be used to examine the post fire recovery to determine potential correlating trends with rehabilated 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: Nine erosions plots were established on a western facing 20 degree slope of D OSA at Mining Area C in July 2012 to assess varying surface treatments and armour treatments on minimising surface erosion. The intent of these plots was to collect runoff and erosion data from a range of surfaces and surface treatments. The data will inform the design process for the construction of OSAs containing highly erodible fine-grained waste such as the Marra Mamba geological units. The trial is designed to concurrently investigate the amount of rock required to provide sufficient armouring against erosion forces through sediment displacement measurement. Sediment and runoff data has been collected from the plots between 2012-2015. During this time Area C has received above average rainfall with 2013/2014 being among the wettest on record. Validation improves the accuracy of erosion model predictions, particularly in this case when different surface treatment and ripping techniques are being assessed and erosion predictions are being made for newly rehabilitated slopes that are undergoing armouring by rainfall. The trial at Area C is currently being finalised. Further erosion plots were established at Mt Whaleback in both analogue and rehabilitated final slope conditions with this data adding to build a complete WAIO waste profile over the coming years as more plots are installed across WAIO operations.
Rehabilitation Monitoring with Remote Sensing	Safety, scale, costs and data quality are all considerations when undertaking monitoring of rehabilitation sites. BHP Billiton Iron Ore is undertaking a project during FY2016 to understand the limitations and capabilities of monitoring rehabilitation utilising remote sensing technologies, and to effectively integrate this technology where possible into the rehabilitation monitoring program. Advances in remote sensing technologies in recent years provide the opportunity to quantitatively assess rehabilitation development across large geographical

Subject	Research Summary
	extents, potentially in significantly less time and at a lower cost.
Pilot Fauna Monitoring Program	Yarrie: a pilot ant fauna monitoring program is being scoped with the aim to collect baseline data and establish trajectories for changes in ant species composition through time and in relation to plan community development. The purpose of this trial study is to consider the value in the developing a fauna monitoring protocol for assisting to define and measure rehabilitation success.
Pilbara Provenance Project	BHP Billiton Iron Ore is co-funding with Parks and Wildlife and Rio Tinto Iron Ore a three year collaboration study to address uncertainty and provide clarity with respect to defining seed provenance zones for a suite of Pilbara species used in rehabilitation and revegetation initiatives.

Table D3: 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 AMD/ARD Passivation Treatments Completed 2013	Confirmation and definition of AMD/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.

Subject	Research Summary
Environmental impact of the storage of lignite waste rocks from the Jimblebar iron ore mine, Newman, Western Australia 2013	Masters research project 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 Completed 2013	Conducted a desktop study of potential subaqueous disposal of shale. Included review of several case studies and examples that have been described in the 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.
Investigation into PAF Waste and Shale Reactivity Iron Ore Mines in the Pilbara Completed 2014	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 Findings: Characterised the reactivity of reactive pyritic shale samples and relationships between acid generation potential and spontaneous combustion reactivity.

Table D4: 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	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 mine sites across the Pilbara region where shale is encountered to assess implications for waste rock management and closure. Research partner: (EIGG) at Curtin University

Subject	Research Summary
Goldsworthy Mine	
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
Long-term acid rock and tailings drainage mitigation through source control	Extension of previous AMIRA International research to investigate and identify effective source control technologies and designs for preventing or minimising AMD drainage. Technologies include co-disposal of waste materials and biological passivation. Includes case studies for WAIO mine sites. Research partners: AMIRA International, University of South Australia, Levay & Co. Env. Services, and Australian Research Council
Validation and Standardisation of Sequential Leaching Tests to Better Predict the Impact of Mining on Ground and Surface Water Quality.	Research, develop and validate sequential leaching laboratory methods to better identify potential contamination risks to ground and surface water quality. Focus on streamlining of the process in predicting the potential impact of mining operations at WAIO mine sites. Research partners: The ChemCentre of Western Australia, Mineral Research Institute of Western Australia

Appendix E: Eastern Ridge mining operations Closure Risk Assessment

Provided on CD

Appendix F: WAIO AMD Management Standard BHP Billiton Iron Ore, 2014)

Provided on CD

Appendix G: The Eastern Ridge mining operations seed list

Provided on CD

Iron Ore

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6 January 2014

Anthony Sutton
Director Assessment and Compliance
Office of the Environmental Protection Authority
Locked bag 33
Cloisters Square
PERTH WA 6850

RE: Orebody 24/25 Decommissioning and Rehabilitation Plan Update

Dear Anthony,

Condition 9-1 of Ministerial Statement 834 requires BHP Billiton Iron Ore to 'implement the proposal in accordance with the Decommissioning and Rehabilitation Plan provided as Appendix B of Orebody 24/25 Upgrade Project Environment Protection Statement or subsequent revisions'. BHP Billiton Iron Ore submitted Revision 2 of the Decommissioning and Rehabilitation Plan in January 2010.

Condition 9-2 of Ministerial Statement 834 states 'the proponent shall review and revise the Decommissioning and Rehabilitation Plan required by condition 9-1 at intervals not exceeding 5 years'. This 5 yearly review is required in January 2015.

BHP Billiton Iron Ore requests approval to delay submission of the Decommissioning and Rehabilitation Plan for the Eastern Ridge Operations to allow integration with additional projects that the business proposes to seek approval for in 2015 and a planned revised proposal for the site. It is anticipated the updated Decommissioning and Rehabilitation Plan will be available and submitted in December 2015. Additionally the updated Plan will be prepared in accordance with the revised Mine Closure Planning Guidelines, when released. During this interim period BHP Billiton Iron Ore will continue to operate utilising the existing Decommissioning and Rehabilitation Plan.

If you require further information or clarification, please contact Brendan May (Senior Environment Advisor) on (08) 9154 8510 or brendan.may@bhpbilliton.com.

