BHP Billiton Iron Ore

Pilbara Public Environmental Review

Strategic Proposal

SUPPLEMENTARY REPORT

bhpbilliton

Document Control

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DISCLAIMER

This Supplementary Report has been prepared for submission to the Western Australian Environmental Protection Authority in response to public comments received during the review period of the Pilbara Public Environmental Review Strategic Proposal (PERSP). This Supplementary Report is to support the information contained in the PERSP for the purpose of the Minister for Environment making a determination regarding whether to approve BHP Billiton Iron Ore's Proposal under the Western Australian *Environmental Protection Act 1986*. This Supplementary Report and the PERSP have been developed for this purpose only, and no one other than the Environmental Protection Authority or the Minister should rely on the information contained in these documents to make any decision.

In preparing the Supplementary Report and PERSP, BHP Billiton Iron Ore has relied on information provided by specialist consultants, government agencies and other third parties available during preparation.

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NOTE ON CURRENCY

Where possible, the contents of this Supplementary Report are up to date as at **21 December 2016.**

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Document Abbreviations

ABBREVIATION	MEANING
AMD	acid and metalliferous drainage
CALM	Department of Conservation and Land Management
DAA	Department of Aboriginal Affairs
DER	Department of Environment Regulation
DMP	Department of Mines and Petroleum
DoW	Department of Water
DPaW	Department of Parks and Wildlife
EHU	ecohydrological unit
EIA	environmental impact assessment
EP Act	*Environmental Protection Act 1986* (WA)
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ESD	Environmental Scoping Document (BHP Billiton Iron Ore 2013)
ha	hectare
IUCN	International Union for Conservation of Nature
MAR	managed aquifer recharge
MNES	matters of national significance
Mtpa	million tonnes per annum
OEPA	Office of the Environmental Protection Authority
PEC	priority ecological community
PERSP	Public Environmental Review Strategic Proposal
SEA	strategic environmental assessment

ABBREVIATION	MEANING
TEC	threatened ecological community
WC Act	*Wildlife Conservation Act 1950*

Document Definitions

TERM	DEFINITION
asset	A specific component of the biophysical environment that supports one or more environmental or social values. Examples include the Karijini National Park and Fortescue Marsh.
BHP Billiton Iron Ore Strategic Proposal	The BHP Billiton Iron Ore Strategic Proposal encompasses the Company's planned development for mining and support infrastructure for the Pilbara within the geographic extent of the Project Definition Boundary.
bioregion	A biogeographic region as defined in the Interim Biogeographic Regionalisation for Australia (DSEWPaC 2012a).
Derived Proposal	A Derived Proposal is a future proposal that was identified in the Strategic Proposal, that has been referred to and considered by the EPA, and that is then declared to be a Derived Proposal.
future operation	Future operations within the context of the Strategic Proposal include greenfield and existing mines and expansions, together with supporting infrastructure including (but not limited to) rail lines, accommodation villages and roads.
greenfield	Greenfield exploration seeks to discover mineral deposits in new areas, away from the local area of producing mines.
landscape	A spatially heterogeneous area, scaled relative to the process of interest. Within landscapes, it is usually possible to define a series of different ecosystems, landforms, habitats and natural or man-made features.
local	Pertaining to a discrete area and its immediate vicinity (as opposed to the whole area within the Project Definition Boundary or the whole bioregion).
local scale	At the scale of a local activity – e.g. the zone of impact of a particular activity. Used to differentiate between regional-scale impacts (i.e. impacts at the scale of the bioregion or on the entire distribution of a species) and impacts at the scale of a future mine.
mining operation	A site of mining activities on BHP Billiton Iron Ore tenure. The mining operation may contain one or more processing hubs within it, depending on the mining strategy.
mitigation hierarchy	The order in which measures to reduce the risk of impact are to be applied, namely avoid, minimise, rehabilitate and (where appropriate) offset.
Project Definition Boundary	The geographical extent of the Strategic Proposal for the purposes of Commonwealth and state environmental impact assessment.

TERM	DEFINITION
Office of the EPA	The Office of the EPA supports the EPA in conducting environmental impact assessments and developing policies to protect the environment.
Public Environmental Review Strategic Proposal	The document that outlines the potential impacts of the Strategic Proposal on factors and the management strategies to address these potential impacts. It is assessed by the EPA in considering whether the Strategic Proposal is environmentally acceptable.
region	Pertaining to a vast area (e.g. an entire IBRA bioregion as opposed to a specific locality).
regional scale	At the scale of the region. Used to differentiate between local-scale impacts (i.e. at the scale of a future mine) and impacts at a broader scale.
Strategic Proposal	BHP Billiton Iron Ore's proposal for future mining operations within the Project Definition Boundary.
study area	This is the spatial boundary for a technical study and varies depending on the factor being considered. The study areas are a subset of the Project Definition Boundary.
value	Any particular benefit or use of the environment that is important for a healthy ecosystem or for public benefit. Values are not quantifiable and cannot be directly monitored, measured or assessed.

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1 INTRODUCTION

> The EPA provides a copy of the submissions (with the names of private individuals removed) to the proponent soon after the close of the public review period. The EPA also summarises the pertinent issues raised in the submissions and provides these to the proponent.
>
> The proponent is required to prepare a written response to the issues raised in the summary of the submissions to the satisfaction of the EPA. This is an opportunity for the proponent to clarify, review or modify aspects of the proposal to address issues raised in the submissions. Any amendments to the original proposal or management measures should be clearly stated in the proponent's response to submissions and may need to be consented to by the EPA under section 43A of the Act.
>
> EIA Administrative Procedures 2012 (s10.2.6)

The EPA has recently revised its Administrative Procedures, Policy and Guidance material (December 2016). Where relevant, BHP Billiton Iron Ore has undertaken the EIA in accordance with Part IV Division 1 of the EP Act and the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016, however .the administrative procedures applying at the time the decision was made on the level of assessment for the proposal will apply: the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012.

1.1 BACKGROUND TO THE PILBARA PUBLIC ENVIRONMENTAL REVIEW STRATEGIC PROPOSAL

To initiate the strategic environmental assessment process, BHP Billiton Iron Ore lodged a Strategic Proposal Referral Document with the EPA on 6 July 2012 under s. 38 of the *Environmental Protection Act 1986* (BHP Billiton Iron Ore 2012). Following public comment, the EPA announced on 25 July 2012 the decision to proceed with the assessment and set the level of assessment at Public Environmental Review Strategic Proposal (PERSP). The PERSP document was submitted to the EPA for release for public comment in March 2016 and this process is described in further detail below.

1.2 BHP BILLITON IRON ORE'S APPROACH TO SUBMISSIONS

In seeking approval for this long-term development program, BHP Billiton Iron Ore has sought comment from stakeholders, including the public, on the impact assessment and management approach proposed in the PERSP. The aim of this process is to provide the Western Australian Minister for Environment and Heritage with confidence that implementation of BHP Billiton Iron Ore's Strategic Proposal will not have unacceptable environmental impacts and that the processes agreed to as part of the Strategic Proposal will ensure impacts remain acceptable over the life of the approval.

The PERSP was subject to a 12 week public review period from 21 March to 13 June 2016. Twelve key themes were raised in the public submissions:

1. General Comments
2. Flora and vegetation
3. Hydrological processes
4. Inland waters environmental quality
5. Subterranean fauna
6. Terrestrial fauna
7. Heritage

8. Human health
9. Offsets
10. Rehabilitation and decommissioning
11. Other
12. Issues from submissions received after close of submission period

The comments on the above themes were received from 10 separate entities (organisations, groups, individuals or representatives) with a total of 64 individual specific comments made.

This Supplementary Report seeks to address the comments raised within those submissions (EPA Assessment No. 1934). This report concludes the public comment component for the Strategic Proposal as shown in Figure 1.

BHP Billiton Iron Ore was provided a summary of submissions received from the EPA (Table 1 of this Supplementary Report) and has provided response to each item within the table. In areas where the response requires a more comprehensive explanation these are discussed further in Section 3 of this document.

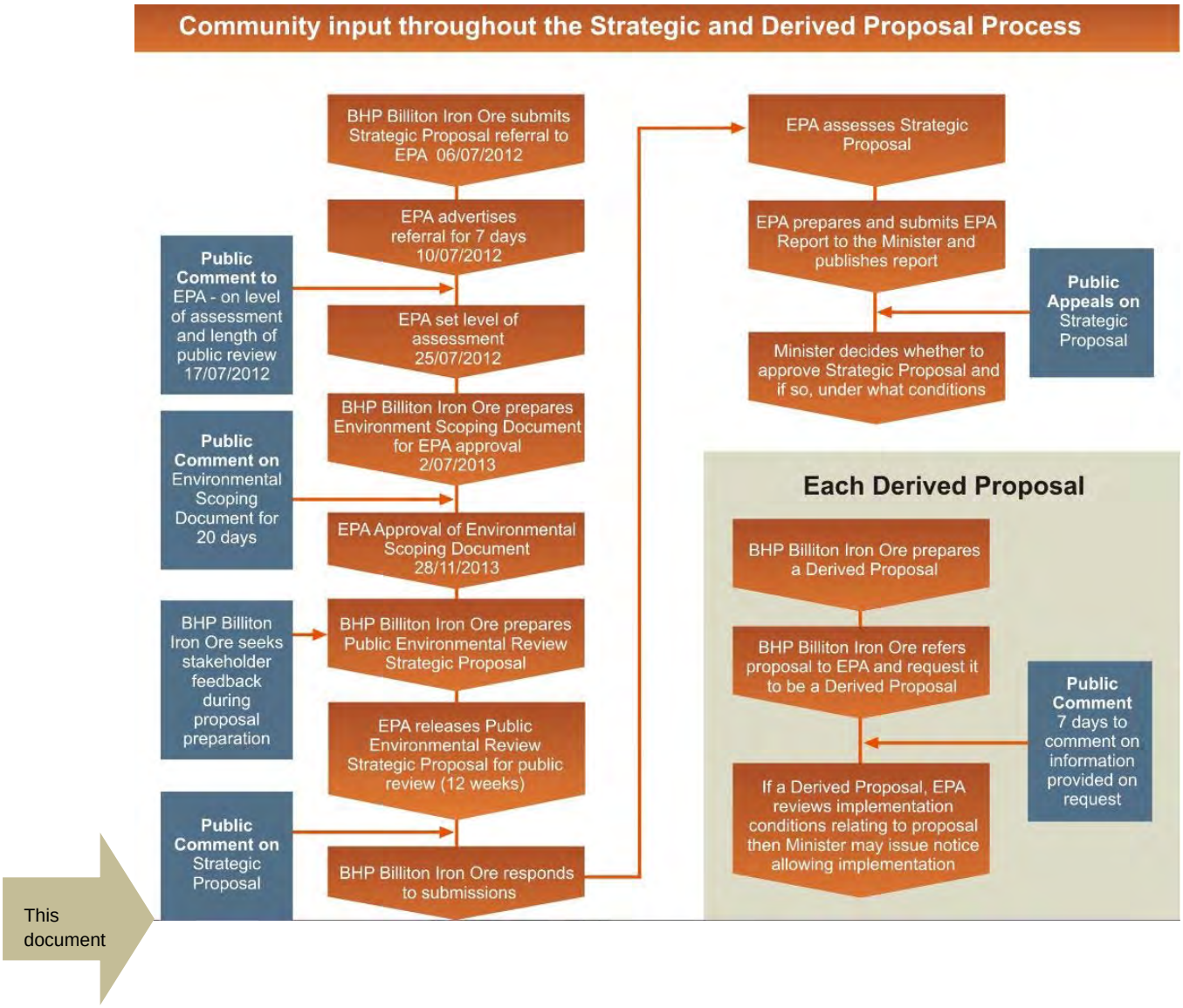

Figure 1: Strategic Proposal Assessment Process Phase

2 SUMMARY OF SUBMISSIONS

2.1 SUBMISSIONS RECEIVED

A transcript of all submissions received during the 12 week PERSP public comment period are provided in Table 1. Where the comment is part of a broader discussion, a reference to the section in this report, which provides further detail, has been provided.

Table 1: Submissions received during public comment period

Submitter	Issue Number	Submission and/or issue	Response to comment
The proposal – General comments			
Care for Hedland	1.	Views the management of dust emissions, efficient use of water and the use of water (including fit for purpose water for industrial use) as important in not only the specified areas but also in Port Hedland where the end products of the mines will be shipped.	BHP Billiton is committed to the sustainability of the environment, congruent with operational sustainability. This includes the management of dust and water. While activities within Port Hedland are out of the scope of the Strategic Proposal, the potential for indirect impacts has been assessed. As detailed in the PERSP, there are not anticipated to be any additional impacts to the amenity of the Port Hedland urban area as a result of the proposed Pilbara Expansion (refer to the Summary of Assessment Outcomes for each factor in Chapter 8 of the PERSP). Air emissions modelling for sensitive receiver locations within the Project Definition Boundary (PERSP section 8.4.2.4)

Submitter	Issue Number	Submission and/or issue	Response to comment
			shows that, with the implementation of management measures, the EPA objective for air quality can be met. Any future changes to ore volumes or port functions associated with BHP Billiton's activities at Port Hedland will be considered separately, including the requirement for impact assessment or amendment to existing approvals and licences at Port Hedland (i.e. separate to the Strategic Proposal).
Public Submission	2.	The PER includes several areas of interest, which may be defined as the project area or project definition boundary (different terms are used throughout the document). Some, such as the project definition boundary in Figure ES3, include a lot of land that does not belong to BHP. It is not possible to tell which areas have been assessed for impact. Isn't this important? Doesn't the EPA have a whole guidance document on this? Yet the first thing you read is about the area they are looking at, and you can't tell what it is.	The Project Definition Boundary provides the boundary in which activities proposed under the Strategic Proposal may occur (refer to Section 2.2 of the PERSP). The impact assessment has been conducted over a broader area, within the Pilbara IBRA, to examine the potential impact of activities in the Project Definition Boundary on the broader environment (refer to Chapter 7 of the PERSP, and results provided in Chapter 8). BHP Billiton Iron Ore's current tenure within the Project Definition Boundary has been used to provide a conceptual model and to provide a quantum of maximum foreseeable impact to environmental Factors. The indicative disturbance footprint contained within this has been based on geology and mining process and we expect it to be strongly correlated with future developments. Development could potentially occur at any location within the Project Definition Boundary, subject to BHP Billiton Iron Ore having or acquiring appropriate tenure for development.

Submitter	Issue Number	Submission and/or issue	Response to comment
			The PERSP detailed the regional cumulative impact assessment, which included evaluation of environmental assets and species and identified those at risk of future impact without mitigation. A management approach was defined and as an outcome of the assessment and application of the management approach BHP Billiton Iron Ore concluded that future proposals anywhere within the Project Definition Boundary would not have an unacceptable impact to the environmental Factors and that the EPA objectives could be met. BHP Billiton Iron Ore will be required to verify that the EPA objectives for any future proposal, can be met prior to implementation. If the EPA determines that impacts relating to any future proposal have not been adequately addressed in the PERSP, the EPA may decide not declare the development a derived proposal. In this circumstance, further assessment will occur. The location of future development activities within the Project Definition Boundary will be identified in future proposals. For the purposes of assessing the Strategic Proposal as a whole, a conceptual direct disturbance footprint, based on BHP Billiton current tenure, has been used as the basis of the impact assessment for each factor. The extent of the impact assessment has been determined specific to each factor as different environmental factors need consideration at different scales (for example at a catchment or airshed scale). Extensive EPA Guidance material has been consulted in the development of this

Submitter	Issue Number	Submission and/or issue	Response to comment
			impact assessment approach, as detailed in Appendix 1 of the PERSP.
Public submission	3.	Section 4.1, Figure 3 states that Derived Proposals will be used to validate and verify material factors. However, given no assessment of impacts at a site-specific basis has been undertaken in the PER and given that both the baseline and impact assessments presented do not meet the EPA Guidance for key factors (Such as flora and vegetation survey effort and content), it should be a requirement of the Derived Proposal to provide information to a level that allows for the assessment of key factors, not just verification. I can understand that the PER has the potential to identify what may be the key factors, but that is about it. If this is a “strategic” proposal, then why wasn’t it referred under Section 16(e), which allows for this more clearly?	BHP Billiton acknowledges the unique opportunity in undertaking a regional-scale assessment through a Strategic Environmental Assessment approach to allow for better understanding of cumulative regional-scale impacts and in doing so, to develop a management approach that will ensure that the environmental objectives can be met. Strategic Environmental Assessments have not been extensively undertaken in Western Australia and BHP Billiton appreciates that there may be uncertainty in the view of stakeholders regarding such an approach. The PERSP provides a regional assessment of potential impacts of the Strategic Proposal against the EPA’s objectives for each environmental Factor. Coupled with the validation process undertaken at the Derived Proposal stage, for specific proposed development, the strategic assessment process provides an additional validation step to ensure the EPA’s objectives can be met for future proposals. Key preliminary factors are determined by the EPA (with input from stakeholders during the public consultation period) at the Environmental Scoping Document (ESD) phase. This was completed in 2012 and the preliminary key factors determined through that process were included in the PERSP. All studies identified in the ESD have been completed (refer Chapter 14 of the PERSP) to meet the

Submitter	Issue Number	Submission and/or issue	Response to comment
			regulatory requirements and with reference to relevant guidance material as detailed in Appendix 1 of the PERSP. The impact assessment contained within the PERSP examines the environmental factors and the likely significance of impact to the environment as a result of implementing future proposals once mitigation measures have been applied. The Strategic Proposal impact assessment was conservative and included cumulative impact assessment at the regional scale. The assessment demonstrated that the environmental objectives can be met. Section 16(e) of the Environmental Protection Act 1986 is a mechanism whereby the EPA prepares strategic advice to the Government. A Strategic Environmental Assessment on the other hand is a mechanism of Part IV of the Environmental Protection Act 1986, which allows for the referral, assessment and approval of Strategic Proposals. The EPA's declaration that future referred proposals are Derived Proposals is legislated for in the Environmental Protection Act 1986 (s39B), and forms part of the Strategic Environmental Assessment process. Please refer to EPA Environmental Impact Assessment Administrative Procedures 2016 for further detail. The referral documentation for a Derived Proposal will contain validation and verification of the key environmental factors assessed for in the Strategic Proposal. It is not the function of the Derived Proposal declaration process to assess key factors, but rather to demonstrate that the

Submitter	Issue Number	Submission and/or issue	Response to comment
			environmental issues raised by the proposal were adequately addressed when the Strategic Proposal was assessed, there is no significant new information or changes in this regard, and the management objective(s) can be met.
2. Flora and vegetation			
Care for Hedland	4.	Care for Hedland has interest in the development around the TECs in figure 18 numbered 5, 10, 11, 2, 3. These are of concern as they are in the boundaries for development, particularly area 5 as it is a high biodiverse area with threatened species.	The Ethel Gorge Aquifer Stygobiont community, Weeli Wolli Spring, West Angelas cracking clays, and Coolibah – Lignum Flats sub-type 1 and 2 are considered as highest priority for management by BHP Billiton Iron Ore. BHP Billiton Iron Ore is committed to the biodiversity management objective and will continue to consult with stakeholders accordingly. The impact assessment in Section 8.1.2.4 of the PERSP shows that even in the highest potential impact scenario, and in considering impacts at a regional scale from BHP Billiton Iron Ore and third party activities, the implementation of future proposals will not result in unacceptable impacts to these TECs and the EPA's objectives can be met. It is expected that the application of the mitigation hierarchy (avoid, minimise, rehabilitate and offset) during project development will target avoidance of impacts to these areas and further reduce the above impacts. BHP Billiton Iron Ore have conducted and sponsored a large amount of surveys, research and monitoring to better understand the functioning of these communities and our

Submitter	Issue Number	Submission and/or issue	Response to comment
			potential impacts upon them. This information was included in the PERSP and has enabled BHP Billiton Iron Ore to conclude that implementation of future proposals will not result in unacceptable impacts. This work will continue and be included in the referral documentation for Derived Proposals that include developments that have the potential to impact these communities.
Wildflower Society of WA	5.	*Failure to meaningfully address regional representation of vegetation.* This will continue to be an ongoing problem for all projects in EIA while no regional plot database exists for Western Australia. It is not possible to complete meaningful EIA for vegetation and ecosystems at any level without this data. None of the existing data or mapping for vegetation is at an appropriate level of detail to be used in EIA. It is problematic enough at a project scale to be approving projects without really understanding their true impacts on vegetation. But for a strategic assessment it is operating blind on a large scale and projecting decisions based on poor information well into the future. That a strategic assessment can be considered without proper regional information on plan communities (vegetation) is beyond comprehension. Especially when this data exists. Beard mapping is too broad in scale to be considered appropriate in any EIA as an appropriate measure of regional representation of vegetation. Even PECs and TECs are not an appropriate measure. They are essentially guesswork as there	BHP Billiton Iron Ore acknowledges the challenges and opportunities in the collation and availability of accurate biodiversity data. We will continue to work closely with regulatory and decision making authorities to improve the quality and availability of biodiversity data. BHP Billiton Iron ore, in addition to sourcing our own data from site-specific surveys, was also provided with all the available regional data from regulatory and decision making authorities, and publically available data from the Atlas of Living Australia. The PERSP determined impact assessment scenarios at a regional level for a number of modelled development scenarios. This high-level approach is integral to a strategic assessment of this scale and is used to determine understanding of the broader ecology of the region, and the foreseeable impacts at this scale. Finer-scale verification of potential impacts will be provided at Derived Proposal phases based on association level mapping and fine scale data across BHP Billiton Iron Ore tenure.

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		has been no systematic analysis of restricted communities applied consistently across the region. No TECs have been added to the list since 2002, anywhere in Western Australia. This undermines the whole concept of state listed TECs, in that they do not even represent an up to date account of threatened ecological communities. This is not the fault of BHP, there were several things they could have done. Number one amongst them recognising this lack of information earlier in the process and exercising their substantial influence to help get the data released. As an organisation that pays for baseline surveys, ensuring they actually serve a purpose should surely be a priority? The whole purpose of the Level 2 plot based survey is to statistically analyse plot data against a regional plot dataset to demonstrate the true regional representation of vegetation types, in the manner that science of the plot based survey intended. The absence of regional plot dataset essentially means that for 20 years or more now, BHP has been completing pointless plot surveys. The CSIRO 'biodiversity significance modelling' appeared to be an attempt to remedy this failure. However the premise underpinning this study is flawed. Species richness does not define what ecosystems are or are not significant. It is unique assemblages of species that determines conservation significance. Communities can have low species richness and low turnover and still be unique and restricted. The CSIRO analysis also seems to say that the hilltops in the Pilbara have low significance, probably again due to low species richness. At least some of those hilltops may be shown to have restricted	BHP Billiton Iron Ore has mapped the vegetation associations across 54% of its tenure. Surveys underpinning this mapping have been conducted in accordance with EPA Guidance Statement 51. BHP Billiton Iron Ore have implemented a standardised vegetation classification system for the vegetation mapping of its tenure in the Pilbara. The classification is based on Specht (1970) with modification by Aplin (1979) and Trudgen (2009) and has been endorsed by DPaW. The vegetation classification system used is equivalent to the level of "association" or Level V of the National Vegetation Information System (NVIS) classification framework. The CSIRO modelling utilised biological survey data provided by BHPBIO (concentrated mostly in or around BHP Billiton Iron Ore tenements) which were combined with data from a systematic and representative survey of over 300 sites across the Pilbara Bioregion conducted by the Western Australian Department of Parks and Wildlife (DPaW), and with species locality records accessed from the Atlas of Living Australia (ALA). These combined data were subjected to rigorous vetting procedures before being employed in subsequent modelling analyses of species compositional dissimilarity using generalised dissimilarity modelling (GDM) and richness using generalised additive modelling (GAM) that underpinned the assessment of biodiversity significance. Hence species richness was not the only indicator examined.