Yours sincerely

J Dippenaar

Chris Dark
General Manager – Eastern Ridge

Eastern Ridge Hub Closure Register

	Risk Identification and Analysis						Risk Control Strategy				Uncontrolled Risk			Residual Risk Rating		
Risk No.	Risk Factor	Risk Issue	Domain	Event	Causes	Impacts/Outcomes	Preventive Control Strategy (existing and planned as part of project)	Mitigating Controls (existing and planned as part of project)	Tools (models, procedures etc)	Improvement Activities	Sev	Like	Ranking	Sev	Like	RRR
1	Terrestrial Environmental Quality - AMD	Potential acid and saline drainage forming materials	ER Hub	AMD seepage from ex-pit OSA's to groundwater or surface water with negative impact on receptor(s)	a) PAF encapsulation design is ineffective or PAF waste material stored in a uncontrolled manner that will allow release of AMD. b) Poor PAF waste characterisation and/or AMD source identification. c) Mine plans (governing PAF exposure and OSA construction) not followed. d) The geological, resource and mining models lacks the detailed location and volume of PAF material. e) Mine plans change without consideration to AMD management. f) Changes in climate (increased rainfall) make previous OSA and pit design standards ineffective. g) Lack of control of low quality water. h) Waste schedule doesn't consider PAF waste destination based model coding. i) Waste containing PAF waste material used as backfill in an uncontrolled manner.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy may result in in-ability to relinquish site. May delay future approvals. b) Financial: Remedial work post closure; future approvals conditions. c) Prosecution/Litigation: Non-compliance leading to prosecution and litigation and associated consequences d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.); Water dependant receptor value (Ethel Gorge TEC, Homestead Creek) declines; Poor quality water release scars downgradient vegetation. 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.	a) Waste Characterisation, modelling and inclusion in mine planning design and schedules b) Identification of PAF material in mined waste and segregation of PAF overburden. c) Construction of PAF containment cells in OSA's in accordance with leading practice to minimise AMD generation and discharge. d) Other options; blending PAF material with neutralising material prior to disposal, in order to neutralise the stored acidity upon re-wetting; d) Other options: Regrade execution to regrade design tolerance (ie Rehab WIN).	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	a) AMD Management Standard b) Mine Closure Plan and associated management plans c) Conformance to mine plan checks and balances. Verification of OSA compliance to 'as dumped design' d) Site PAF Management Procedures and including waste dump design criteria (if applicable). e) Research & Development (store and release, and other programs). f) Life of Mine waste strategy informed by the closure plan. g) PAF coding included within Resource Model carried through to Mining Model h) Eastern Ridge AMD Risk Assessment i) OSA Design Manual	a) Continued sampling and characterisation of waste material geochemistry b) Monitoring of water. c) Fate and transport modelling if warranted based on risk. d) Continue with R&D for PAF Management: (ex-pit and in-pit disposal, store and release covers, geochemical testing methods, etc.) e) Invesitigate capability of WAIO FMS (Mine Star) for tracking of waste from source to destination.	10	3	30	10	1	10
1a			OB25	ex-pit OSAs - impact on groundwater or surface water	Overall, there is a low risk of AMD from OSA's and a low to negligible risk of AMD from stockpiles. A significant proportion of the PAF OSA material is contributed by the Scree units, which may not contain sulphidic sulphur. PAF material risk identified in mined waste (SRK Risk Assessment predicts ~2.2MT to 5.1MT or 2.5% to 5.9% PAF overburden from OB25P3; ~0.4MT to 1.6MT or 0.4% to 1.5% PAF overbuden from OB25P1; ~ 0.1MT to 0.3MT or 0.5% to 1.2% PAF overburden from OB25P4)	Environment: Degradation of surface water and/or groundwater quality. Degradated water entering Homestead Creek and Fortescue River, Ethel Gorge Aquifer, Ophthalmia Dam, Newman Water Reserve and Proximate Ecosystems	Ongoing use of existing PAF containment cells in OSA's in accordance with leading practice to minimise AMD generation and discharge.			Nothing specific required. BAU	10	3	30	10	1	10
1b			OB23	ex-pit OSAs - impact on groundwater or surface water	There is a low potential for AMD from OSA's and there is a low to negligible AMD potential from stockpiles. Most of the PAF OSA material is contributed by the surface scree, which may not contain sulphidic sulphur. SRK Risk Assessment predicts ~0.06 to 0.3MT or 0.4%-1.7% PAF overburden at OB23.	OB23 is the closest deposit to Ethel Gorge TEC. It is hydraulically connected to the adjacent Ophthalmia Dam. Any leaching of potentially acidic or saline water to the surrounding environment may have a potentially significant impact.	Ongoing use of existing PAF containment cells in OSA's in accordance with leading practice to minimise AMD generation and discharge.			Nothing specific required. BAU	10	3	30	10	1	10
1c			OB24	ex-pit OSAs - impact on groundwater or surface water	PAF material risk identified in mined waste (SRK Risk Assessment predicts ~0.9MT to 2MT or 0.6-1.2% AWT PAF overburden; and ~0.1MT- 0.15MT or 1.4%-2% BWT PAF overburden from OB24)	Environment: Degradation of surface water and/or groundwater quality. Degradated water entering Homestead Creek and Fortescue River, Ethel Gorge Aquifer, Ophthalmia Dam, Newman Water Reserve and Proximate Ecosystems	Utilisation of existing or construction of additional PAF containment cells in OSA's in accordance with leading practice to minimise AMD generation and discharge.			Nothing specific required. BAU	3	3	9	3	0.1	0.3
1d			OB25w	ex-pit OSAs - impact on groundwater or surface water	PAF material risk identified in mined waste (SRK Risk Assessment predicts ~4,500-12,500 tonnes or 0.02-0.07% Phase 1 (Joffre AWT)AWT. 22,300 tonnes (based on 0.1% S) (no PAF using 0.2% S) or 0.7% volume (10,600 m3) for Phase 2 (Joffre BWT, sub-pits D1, D2, D3, D4).	Environment: AWT PAF risk identified as low; Environment: BWT mining potential receptors include Fortescue River, Homestead Creek, Ophthalmia Dam, Newman Water Reserve, Homestead Borefield and proximate ecosystems	Utilisation of existing or construction of additional PAF containment cells in OSA's in accordance with leading practice to minimise AMD generation and discharge.			Nothing specific required. BAU	3	1	3	3	0.1	0.3
1e			OB32	ex-pit OSAs - impact on groundwater or surface water	PAF material risk identified in mined waste (SRK Risk Assessment predicts ~11,000 tonnes or 0.1% AWT PAF overburden;	Negligable	Utilisation of existing or construction of additional PAF containment cells in OSA's in accordance with leading practice to minimise AMD generation and discharge.			Review the AMD risk assessment following update of the Geological model with more extensive data.	3	1	3	3	0.1	0.3
2	Terrestrial Environmental Quality - AMD	Potential acid and saline drainage forming materials	ER Hub	AMD Seepage from in-pit OSA's to groundwater with negative impact on receptors (s)	a) Waste containing PAF waste material used as backfill in an uncontrolled manner. b) Poor AMD source identification. c) Mine plans (governing PAF exposure and OSA construction) not followed. d) The geological, resource and mining models lacks the detailed location and volume of PAF material. e) Mine plans change without consideration to AMD management. f) Lack of control of low quality water. g) 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 prosecution and litigation and associated consequences.	a) Waste Characterisation, modelling and inclusion in mine planning design and schedules b) Identification of PAF material in mined waste c) Construction of PAF containment cells for inpit OSA's in accordance with leading practice to minimise AMD generation and discharge. d) Other options; blending PAF material with neutralising material prior to disposal, in order to neutralise the stored acidity upon re-wetting	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	a) AMD Management Standard b) Mine Closure Plan and associated management plans c) Conformance to mine plan checks and balances. Verification of OSA compliance to 'as dumped design' d) Site PAF Management Procedures and including waste dump design criteria (if applicable). e) Research & Development (store and release, and other programs). f) Life of Mine waste strategy informed by the closure plan. g) PAF coding included within Resource Model carried through to Mining Model h) Eastern Ridge AMD Risk Assessment i) OSA Design Manual	a) Continued sampling and characterisation of waste material geochemistry. B) Monitoring of water. C) Fate and transport modelling if warranted based on risk. D) Continue with R&D for PAF Management: (ex-pit and in-pit disposal, store and release covers, geochemical testing methods, etc.)	10	3	30	3	0.1	1
2	Terrestrial Environmental Quality - AMD	Potential acid and saline forming materials	ER Hub	Groundwater quality has negative impact on receptor(s)	a) AMD release from unsaturated pit wall rock with seepage to GW. OR from saturated pit wall rock below water table following groundwater rebound. b) Evapoconcentration of dissolved solids due to exposed surface water and limited through flow c) AMD source material is left exposed in the pit walls (sulphides exposed on the pit walls above the recovery water table, or within water table fluctuation zone) d) solutes contained in inflowing groundwater e) Poor source (AMD, saline etc) identification. f) Mine plans (governing PAF exposure) not followed. g) The geological, resource and mining models lacks the detail location of PAF material. h) Mine plans change without consideration to AMD management. i) Erosion exposes PAF located behind pit wall surface (fracking). j) Hydrogeological model unable to predict adverse closure outcomes. k) Closure criteria not explicitly defined. l) Groundwater management controls not adequate in long term. m) Not properly defining pathways for impacts. n) Inadequate knowledge or assessment of backfilled waste characteristics causing contaminant leaching. o) Gradually migration occurs due to density driven flow or significant flushing event	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 dependant receptor value (Ethel Gorge TEC), elevated pit lake salnity 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 prosecution and litigation and associated consequences.	a) Adopt and implement final mine void closure strategy that addresses residual AMD risk (e.g partial or full backfill) b) Other management options may include treating pit walls to prevent AMD, placement of neutralising backfill material against pit walls.	a) Monitoring of risk indicators (visual inspection of waste dumps, surface water sampling, groundwater sampling). b) Interception and treatment of water. C) Treat pit lake water following water table rebound (e.g. lime addition)	a) AMD Management Standard b) Mine Closure Plan and associated management plans c) Conformance to mine plan checks and balances. Verification of OSA compliance to 'as dumped design' d) Site PAF Management Procedures and including waste dump design criteria (if applicable). e) Research & Development (store and release, and other programs). f) Life of Mine waste strategy informed by the closure plan. g) PAF coding included within Resource Model carried through to Mining Model h) Eastern Ridge AMD Risk Assessment i) OSA Design Manual	a) Continued sampling and testing of material (Static or possible kinetic testing). B) Monitoring of water. C) Fate and transport modelling if warranted based on risk. D) Continue with R&D: PAF Management (ex-pit) Research & Development (store, release and other programs)	10	1	10	3	0.1	1
2a			OB23		Overall, there is a low potential for AMD from pit wall run-off. The pitwall PAF material forms isolated hotspots, mostly on the southern wall. SRK Risk Assessment predicts ~850-3,000m² or 0.3-1.1% exposed PAF wallrock at OB23.	Environmental: degradation of GW quality (flux if backfilled), local pit lake water quality degradation if not backfilled. Health and Safety: attractiness for unauthorised public access at closure. Due to the significant alkalinity in the inflowing groundwater, acidic condition would not be expected to develop within the pit void.	Backfill of the BWT pit to AWT with inert waste. Management of cumulative impact period during ER operations through Managed aquifer recharge (if required) to reduce accumulation of solutes and spikes being flushed.			Develop Trigger Action and Response Plan (TARP) to enable timely response to water quality risks as they arise before and during the backfill process.	10	3	30	10	1	10
2b			OB25		For Pit 3 there is a low risk of AMD from pit wall run-off. PAF pitwall exposure is concentrated on or near the pit floor, with isolated hot spots near the pit crests. For Pit 1 there is a low risk of AMD from pitwall run-off. SRK AMD Risk Assessment predicts ~4,000-47,000m² or 0.3% to 3.2% exposed PAF wallrock at OB25P3; ~9,000-32,000m² or 0.5-1.8% exposed PAF wallrock at OB25P1/P4.	Environmental: degradation of GW quality (flux if backfilled), local pit lake water quality degradation if not backfilled. Pit lake water quality (post closure) outside natural variation: a) Baseline salinity (200-2300, rate of increase 130 to 270mg/L). Predicted salinity for pit lake >7,000mg/L b) SO4 (baseline in area 76-200mg/L), predicted 1000-5000mg/L Low potential for pit lake to be acidic, transitory only Not anticipated to be toxic to migratory species/flora/fauna	Backfill of the BWT pit to AWT with inert waste. Management of cumulative impact period during ER operations through Managed aquifer recharge (if required) to reduce accumulation of solutes and spikes being flushed.			Develop Trigger Action and Response Plan (TARP) to enable timely response to water quality risks as they arise before and during the backfill process.	10	3	30	10	1	10
2c			OB24		SRK AMD Risk Assessment predicts ~54,000-74,000m² or 1.9-2.6% PAF exposed PAF wall rock at OB24. Coincident with base of pit floor, some at premining water table interface Localised oxidation from mining and dewatering activities generating AMD to groundwater and/or pit lake. Recovery water table may below/within PAF zone and change seasonally causing additional oxidation and mobilisation	Environmental: degradation of GW quality (flux if backfilled), local pit lake water quality degradation if not backfilled. Connectivity to regional GW with no significant through flow. Unlikely to reach the TEC receptor or water supply bore field	Mine void closure strategy to developed addressing residual AMD risks options include: a) Avoiding exposure of PAF in final pit wall b) Backfill to above pre-mining water table c) covering exposed PAF with 10-20m of NAF or ANC material (dependent of GW recovery level)			Understand final exposures throughout the life of mine and develop mine waste closure strategy that addresses residual AMD risk.	3	1	3	1	0.3	0.3
2d			OB25w		SRK AMD Risk Assessment predicts ~600-1,300m² or 0.2-0.4% exposed AWT PAF wall rock; ~ m² or % exposed BWT PAF wall rock at OB25W	If pit void backfilled, there is a possibility that there could be preferential recharge through unconsolidated backfill. Such recharge could form a pathway for transport of solutes from the backfill to groundwater, Also there may also be potential for groundwater mounding below the void, resulting in local hydraulic gradients that different from the main regional one	Backfill of the BWT pit to AWT with inert waste.				10	1	10	3	0.1	1
2e			OB32		SRK AMD Risk Assessment predicts that no PAF wall rock will be exposed AWT at OB32E	N/a	BAU only.				10	1	10	3	0.1	1