Submitter	Issue Number	Submission and/or issue	Response to comment
		plant communities, if and when a proper multivariate analysis of the Pilbara Biodiversity Survey plot data is ever completed. CSIRO also acknowledged the unavailability of DPaW flora and vegetation data. However they still went ahead with the study without adequate regional information on flora and vegetation. Obscure studies of dubious value would not have been required if the Pilbara Biodiversity Survey plot data had been published. A simple multivariate analysis including BHP plot data and DPaW plot data according to internationally standardised best practice methods in vegetation science, is all that was required to assess regional significance and representation of vegetation. A simple multivariate analysis using quality comprehensive plot data would have provided a straightforward and meaningful outcome. Instead the CSIRO study does the opposite, it uses inadequate data, analyses it in a complicated way and produces what seem to be meaningless results.	Limitations in the predictive capacity of the community-level models are incorporated into the models as a statistically-based estimate of uncertainty. The estimated uncertainty is used to spatially represent the limitations of the output for decision making. Commitments relating to the objectives for the management of key environmental factors have been made, and the ability to maintain these commitments will be subject to verification at Derived Proposal stage. BHP Billiton Iron Ore is committed to adaptive management and continuous improvement. As new data and information becomes available this will be considered and BHP Billiton Iron Ore management systems and processes appropriately adapted within established approval mechanisms to best meet our environmental objectives. BHP Billiton Iron Ore has provided DPaW with the data used in the PERSP, in the interest of building the scientific knowledge base for Pilbara flora and vegetation.
Wildflower Society of WA	6.	*Peer review* The Peer Review Panel contained expertise on process, hydrology and fauna. Out of the eleven people listed, five were fauna specialists. One single academic provided advice on one single flora species. Everyone acknowledges that natural systems need to be managed at an ecosystem level, and then no one does it. There	BHP Billiton Iron Ore acknowledges the value that technical specialists can add to the impact assessment and management measure development. Technical review, by specialised experts took place throughout the development of the PERSP, with a broader focus on the ecology of the region, and the interdependencies of flora and fauna species within the environment. This included with government agencies and respected technical experts in

Submitter	Issue Number	Submission and/or issue	Response to comment
		was not one appropriate person on the panel to provide a Peer Review of the vegetation and ecosystem component of this report. Flora and Vegetation are two separate sciences and two separate disciplines, with vegetation a much more complicated science than both fauna and flora. Yet there is minimal expertise representing flora and no expertise representing vegetation. Vegetation is the most important component of biological EIA as it is a proxy for ecosystems. It is not the role of the community to provide extensive technical review, and yet it has been left to us to point out what are major technical issues. If a result of this submission is that a Peer Review of vegetation is commissioned, more discretion needs to be applied as to who does it. An academic who claims a generalised understanding of biological science is not necessarily appropriate. A statistician with limited botanical experience is not necessarily appropriate. Someone with no Pilbara experience is not appropriate. It is a very useful litmus test to ask prospective reviewers if they can name the science that deals with floristics and vegetation. If they cannot answer this, they are not appropriate reviewers. People can generally name taxonomy as the science underpinning the description of species, but very few people can name the science underpinning the plot-based assessment of vegetation. They cannot name the science how can they possibly review a process that is based on that science?	this field. This assessment was undertaken to meet the EPA's requirements of Guidance Statement 55 "Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process" (EPA 2003). The formalised Peer Review Group were engaged to allow for collaboration in an otherwise developing environmental impact assessment and approval mechanism. In particular, the reviewers were selected based on specialist knowledge of the matters of national environmental significance (MNES) considered in the federal Strategic Assessment undertaken in parallel with the PERSP. Some of the information from the Strategic Assessment was included in the PERSP. The Peer Review Panel were selected based on technical expertise, skills set, and recognition in the industry and within regulatory authorities as being experts in their field. Their scope included review of the conservation significant species, however their review did extend beyond their species-scope to look more broadly at ecosystem interaction. Further peer review is not considered necessary for the PERSP and this document is not the end of the assessment process, with the Strategic Proposal and PERSP yet to be assessed by the EPA.

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Wildflower Society of WA	7.	*Inaccurate Condition Assessment Mapping* Condition assessments and mapping are not consistent across the BHP [Billiton Iron Ore] datasets and condition has been widely downgraded in some areas. This hasn't been deliberate. The condition scale used, was originally developed by Bronwen Keighery for use on the Swan Coastal Plan. A bioregion significantly more degraded and fragmented than the Pilbara. Some of the consultants used by BHP do not understand the context of this condition scale, and it has meant that many surveys have regularly underestimated the condition of the vegetation. The uplands in the Pilbara, apart from areas of localised disturbance, are in Excellent to Pristine condition. There are no weeds in the uplands and they are not grazed. Where and how has their condition been compromised enough to justify a downgrading? Even when the soil is disturbed, weeds rarely take hold and the disturbance rectifies itself. They are almost universally perfectly intact. Table 19 (page 125) does not represent an accurate breakdown of vegetation condition. As the report correctly states, it is lowlands that are vulnerable to degradation, but even most of these are not degraded to the extent that would account for listing such large areas as Degraded to Good condition. We believe this is important because if the strategic assessment is approved, this document is a record of the condition of vegetation at a given point of time that does not accurately reflect reality.	In undertaking this assessment, BHP Billiton Iron Ore has adopted the approach in determining vegetation condition as per EPA Guidance Statement 51, which is a standard requirement in the way impact assessment is currently undertaken in WA. BHP Billiton Iron Ore recognises the high quality of current vegetation condition within the region, reflected in the fact that Table 19 of the PERSP lists that over 89% of BHP Billiton tenure is in Very Good or better condition. Much of this tenure has been historically grazed and includes some areas that are currently or have historically been subject to degradation, particularly from livestock grazing and, more recently, mining activity. The remaining 11% of BHP Billiton Iron Ore tenure is typically contained in lowland areas around waterways or on plains. BHP Billiton acknowledges the limitation on publicly available data at a regional level, and as such has sought to conduct detailed surveys on its own tenure. The data provided at a regional scale is appropriate and allows for strategic assessment of landscape values, and verification for future development at the Derived Proposal stage is always required.

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Public submission	8.	Major companies have 50-100 years of mining proposed so they need to develop procedures which do not need to impact on ecological communities on the scale they do. Unless and until one closed mining lease is in a mature state of rehabilitation and functioning as a mature ecological system they should not be permitted to secure further leases. There are going to be less and less viable ecological communities intact as we go forward, so many should automatically be ruled out of bounds. There is a failure of the EPA to recognise cumulative long term impacts on many developments. Cumulative impacts of land clearing and vegetation clearing, thinning and modification have not been quantified accurately or publically. There is no running sheet on what we have or have lost in WA.	The Strategic Proposal presented all of BHP Billiton Iron Ore's current tenure in the Pilbara and has assessed the impact of potential mining development for the next 100 years. This is a shift-change in the way mining impact assessment has been undertaken in WA and allows for the first time the assessment of cumulative impacts at a regional scale. BHP Billiton Iron Ore has undertaken a number of factor-based regional cumulative impact assessments to support the PERSP. Using a spatial GIS analysis, relevant direct and indirect impacts (from both BHP Billiton Iron Ore and third party activities) have been considered. The assessment covered: • Land (biodiversity) • Water (surface and groundwater) • People (heritage and amenity) • Air (air quality specifically considering particulates and greenhouse gases); and • Integrating factors (closure and rehabilitation) The key inputs into the cumulative impact assessment are summarised in Table 9 of the PERSP. There is an allowance to acquire further tenure within the Project Definition Boundary, as long as BHP Billiton Iron Ore can demonstrate that the objectives for the key environmental factors can be met. Whilst there is no regulatory limit on the amount of tenure which can be acquired, BHP Billiton Iron Ore does try to

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			restrict the amount of active mining tenure both for impact and cost minimisation purposes. Often more than one resource deposit is required to be mined, so that product can meet market demands for quality and quantity. BHP Billiton Iron Ore will be required to meet Closure and Rehabilitation standards, as detailed in Section 8.5.2 of the PERSP. BHP Billiton Iron Ore continues to work in partnership with relevant institutions and government bodies on closure and rehabilitation studies to ensure the best possible closure and rehabilitation success for its operations as identified in Case Study 10 of the PERSP.
3. Hydrological processes			
Public submission	9.	Recommend that the section dealing with water discharges be reviewed/expanded and that the effect of mining operations on stream ecosystems be included, as well as on the identified key receptors. *Rationale* There is increased mining below the water table in the Pilbara that requires extensive dewatering. This water is either used, re-injected or discharged. When mines close the discharge will discontinue. Such large and prolonged changes to the natural hydrological regime will have major effects on the receiving environment.	BHP Billiton Iron Ore acknowledges the importance of water management in a semi-arid climate such as the Pilbara. Potential surface water impacts have been assessed at a regional scale and the PERSP found that the potential impacts were unlikely to be significant and that any discharges will be temporary. Specific discharge proposals will be developed once detailed design has been undertaken and the mitigation hierarchy applied. As such, subject to individual project design, any potential impacts would be validated at Derived Proposal phase in line with outcomes identified through

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		Stream environments in the Pilbara are limited in extent, are generally in good condition, they act as corridors, they provide habitat and drought refuges and have high aesthetic and cultural value. Terrestrial ecosystems with a dependency on ground-water are uncommon, they frequently include species with restricted distribution and some ecosystems are classified as TEC/PEC's. Discussion concentrates more on the potential effects of dewatering rather than on discharge, whereas I believe the results of monitoring show that, while both can be important, discharges have had the greater effect, both in aerial extent and in magnitude. Some of these changes can however be viewed as positive, for example the colonisation of bare areas in the stream-bed by melaleuca as well as increases in sedgelands and native bulrush. In addition, the detrimental change caused by dewatering may be ameliorated by supplementation (as in Weeli Wolli spring) but once dewatering and discharge has commenced there is minimal operational flexibility. The changes caused by mining operations to the ecology also need to be viewed in the light of this very dynamic natural environment, with its episodic occurrences of drought, severe flood, defoliating wildfire and stance replacement by regeneration. These events occur even when the sites are located on a "natural and protected" tenure, such as a Sanctuary or National Park. Annual changes in baseline estimates of crown cover of 20-30 percent are not uncommon.	assessment of the Strategic Proposal and contained in relevant water management plans. Where discharges to the environment are required (for example from dewatering activities), other approvals may also be required, for example an environmental licence under Part V of the *Environmental Protection Act 1986* and further studies would be undertaken as part of these assessments, as required. These additional regulatory processes would further address the potential environmental impact and proposed management measures. BHP Billiton Iron Ore is also guided by the hierarchy of surplus water management recommended by the Department of Water. Greater value uses for the water are considered before surface water discharge. a surplus water management tiered hierarchy is employed to minimise the hydrological footprint, including: 1. Transfer to other neighbouring operations that maybe in deficit. 2. Return to aquifer, where surplus water is reinjected to the aquifer system. 3. Minimise use to reduce or mitigate the drawdown footprint where feasible. 4. Onsite use of water for process water supply. 5. Discharge to surface water features is only considered once other surplus water management options have been explored. As surficial discharge is the last option in the management hierarchy, impacts to stream ecology are minimised where

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			possible. Where discharge into stream or waterways is required for a future proposal, BHP Billiton Iron Ore will be required to demonstrate that biodiversity and water objectives are able to be met through the Derived Proposal process.
Public submission	10.	Firstly all mining companies in WA must move towards providing (sustainable) privately resourced water supply. This may very well require the establishment of a network of pipes on a landscape scale from renewable energy driven desal units peppered across the coast and in areas where saline groundwater is a negative impact on ecology. The days of using finite and diminishing groundwater must end today. WA and Australia are basically exporting their water by stealth by way of products which have too great a component of water involved in production. Water from de-watering should be returned to the ground and stored in the interim. It should never be wasted on wetting roads, rocks and other wasteful activities. Using massive amounts of water on animal fodder is not a productive end use either. This water is a million year plus storage of easily made potable water. WA needs an independent audit of our 'current' state of ecological integrity.	BHP Billiton Iron Ore acknowledges the importance of water management in a semi-arid climate such as the Pilbara and ensures sustainable water management practices in its operations. Managed Aquifer Recharge (MAR) is used at numerous BHP Billiton Iron Ore operations to return dewatered water back to natural aquifers Activities such as dust suppression are required to meet human health, amenity and environmental requirements. De-watered water may be used for these purposes, and ultimately water which is discharged to the ground, ends up back in the environmental system, either in surface water systems or infiltration into groundwater aquifers.
DoW	11.	The drawdown modelling presented is simplistic, and should be considered conservative, given that groundwater impact	Noted. BHP Billiton Iron Ore has worked in collaboration with the DoW and industry experts to develop the drawdown

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		management/mitigation strategies have not been considered in the assessment of ecohydrological change.	modelling and verification will be provided for Derived Proposals as applicable. The model was appropriate at the scale of the strategic environmental assessment and has enabled BHP Billiton to conclude implementation of the Strategic Proposal won't result in unacceptable groundwater impacts.
DoW	12.	The estimation of storage is hard to verify, as the estimation of regional change in groundwater storage (i.e. storage of the regional aquifer interpreted as the saturated Tertiary detritals and weathered dolomite of the Wittenoom Formation) resulting from the proposal, has some fundamental assumptions which, if wrong, could seriously underestimate impacts (e.g. if storage is underestimated, there may be larger impacts to the regional aquifer). However, given the regional nature of the study, this level of uncertainty is appropriate and the DoW assumes that the level of risk will be revisited at the derived proposal stage. If the risk of impact to the regional aquifer is discovered to be greater than predicted in the Strategic Proposal, the future proposal may not qualify as "derived".	Noted. BHP Billiton Iron Ore commits to meeting its objectives for water. BHP Billiton Iron Ore has worked in collaboration with the DoW and industry experts to develop the groundwater model appropriate for the strategic environmental assessment. Verification that the objectives can be met will be provided for in referral documentation for Derived Proposals as applicable. Before the EPA declares that a referred proposal is a Derived Proposal(s) it must consider the criteria specified in section 39B of the EP Act. This will require BHP Billiton to demonstrate that the environmental issues raised by the proposal were adequately addressed when the Strategic Proposal was assessed, there is no significant new information or changes in this regard, and management objective(s) can be met. This process will ensure that impact predictions are verified for specific future proposals for relevant key environmental factors.
DoW	13.	There is insufficient information provided regarding cross section used to determine an average saturation thickness of 50m. An	Noted. BHP Billiton Iron Ore commits to meeting its objectives for water. BHP Billiton Iron Ore has worked in

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		estimated average specific yield of 0.05 is reasonable. Despite this, the level of uncertainty associated with the determination of the groundwater drawdown is appropriate for this strategic level of assessment. Rainfall recharge and groundwater level recovery is not considered which again makes drawdown estimates conservative.	collaboration with the DoW and industry experts to develop the groundwater model and verification that the objectives can be met will be provided for in the referral documentation for Derived Proposals as applicable.
DoW	14.	The Department would require, as part of its licencing process for any derived proposal, appropriate levels of investigation to support the intended groundwater abstraction. The Departments' intent is to manage drawdown impacts whilst a groundwater licence is in force, however the Department does not have the legislated authority to manage water resources and their water-dependent values when a licence is no longer in force. Strict ministerial conditions on the SEA requiring adequate collection of baseline information – prior to presenting a derived proposal – as well as adequate investigation, monitoring and management throughout the entire mining cycle (proposal to relinquishment) should be compulsory as part of the project approval. This will ensure that drawdown impacts on groundwater-dependent ecosystems and values are minimised and can be managed to levels agreed to, prior to any (increased) groundwater abstraction required for the Proposal.	BHP Billiton Iron Ore will still require water abstraction licences which the DoW will licence as applicable. We will engage with regulatory authorities, government authorities, stakeholders and industry experts in meeting the requirements of any Ministerial Conditions related to water. Consideration of the management of the full water lifecycle (including groundwater abstraction) will be detailed in the referral documentation for Derived Proposals as applicable. BHP Billiton Iron Ore expects there to be an appropriate level of monitoring and data collection required, to support future Derived Proposals.
DoW	15.	*Climate change* Climate variability has been addressed in parts of the Strategic Proposal; however there is a distinct lack of information provided on the projected "future climate". It is not clear if "future climate	Future climate scenarios have been considered as far as practicable, and have influenced the structure and outputs of the model.

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		scenarios" were included in the modelling development scenarios presented. This information will become crucial at the derived stage, and the Department expects future proposals should consider best available data and predictions, including latest climate change scenarios. The proponent should commit to incorporate these at the derived stage. Three development scenarios and third party operations have been presented for four regions (hubs) within the Pilbara Expansion study. Water balances were calculated using numerical hydrological modelling for active mine sites and conceptual understanding of the hydrological systems. These modelling results do not include future climate data.	Two model runs were undertaken with climate sensitive parameters updated to reflect the conditions under the latest dry and wet climate predictions for the Pilbara. The runs were used to assess whether climate change may influence model predictions. A CSIRO model provided simulated rainfall and evaporation for several climate change scenarios. These data essentially provide an answer to the question "What would the historical record have looked like under different climatic conditions?" The data were used to estimate the change in historical streamflow. This process resulted in an overall addition of the number of stream flow events in the wettest scenario and an overall removal of stream flow events in the driest scenario. These data were then used to adjust model settings including Dam water level, creek flows and rainfall recharge. BHP Billiton Iron Ore's adaptive management approach will allow for changes in information, technology and the environment to be managed for accordingly. In this way, BHP Billiton Iron Ore will consider the most contemporary information with respect to climate change scenarios for future proposals and demonstrate that the objectives for key environmental factors can still be met.
DoW	16.	There is minimal surface water data available and presented for the SEA footprint and much of the information used for the assessment is sparse. Where no gauging data was available, runoff frequency and volumes have been estimated via	Where surface water has the potential to be impacted in Derived Proposal developments, BHP Billiton Iron Ore will establish baseline conditions and outline management actions to ensure that the objective for Hydrological

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		correlation with rainfall and/or correlations with gauged runoff in similar catchments. The DoW recommends BHP [Billiton Iron Ore] commits to enhancing baseline data collection by gathering water quality and volumetric flow data in snapshots, to expand the existing baseline information and for validation of the current and future modelling.	Processes and Inland Waters Environmental Quality are met. BHP Billiton Iron Ore will engage with regulatory authorities, government authorities, stakeholders and industry experts in the development of baseline studies, monitoring programs and management requirements in order to meet any Ministerial Conditions for the Strategic Proposal. BHP Billiton Iron Ore voluntarily continues to develop an extensive regional hydrological monitoring network to improve baseline data in its operating region.
DoW	17.	*Fortescue Marsh* The water balance of Fortescue Marsh catchment is dominated by surface water contribution. To date, no detailed surface water investigations have been undertaken to evaluate the potential impacts and influence of mining related episodic flow events in the Weeli Wolli Creek and Koodaideri Creek, both of which discharge to the Fortescue River Valley and towards Fortescue Marsh (as part of Weeli Wolli catchment). The DoW recommends further investigation is undertaken throughout the life of mine, including commitment to investigation of cumulative impacts within Weeli Wolli catchment, and other affected surface water catchments (hubs).	BHP Billiton Iron Ore will engage with regulatory authorities, government authorities, stakeholders and industry experts in the development of management actions for future proposals that may impact Fortescue Marsh. This will include the consideration of developing baseline data to determine triggers and thresholds for key assets, which will contribute to the knowledge of the function of Fortescue Marsh.
DoW	18.	Water balance for ungauged catchments were developed using a chloride-based method, without baseline date. The SEA acknowledged that some of the water balance components are	Noted.

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		associated with potentially large uncertainties and the results of chloride-based water balances should be used with caution. BHP Billiton Iron Ore should provide site specific monitoring recommendations at both the strategic scale, and for future derived proposals.	As stated in section 8.2.1.3 of the PERSP, BHP Billiton Iron Ore's Water Management Toolkit will provide for site specific baseline studies, and associated surface water monitoring as applicable. These will be detailed at the Derived Proposal stage.
DoW	19.	Modelling practices and tools (models, software and guidelines) may change with time producing different results to those from 2015/16. Future modelling scenarios should not be solely related to the results presented in the Strategic Proposal but be updated to reflect these changes, and with best available data at that time.	BHP Billiton Iron Ore acknowledges that knowledge, management requirements and management practices will change over time. As a result, the PERSP has allowed for an adaptive management approach which will ensure that changes in science, methodology and baseline data can be managed in such a way as to continue to maintain the management objective for Hydrological Processes and Inland Waters Environmental Quality.
DoW	20.	*Ecohydrological units (EHU)* The DoW understands the Ecohydrological Units model is the framework for identifying surface water and groundwater dependent environments and the ecosystems at (potential) risk – through changes in surface water and groundwater regimes. Small-scale exceptions to these rules often represent high value environments; for example transitions between EHU3 and EHU4, break of slope or narrow upper gorges, have been found to support groundwater dependent wetlands and/or vegetation. DoW requests clarification on what future studies are planned to identify and assess risks to these exceptions, and whether ongoing work will be:	BHP Billiton Iron Ore has undertaken an additional study to provide further clarity on the environmental values of rock pool habitats such as those in EHU3 and EHU4. The results of the work are presented in Appendix 1 to this Supplementary Report and summarised in Section 3.3.3.. The study explores the values of permanent and semi-permanent pools to terrestrial vertebrate fauna and reviews the character and basic hydrological processes of permanent and semipermanent rock pools. The study found that while few Pilbara fauna species would rely specifically on rock pools, these environments may be locally (ephemeral systems) or regionally (permanent systems) important as they can provide resources that are

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		• a condition of the SEA approval; or • as baseline collection for each derived proposal. Stygofauna habitat has been limited in representation to calcretes – represented as a portion of EHU7. Stygofauna habitat extends beyond EHU 7 with high likelihood of inhabiting alluvium and CID across the extent of EHU8 and EHU9, as well as the potential to inhabit EHU5 and 6 (especially where depth to groundwater is <40m). The EHU model should be revised to reflect this general understanding of stygofauna habitat. EHU6 includes areas of sheet flow associated with banded-vegetation types. Sensitivity to surface water change has been rated as low. These sheet flow communities will be highly sensitive to change in sheet flow through the placement of roads and railways and other obstructions and this should be recognised in the EHU framework. Please provide additional information on the impacts discussed above in these ecohydrological units.	utilised by fauna for key ecological activities. As such, BHP Billiton Iron Ore will manage Permanent rock pools as Tier 1 Key Assets and Ephemeral systems as Tier 2 (refer Section 6.2 in the PERSP). Risks to these systems will thus be (in the first instance) avoided where practicable, or mitigated to an acceptable level and we will continue to work with Traditional Owners to further determine cultural values associated with these environments. Stygofauna occurrence at a regional scale remains difficult to determine. In acknowledging this, in addition to the EHU model, BHP Billiton Iron Ore undertook a specific Subterranean Fauna Assessment (Appendix 6 of the PERSP). This study determined potential areas with high species richness, and probability for habitat. We are committed to meeting the objectives for Subterranean fauna as detailed in Section 8.1.5 of the PERSP. BHP Billiton Iron Ore further acknowledges the importance of considered mine planning and design to ensure that impacts to the environment, including ecohydrological considerations, are mitigated and/or managed appropriately. Sensitivity to change at EHU6 has been rated as low as the vegetation accesses stored soil moisture derived from incipient rainfall and run-on/local scale redistribution. It is not anticipated that the placement of infrastructure would significantly change the function of this EHU. Stygofauna have been assessed in further detail in Section 8.1.5 of the PERSP.

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			The specific methods of managing potential impact to vegetation and flora within this EHU for future development will be detailed in the referral documentation at the Derived Proposal stage, as applicable. It should be noted that the EHU model was not developed as a strategic decision making tool but consideration was given to using it as a proxy. Further validation that environmental objectives will be met will be provided in future proposal submissions.
DoW	21.	*Cumulative Impacts* The PER does not mention the departments "Cumulative Impacts (CI) for Water in Mining" project. Specifically, the DoW is developing a clear CI method, in consultation with stakeholders – including the proponent. BHP Billiton Iron Ore has indicated support for the CI project; therefore DoW believed there should be a commitment to ensure CI frameworks from the SEA are designed to be consistent with DoW policy and processes. BHP Billiton Iron Ore commits to meeting the objectives of EPA guidance "Environmental and water assessments relating to mining and mining-related activities in the Fortescue Marsh management area" (Report 1484). The EPA report should recognise that ongoing work will provide an opportunity to inform and update this guidance and allow for additional key environmental assets to be identified and subject to similar guidance.	BHP Billiton Iron Ore supports the DoW in its CI project development. BHP Billiton Iron Ore will seek to engage with DoW in the development of groundwater and surface water management measures, in alignment with contemporary guidance (including but not limited to consistency with DoW policy and processes). BHP Billiton Iron Ore will continue to mitigate risks to hydrological processes and risks to inland waters environmental quality from its activities to an acceptable level. Through adaptive processes and review, we will consider relevant contemporary guidance material in the development of management measures in order to meet these objectives.