Eastern Ridge Hub Closure Register

	Risk Identification and Analysis						Risk Control Strategy				Uncontrolled Risk			Residual Risk Rating		
Risk No.	Risk Factor	Risk Issue	Domain	Event	Causes	Impacts/Outcomes	Preventive Control Strategy (existing and planned as part of project)	Mitigating Controls (existing and planned as part of project)	Tools (models, procedures etc)	Improvement Activities	Sev	Like	Ranking	Sev	Like	RRR
3	Hydrology - Groundwater	BWT pit void	ER Hub	Groundwater quantity has negative impact on receptor(s)	a) Inadequate capture of regional water baseline data for predictive assessment. b) Hydrogeological model unable to predict adverse closure outcomes. c) Closure criteria not explicitly defined. d) Groundwater management controls not adequate in long term. e) Not properly defining pathways for impacts. f) Gradually migration occurs due to density driven flow or significant flushing event changing GW gradient temporarily	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. Any impact on habitat or TEC biodiversity and abundance results in response from regulators and interested NGO (e.g. WA Museum) that impacts BHPBIO's reputation. b) Financial: Remedial work post closure; future approvals conditions. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.); - Water dependant receptor value (Ethel Gorge TEC) declines. Potential very minor impact on TEC biodiversity and abundance could be considered a moderate impact due to significance. Groundwater levels reduced by 1m (if OB25 left as void). 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	a) East Pilbara Water Resource Management Plan: Environmental receptors identified, valued and documented. Ophthalmia Dam remains in perpetuity as a recharge feature. b) Mine void closure strategy (see below) c) Numerical groundwater models inform pit closure strategy (backfill, backfill material, through flow) d) Local and regional monitoring network active	a) Treatment of pit void water during operations. b) Monitoring of risk indicators (visual inspection of waste dumps, surface water sampling, groundwater sampling).	a) Mine Closure Plan b) Conceptual Hydrogeological model c) Numerical Hydrogeological model c) Monitoring of groundwater levels, via regional monitoring network	a) as above for risk 1, 2 & 3 b) Hydrodynamic trial to resolve key uncertainties c) Update conceptual model and re-calibrate numerical model based on hydrodynamic trial; subsequent model review / validation.	30	1	30	1	0.03	0.03
3a			OB23		BWT Pit void may result in groundwater sink and subsequent pit lake.	Water level recovery is quick at OB23 due to high recharge rates from Ophthalmia Dam and Homestead and Shovelanna Creeks;	Mine void closure strategy: Backfill to AWT with inert waste				30	1	30	30	0.1	3
3b			OB25		BWT Pit void may result in groundwater sink and subsequent pit lake.	Water level recovery is quick at OB25 Pit 3 and within the TEC (within 40 Years) due to high recharge rates from Ophthalmia Dam and Homestead and Shovelanna Creeks; Water level recovery is slower away from Ophthalmia Dam (e.g. OB24 & OB25W) with initial recovery within 50 years, the majority of recovery will have occurred within 100 years, however full recover may take several hundred years. Potential seasonal through flow at OB25 Pit 3 due high lake recovery level.	Mine void closure strategy: Backfill to AWT with inert waste				30	1	30	30	0.1	3
3c			OB24		BWT Pit void may result in groundwater sink and subsequent pit lake.	Groundwater capture by pit voids is local in scale; Modelling shows the potential for a permanent reduction in local groundwater resource in vicinity of OB24 pits; Modelling shows the potential for permanent drawdown (~1m) in eastern-most part of TEC, however historical monitoring records of water levels indicate that full recovery is likely. Voids at OB24 pit have the potential to have the most significant effect on long-term groundwater levels and flow paths in the Eastern Ridge mining area, if the groundwater model is accurate.	Mine void closure strategy: Pt void remains (pit lake forms) Impact assessment does not show that any further actions are required, as potential risk of impact is localised.				30	0.1	3	30	0.1	3
3d			OB25w		BWT Pit void may result in groundwater sink and subsequent pit lake.	Groundwater capture by pit voids is local in scale; Modelling shows the potential for a permanent reduction in local groundwater resource in vicinity of OB25 West Joffre pit; Modelling shows the potential for permanent drawdown (~1m) in eastern-most part of TEC, however historical monitoring records of water levels indicate that full recovery is likely. Voids at OB25 Joffre pit have the potential to have the most significant effect on long-term groundwater levels and flow paths in the Eastern Ridge mining area, if the groundwater model is accurate.	Mine void closure strategy: Pt void remains (pit lake forms). Impact assessment does not show that any further actions are required, as potential risk of impact is localised.				30	0.1	3	30	0.1	3
3e			OB32		No BWT mining	N/a	N/a	N/a	N/a	N/a	1	1	1	1	1	1
4	Landform - Pit Void	Landform instability (pit voids)	ER Hub	Final landform failure, beyond agreed abandonment structure, causing negative impact on surroundings post closure	a) Inadequate geotechnical understanding of pit wall geology. b) Poorly managed hydraulic gradients within walls during water table 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. g) Abandonmnent structure incorrectly designed for pit wall slope (hard rock, unconsolidated material) h) Pit slope design criertia had unknown risks not realised at the time i) Constraints prevented the bund being located appropriately j) Extreme weather (flood) event leads to failure of pit wall	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.); Surface water - potential for Homestead Creek to be captured by adjacent pit void/s (OB25, Pit 3). e) Cultural Heritage: Negative impact on areas of significant cultural and or heritage f) Health and safety of people adversely affected, especially by public seeking to access the site. g) Community values adversely affected. h) Future regulatory approval delays i) Unable to relinquish site as unable to acheive final landuse. 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) Backfill of OB25 Pit 3 to miitigate risk of creek capture; (g) Abandonment bund designed to withstand extreme flood events; h) Validation of design assumptions during operational life of mine.	a) Review deficiencies and address.	a) Mine Closure Plan landform design process and Master Area Form Process b) Geological model (highlights fault zones). c) Geotechnical pit model informs pit design. d) Survey (final blast wall design against actual pit wall). e) Surface hydrology assessment (considers upstream catchment, sediment load, downstream receptors). (f) Backfill strategy to address geotechnical issues.	a) Validation of design assumptions during operational life of mine. b) Ensure Master Area Design process for final recommended pit design includes abandonment bund projections to assess any constraints (ie tenure, heritage, environment, geotech)	3	1	3	3	0.3	0.9
5	Landform - Pit Void	Landform instability (pit voids)	ER Hub	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 water table 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.	a) Review deficiencies and address.	a) Mine Closure Plan landform design process and Master Area Form Process b) Geological model (highlights fault zones). c) Geotechnical pit model informs pit design. d) Survey (final blast wall design against actual pit wall). e) Surface hydrology assessment (considers upstream catchment, sediment load, downstream receptors). (f) Backfill strategy to address geotechnical issues.	a) Validation of design assumptions during operational life of mine.	1	1	1	1	0.03	0.3
6	Landform - OSAs	Landform instability (OSA)	ER Hub	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, including potential impact to visual amenity.	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	a) Review deficiencies and address.	(a) Mine Closure Plan landform design process and Master Area signoff procedure (b) Verification procedures for construction of landforms with final landform design (c) 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.	(a) Ongoing waste characterisation and erosion potential modelling (b) Review of historical performance to inform regular review and update of relevant procedures / practices	30	1	10	3	1	3
7	Sustainability	Revegetation establishment	ER Hub	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. Future approvals requirements potentially more onerous or delayed. b) Financial: Remedial work post closure. c) Prosecution/Litigation: Legal non-compliance and associated actions. d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.). Intended post-closure land use not acheived. 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.	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. g) Topsoil reconcilliation and waste characterisation	a) Rehabilitation monitoring program b) Progressive rehabilitation within 5YR mine planning. c) Annual topsoil reconciliation.	a) WAIO Rehabilitation Strategy. b) WAIO Rehabilitation Standard and seed management protocols. c) Growth Media Atlas and growth media trials. d) Mine closure plan. e) Annual topsoil reconcilliation f) Rehabilitation monitoring program	(a) Botanic Gardens and Park Authority: Restoration Seed Bank: to address the long term management of seed collection, storage, and germination strategies. b) Development of agreed ecological completion criteria. c) Ongoing waste characterisation	3	1	3	1	1	1
8	Sustainability	Standing water attracts fauna	ER Hub	Fauna attracted to pit lake/s resulting in death or injury	a) Poor final landform design allows for ponding of water and/or fauna access to mine voids b) Pit abandonment bunds allow access for fauna; c) Lack of or inappropriate fencing to prevent fauna access to potential water sources.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure. c) Prosecution/Litigation: legal non-compliance possible d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) e) Cultural Heritage: f) Health and safety of people adversely affected. g) Community values adversely affected.	a) Abandonment bund design (to be installed at closure) b) Design and install reasonable duty of care control measures for preventing ponding and fauna access, such as fencing etc of the closed site, in consultation with Department of Parks and Wildlife proir to closure (if necessary) c) Mine Closure Plan d) Backfill of accessible below water table pits (OB23, OB25 P1 & P3) to above water table (reduces attraction) e) Regular inspections of site post closure	a) Review deficiencies and address.	a) Mine Closure Plan b) Regular inspection c) Abandonment bund design d) DMP Closure Guide.	a) Identify and design reasonable duty of care control measures for fauna management post-closure, in consultation with Department of Parks and Wildlife, if necessary.	3	10	30	1	1	1
9	Safety	Public access	ER Hub	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. Unable to relinquish site following serious injury/death until risk is controlled. b) Financial: Remedial work post closure. Cost to backfill pit to eliminate drowning risk post closure. c) Prosecution/Litigation: if any incidences occur which lead to injury or fatality 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, including potential for members of the public to be injured, potentially fatally. g) Community values adversely affected	a) Consultation with East Pilbara Shire b) Design and install reasonable duty of care control measures for safety management, such as fencing/signage etc of the closed site. c) Regular inspections d) Closure Plan e) Abandonment bund design (to be installed at closure) f) Infrastructure (as an attraction) will be removed as per Closure Provision. g) DMP Closure Guide. h) Backfill of accessible below water table pits (OB23, OB25 P1 & P3) to above water table (reduces attraction)	a) Review deficiencies and address. b) Have alternative access tracks built	a) Mine Closure Plan b) Regular inspection c) Abandonment bund design d) DMP Closure Guide.	(a) Update Mine Closure Plan in accordance with agreements reached with stakeholders in relation to infrastructure to be removed at closure b) Consultation with Shire of East Pilbara c) Identify and design reasonable duty of care control measures for safety management at closure	30	1	30	30	0.3	9