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4. Inland waters environmental quality			
DoW	22.	It is unclear if the issue of surface water quality has been adequately addressed. Key indicators presented for the preservation of the ecological values have included surface water quality; however there are no recommendations for further/future surface water quality monitoring. If this information has been included, the DoW requests clarification on where within the documentation this is.	BHP Billiton Iron Ore acknowledges the inherent connection between water and ecological function. Section 8.2.1.3 of the PERSP presented BHP Billiton Iron Ore's Water Management Toolkit. Figure 42 includes controlled surface water discharge and surface water monitoring as Water Management tools. Where surface water has the potential to be impacted in Derived Proposal developments, BHP Billiton Iron Ore will establish baseline conditions and outline management actions to ensure that the objective for Hydrological Processes and Inland Waters Environmental Quality are met. BHP Billiton Iron Ore will engage with regulatory authorities, government authorities, stakeholders and industry experts as required in the development of baseline studies, monitoring programs and management requirements in order to meet any Ministerial Conditions for the Strategic Proposal. BHP Billiton Iron Ore will also voluntarily continue to develop a hydrological monitoring network to improve baseline data in our operating region. We further acknowledge the importance of considered mine closure planning and rehabilitation design to ensure that impacts to the environment, including surface water quality considerations, are mitigated and/or managed appropriately. PERSP Sections 8.5.12, 8.5.1.4, 8.5.2.1, Table 80 and Section 8.5.2.2 detail the potential impacts and associated

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			management of surface water during rehabilitation and post closure. Case Studies are also provided in Section 8.5.2.3.
DoW	23.	The Strategic Proposal lists protection of water quality through sediment trapping and nutrient stripping among the ecological services. DoW assumes that baseline information will be established prior to (pre) submission of the derived proposal, and this baseline to be set as a trigger for each mining area. Can BHPBIO confirm that this baseline information will be collected and used?	Each Derived Proposal application will identify the key environmental assets relevant to the particular development. Where water quality is a key factor, BHP Billiton Iron Ore will establish baseline conditions and outline management actions to ensure that the objective for Hydrological Processes and Inland Waters Environmental Quality are met.
DoW	24.	BHP Billiton Iron Ore asserts that the potential for regional change in surface water quality is negligible and normal business management practices used by BHP Billiton Iron Ore have been efficient in the past. Future climate change projections may make current management practices impractical, and at the derived proposal stage these management practices may need to be revised, incorporating regional scale impacts.	BHP Billiton Iron Ore acknowledges the inherent connection between water and ecological function, and that climate change presents a risk and challenge for future operations. Section 12.1.1 of the PERSP presented BHP Billiton Iron Ore's adaptive management approach which will allow for changes in science, methodology and baseline data to be managed in such a way as to continue to maintain the management objective for Hydrological Processes and Inland Waters Environmental Quality.
5. Subterranean fauna			
DoW	25.	It was a scoping requirement that the proponent 'Correlate biophysical and geological parameters within known subterranean fauna species records and habitat distributions in the regions, to inform habitat mapping' (Table 4, ESD). It is not	BHP Billiton Iron Ore has a regionally- developed learning from a substantive history of stygofauna assessment in the Pilbara. Biophysical parameters of stygofaunal occurrence were modelled to inform potential habitat at a regional scale,

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		clear if biophysical parameters were correlated with stygofauna species records and habitat distribution as required, and the DoW seeks clarification on whether this correlation occurred.	the results of which are contained within PERSP Appendix 6 – Subterranean Fauna Assessment. The Subterranean Fauna Assessment: 1. Briefly reviews subterranean fauna and their occurrence in the Pilbara; 2. Provides a summary of the characteristics of the Pilbara and Strategic Proposal area, including geology and hydrogeology; 3. Provides more detailed information on the occurrence of subterranean fauna in the Pilbara and Strategic Proposal area, including identification of areas with known or potentially rich subterranean fauna communities (focal sites) and a summary of the distributional characteristics of different subterranean fauna groups; and 4. Maps areas that may support significant subterranean fauna communities. In identifying prospective habitat, areas with a depth to groundwater of less than 40m were considered as potential habitat, providing a conservative approach. Areas of prospective stygofauna habitat were ranked as Low or High based on whether depth to groundwater was greater or less than 40m. Groundwater drawdown levels were then used to determine potential risk of impact to stygofauna from the Conceptual Development Scenarios (PERSP Section 8.1.5.4). Outcomes presented in the PERSP incorporated existing knowledge and an assessment of BHP Billiton Iron Ore's

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			data as outlined in Appendix 6. An assessment of the stygofauna records from the Pilbara Biological Survey by Halse et al. 2014 found that water chemistry appeared to have limited influence on stygofauna occurrence in the Pilbara. Species diversity was negatively correlated with salinity in this study. Groundwater salinity within the PERSP assessment area is typically fresh to brackish and not considered sufficiently variable at levels to impact stygofauna assemblages that would provide value in applying salinity as a factor in mapping habitat at a regional scale. Initial work completed for the SEA is presently being tested and expanded through a two year project with CSIRO Land and Water that includes modelling stygofauna diversity patterns in the Pilbara. Scoping for this study included input from the WA Museum, DPaW, and the OEPA. Outcomes from this work are expected in financial year 2018.
DoW	26.	*Asset ranking system* Flora and fauna species have been ranked according to their priority for management consideration by the proponent (3-tier system, Table 7) however, stygofauna species are not dealt with in the ranking system. Presumably this is because no subterranean fauna species or ecological community in the Pilbara is currently listed or formally recognised under the EPBC Act, IUCN Red List or Wildlife Conservation Act 1950. As a	BHP Billiton Iron Ore acknowledges the lack of elevated legislative protection of stygofauna species, which is why it has progressed with a precautionary approach. The management objective for assets and species is dependent upon the Tier in which they are recognised (required level of protection). Currently, due to the lack of formal listing or legislative recognition, and their relatively undescribed nature, stygofauna will be managed as Tier 2 species. The Derived Proposal applications will include rationale for determination of whether or not detailed subterranean fauna

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		result, stygofauna species are considered as Tier 3, and have the lowest priority for management. BHP Billiton Iron Ore states that species with non-formal protection will be assessed on a case by case basis to determine management priority. Clarification is required as to what 'management priority' means, as the 3-tier ranking does not seem to include stygofauna species. This is especially important if stygofauna species are not considered by the proponent as a significant factor (paragraph 2, page 55). DoW understands the case by case basis to mean that for each derived proposal, the proponent commits to undertaking detailed subterranean fauna surveys that will help determine if a particular stygofauna species is worth protecting. This ranking of species is expected to be independent of the 3-tier ranking system described in the Strategic Proposal. Can you please provide clarification on this matter?	surveys are required, based on the nature of the activity and the subterranean composition of the individual site. Hence, the requirement for undertaking detailed subterranean fauna surveys will be determined on a case-by-case (Derived Proposal) basis, subject to individual project details and the conditions set by the Minister in respect to the Strategic Proposal. BHP Billiton Iron Ore will develop outcomes and objectives for Subterranean fauna in conjunction with regulatory authorities and will verify that these can be met at Derived Proposal stage, as applicable.
DoW	27.	*Section 8.1.5.4 – Impact to Stygofauna: Stygofauna habitat prospectivity mapping* (Figure 34 of the Strategic Proposal) is based on depth to groundwater only. DoW considers that surface geology is also an important factor in mapping stygofauna habitat due to the fact that they inhabit unconfined aquifers. Different lithologies have variable pore space and connectedness; therefore the DoW suggests a multi-factor analysis in mapping stygofauna habitat (including geology and depth to water) to provide a more definitive habitat prospectivity map and to inform the EPA's final assessment.	BHP Billiton Iron Ore acknowledges that biophysical features can influence the presence of stygofauna. Biophysical parameters of stygofaunal occurrence was modelled to inform potential habitat at a regional scale, the results of which are contained within PERSP Appendix 6 – Subterranean Fauna Assessment. Additionally, the methodology did incorporate a geological element by only considering the regional aquifer systems in the assessment. There are insufficient data to determine the local and hydrogeological properties of the medium.

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			Contemporary studies indicate only low numbers of stygofauna below a 30m depth. Accordingly, the depth to groundwater across the eastern and central parts of the Strategic Proposal area was modelled to identify areas that are potentially prospective for stygofauna and areas where few stygofauna will occur, irrespective of geology, because the water table is too far below the surface. A conservative criterion of below 40m to water table was used to identify these prospective areas (in line with DoW recommendations). This methodology and approach was provided in Appendix 6 to the PERSP. The EPAs Environmental Assessment Guideline 12 provides some guidance on subterranean fauna survey technique, as followed by BHP Billiton Iron Ore: “Adequate survey is integral to understanding the species present, nevertheless the EPA recognises that the use of surrogates can augment existing information. The use of surrogates together with the information gathered during survey, aims to raise the level of confidence in the predictions of impacts and provide sufficient confidence that the environmental objective can be met.”
6. Terrestrial fauna			
Care for Hedland	28.	It is important for all types of flora and fauna, that the provision of effective and meaningful wildlife corridors between minesites and across railway corridors is an important consideration.	The Regional Management Approach will be consistent with EPA guidance and state government policy, namely: avoid impact, and minimise impact as the first measures of

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			minimising disturbance footprints. In this way ecological linkages will be retained where possible and we have historically destocked areas for this purpose. We have considered corridor thinking in our approach to offsets more broadly. In avoiding and minimising disturbance to vegetation wherever possible, BHP Billiton Iron Ore can endeavour to retain as much native vegetation and habitat as practicable. Certain 'clearing exclusion' areas will apply in the case of protected flora, vegetation and habitat.
Care for Hedland	29.	As mentioned in the document there is no dataset for vertebrate fauna in the Pilbara. Perhaps there should be an initiative to get this data as to have a baseline for the area.	BHP Billiton Iron ore, in addition to sourcing our own data from site-specific surveys, was also provided with all the available regional data from regulatory and decision making authorities, and publically available data from the Atlas of Living Australia. As part of the Pilbara Expansion Public Environmental Review Strategic Proposal, BHP Billiton Iron Ore has provided all data to DPaW, with the intent for it to be made publicly available.
7 Heritage.			
Department of Aboriginal Affairs	30.	Based on the records available to DAA regarding past Aboriginal heritage surveys, DAA is of the opinion that potential impacts to	Noted. BHP Billiton Iron Ore will continue to meet the requirements of the *Aboriginal Heritage Act 1972*. BHP Billiton Iron Ore acknowledges the significance of Aboriginal

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		Aboriginal sites from the Proposal can be addressed by the provision of the Aboriginal Heritage Act 1972.	heritage values in the Pilbara region and continues to commit to regular engagement of Traditional Owners.
8. Human Health			
Care for Hedland	31.	Care for Hedland supports the view that the State regulatory authorities should have more involvement in the measurement of dust emissions from these operations, particularly when the operations are within close proximity to residential townships and populations.	While activities within Port Hedland are out of the scope of the Strategic Proposal, the potential for indirect impacts has been assessed. Dust modelling was undertaken for the Strategic Proposal and was conservative in nature (it modelled all of BHP Billiton's current and potential future operations as being operational at the same time, which will rarely if ever be the case). The modelling considered impacts to sensitive receptors in the vicinity of future operations, including Newman township. Monitoring programs are part of BHP Billiton's existing and ongoing management practices and BHP Billiton will continue to work with relevant regulatory authorities. Any proposed changes to production and export associated with BHP Billiton's activities at Port Hedland will be considered separately, including the requirement for impact assessment or amendment to existing approvals and licences. BHP Billiton Iron Ore remains open to regulatory involvement in monitoring in communities.