Eastern Ridge Hub Closure Register

	Risk Identification and Analysis						Risk Control Strategy				Uncontrolled Risk			Residual Risk Rating		
Risk No.	Risk Factor	Risk Issue	Domain	Event	Causes	Impacts/Outcomes	Preventive Control Strategy (existing and planned as part of project)	Mitigating Controls (existing and planned as part of project)	Tools (models, procedures etc)	Improvement Activities	Sev	Like	Ranking	Sev	Like	RRR
9a			OB23		OB23 is close to public infrastructure which make is more suseptable to unauthorised public access.		Backfill of OB23 to above water table, identified as an accessible below water table pits (reduces attraction)				30	1	30	30	0.3	9
9b			OB25		OB25 is close to public infrastructure which make is more suseptable to unauthorised public access.		Backfill of OB25 Pit 3 to above water table, identified as an accessible below water table pits (reduces attraction)				30	1	30	30	0.3	9
9c			OB24		OB24 is not close to public infrastructure and not easily accessible to the public.		No additional controls considered necessary. To be reviewed once final landform design is complete.			Design final control measures once final landform design is complete.	30	1	30	30	0.3	9
9d			OB25w		OB25 West is not close to public infrastructure but is closer to the Town of Newman however it is not easily accessible to the public.		No additional controls considered necessary. To be reviewed once final landform design is complete.			Design final control measures once final landform design is complete.	30	1	30	30	0.3	9
9e			OB32		OB32 is not close to public infrastructure but is closer to the Town of Newman however it is not easily accessible to the public.		No additional controls considered necessary. To be reviewed once final landform design is complete.			Design final control measures once final landform design is complete.	30	1	30	30	0.3	9
10	Hydrology - Surface Water	Creek capture	All Pits adjacent to named creeks	Creek overtops pit crest and erodes away the pit crest. All future events then drain into the pit.	a) Inadequate bunding of pits adjacent to Homestead Creek. b) Failure of flood levee due to overtopping or localised ersion / failure c) Engineered levee not maintained (ie growth of trees / fauna burrowing)	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure; future approvals may be delayed or subject to additional or more onerous conditions. c) Prosecution/Litigation d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.) resulting from reduced quantity of downstream surface water flow, particularly: - Surface water would not reach downstream environment, including Fortescue Marsh. - Potential loss of riparian vegetation, dependant on surface water flows (Homestead Creek). - Homestead Creek provides freshwater flows to Ethel Gorge TEC and Fortescue Marsh. Capture to pit would significantly diminish freshwater re-charge to protected area. 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.	a) Well designed and constructed flood protection bunding that complies with government mine closure requirements for pits adjacent to Homestead Creek.	No additional required	(a) Surface water modelling, including studies undertaken to determine the local surface water drainage requirements and detailed design criteria for flood bunding to meet closure requirements. (b) Mine Closure Plan, outlines management and implementation options in detail, including final landform designs c) Flood protection design and final landform design, especially of areas adjacent to creek and drainage lines, for closure (appropriate specifications eg design life)	(a) Develop design principles and details for structures remaining post mining that will be exposed to surface drainage including flood bunds.	30	1	30	10	0.1	1
10a			OB23		*Pit void adjacent to Homestead Creek.* a) Conservative GW recovery (460m RL) would result in slip failure intersecting, causing Creek capture. Creek capture would result in all rainfall event <Q100 being contained within pit void b) Realistic GW recovery would result in slip failure extending into the 50m no disturbance zone, which would cause failure of abandonment bund.	a) Creek capture would result in all rainfall event <Q100 being contained within pit void b) Flood levee causing creek capture. Creek capture would result in all rainfall events <Q50 being contained within pit void (and 50% Q100 flows) c) Homestead Creek downstream-significant, permanent impact to local creek d) Homestead Creek provides freshwater flows to TEC. Capture to pit would significantly diminish freshwater re-charge to protected area. e) Approval delay costs	Design and construct the flood protection solutions, including backfill of OB23, to ground level to minimise likelihood of creek capture.				30	1	30	10	0.1	1
10b			OB25		*Pit void adjacent to Homestead Creek.* a) Conservative GW recovery (460m RL) would result in slip failure intersecting, causing Creek capture. C b) Realistic GW recovery (485m RL) would result in slip failure extending into the 50m no disturbance zone, which would cause failure of abandonment bund. Flood levee causing creek capture.	*Pit void adjacent to Homestead Creek.* a) Creek capture would result in all rainfall event <Q100 being contained within pit void b) Creek capture would result in all rainfall events <Q50 being contained within pit void (and 50% Q100 flows) c) Homestead Creek downstream-significant, permanent impact to local creek d) Homestead Creek provides freshwater flows to TEC. Capture to pit would significantly diminish freshwater re-charge to protected area. e) Approval delay costs	Design and construct the flood protection solutions, including backfill of OB25 P3, to approx ground level to minimise likelihood of creek capture.				300	0.3	90	10	0.1	1
10c			OB25w		*Dales pit void adjacent to Homestead Creek.* a) Pit is upslope from Homestead Creek, however it is within the 1:10,000 year flood zone and therefore susceptible to creek capture. b) More component geology adjacent to OB25 West Dales pits, which is less susceptible to erosion results in creek capture.	*Dales pit void adjacent to Homestead Creek.* a) Events greater than a 1:10,000 year event are susceptible to creek capture. b) Geomorphological change resulting from long term stream dynamics is less likely due to more component geology adjacent to OB25 West Dales pits, which is less susceptible to erosion.	Design and construct the flood protection solutions, such as engineered flood levees, to minimise likelihood of creek capture.				30	1	30	10	0.1	1
10d			OB32		*Pit void adjacent to Homestead Creek and a local tributary.* a) Pit is upslope from Homestead Creek, however it is within the 1:10,000 year flood zone and therefore susceptible to creek capture. b) Geomorphological change resulting from long term stream dynamics is less likely due to more component geology adjacent to OB32, which is less susceptible to erosion.	*Pit void adjacent to Homestead Creek and a local tributary.* a) Events greater than a 1:10,000 year event are susceptible to creek capture. b) Geomorphological change resulting from long term stream dynamics is less likely due to more component geology adjacent to OB32 pit, which is less susceptible to erosion.	Design and construct the flood protection solutions, such as engineered flood levees, to minimise likelihood of creek capture.				10	1	10	10	0.1	1
11	Hydrology - Surface Water	Surface water quality and quantity		Surface water flow and quality offsite does not meet acceptable limits	a) Final landform design is inadequate (diversion structure, pit wall, OSA or landbridge) or inhibits surface water flows. b) Waste rock geochemistry poorly characterised and integrated into predictive assessments c) Inadequate sensitivity testing (e.g., Climatic variation/ baseline flow estimation) d) Small diversion from northern catchments not feasible (local creeks captured within the pit) e) Lack of or insufficent understanding of material characterisation to inform final landform design and construction f) Inappropriate use of material in construction of closure structures (diversion structure, pit wall, OSA)	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy. b) Financial: Remedial work post closure; future approvals conditions. c) Prosecution/Litigation: Non-compliance leading to prosecution and litigation and associated consequences. d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.); Reduced quality and quanitity of downstream surface water flow. Potential loss of riparian vegetation, dependant on surface water flows. Sedimentation of downstream environment/s. e) Cultural Heritage: f) Health and safety of people adversely affected. g) Community values adversely affected.	a) OSA Design Manual b) Master Area design review process to verify that closure design guidance has been incorporated. c) Flood protection design for closure (appropriate specifications e.g., design life) d) Baseline surface water models includes sensitivity testing e) Surface water monitoring network (water quantity and quality) f) Surface water assessments inform infrastructure design	a) Review deficiencies and address.	a) OSA Design Manual b) Master Area design review process to verify that closure design guidance has been incorporated. c) Flood protection design and final landform design, especially of areas adjacent to creek and drainage lines, for closure (appropriate specifications e.g., design life) d) Baseline surface water models includes sensitivity testing e) Surface water monitoring network (water quantity and quality) f) Surface water assessments inform infrastructure design	(a) Develop design principles and details for structures remaining post mining that will be exposed to surface drainage including flood bunds.	3	3	9	1	0.3	0.3
10a			OB23		Standard management of minor drainage lines						3	3	9	3	0.1	0.3
10b			OB25		Standard management of minor drainage lines						3	3	9	3	0.1	0.3
10c			OB25w		Haul Roads across minor tributaries to Homestead Creek, there would be a loss of surface water flows if these structures are not constructed to allow for surface water flows to be maintained post-closure.	Detrimental impact to the ecology (fauna, flora, soil etc.), resulting from a loss of surface water flows, could include: - Potential loss of riparian vegetation, dependant on surface water flows (Homestead Creek). - Homestead Creek provides freshwater flows to Ethel Gorge TEC and Fortescue Marsh. Loss of freshwater flows could diminish freshwater re-charge to protected area.	Design solution that sustains a permanent flow path post-closure for all surface water flows from minor drainage lines into Homestead Creek.				10	3	30	1	1	1
10d			OB32		Several small drainage lines are being diverted during operations. There would be a loss of surface water flows if these structures are not constructed to allow for surface water flows to be maintained post-closure.	Detrimental impact to the ecology (fauna, flora, soil etc.), resulting from a loss of surface water flows, could include: - Potential loss of riparian vegetation, dependant on surface water flows (Homestead Creek). - Homestead Creek provides freshwater flows to Ethel Gorge TEC and Fortescue Marsh. Loss of freshwater flows could diminish freshwater re-charge to protected area.	Diversions need to be appropriately designed for closure to ensure a permanent flow path is sustained post-closure.				10	3	30	1	1	1
12	Hydrology - Surface Water	Construction of abandonment bund and interaction with protection bund.	ER Hub	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.	a) Company Reputation: Community & Government concerns about Company's ability to leave positive legacy and hand site back to government. b) Financial: Remedial work post closure; future approvals may be delayed or subject to additional or more onerous conditions. c) Prosecution/Litigation: Non-compliance leading to prosecution and litigation and associated consequences. d) Environmental: Detrimental impact to the ecology (fauna, flora, soil etc.), particularly: - Impact on natural flow regime, including changes to creek channel geomorphology - Reduced quality and quantity of downstream surface water flow. e) Cultural Heritage: f) Health and safety of people adversely affected. - Abandonment bund may erode and fail due to inappropriate location - Failure and/or location may allow for inadvertant access to the site - Potential for injury or fatality from public site access g) Community values adversely affected.	a) Well designed and constructed abandonment/flood protection bunding that complies with government mine closure requirements. Minor creek relocation if required. b) Liaise with government agencies prior to closure to ensure appropriate location of post-closure structures to meet government requirements and manage risk factors.	No additional required	(a) Mine Plan and final landform designs (b) Government Mine Closure Guidelines and requirements	(a) Where overburden storage areas encroach in the flood zones, additional studies will be completed to determine the 100 year Average Recurrence Interval (ARI) flood event.	30	1	30	10	0.03	0.3
12a			OB23		Homestead Creek is within 100m of the pit crest - potential for the abandonment bund to be located within the creek channel.		Backfill of the OB23 pit to ground level results in the no abandonment structure required.		Final landform design of OB23 pit void backfill.		30	1	30	10	0.03	0.3

Eastern Ridge Hub Closure Register

	Risk Identification and Analysis						Risk Control Strategy				Uncontrolled Risk			Residual Risk Rating		
Risk No.	Risk Factor	Risk Issue	Domain	Event	Causes	Impacts/Outcomes	Preventive Control Strategy (existing and planned as part of project)	Mitigating Controls (existing and planned as part of project)	Tools (models, procedures etc)	Improvement Activities	Sev	Like	Ranking	Sev	Like	RRR
12b			OB25		Homestead Creek is within 100m of the pit crest - potential for the abandonment bund to be located within the creek channel.		Backfill of the OB25 Pit 3 pit to ground level results in the no abandonment structure required.		Final landform design of OB25 Pit 3 pit void backfill.		30	1	30	10	0.03	0.3
12c			OB25w		Homestead Creek is within 100m of the pit crest - potential for the abandonment bund to be located within the creek channel.		Design and construct the final landforms to meet site abandonment government requirements and manage risk factors.		Final landform design to meet site abandonment government requirements and manage risk factors.	Design the final landforms to meet site abandonment government requirements and manage risk factors.	30	1	30	10	0.03	0.3
12d			OB32		Homestead Creek is within 100m of the pit crest - potential for the abandonment bund to be located within the creek channel.		Design and construct the final landforms to meet site abandonment government requirements and manage risk factors.		Final landform design to meet site abandonment government requirements and manage risk factors.	Design the final landforms to meet site abandonment government requirements and	30	1	30	10	0.03	0.3
12e			OB24		N/a - deposit is not adjacent to Homestead Creek.	No impacts to Homestead Creek identified	N/a				1	1	1	1	0.03	0.03
13	Heritage	Heritage	ER Hub	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 management 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	(a) Cultural Materials Management Plan; (b) Nyiyaparli Comprehensive Native Title Agreement; (c) Sustainable Heritage Strategy; (d) mine closure plan		3	1	3	3	0.01	0.3
14	Community	Community	ER Hub	Operations cease at Eastern Ridge 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) Rehabilitation/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 consideration for closure plan/design. e) Safety management including fencing/signage etc of the closed site.	a) Stakeholder Engagement Plan b) Have alternative access tracks built	a) Stakeholder Engagement Plan, b) Eastern Pilbara Water Resource Management Plan c) Safety management taking into consideration for closure plan/design.	(a) Stakeholder Engagement Plan	10	1	10	3	1	3