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Town of Port Hedland	32.	To protect both the Port Hedland environment and living conditions for the community, the following comments are made: • BHP Billiton Iron Ore and other operators consider the findings of the Port Hedland Dust Health Risk Assessment and take relevant action to ensure that dust emissions (individual and collective) for Port Hedland operations do not negatively impact on surrounding sensitive receptors. If an increase in production and export is proposed then effective control mechanisms to reduce dust and noise emissions need to be implemented. • The necessary planning restrictions imposed on development to mitigate the adverse health effects of dust on residents this inhibiting the improvement of lots in the West End.	BHP Billiton Iron Ore acknowledges the release of the Health Department's Health Risk Assessment report (HRA) (DoH 2016). The Company supports the HRA's recommendations and is committed to managing its contribution to overall dust levels at the port. Whilst activities within Port Hedland are out of scope for the Strategic Proposal, BHP Billiton Iron Ore has considered potential indirect impacts of secondary actions associated with implementation of the Strategic Proposal. Secondary actions are those that are not directly related to the scope of the Strategic Proposal but that may arise as a result of development undertaken for the Strategic Proposal. In considering indirect impacts, BHP Billiton Iron Ore identified that it's port operations at Port Hedland may require changes to throughput volumes as a result of the implementation of Derived Proposals under the Strategic Proposal but that indirect impacts to Port Hedland are unlikely to occur. Any proposed changes to production and export associated with BHP Billiton's activities will be considered separately, including the requirement for impact assessment or amendment to existing approvals and licences.

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9. Offsets			
Public submission	33.	The flawed concept of 'environmental offsets' must be abandoned immediately in all developments in WA. It is a perverse system which is exploitative of existing and diminishing environmental communities/assets which delivers no demonstrable gain or even maintain current levels of existing biological communities.	BHP Billiton Iron Ore understands that avoidance is the best environmental outcome and will utilise the mitigation hierarchy (Section 12.1.1 of the PERSP) in all instances. The use of offsets is a WA State Government Policy and BHP Billiton Iron Ore will align with legislative requirements, as determined in the *Environmental Protection Act 1986* for residual environmental impacts, at the discretion of the Minister for the Environment and Heritage.
DPaW	34.	**Recommendation:** That if the proposal is considered acceptable, Parks and Wildlife [should be] involved in discussions of possible conservation offset measures aimed at mitigating the residual impacts of the project on conservation significant values. It is recommended that the identification of offsets takes into account the impacts of the proposal on: • Parks and Wildlife-,managed land (including proposed reserves) at the time of referral of the derived proposal; and • Conservation significant biodiversity values (e.g. flora, fauna and ecological communities).	Noted. BHP Billiton will continue to collaborate with and be advised by DPaW as appropriate. Since lodgement of the PERSP for public review, development of the Pilbara Strategic Conservation Fund has been initiated by the OEPA. BHP Billiton Iron Ore has allowed for contributions to the fund in its offsets approach (Section 8.5.3 of the PERSP). BHP Billiton understand that the Regional Conservation Strategy will be prepared by DPaW and will inform the goals, objectives and strategies for the fund.

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Public submission	35.	I recommend that the discussion on the types of offsets that could be available to mining companies should be expanded. I also recommend that fire management should be included as an offsets measure. Rationale: Offset strategies are discussed. Workshops and a CSIRO study have evaluated the key threatening processes and the top three most cost-efficient strategies for investment were listed as follows: management of feral ungulates, cat management and sanctuaries. The 'Sanctuaries' concept is site-based whereas the other two measures are landscape-based. I would agree with these strategies, but, I would add another key factor: the management of fire. The EPA's strategic conservation initiative (the Pilbara Conservation Fund) is being developed through a series of workshops. While BHPB endorses the concept 'in principle' it has reserved commitment until all arrangements are agreed and in place. Some Offset for 'residual damage' will certainly be required by the State as the 'Conceptual Full Development Scenario" in Table 8, p71, is estimated to have a footprint within the project area of some 228,000ha (BHPB 125,000ha), of which a large part (about 50,000ha for BHPB operations, p395) will be mine-pits that will be difficult/not possible to rehabilitate successfully and where any future use will be restricted by considerations of OHS, fluctuating water tables and possibly water quality problems.	With a Strategic Proposal spanning a long timeframe, there is a great potential for innovation and change in the methodologies available for offsets implementation. BHP Billiton Iron Ore will be open to exploring any such opportunities as long as the key factor objectives can be met. Since lodgement of the PERSP for public review, development of the Pilbara Strategic Conservation Fund has been initiated by the OEPA. BHP Billiton Iron Ore has allowed for contributions to the fund in its offsets approach (Section 8.5.3 of the PERSP). BHP Billiton understand that the Regional Conservation Strategy will be prepared by DPaW and will inform the goals, objectives and strategies for the fund. Our understanding is that the Strategy will focus on 'on-ground' initiatives which will likely include fire management.

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		I assume that 'sanctuaries' suggests the location and protection, by management, of identified 'key' sites, for example: TEC's, PEC's, DRF, clay-pans, grasslands, banded mulga, stream zones and cultural/historic locations. The report has identified at least a dozen sites that would qualify (Table 13) and I am confident that at least a dozen more valuable sites could easily be added. As mentioned earlier, at least half are likely to be located on pastoral land, and many are on leases held by the major mining companies. Protection and management of 'sanctuaries' will be more focused than the other three landscape based measures that have been proposed and could therefore employ additional management techniques. For example – partial destocking, rotation grazing, drainage, supplementation, fencing or weed control may well be appropriate in some cases. The involvement and cooperation of the lessee will be essential. And direct or 'in-kind' costs borne by the lessee should be recognised by the EPA as a legitimate Offset contribution. I also find it incongruous that mining companies are required to spend millions of dollars rehabilitating relatively small areas within a pastoral landscape that may be severely damaged from overgrazing by pastoralists (e.g. parts of the North Eastern Goldfields and Pilbara). Pastoral management on leases held by mining companies tends to be more conservative as this is not their primary source of income. I believe that the EPA and DPaW should be able to recognise improvements in pastoral management by mining companies as a positive, landscape-wide	

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		contribution to enhancing biodiversity (i.e. as an Offset under the strategic conservation initiative). The model provided by the Pilbara Conservation Fund appears more suited to landscape-based management initiatives. A case-by-case evaluation is more appropriate for each 'Sanctuary' site. While the model is simple to apply (footprint disturbed by mining in ha x $/ha) it appears to be rather 'one dimensional' and additional options for Offsets should be explored, as discussed above.	
DoW	36.	The EPA recognises the conservation significance and the need for preservation of subterranean fauna via its current assessment processes – however it is not clear at which point stygofauna species become a significant factor in a derived proposal. DoW recommends that EPA initiates Pilbara wide stygofauna species mapping to incorporate stygofauna into the T1, T2 and T3 ranking system. DoW suggests that this mapping could be established as an offset condition.	Noted. Since lodgement of the PERSP for public review, development of the Pilbara Strategic Conservation Fund has been initiated by the OEPA. BHP Billiton Iron Ore has allowed for contributions to the fund in its offsets approach (Section 8.5.3 of the PERSP). The fund could potentially include activities which could contribute to better environmental knowledge.
10. Rehabilitation and decommissioning			
DPaW	37.	If the proposal is considered acceptable a condition of approval [should be] applied that requires monitoring and reporting on the recovery of the closure and rehabilitation (including rehabilitation relating to construction activities, i.e. borrow pits, quarries, turkey	As outlined in Sections 8.5.2 and 12.2.6 of the PERSP for all Derived Proposals that require a Mine Closure Plan BHP Billiton Iron Ore will ensure alignment with the contemporary State government Guidelines (e.g. Guidelines for Preparing Mine Closure Plans (DMP & EPA)). These guidelines

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		nests, etc.), relevant to completion criteria, until criteria have been met to the satisfaction of Parks and Wildlife.	include requirements for monitoring, reporting and completion criteria. BHP Billiton Iron Ore will further ensure that Parks and Wildlife are consulted in the development of completion criteria at the time of Mine Closure Plan preparation.
DMP	38.	As a result of the Draft PER review, DMP identified deficiencies in the outcome-based management objective for rehabilitation and closure. DMP is of the opinion that this has now been adequately addressed in the final version of the PER.	Noted.
DoW	39.	The Proponent was required to present an outline of their closure and rehabilitation research and monitoring programs undertaken within the region as part of the scoping requirement. Several case studies have been presented which show rehabilitation trials, AMD, mine pit lakes and post mining land use – detailing historic work completed – however there is little provided on future, planned research. DoW request future and ongoing research on closure and rehabilitation are undertaken as a condition of ministerial approval. BHPBIO's management approach for surface water states that they will "minimise impacts to surface water through surface drainage control and pit lake management". Surface water management during rehabilitation and post closure is crucial for long term impact minimisation, especially given potential pit-lake scenarios.	As outlined in Sections 8.5.2 and 12.2.6 of the PERSP for all Derived Proposals that require a Mine Closure Plan we will ensure alignment with the contemporary state government Guidelines (e.g. Guidelines for Preparing Mine Closure Plans (DMP & EPA)). These guidelines including requirements for outlining a schedule of work for research, investigations and trials along with reporting the outcomes of these programs. This will include undertaking more detailed studies and design as each referred project reaches maturity to allow for the development of detailed Mine Closure Plans for assessment. More specific detail regarding the management approach for surface water and potential pits lakes will be addressed in Mine Closure Plans for Derived Proposals, if applicable.

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		The outcomes based management objectives presented are based on a regional management approach, with an adaptive management hierarchy, closure toolkit and mine closure plans. The DoW considers the information presented is acceptable for this strategic level; however more specific detail will be required at the derived proposal stage.	
11. Other			
Public submission	40.	*Assessment process* There doesn't seem to be any actual assessment of impacts these future mines will have on the environment. It doesn't say how the environment will be protected from all these mines. And there is no assessment of the impacts to enable the EPA to tell it is going to be unacceptable or not? It is very difficult to see how the EPA is going to assess this proposal with the information given.	A strategic environmental assessment cannot necessarily consider site specific mitigation and residual impacts for all environmental factors in the same way as individual proposals. Detailed individual proposal scopes and proposal-specific mitigation measures will be developed following approval of the Strategic Proposal. These will be detailed in the referral documentation for future development at Derived Proposal stage. The Strategic Proposal provides for regional (landscape scale) impact assessment of the cumulative (conservative/worst case) impact of development on BHP Billiton Iron Ore's current tenure in the Pilbara, in addition to reasonably foreseeable third party projects. This has demonstrated that key environmental factors and regional environmental assets can be managed to meet the objectives stated in the PERSP. The management approach has been defined in the PERSP. The management approach has been defined in the PERSP. Detail on the specific management actions for a future proposal, to

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			ensure that the environmental objectives are met, will be identified at the Derived Proposal stage.
Public submission	41.	*Strategic proposal process* It is not clear on the Derived Proposal process – this is not standard for PERs. I have not seen this process before. So, the EPA will be issuing approval for mines it hasn't assessed? How is that OK? Also, given the enormous lack of site specific information included in this PER, the Derived Proposals are going to be huge, yet there is only a 7 day public comment period. This should be extended. Otherwise, this proposal should include more site-specific information.	BHP Billiton acknowledges the unique opportunity in undertaking a regional-scale assessment through a Strategic Environmental Assessment approach to allow for better understanding of cumulative regional-scale impacts and in doing so, to develop a management approach that will ensure that the environmental objectives can be met. Strategic Environmental Assessments have not been extensively undertaken in Western Australia and BHP Billiton appreciates that there may be uncertainty in the minds of stakeholders regarding such an approach. Derived Proposals are legislated for in the *Environmental Protection Act 1986* (s39B), as part of the Strategic Environmental Assessment process. Please refer to EPA Environmental Impact Assessment Administrative Procedures 2016 for further detail. A Strategic Environmental Assessment is in its nature, conducted at a higher level than for individual proposals. The PERSP provides assessment of potential impacts of the Strategic Proposal at a regional scale, thereby focusing on broad ecosystem function and environmental factor values. Objectives for the management of key environmental factors have been set. The purpose of the Derived Proposal process is to verify that the environmental issues raised by the proposal were adequately addressed when the Strategic Proposal was assessed, there is no significant new

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			information or changes in this regard, and these objectives can be met. The public comment on the Derived Proposal is not intended to provide review of an impact assessment, but rather a review of whether the criteria for declaring a referred proposal to be a Derived Proposal is met. The comment period reflects the standard timeframe for public comment on referred proposals under s2.5.1 of the EIA Administrative Procedures 2016. A Derived Proposal template was provided in Appendix 11 of the PERSP and further clarification is provided in Section 4.2 of this Supplementary Report.
Public submission	42.	*Policies and guidance* The EPA now has a very useful page on its website about guidance and policies, It is not clear how these have been followed and met within this proposal. Specifically given the lack of site specific information, usually provided in a PER. The impact assessments certainly do not meet the EPA's guidance for things like flora and vegetation assessments. It is presumed that this will be undertaken in the Derived Proposal stage. But does that really meet the Guidelines? Aren't the Guidelines supposed to be met before the EPA gives approval, not after?	A detailed summary of relevant legislation, policy and guidance, and applicability to the Strategic Proposal was provided in Appendix 1 of the PERSP. The EPA guidance for undertaking and assessing impacts to the key EPA factors is considered to be met for all factors in the Project Definition Boundary. What is different about the Strategic Proposal from 'traditional' assessments is the scale at which this impact assessment is undertaken. The impact assessment for the Pilbara Expansion has been undertaken at a regional scale, in line with requirements for a Strategic Environmental Assessment. The requirements of the EP Act (Part IV) for Strategic Environmental Assessments must be met before EPA provides its recommendations to the Minister for the

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			Environment. If the Minister approves the Strategic Proposal, BHP Billiton Iron Ore is not authorised to commence development included within the scope of the Strategic Proposal, rather may progress to the next stage by seeking a Derived Proposal declaration from the EPA in respect to referred proposals for future development. Before the EPA declares that a referred proposal is a Derived Proposal(s) it must consider the criteria as specified in section 39B of the EP Act. This will require BHP Billiton to demonstrate that the environmental issues raised by the proposal were adequately addressed when the Strategic Proposal was assessed, there is no significant new information or changes in this regard, and management objective(s) can be met. This process will ensure that impact predictions are verified for specific future proposals for relevant key environmental factors For further information, refer to Section 4.2 of this Supplementary Report.
Public submission	43.	*Level of information in the PER* It's hard to see the 'strategy' in this proposal. I mean there is a lot of information but it's too high level to be useful for site specific assessment, but there is no clear overarching framework for how each environmental factor is going to be assessed, mitigated and managed either. It says there is, but in reading the document it is really difficult to see that the framework is present.	BHP Billiton acknowledges the unique opportunity in undertaking a regional-scale assessment that is offered through a Strategic Environmental Assessment approach, to allow for better understanding of cumulative regional-scale impacts and in doing so, to develop a management approach that will ensure that the environmental objectives can be met. Strategic Environmental Assessments have not been extensively undertaken in Western Australia and BHP

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		None of the information is site specific, or even tenure specific. High level information, as whether land is in the conservation estate or setting up these Ecohydrological Landscape Units, is focused on. But there is not analysis of, for example, the percentage of riverine units which present and which are going to be impacted by the proposal. Without this sort of information how can the EPA tell if the proposal impact of the implementation of the proposal is going to be environmentally acceptable? This level of information is absent for all key factors. Without which it seems impossible for the EPA to undertake an acceptable assessment of impacts and to determine whether the proposal will result in significant impacts to the factors it outlines in its guidance.	Billiton appreciates that there may be uncertainty in the minds of stakeholders regarding such an approach. The EPA guidance for undertaking and assessing impacts to the key EPA factors is considered to be met for all factors in the Project Definition Boundary. What is different about the Strategic Proposal from 'traditional' assessments is the scale at which this impact assessment is undertaken. The impact assessment for the Strategic Proposal has been undertaken at a regional scale, in line with requirements for a Strategic Environmental Assessment. The requirements of the EP Act (Part IV) for Strategic Environmental Assessments must be met before EPA provides its recommendations to the Minister for the Environment. If the Minister approves the Strategic Proposal, BHP Billiton Iron Ore is not authorised to commence development included within the scope of the Strategic Proposal, rather may progress to the next stage by seeking a Derived Proposal declaration from the EPA in respect to referred proposals for future development. Before the EPA declares that a referred proposal is a Derived Proposal(s) it must consider the criteria as specified in section 39B of the EP Act. This will require BHP Billiton to demonstrate that the environmental issues raised by the proposal were adequately addressed when the Strategic Proposal was assessed, there is no significant new information or changes in this regard, and management objective(s) can be met. This process will ensure that impact

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			predictions are verified for specific future proposals for relevant key environmental factors. For further information, refer to Section 4.2 of this Supplementary Report.
Public submission	44.	*Cumulative impact assessment* A cumulative impact assessment for the entire proposal has not been presented (sure, baseline information is there, but limited information on overall impact is presented) and not enough information on development scenarios is provided for other parties in the project definition boundary to undertake assessments of their own. Will BHP Billiton be providing information to the EPA or other proponents which allows this level of assessment to be undertaken? It is a serious concern to the community that the level of development being shown in this proposal is being considered in the Pilbara. And BHP is only one operator, it's got to be assumed that Rio or FMG have similar plans for development.	In undertaking the only WA, private industry-led, Strategic Environmental Assessment, BHP Billiton Iron Ore has provided for the first time a life of asset mine development scenario that allows for the assessment of cumulative impacts at a regional scale. This cumulative impact assessment has been undertaken for BHP Billiton Iron Ore's current and potential future developments, the results of which are contained in Chapter 8 of the PERSP. The regional impact assessment results will require consideration by third parties for development(s) as applicable. The Full Development Scenario forms the basis of the impact assessment in the PERSP will inform the EPA's advice to the Minister on the impacts of the Strategic Proposal. BHP Billiton Iron Ore has demonstrated that the key factor objectives are able to be met for the Full Development Scenario. Data contained in the PERSP has been supplied to the EPA and DPaW with the intent for it to be publicly available.

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Public submission	45.	*Implementation conditions and management plans* The PER contains a lot of nice words about mitigation and management approaches to the key factors. How will the company be held to these commitments? Will these be referred to in the Ministerial Statement? There are an awful lot of them, but given no management plans were provided to comment on, surely these commitments (such as Table 44 in the PERSP) will need to be reflected in the approval, if given.	The management approach has been defined in the PERSP. Detail on the specific management actions for a future proposal to ensure that the environmental objectives are met will be identified at the Derived Proposal stage. BHP Billiton Iron Ore will track and incorporate obligations in these Management Plans for OEPA endorsement prior to implementation of future proposals. Table 44 (and similar) in the PERSP provides examples of potential management approaches. To allow for changes to the environment, processes, technology and knowledge, the management approach is adaptive. The ability to meet the key factor objectives is the overarching focus and BHP Billiton Iron Ore expects that Ministerial Conditions will be set to provide for this.
Wildflower Society of WA	46.	The concept of a strategic assessment is fundamentally a sound one. However, to implement one as it was intended, the planning needs to be based on comprehensive and sound regional information. There is no real excuse in this case for why it wasn't possible. The regional information was collected 14 years ago. It has simply not been released.	BHP Billiton Iron Ore acknowledges the challenges and opportunities in the collation and availability of accurate biodiversity data. BHP Billiton Iron Ore has sought to use all available data, supplementing our own data with that supplied by regulatory authorities and data which are publicly available. As part of the Pilbara Expansion Public Environmental Review Strategic Proposal, BHP Billiton Iron Ore has provided all data to DPaW, with the intent for it to be made publicly available.

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Town of Port Hedland	47.	Whilst the proposed Pilbara Expansion, as detailed in the strategic proposal, does not directly impact on Port Hedland, the proposal does pose potential secondary impacts on our community. Port Hedland has, over the history of bulk commodity exports, been subjected to significant exposure to dust as well as other environmental and social impacts created by 'boom' times and the substantial migration of a temporary workforce. To protect both the Port Hedland environment and living conditions for the community, the following comments are made: • All current and future mining and logistical issues should be formally required to operate under 'international best practice' guidelines. • BHP Billiton Iron Ore consider the findings of the Port Hedland Dust Health Risk Assessment and take relevant action to ensure that dust emissions (individual and collective) for Port Hedland operations do not negatively impact on surrounding sensitive receptors. If an increase in production and export is proposed then effective control mechanisms to reduce dust and noise emissions need to be implemented. • The amenity of the Port Hedland urban area should not be negatively impacted as has been experienced by: - The necessary planning restrictions imposed on development to mitigate the adverse health effects of dust on residents [thus] inhibiting the improvement of lots in the West End; and - Adverse effects on the visual aesthetics of the community through the settling of dust on structures.	BHP Billiton Iron Ore is committed to effective dust management at the port. The effectiveness of our broad range of leading dust controls has seen our contribution to overall dust levels in Port Hedland diminish over time, despite an increase in production. Whilst activities within Port Hedland are out of scope for the Strategic Proposal, BHP Billiton Iron Ore has considered potential indirect impacts of secondary actions associated with implementation of the Strategic Proposal. Secondary actions are those that are not directly related to the scope of the Strategic Proposal but that may arise as a result of development undertaken for the Strategic Proposal. In considering indirect impacts, BHP Billiton Iron Ore identified that it's port operations at Port Hedland may require changes to throughput volumes as a result of the implementation of Derived Proposals under the Strategic Proposal. Potential indirect impacts outside the Project Definition Boundary for implementation of the Strategic Proposal have been identified and have either been adequately addressed through existing approvals or will be assessed through future approvals where required. Any proposed changes to the functioning or ore volumes at Port Hedland associated with BHP Billiton's activities will be considered separately, including the requirement for impact assessment or amendment to existing approvals and licences at Port Hedland (i.e. separate to the Strategic Proposal).

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DPaW	48.	*Conservation Estate/DPaW Managed Lands* DPaW has the following recommendations in regards to the State's conservation estate: **Recommendation:** That, if the Strategic Proposal is considered acceptable, a condition of approval [should be] applied that ensures there are no impacts from derived proposals on the values of CALM Act reserves, in particular the class A Karijini National Park and class A Mungaroona Range Nature Reserve. **Recommendation**: That selection of prospective ore bodies and the design and location of infrastructure for the derived proposals [should] include application of the mitigation hierarchy for potential impacts on the range of values of Parks and Wildlife managed lands (e.g. flora, fauna, communities, recreation, tourism, other visitor activities, etc.), particularly the Juna Downs proposed reserve area, which appears to be subject to proposed direct impacts from three mining proposed operation area hubs (Munjina/Upper Marillana, Tandanya and Mudlark). **Recommendation:** That, if elements of a derived proposal have impacts on proposed CALM Act conservation reserve areas and these impacts are considered acceptable, a condition of approval [should be] applied that requires the development and achievement of best practice completion criteria (i.e. specific, measurable, attainable, realistic and timely) to the requirements of the Office of the EPA on advice from Parks and Wildlife. The land area within the 'Project Definition Boundary' covers approximately 7,650,074 ha and based on the proponents 'Full	BHP Billiton Iron Ore acknowledges the recommendations of the Department of Parks and Wildlife, specifically: We acknowledge the biodiversity values associated with gazetted Nature Reserves and considers them Tier 1 assets, for prioritised environmental management. Karijini National Park has been excluded from the scope of potential activities associated with the Strategic Proposal as a result. The cumulative impact assessment contained within the PERSP shows that the values of CALM Act lands are not anticipated to be impacted as a result of BHP Billiton Iron Ore's Strategic Proposal. This will be verified in Derived Proposals with BHP Billiton Iron Ore detailing how its objectives for regional biodiversity, flora and vegetation, and terrestrial fauna will be met. Verification at the Derived Proposal stage enables future changes to land use, and conservation estate boundaries to be taken into consideration at the time of specific developments. BHP Billiton Iron Ore will continue to engage with DPaW, industry experts, regulatory authorities and other stakeholders, when developing and implementing management measures, to ensure that the objectives for flora and vegetation, and fauna are met. Management Plans will include triggers, thresholds and specific measures as appropriate.

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		Conceptual Development Scenario' (i.e. total impact area based on the proponent's potential disturbance footprint, reasonably foreseeable third party disturbance footprint and other disturbances) the proposal has the potential to impact on a total area of 277,746 ha. The 'Project Definition Boundary' is primarily located within the Pilbara bioregion of Western Australia and extends across three biogeographic subregions including the Pilbara, Gascoyne, and Little Sandy Desert as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (DSEWPaC, 2012). One of the key functions and priorities of Parks and Wildlife (and its predecessors) is to establish and manage a comprehensive, adequate and representative (CAR) conservation reserve system designed to meet national and international targets. Currently there are significant gaps in Western Australia's conservation reserve system generally, and in the Pilbara bioregion. The desired CAR reserve system target is at least 15 per cent of the area of terrestrial ecosystems within each bioregion in International Union for Conservation of Nature (IUCN) Category I, II, or IV reserves. Only 14 of the 164 vegetation associations in the Pilbara bioregion are adequately represented in the formal conservation reserve system. Parks and Wildlife, in attempting to meet this target, has acquired pastoral leases (full and part, like the pastoral leases identified in item 1 above) with State and Commonwealth funds for addition to the conservation reserve system,/ Formal reservation requires additional negotiation with native title holders or claimants and	Since lodgement of the PERSP for public review, development of the Pilbara Strategic Conservation Fund has been initiated by the OEPA. BHP Billiton Iron Ore has allowed for contributions to the fund in its offsets approach (Section 8.5.3 of the PERSP). BHP Billiton Iron Ore will support the application of these offsets to provide for conservation of environmental assets throughout the Pilbara IBRA.