Eastern Ridge – Closure Risk Assessment – Existing Operations

Risk Factor	Risk Event	Orebody 23			Orebody 25		
		Risk Issue	Uncontrolled Risk Ranking	RRR	Risk Issue	Uncontrolled Risk Ranking	RRR
Hydrology - Groundwater	Groundwater quantity has negative impact on receptor(s)	**BWT mining – committed to backfill pit void.**	High	Low	BWT mining – **committed to backfill pit void.**	High	Low
Hydrology - Surface Water – Creek capture	Creek overtops pit crest and erodes away the pit crest. All future events then drain into the pit.	BWT mining – **committed to backfill pit void.**	High	Low	BWT mining – **committed to backfill pit void.**	Material (90)	Low
Hydrology - Surface Water	Surface water quantity and quality offsite does not meet acceptable limits	Standard management of minor drainage lines	Moderate	Low	Standard management of minor drainage lines	Moderate	Low
Landform - Pit Void & OSAs	Final landform failure causing negative impact on surroundings post closure	Risk same across whole Hub.	Moderate	Moderate	Risk same across whole Hub.	Moderate	Moderate
Terrestrial Environmental Quality – AMD	Groundwater quality has negative impact on receptor(s)	**Backfill of BWT pits to AWT** - potential acid and saline drainage	High	Moderate	**Backfill of BWT pits to AWT** - potential acid and saline drainage	High	Moderate
Terrestrial Environmental Quality – AMD	AMD seepage from ex-pit OSA's to groundwater or surface water with negative impact on receptor(s)	**Backfill of BWT pits to AWT** - potential acid and saline drainage	High	Moderate	**Backfill of BWT pits to AWT** - potential acid and saline drainage	High	Moderate
Sustainability	fauna attracted to pit lakes or standing water results in death or injury	Backfill of BWT pits to AWT.	High	Low	Backfill of BWT pits to AWT.	High	Low
Sustainability	Revegetation fails to establish and/or self-sustain.	Risk same across whole Hub.	Moderate (3)	Low (1)	Risk same across whole Hub.	Moderate (3)	Low (1)
Safety	Injury or death to public caused from accessing abandoned/ closed site (not relinquished)	Backfill of BWT pits to AWT. If occurs, severity = high.	High (30)	Moderate (9)	Backfill of BWT pits to AWT. If occurs, severity = high.	High (30)	Moderate (9)
Heritage	Cultural values are not replaced/preserved at the end of closure due to ineffective cultural materials management and lack of consultation.	Risk same across whole Hub.	Moderate (10)	Low (0.3)	Risk same across whole Hub.	Moderate (10)	Low (0.3)
Community	Operations cease at Eastern Ridge resulting in the lack of community sustainability caused by economic reduction post mining.	Risk same across whole Hub.	Moderate (10)	Moderate (3)	Risk same across whole Hub.	Moderate (10)	Moderate (3)

Eastern Ridge – Closure Risk Assessment – New Scope

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		Orebody 24 - BWT			Orebody 25 West			Orebody 32		
Risk Factor		Risk Issue	URR	RRR		URR	RRR		URR	RRR
Hydrology - Groundwater	Groundwater quantity has negative impact on receptor(s)	BWT mining – pit void. Localised impact to GW	High (30)	Moderate (3)	BWT mining – pit void. Localised impact to GW	High	Moderate	AWT mining only – groundwater risk negligible	Low	Low
Hydrology - Groundwater	Groundwater quality has negative impact on receptor(s)	BWT mining – pit void. Localised impact to GW	Moderate	Low	BWT mining – pit void. Localised impact to GW	Moderate	Low	AWT mining only – groundwater risk negligible	Low	Low
Hydrology - Surface Water – Creek capture	Creek overtops pit crest and erodes away the pit crest. All future events then drain into the pit.	No pits near named Creek.	Low	Low	Dales pit close to Homestead Ck	High	Low	Creek capture a risk – pit close to Homestead Ck	High	Low
Hydrology - Surface Water	Surface water quantity and quality offsite does not meet acceptable limits	No change of risk to current operations	Moderate	Low	Haul Roads across minor creeks to HC. If left – would pond up behind the landbridges. If removed, then restore creek flow. Risk of sedimentation and loss of flow.	Moderate	Low	Several small creeks being diverted during ops which will need to be appropriately designed for closure.	Moderate	Low
Landform - Pit Void & OSAs	Final landform failure causing negative impact on surroundings post closure	Risk same across whole Hub.	Moderate	Moderate	Risk same across whole Hub.	Moderate	Moderate	Risk same across whole Hub.	Moderate	Moderate
Terrestrial Environmental Quality – AMD	AMD or saline water seepage from landforms to groundwater or surface water with negative impact on receptor(s)	Potential acid and saline drainage forming materials	Moderate	Low	Potential acid and saline drainage forming materials	Moderate	Low	AWT mining only – PAF risk negligible.	Low	Low

Eastern Ridge – Closure Risk Assessment – New Scope

		Orebody 24 - BWT			Orebody 25 West			Orebody 32		
Risk Factor		**Risk Issue**	**URR**	**RRR**		**URR**	**RRR**		**URR**	**RRR**
Sustainability	fauna attracted to pit lakes or standing water results in death or injury	Standing water attracts fauna risk – pit void	High (30)	Moderate	Standing water attracts fauna risk – pit void	High	Moderate	AWT mining only – fauna risk negligible	Low	Low
Sustainability	Revegetation fails to establish and/or self-sustain.	Risk same across whole Hub.	Moderate (3)	Low (1)	Risk same across whole Hub.	Moderate (3)	Low (1)	Risk same across whole Hub.	Moderate (3)	Low (1)
Safety	Injury or death to public caused from accessing abandoned/ closed site (not relinquished)	BWT mining – pit lake attractive to public. If occurs, severity = high.	High (30)	Moderate (9)	BWT mining – pit lake attractive to public. If occurs, severity = high.	High (30)	Moderate (9)	AWT mining only – safety risk low	Low	Low
Heritage	Cultural values are not replaced/preserved at the end of closure due to ineffective cultural materials management and lack of consultation.	Risk same across whole Hub - BAU	Moderate (10)	Low (0.3)	Risk same across whole Hub - BAU	Moderate (10)	Low (0.3)	Risk same across whole Hub - BAU	Moderate (10)	Low (0.3)
Community	Operations cease at Eastern Ridge resulting in the lack of community sustainability caused by economic reduction post mining.	Risk same across whole Hub - BAU	Moderate (10)	Moderate (3)	Risk same across whole Hub - BAU	Moderate (10)	Moderate (3)	Risk same across whole Hub - BAU	Moderate (10)	Moderate (3)

URR - Uncontrolled Risk Rating; RRR – Residual Risk Rating

Severity Level	Health[1] and safety	Environment	Community	Reputation	Legal	Financial[2]	Severity Factor
	Impact Types						
7	>50 fatalities. Permanent impairment >30% of body to more than 500 persons.	Permanent severe impact/s to land, biodiversity, ecosystem services, water resources or air.	Severe, widespread community health, safety or security impacts (>1000 households) or human rights violations; complete destruction of >1000 houses or community infrastructure; complete irreversible desecration of multiple structures/objects/places of global significance.	Crisis event or publication of highly confidential material information resulting in international media, government, regulator, NGO campaigning and employee condemnation of the company (>6 months). Long term damage to company reputation.	Bankruptcy, closure / nationalisation of operations on multiple sites.	≥ US$2.5 billion (BHP Billiton share)	1000
6	>20 fatalities. Permanent impairment >30% of body to more than100 persons.	Severe impact/s (>20years) to land, biodiversity, ecosystem services, water resources or air.	Extensive community health, safety or security impacts (>200 households) or human rights violations; extended serious disruption to people's lives (>1000 households); extensive damage to >1000 houses or community infrastructure or structures/ objects/places of global cultural significance.	Crisis event or publication of confidential material information resulting in international media, government, regulator, NGO campaigning and employee condemnation of the company (< 6 months). Ongoing condemnation results in damage of the reputation of the company.	Lack of valid operating title, forced closure of an operation, competition, anti-corruption , international trade law or tax breach; Major personal injury class actions. Nationalisation of Operation by host government.	≥ US$1 billion to <US$2.5 billion (BHP Billiton share)	300
5	2-20 fatalities. Permanent impairment >30% of body more than 10 persons.	Serious or extensive impact/s (<20 years) to land, biodiversity, ecosystem services, water resources or air.	Serious community health, safety or security impacts (>50 households) or human rights violations; extended disruption to people's lives (>200 households), extensive damage to >200 houses or structures/ objects/places of national cultural significance.	Serious national and international negative media attention. General public and NGO adverse reaction with interest from regulators (< 3 months). Structured campaigning from employees, NGOs or communities having a major impact on the Business / Asset reputation.	Prosecutions for criminal breaches resulting in jail terms for employees or agents or defendant to major civil litigation.	≥ US$250 million to <US$1 billion (BHP Billiton share)	100
4	Single fatality. Permanent impairment >30% of body to one or more persons.	Major impact/s (<5 years) to land, biodiversity, ecosystem services, water resources or air.	Serious community health, safety or security impacts (<50 households). Multiple allegations of human rights violations; extended disruption to people's lives (>50 households); extensive damage to >50 houses; moderate irreversible damage to structures/ objects/places of national cultural significance.	Adverse national media attention. General public and NGO adverse reaction with interest from regulators with no material outcome. Structured campaigning from employees, NGOs or communities having a major impact on the Business / Asset reputation.	Signicant civil litigation.	≥ US$25 million to <US$250 million (BHP Billiton share)	30
3	Permanent impairment <30% of body to one or more persons. Restricted or lost days due to injury or illness	Moderate impact/s (<1 year) to land, biodiversity, ecosystem services, water resources or air.	Moderate community health, safety or security impacts (<50 households). Single allegation of human rights violations; moderate disruption to people's lives (<50 households); extensive damage to <50 houses; moderate reversible damage to structures/objects/ places of national cultural significance.	Attention from regional media and/or heightened concern by local community. Criticism by community, NGOs or activists. Asset reputation adversely affected.	Breach of regulation. Lack of valid exploration title.	≥ US$2.5 million to < US$25 million (BHP Billiton share)	10
2	Objective but reversible impairment. Medical treatment injury or illness.	Minor impact/s (<3 months) to land, biodiversity, ecosystem services, water resources or air.	Minor community health, safety or security impacts (<10 households) or human rights infringements; inconvenience to livelihoods <6 months; moderate damage to <50 houses or community infrastructure; minor, reversible damage to structures/ objects/places of regional cultural significance.	Adverse local public or media attention and complaints. Heightened scrutiny from regulator. Asset reputation is adversely affected with a small number of people.	Minor legal issues and non- compliances with commitments.	≥US$250,000 to <US$2.5 million (BHP Billiton share)	3
1	Low-level short-term subjective symptoms or inconvenience. No medical treatment.	Low-level impact/s to land, biodiversity, ecosystem services, water resources or air.	Single low level community health, safety or security impact; low-level inconvenience <2 weeks; minor, reversible, low-level disturbance or minor damage to a single house or structure/object/place of regional cultural significance.	Public concern restricted to local complaints. Low-level interest from local media and/or regulator.	Low-level legal issue.	<U$250,000 (BHP Billiton share)	1

(1) Impairment to be determined using the American Medical Association Guide to Permanent Impairment.
(2) Where the financial impact is *expected* to be a one-off amount, it must be calculated as the resultant change in the Earnings Before Interest and Tax (EBIT) in that year.
Where the financial impact is expected to be an ongoing annual reduction in EBIT, it must be calculated as the Net Present Value (NPV) of those future reductions in EBIT.

Risk Assessment Matrix (RRR)

Likelihood		Severity						
	Level	1	2	3	4	5	6	7
	Factor	1	3	10	30	100	300	1000
Almost certain	10	10 (Moderate)	30 (High)	100 (Material)	300 (Material)	1000 (Material)	3000 (Material)	10000 (Material)
Likely	3	3 (Moderate)	9 (Moderate)	30 (High)	90 (Material)	300 (Material)	900 (Material)	3000 (Material)
Possible	1	1 (Low)	3 (Moderate)	10 (Moderate)	30 (High)	100 (Material)	300 (Material)	1000 (Material)
Unlikely	0.3	0.3 (Low)	0.9 (Low)	3 (Moderate)	9 (Moderate)	30 (High)	90 (Material)	300 (Material)
Rare	0.1	0.1 (Low)	0.3 (Low)	1 (Low)	3 (Moderate)	10 (Moderate)	30 (High)	100 (Material)
Very Rare	0.03	0.03 (Low)	0.09 (Low)	0.3 (Low)	0.9 (Low)	3 (Moderate)	9 (Moderate)	30 (High)

Likelihood table

Use this table to measure the chance of the impact at the severity which is being used in the calculation of the ***Residual Risk Rating***

Uncertainty	Business	Projects	Likelihood Factor
	Based on BHP Billiton and industry experience and expected future conditions, the risk event:	Based on BHP Billiton and industry experience and expected future conditions, with similar studies or projects, the risk event:	
Almost certain	Could be incurred more than once in a year.	Could be expected to occur more than once during the study or project delivery.	10
Likely	Could be incurred over a 1 - 2 year budget period.	Could easily be incurred and has generally occurred in similar studies or projects.	3
Possible	Could be incurred within a 5 year strategic planning period.	Incurred in a minority of similar studies or projects.	1
Unlikely	Could be incurred within a 5 – 20 year timeframe.	Known to happen, but only rarely.	0.3
Rare	Could be incurred in a 20 - 50 year timeframe.	Has not occurred in similar studies or projects, but could.	0.1
Very rare	For a system failure: * This consequence has not happened in industry in the last 50 years. For a natural hazard: * The predicted return period for a risk of this strength/ magnitude is one in 100 years or longer.	Conceivable, but only in extreme circumstances.	0.03

Iron Ore Controlled Document

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Standard

Acid and Metalliferous Drainage Management

Closure Planning   Number: 0096370   Version: 2.0



Approval Record

Reviewer Role	Name
Principal GeoEnvironmental Advisor – Closure Planning	Richard Marton
Approver Role	**Name**
Manager Closure Planning	Joanne Heyes

Document Amendment Record

Version	Change Effected	Date of Change
1.0	New Document	01/08/2013
2.0	Scheduled review – approver name updated	02/09/2014

Key Stakeholders

The following people have a stated interest in this document and should be informed of any significant changes to content:

Department	Name	Position
Business Planning	Blair Douglas	Manager Water Planning
HSEC Environment	Bert Huys	Manager Environment Operations
HSEC Environment	Mark Garrahy	Manager Environment Approvals
Mine Planning	Jed Youngs	Manager Hydrology
Mine Planning	Calvin Snodgrass	Manager Mine Planning
Exploration	Troy Herbert	Manager Technical Development
Exploration	Andrew Bailey	Manager Geological Services
Mine Services	Paul Oakley	Manager Planning and Estimation

Table of Contents

1. Introduction and Purpose

BHP Billiton Iron Ore (BHPBIO) operates mines in the Pilbara of Western Australia that generate mine waste and expose geological surfaces that could result in Acid and Metalliferous Drainage (AMD) if the operations and materials are not properly managed. The AMD Management Standard outlines minimum requirements for consistent and practicable AMD management across all BHPBIO's functions and operations.

AMD includes the release of low pH drainage waters otherwise described as Acid Rock Drainage (ARD) from potentially acid forming (PAF) mine waste or exposed surfaces. It can also include metals release or saline drainage in acidic or non-acidic waters. If improperly managed, AMD can cause environmental impact by altering the quality of surface and groundwater resources which support important environmental receptors.

The Standard outlines requirements to ensure that AMD is managed throughout the life of mine from exploration through mine planning, operations and closure to ensure that risks associated with AMD are identified and controlled.

2. Scope and Application

The Standard describes AMD management objectives, requirements and references and supporting documents upon which the Standard is based.

This Standard applies to all BHPBIO mining and mining-related activities and facilities and all personnel who are involved with work affecting AMD management. The Standard applies to mine sites in all phases of development which include new mine projects, sustaining mine expansions to mines and existing mines that have been in operation for many years.

A range of activities by BHPBIO functions and operations will enable effective AMD management. This Standard addresses work performed by HSEC and Planning functions as well as Mines operations. Elements addressed by the Standard range from waste rock sample collection during site exploration to environmental approvals and compliance, mine waste management planning and implementation, and mine closure. The AMD Management Standard does not preempt established strategies, accountabilities and responsibilities, but it supplements them by defining requirements that deliver consistent AMD management.

Unless otherwise stated, managers with principal responsibility for BHPBIO mining functions and operations are responsible for the communication and implementation of the performance requirements contained in this Standard.

3. AMD Management Requirements

The conceptual AMD management process flow is illustrated in Figure 1. The following sections describe the critical objectives and requirements within major components of the process flow. The conceptual process flow is sequential requirements during mine development and closure. However, in practice AMD management (particularly for well established operations) is iterative with a strong adaptive management approach. For example, the assessment of risks associated with potential AMD sources for a mine site can be revised as new information becomes available with outcomes incorporated into mine plan revisions.

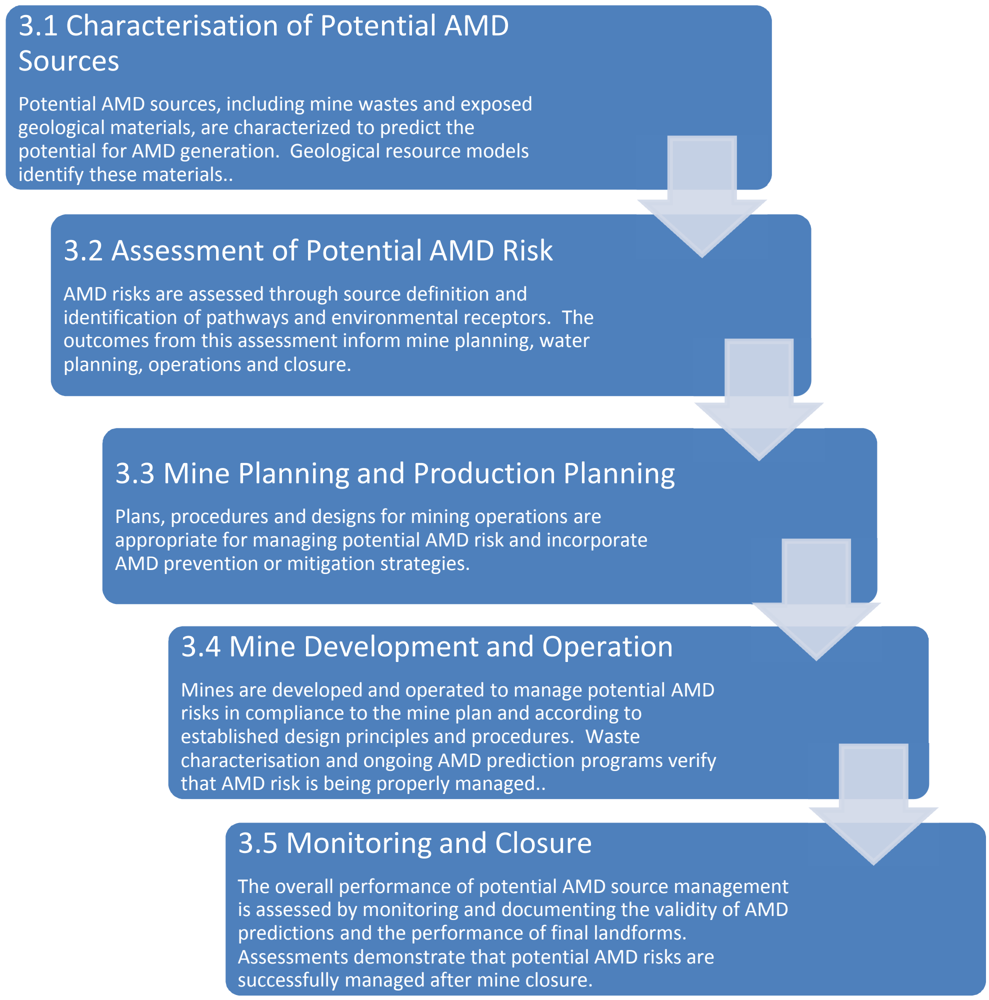

Figure 1: AMD Management process flow

3.1. Characterisation of Potential AMD Sources

Objectives: Planning for AMD management begins during early mine studies. Potential AMD sources, including mine wastes and exposed geological materials, are characterized by conducting appropriate geochemical studies aimed at predicting the potential for AMD generation. Geological resource models identify these materials.

Specific requirements to meet those objectives include:

- Requests for drilling program samples must be made during upfront drill planning and specify the locations and numbers of samples based on an assessment of the proposed drill programs, geological data and available pit shell designs.
- Geochemical baseline studies, including testing of mine waste rock and pit wall rock, must identify the short and long term potential for AMD generation.
- Long duration geochemical testing programs must be established and maintained to support predictions regarding potential AMD generation.
- A comprehensive AMD data management system must be maintained to supplement geological and assay data.

- Geological resource models must include coding for potential AMD source materials.

3.2. Assessment of Potential AMD Risk

Objectives: AMD risks are assessed through source definition (characterization of potential AMD sources), and identification of pathways and environmental receptors. The outcomes from this assessment inform mine planning, water planning, operations and closure.

Specific requirements to meet those objectives include:

- Conceptual site models and preliminary assessments of mine wastes and exposed geological surfaces must provide sufficient information to evaluate Overburden Storage Areas (OSA's) and pit voids as potential AMD sources.
- Formal reviews of risk from potential AMD sources must be conducted based on preliminary evaluations of AMD risk and revised as needed based on new information or changes to mine plans.
- Information and data regarding potential AMD sources (e.g. source terms and processes for potential acid, metals or saline drainage) must be considered in outcome based approaches to protecting environmental receptors and assessing risks to water resources.
- Assessments of risks from potential AMD sources must inform mine Water Planning and operational management and strategy.
- Detailed assessments and refinement of site AMD models, such as additional characterization studies and geochemical modeling, must be completed if warranted based on water management strategies and the potential severity of AMD risk.
- Environmental approval documents and conceptual site closure plans must account for potential AMD risk.

3.3. Mine Planning and Production Planning

Objectives: Plans, procedures and designs for mining operations are appropriate for managing potential AMD risk and incorporate AMD prevention or mitigation strategies.

Specific requirements to meet those objectives include:

- Mine plans must estimate the quantity of materials that present potential AMD risk and provide segregation of these materials based on AMD coding in geological resource models.
- Final landform designs for OSAs must be based on design principles that prevent or mitigate AMD risk. Mine pit designs and waste scheduling must consider avoidance of potential AMD sources.
- Plans for mine waste testing must be appropriate for the level of the potential AMD risk and the scale of the operation.

3.4. Mine Development and Operation

Objectives: Mines are developed and operated to manage potential AMD risks in compliance to the mine plan and according to established design principles and procedures. Waste characterisation and ongoing AMD prediction programs verify that AMD risk is being properly managed.

Specific requirements to meet those objectives include:

- Operational procedures must support the execution of AMD management according to the mine plans. This includes testing, tracking, verifying and reporting potential AMD source material classification, movement and placement.
- Mine waste testing results must inform medium and short term planning and provide input to change management if testing demonstrates that the current mine plan could result in unacceptable risks.

3.5. Monitoring and Closure

Objectives: The overall performance of potential AMD source management is assessed by monitoring and documenting the validity of AMD predictions and the performance of final landforms. Assessments demonstrate that potential AMD risks are successfully managed after mine closure.

Specific requirements to meet those objectives include:

- If AMD risks have been identified, surface and groundwater quality must be monitored according to water management strategies throughout mine operation and into the post closure period to assess the effectiveness of AMD source management.
- AMD assessment programs must continue throughout mine operation to confirm predictions regarding AMD potential, and the site AMD model must be updated as appropriate based on new information to inform operational and water management strategies.
- Where adaptive management is required due to unacceptable testing or monitoring results, AMD management procedures must be revised to address any changes in AMD risk.

4. Definitions and Abbreviations

Term	Description
ARD	Acid Rock Drainage; release of low pH drainage waters resulting from the oxidation of sulphide bearing rocks.
AMD	Acid & Metalliferous Drainage includes ARD, metals or saline drainage in low or neutral drainage waters from mining processes.
GARD	Guide for Acid Rock Drainage
HSEC	Health safety Environment and Community
INAP	International Network for Acid Prevention
OSA	Overburden Storage Area
PAF	Potential Acid Forming; sulphide bearing rock types (e.g., pyrite) having the potential to oxidise upon exposure to air/water and result in acid formation.

5. Supporting Documents

The BHPB Iron Ore AMD Management Standard is informed by and consistent with a set of internal corporate, regulatory and industry standards, principles and guidelines.

External

- Department of Industry Tourism and Resources (2007) Managing Acid and Metalliferous Drainage — Leading Practice Sustainable Development Program for the Mining Industry. Department of Industry, Tourism and Resources, Canberra.
- The Global Acid Rock Drainage (GARD) Guide, May 2012, developed by the International Network of Acid Prevention (INAP).
- Department of Mines and Petroleum/Environmental Protection Authority (2011) Guidelines for Preparing Mine Closure Plans 2011.
- ANZECC/ARMCANZ, 2000, Australian Water Quality Guidelines for Fresh and Marine Waters, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
- Australian Government, 2000, Environment Protection and Biodiversity Conservation Act (EPBC Act).
- Other State and Federal Acts and Policy Statements.

Internal

BHP Billiton's commitments to effective management of mine waste to prevent or mitigate environmental impacts exist within the BHP Billiton Charter, the BHP Billiton Group Level Documents (GLD's), BHPB Billiton Iron Ore standards and the references cited in these documents.

- Group Level Documents (GLDs), specifically GLD.009 (Environment) and GLD.017 (Risk Management)
- BHP Billiton Charter
- Closure Planning Standard (2013)
- Environment Strategy (2012)
- Exploration Standard (2012)
- Mine Geology Standard (2012)
- Mine Planning Standard (2011)
- Water Management Guidelines (2012)
- Water Management Standard (2012)
- Pilbara Water Management Strategy (2013)
- Rehabilitation Standard (2011)

Domain	OSA			Infrastructure	Road/rail/corridors	TSF	Mine Pit		
Landform	Lower Slope /Plains	Mid Slope	Crest/Mesa	Lower Slope /Plains	Lower Slope /Plains	Lowlying floodplain	Lowlying floodplain	Major drainage line / Creek	Escarpment / steep slope into pit
Community	Triodia Hummock Grassland to Open Hummock Grassland	Triodia Hummock Grassland	Triodia Hummock Grassland	Triodia Hummock Grassland to Open Hummock Grassland	Triodia Hummock Grassland to Open Hummock Grassland	Triodia Hummock Grassland	Triodia Hummock Grassland	Eucalyptus Woodland to Open Woodland	Triodia Open Hummock Grassland
Species									
Abutilon cryptopetalum								P	
Abutilon cunninghamii									
Abutilon dioicum	P			P	P				P
Abutilon fraseri									
Abutilon lepidum			P					P	
Abutilon macrum									
Abutilon otocarpum	P			P	P				P
Abutilon oxycarpum									
Abutilon oxycarpum subsp. prostratum									
Abutilon sp. indet.									
Abutilon trudgenii MS									
Acacia adoxa var. adoxa	P		**P**	P	P				
Acacia adsurgens									
Acacia ancistrocarpa	**P**	P		**P**	**P**	**P**	**P**		
Acacia aneura									
Acacia aptaneura	P			P	P	P	P		**P**
Acacia ayersiana									
Acacia bivenosa	**P**	P	**P**	**P**	**P**	**P**	**P**	P	
Acacia catenulata subsp. occidentalis	P	**P**		P	P	P	P		
Acacia citrinoviridis								**P**	
Acacia dictyophleba	P		P	P	P	P	P		
Acacia elachantha	P			P	P	P	P		
Acacia hamersleyensis									
Acacia hilliana	**P**		**P**	**P**	**P**				
Acacia inaequilatera	**P**	P	**P**	**P**	**P**				
Acacia incurvaneura	**P**	**P**		**P**	**P**				
Acacia kempeana			P						
Acacia ligulata	P			P	P	P	P		
Acacia maitlandii			P						P
Acacia monticola	**P**	**P**		**P**	**P**	P	P	**P**	
Acacia pachyacra	P			P	P	P	P	P	P
Acacia paraneura									

Approx %Cover	
<1	P
1-20	P
21-40	P
41- 60	P
61-80	P
>80	P

Acacia pruinocarpa	P	P	P	P	P				
Acacia pteraneura									
Acacia pyrifolia	P			P	P	P	P	P	
Acacia rhodophloia									**P**
Acacia sclerosperma subsp. sclerosperma						P	P		
Acacia sibirica			P						
Acacia synchronicia	**P**	**P**	P	**P**	**P**				
Acacia tenuissima	**P**		**P**	**P**	**P**	**P**	**P**		
Acacia tetragonophylla		P	P						
Acacia tumida var. pilbarensis									**P**
Acacia victoriae									
Alternanthera denticulata								P	
Alternanthera nana								P	
Amaranthus interruptus									
Amaranthus undulatus								P	P
Ammannia multiflora								P	
Amphipogon sericeus			P						
Amyema fitzgeraldii									
Amyema preissii									
Anthobolus leptomerioides	P			P	P	P	P		
Aristida burbidgeae									P
Aristida contorta	P	P	P	P	P	P	P	P	
Aristida holathera var. holathera	P			P	P				
Aristida hygrometrica									
Aristida inaequiglumis									
Aristida jerichoensis var. subspinulifera (P1)			P						
Aristida latifolia									
Aristida obscura									
Aristida pruinosa									
Aristida sp.indet.									
Asteraceae sp.									
Astrotricha hamptonii									**P**
Bergia pedicellaris								P	
Blumea tenella								**P**	
Boerhavia coccinea								P	P
Boerhavia repleta									
Bonamia media var. villosa	P	P	P	P	P				P
Bonamia rosea	P			P	P	P	P		
Bothriochloa ewartiana									
Brachyachne prostrata									
Brunonia australis									
Bulbostylis barbata		**P**	P					P	P
Bulbostylis turbinata									
Calandrinia ptychosperma									
Calandrinia sp.									
Calotis latiuscula (P3)									

Calotis porphyroglossa									
Calytrix carinata			P						
Capparis lasiantha									
Cassytha capillaris	**P**			**P**	**P**	**P**	**P**		P
Cassytha filiformis									
Cassytha sp. indet.									
Centipeda minima subsp. macrocephala								P	
Cheilanthes lasiophylla									
Cheilanthes sieberi subsp. sieberi									
Chrysocephalum apiculatum									
Chrysocephalum gilesii									
Chrysocephalum pterochaetum			P						
Chrysopogon fallax	P			P	P	P	P		
Cleome oxalidea									
Cleome viscosa	P	P		P	P			P	P
Clerodendrum floribundum var. angustifolium									P
Clerodendrum sp. indet.									
Clerodendrum tomentosum var. tomentosum								P	
Codonocarpus cotinifolius	P		P	P	P	P	P		
Commelina ensifolia									
Convolvulus clementii									
Convolvulus remotus									
Corchorus crozophorifolius								**P**	
Corchorus incanus subsp. incanus									P
Corchorus lasiocarpus subsp. lasiocarpus	P		P	P	P				
Corchorus lasiocarpus subsp. parvus									
Corchorus tridens								P	
Corymbia candida subsp. dipsodes	P	**P**		P	P	P	P		
Corymbia deserticola									
Corymbia ferriticola									**P**
Corymbia hamersleyana	**P**	P	P	**P**	**P**	**P**	**P**	**P**	
Crotalaria medicaginea									
Crotalaria medicaginea var. neglecta	P			P	P	P	P	P	
Crotalaria novae-hollandiae subsp. novae-hollandiae									
Cucumis maderaspatanus	P	P	P	P	P			P	P
Cullen cinereum									
Cymbopogon ambiguus	P		P	P	P	P	P	P	**P**
Cymbopogon bombycinus								P	
Cymbopogon obtectus	P			P	P	P	P	P	
Cymbopogon procerus									
Cyperus ? polystachyos									
Cyperus cunninghamii subsp.									
Cyperus difformis								P	
Cyperus iria								P	
Cyperus ixiocarpus								P	
Cyperus rigidellus									P

Cyperus squarrosus								P	
Cyperus vaginatus								P	
Dactyloctenium radulans									
Dampiera candicans			P						
Dichanthium sericeum subsp. humilius									
Dichanthium sericeum subsp. polystachyum								**P**	
Dichanthium sericeum subsp. sericeum									
Dicladanthera forrestii									
Dicrastylis cordifolia	P		P	P	P	P	P		
Digitaria ammophila									
Digitaria brownii									
Digitaria ctenantha									
Diplatia grandibractea									
Dipteracanthus australasicus subsp. Australasicus									
Dodonaea coriacea	P	P	P	P	P				
Dodonaea pachyneura									**P**
Duperreya commixta		P	P					P	P
Dysphania glomulifera subsp. eremaea									
Dysphania melanocarpa forma leucocarpa									
Dysphania rhadinostachya			P						P
Dysphania rhadinostachya subsp. rhadinostachya	P		P	P	P				
Dysphania saxatilis									
Elytrophorus spicatus								**P**	
Enchylaena tomentosa var. tomentosa								P	
Enneapogon caerulescens									
Enneapogon cylindricus			P						
Enneapogon intermedius									
Enneapogon lindleyanus								P	P
Enneapogon polyphyllus	P	P	P	P	P	P	P	P	
Enneapogon robustissimus								P	
Eragrostis cumingii								P	
Eragrostis dielsii									
Eragrostis elongata	P			P	P				
Eragrostis eriopoda	P		P	P	P	P	P		
Eragrostis erophila									
Eragrostis olida									
Eragrostis pergracilis									
Eragrostis setifolia									
Eragrostis tenellula								**P**	
Eremophila cuneifolia									
Eremophila exilifolia			P						
Eremophila forrestii subsp. forrestii									
Eremophila fraseri subsp. fraseri									
Eremophila galeata									
Eremophila lanceolata									
Eremophila latrobei subsp. filiformis			P						

Eremophila latrobei subsp. glabra	P	P	P	P	P				
Eremophila latrobei subsp. latrobei	P	P	P	P	P				
Eremophila longifolia	P		P	P	P	P	P		P
Eremophila maculata subsp. brevifolia									
Eremophila magnifica subsp. velutina									
Eremophila platycalyx subsp. pardalota	P			P	P	P	P		
Eremophila sp.									
Eremophila tietkensii									**P**
Eriachne aristidea									
Eriachne flaccida									
Eriachne helmsii									
Eriachne lanata	P		P	P	P				**P**
Eriachne mucronata	P	**P**	P	P	P			P	**P**
Eriachne pulchella subsp. dominii	P	**P**	P	P	P	P	P	P	P
Eriachne tenuiculmis	P			P	P	P	P	**P**	
Eucalyptus camaldulensis subsp. refulgens								**P**	
Eucalyptus erothermica									
Eucalyptus gamophylla	**P**			**P**	**P**	**P**	**P**		
Eucalyptus leucophloia subsp. leucophloia	**P**	**P**	**P**	**P**	**P**				**P**
Eucalyptus socialis subsp. eucentrica									
Eucalyptus trivalva									
Eucalyptus victrix								**P**	
Eulalia aurea								**P**	
Euphorbia alsiniflora									
Euphorbia australis									P
Euphorbia biconvexa								P	
Euphorbia boophthona									
Euphorbia drummondii									
Euphorbia tannensis subsp. eremophila	P	P		P	P				P
Evolvulus alsinoides var. decumbens									
Evolvulus alsinoides var. villosicalyx	P	P		P	P	P	P	P	P
Ficus brachypoda									P
Fimbristylis dichotoma			P						
Fimbristylis simulans		**P**	P						
Glycine canescens									P
Gompholobium sp. Pilbara (N.F. Norris 908)			P						
Gomphrena cunninghamii								P	P
Gomphrena kanisii			P						
Goodenia cusackiana			P						
Goodenia lamprosperma								P	
Goodenia microptera									
Goodenia muelleriana			P						
Goodenia prostrata									
Goodenia sp. indet.									
Goodenia stobbsiana	P	P	P	P	P				P
Goodenia triodiophila			P						

Gossypium australe								P	
Gossypium robinsonii	P			P	P	P	P	P	P
Grevillea berryana			**P**						
Grevillea striata		P							
Grevillea wickhamii								**P**	
Grevillea wickhamii subsp. hispidula	**P**	**P**	**P**	**P**	**P**	P	P	P	
Hakea chordophylla			P						
Hakea lorea subsp. lorea	P	P	P	P	P	P	P		
Halgania gustafsenii var. gustafsenii MS									
Halgania gustafsenii var. Mid West (G. Perry 370)									
Haloragis gossei									
Heliotropium cunninghamii									
Hibiscus burtonii									
Hibiscus coatesii			P					P	
Hibiscus gardneri	P	P		P	P				
Hibiscus haynaldii									**P**
Hibiscus leptocladus									
Hibiscus sturtii	P			P	P	P	P		
Hibiscus sturtii var. campylochlamys		P							
Hibiscus sturtii var. grandiflorus						P	P		
Hibiscus sturtii var. platychlamys						P	P		
Hibiscus sturtii var. truncatus									
Hybanthus aurantiacus	P		P	P	P	P	P	P	P
Indigofera georgei								P	
Indigofera linnaei								P	
Indigofera monophylla	P		P	P	P			P	
Ipomoea muelleri								P	
Ipomoea plebeia									
Ipomoea polymorpha									
Iseilema eremaeum									
Iseilema vaginiflorum									
Isotropis atropurpurea								P	
Isotropis forrestii								P	
Jasminum didymum subsp. lineare	P	P	P	P	P			P	
Jasminum sp.									
Kennedia prorepens	**P**			**P**	**P**	**P**	**P**		
Keraudrenia nephrosperma	P		P	P	P				
Keraudrenia velutina subsp. elliptica									
Lamarchea sulcata									
Lepidium pedicellosum			P						
Lepidium phlebopetalum									
Lepidium pholidogynum									
Lipocarpha microcephala								P	
Maireana georgei		P							
Maireana planifolia									
Maireana planifolia villosa									

Maireana tomentosa									
Maireana villosa	P	**P**	P	P	P	P	P		
Marsdenia australis									
Marsilea hirsuta								**P**	
Melaleuca argentea									
Melaleuca glomerata								P	
Melhania oblongifolia									
Mirbelia viminalis			P						
Mollugo molluginea								P	
Myriophyllum verrucosum								P	
Neptunia dimorphantha									
Nicotiana benthamiana			P						P
Nicotiana occidentalis subsp. obliqua									
Notoleptopus decaisnei var. orbicularis									
Oldenlandia crouchiana									
Panicum decompositum									
Panicum effusum									
Paraneurachne muelleri	**P**		P	**P**	**P**	**P**	**P**	P	
Paspalidium clementii	P	**P**	P	P	P				P
Paspalidium rarum									
Peplidium maritimum								P	
Peripleura virgata			P						
Perotis rara								P	
Petalostylis labicheoides	P	P	**P**	P	P	P	P	P	
Phyllanthus erwinii			P						
Phyllanthus maderaspatensis								P	P
Pluchea dentex									P
Pluchea rubelliflora								P	
Polycarpaea corymbosa var. corymbosa									P
Polycarpaea holtzei	P	P		P	P				
Polycarpaea involucrata	P	P	P	P	P				P
Polycarpaea longiflora								P	
Polygala isingii	P	P	P	P	P				
Polymeria ambigua	P			P	P	P	P		
Polymeria calycina								P	
Polymeria sp. indet,									
Portulaca pilosa									
Psydrax latifolia	P			P	P	P	P		P
Psydrax suaveolens									
Pterocaulon sp. indet									
Pterocaulon sphacelatum								P	
Pterocaulon sphaeranthoides									
Ptilotus aervoides									
Ptilotus astrolasius	P			P	P	P	P		
Ptilotus auriculifolius									
Ptilotus calostachyus	P		P	P	P	P	P		

Ptilotus clementii			P						
Ptilotus exaltatus var. exaltatus	P	P	P	P	P	P	P	P	P
Ptilotus fusiformis	P			P	P			P	
Ptilotus gaudichaudii var. gaudichaudii	P			P	P				
Ptilotus helipteroides	P			P	P	P	P		
Ptilotus incanus									
Ptilotus macrocephalus									
Ptilotus obovatus	P	P	P	P	P			P	**P**
Ptilotus obovatus var. obovatus									
Ptilotus polystachyus	P			P	P				
Ptilotus roei									
Ptilotus rotundifolius		P	P						
Rhagodia eremaea									
Rhodanthe charsleyae									
Rhodanthe floribunda									
Rhodanthe margarethae									P
Rhyncharrhena linearis	P		P	P	P				
Rhynchosia minima								**P**	P
Rotala diandra								P	
Rulingia loxophylla									
Rulingia luteiflora								P	
Rutidosis helichrysoides									
Salsola tragus subsp. grandiflora								P	P
Santalum lanceolatum	P		P	P	P			P	
Sarcostemma viminale subsp. australe	P			P	P	P	P		
Scaevola amblyanthera var. centralis									
Scaevola browniana									
Scaevola parvifolia subsp. parvifolia	P			P	P	P	P		
Scaevola parvifolia subsp. pilbarae	P			P	P				
Scaevola spinescens								P	
Schizachyrium fragile	P	P	P	P	P				
Schoenoplectus dissachanthus								P	
Schoenoplectus laevis								**P**	
Schoenoplectus subulatus								P	
Sclerolaena convexula									
Sclerolaena cornishiana			P						
Sclerolaena densiflora		P							
Sclerolaena sp. indet.									
Senna artemisioides subsp. artemisioides									
Senna artemisioides subsp. helmsii	P			P	P	P	P		
Senna artemisioides subsp. oligophylla								P	P
Senna artemisioides subsp. oligophylla subsp. helmsii	P		P	P	P				P
Senna ferraria									
Senna glaucifolia	P	P	P	P	P				
Senna glutinosa			P						
Senna glutinosa subsp. glutinosa	P	P	P	P	P				P

Senna glutinosa subsp. pruinosa	P	**P**	P	P	P				
Senna glutinosa subsp. Senna luerssenii	P	P	P	P	P	P	P		
Senna glutinosa subsp. Senna luerssenii Senna stricta									
Senna notabilis	P			P	P	P	P	P	
Senna sericea		P							
Senna sp. indet.									
Senna sp. Meekatharra (E. Bailey 1-26)									
Senna stricta			P						
Senna venusta									P
Sesbania cannabina									
Setaria dielsii									P
Sida arenicola								P	
Sida cardiophylla									
Sida echinocarpa									
Sida ectogama	P		P	P	P				
Sida fibulifera								P	
Sida platycalyx									
Sida rohlenae subsp. rohlenae									P
Sida sp. Excedentifolia (J.L. Egan 1925)		P	P						
Sida sp. Golden calyces glabrous (H.N. Foote 32)			P						P
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	P		P	P	P	P	P		
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)									P
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)									
Sida sp. verrucose glands (F.H.									
Solanum centrale			P						
Solanum horridum			P						P
Solanum lasiophyllum	P		P	P	P				P
Solanum phlomoides	P	P	P	P	P			P	P
Solanum sp. indet.									
Sorghum plumosum									
Sporobolus australasicus								**P**	P
Stackhousia intermedia									
Stackhousia muricata			P						
Stemodia grossa								P	
Stemodia viscosa								P	
Stenopetalum decipiens									
Streptoglossa bubakii									
Stylobasium spathulatum									
Swainsona kingii									
Synaptantha tillaeacea var. tillaeacea								P	
Tephrosia densa	P	P		P	P				
Tephrosia rosea									
Tephrosia rosea var. glabrior								**P**	
Tephrosia sp. Cathedral Gorge (F.H. Mollemans 2420)									
Tephrosia sp. indet									
Tephrosia supina			P						

Themeda avenacea									
Themeda sp. Mt Barricade (M.E. Trudgen 2471)								P	P
Themeda triandra								P	P
Trachymene oleracea	P	P	P	P	P				
Tragus australianus									
Trianthema glossostigma			P						
Trianthema pilosa									
Trianthema triquetra									
Tribulopis angustifolia									
Tribulus astrocarpus									
Tribulus hirsutus									
Tribulus macrocarpus									
Tribulus suberosus	P	P	P	P	P				
Trichodesma zeylanicum	P	P	P	P	P	P	P	P	P
Triodia angusta		P	P					P	
Triodia basedowii									
Triodia brizoides									
Triodia longiceps									P
Triodia pungens	P	P	P	P	P	P	P	P	P
Triodia schinzii	P	P	P	P	P	P	P		
Triodia sp. Shovelanna Hill (S. van Leeuwen 3835)	P	P	P	P	P	P	P		
Triodia wiseana	P	P	P	P	P				
Triraphis mollis									
Triumfetta chaetocarpa								P	
Triumfetta leptacantha									P
Triumfetta maconochieana									P
Triumfetta sp.									
Urochloa occidentalis								P	
Vachellia farnesiana									
Ventilago viminalis									
Vigna lanceolata var. lanceolata								P	
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	P			P	P	P	P		
Waltheria indica									
Yakirra australiensis var. australiensis									