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		stakeholders and approval through Parliament. In the meantime. The department is managing these formal pastoral leases for the purpose of maintaining and enhancing their conservation, landscape and heritage values consistent with their intended purpose as formal CALM Act reserves. The strategic proposal does not appropriately recognise that significant impacts on proposed conservation reserve areas may reduce the likelihood for the CAR formal conservation reserve system targets being achieved. Further, it is uncertain whether further suitable land parcels containing intact areas can be identified or made available to compensate for any loss to these proposed reserves should the strategic proposal be approved. The proponent's 'Full Conceptual Development Scenario' disturbance footprint occurs directly adjacent to Karijini National Park (with some of the proposed disturbance footprints between 50-200 meters from the boundary of the national park) and includes portions of the former Juna Downs Station part pastoral lease. There is a need for clear and specific conditions if the proposal is considered acceptable, to ensure Karijini and Mungaroona Range Nature Reserve, which class A reserves managed under the CALM Act are not directly or indirectly impacted by derived proposals and that impacts on other Parks and Wildlife managed lands (both formal and proposed CALM Act reserves) are considered, and appropriately avoided, minimised, monitored, managed and mitigated.	

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DPaW	49.	*Impact assessment* The PER indicates that an assessment of impacts was undertaken for "…*direct impacts from land clearing only*…" (p. 97) based on modelled cumulative impacts (i.e. disturbance footprints produced for the 'Conceptual Development Scenarios'). It is also noted that the proponent has indicated that "*Detailed engineering design has not yet been undertaken for all elements of the Strategic Proposal, thus the location and timing of mining operations may change in the future*…" (Appendix 4, p.5). The data used in the PER to inform the impact assessment for impacts of the 'Full Conceptual Development Scenario' (p. 131) on significant flora appears to be based primarily on information gathered from the proponent's previous surveys, which have largely been undertaken on areas within its own tenements with some reference to other information sources. This analysis has resulted in identification of a list of 51 taxa that are "*likely to be at risk*" (p. 126) from implementation of the strategic proposal. The results (and level of predicted impacts) presented in the PER do not appear in all cases, to fully document or incorporate available regional data (e.g. information outside of the proponent's tenements), resulting in assessments that in some cases may not be representative of the actual level of risk to significant flora taxa or their conservation status. Significant cumulative risk to flora taxa may result from future risk assessment based on use or extrapolation of information derived	BHP Billiton Iron Ore liaised extensively with DPaW, regulatory authorities and industry experts in order to obtain and utilise all available biodiversity data for the Project Definition Boundary. As such, the best available information was used to inform the impact assessment. BHP Billiton Iron Ore is committed to ensuring that the objectives for Terrestrial Flora and Vegetation are met. This will include the review of relevant publicly available data for the key environmental factors at Derived Proposal stage. Incorporation of these data, including site-specific data, will verify that objectives can be met, with management measures specified, as applicable.

Submitter	Issue Number	Submission and/or issue	Response to comment
		from survey within individual proponents' tenements to inadequately verified habitat prediction modelling.	
DPaW	50.	*Adaptive Management and Identifying and Prioritising Assets and Species* The collective understanding of biodiversity and conservation values in the Pilbara is continually improving through scientific work of government and industry. Parks and Wildlife therefore seeks assurances that the strategic proposal and subsequent derived proposals contain inbuilt strategies for adaptively identifying and improving measures for addressing novel issues and impacts including updated lists of species and communities of high conservation significance and other conservation assets (e.g. both formal and proposed CALM Act lands) over the life of the strategic proposal and subsequent derived proposals. Provisions for adaptive management and assurances for adaptively identifying and protecting conservation significant values are considered particularly relevant. The proponent has defined a process by which it will "…*identify and manage key Assets and Species throughout the Strategic Proposal and Derived process*…" (Appendix 2, p.1). The current ranking system lists "*Assets that have no formal level of protection for conservation purposes or foreseeable level of future protection*…" (Appendix 2, p.3) and "*…species that have no formal level of protection as a threatened species, or foreseeable level of future protection…or novel and undescribed species*" (Appendix 2, p.5) as 'Tier 3' species and indicated that	BHP Billiton Iron Ore acknowledges that flexibility and adaptive management are required when determining the level of protection afforded at a site-specific scale, such as will be case at Derived Proposal phase. We will continue to engage with DPaW, industry experts, regulatory authorities and other stakeholders, when developing and implementing management measures, to ensure that the objectives for Key assets and Significant Species, are managed appropriately. BHP Billiton Iron Ore has sought to use all available data, supplementing our own data with that supplied by regulatory authorities and data which are publicly available. As part of the Pilbara Expansion Public Environmental Review Strategic Proposal, BHP Billiton Iron Ore has provided all data to DPaW, with the intent for it to be made publicly available.

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		'Tier 3' species have "…*the lowest priority for management*." (Appendix 2, p.3 and 5). In some cases (due to the paucity of information involved with novel and undescribed species and potential habitat specialisation), the proposed 'Tier 3' species may be at high risk from development activities and require a level of precautionary protection and adaptive approach to management until enough information can be gathered to: • adequately clarify their distribution and habitat; and • ensure their long term survival is not placed at risk by impacting activities. On this basis it would be appropriate to ensure that the assignment of management ranking for conservation significant flora and fauna make provision for objective criteria and use of available information or further investigations to assess the likelihood that species may be: • geographically restricted: • dependent on specialist habitats; and/or • significantly affected by threatening processes within the region. and therefore more appropriately managed as if they were Tier 1 or 2 species. This issue highlights the high importance of increased collaboration between mining companies and government in documenting, charting and publishing previously collected and future information on the distribution of native species derived	

Submitter	Issue Number	Submission and/or issue	Response to comment
		from biological surveys undertaken for environmental impact assessment and environmental management purposes.	
DPaW	51.	*Derived proposals* Noting the temporal and spatial scope of the strategic proposal and the paucity of precise and reliable information on the distribution and conservation status of species and communities occurring in the strategic proposal area that may be affected by derived proposals in the future, there is a need for careful consideration of future risks and implications to conservation of biodiversity associated with derived proposal impacts and conditions. On this basis, it is requested that the department is closely engaged at the appropriate level early in the development of guidance on required referral information and proposed environmental conditions with suitable opportunities and timeframes for input to conditions designed to address conservation of biodiversity values. **Recommendation:** the conditions or other elements of approval for the strategic assessment are applied that require the following for derived proposals: • Clear identification of all values (flora, fauna, vegetation, springs, pools, creeklines, gorges, visitor experience and amenity, Aboriginal heritage, etc.) in any reserve areas that are at potential risk of indirect impacts from derived proposals and an understanding of the nature and scale of risks.	BHP Billiton Iron Ore acknowledges the biodiversity values associated with Nature Reserves and considers them Tier 1 assets, for prioritised environmental management. The cumulative impact assessment contained within the PERSP shows that the values of CALM Act lands are not anticipated to be impacted as a result of BHP Billiton Iron Ore's Strategic Proposal. This will be verified in Derived Proposal applications. The proposals for individual project development will require a review of baseline information, as well as the potential impacts against those predicted during assessment of the Strategic Proposal in order to demonstrate that the environmental objectives can be met. Derived Proposal process will take account of the matters recommended by DPaW with management measures detailed in Management Plans that BHP Billiton Iron Ore anticipates will be subject to regulatory approval (on advice from Parks and Wildlife as appropriate). Conditions will likely be set on the Ministerial Statement for the Strategic Proposal which are directed to ensuring that BHP Billiton Iron Ore will meet its regional biodiversity, flora and vegetation, and terrestrial fauna objectives.

Submitter	Issue Number	Submission and/or issue	Response to comment
		• A process to ensure there is an adequate understanding of the baseline state of potentially affected values prior to impacts being approved; and • The development and implementation of detailed monitoring, management and contingency measures to the requirements of the Minister for Environment on advice of Parks and Wildlife, that provide a clear mechanism to comprehensively demonstrate and ensure that there are no impacts from the derived proposals (e.g. from dewatering, reduced visitor experience from changes to amenity or access etc.) on the values of CALM Act lands. **Recommendation:** that if the proposal is considered acceptable, a condition(s) or approval [should be] applied to derived proposals to ensure that potential impacts on conservation significant flora, fauna and ecological communities are avoided, minimised, monitored, managed and mitigated (as appropriate) to ensure their conservation status and long term viability is not adversely affected (based on appropriate scientific information and investigations), to the requirements of the Office of the EPA on advice from Parks and Wildlife.	

Submitter	Issue Number	Submission and/or issue	Response to comment
Public submission	52.	I strongly recommend that fire management be included as a fourth key factor. Altered fire regimes are identified as one of four key Regional threats, I fully agree with this assessment. The pattern of fire is shown to be very variable in Fig 8. In my experience, widespread burning usually follows a run of good seasons and there is minimal opportunity after a drought. Unless fire can be managed, all other values are placed at risk (e.g. biodiversity, erosion, tourism, pastoral management, protection of assets). I would therefore have expected to see fire management mentioned as a key and cost-effective measure for land management under Offsets. Fire will interact with all three of the key measures that were identified – feral ungulates, cats and sanctuaries. Wildfire can be a tool for destruction (e.g. to sanctuaries such as Millstream or the E. victrix stands on Mt. Bruce flats) or may affect predation by removal of habitat. Managed fire can also be used in a very positive way to enhance the variety of habitats and biodiversity.	Fire regimes are not provided for in the EPA's factor classifications. Rather, the impacts of fire can be considered under the factors of flora and vegetation, fauna, and human health. Therefore fire was not determined to be a key factor by the EPA, however BHP Billiton Iron Ore has included it in the assessment of impact to flora and vegetation and terrestrial fauna values. As the impacts of fire to biodiversity values are considered with respect to land values, and as the EPA has not determined impacts from fire to be a Key factor, BHP Billiton Iron Ore considers that this threat has been adequately assessed in the PERSP. Fire management is a key consideration in BHP Billiton Iron Ore's activities, and contingency measures are put in place at all mine sites to reduce the potential for unintentional fires. Where offsets meet the desired objectives, they could potentially include fire management measures.
DoW	53.	The department requests that Section 11 – Derived proposal framework – is updated to show the alternate process (e.g. should a proposal fail to be classified as "derived". The alternate assessment process should be detailed, including an example, to allow reader clarification. The DoW seeks clarification whether an adaptive management framework would be sufficient to deal with changes or additions	The adaptive management approach will allow for changes in management practices, knowledge, processes or environmental conditions to be accounted for, so that the environmental factor objectives can continue to be met. Where there is a significant change in environmental factors, which have not been accounted for in the Strategic Proposal, BHP Billiton Iron Ore may be required to

Submitter	Issue Number	Submission and/or issue	Response to comment
		to the list of impacted factors, or alternatively which assessment approach would be used to amend the strategic approval.	undertake further impact assessment before individual project development can proceed. Additional clarification on the Derived Proposal declaration process is provided in Section 4.2 of this Supplementary Report.
12. Issues from submissions received after close of submission period			
Nyiyaparli People	54.	The Nyiyaparli People do not object to the SEA Proposal. We note the consultation process undertaken to date by BHP Billiton Iron Ore and further note that BHP Billiton Iron Ore have made several commitments to the Nyiyaparli People concerning consultation and preparation of Derived Proposals under the WA *Environmental Protection Act* 1986.	BHP Billiton Iron Ore is committed to undertaking scheduled as well as targeted consultation with the Nyiyaparli People in order to provide information about our current and proposed activities. This will include consultation on the identification of opportunities for Nyiyaparli People involvement in data collection and management activities. At first opportunity we will make Derived Proposal, Management Plan and Mine Closure Plan information available for consideration by the Nyiyaparli People. This will be in advance of submission to regulatory authorities, through existing committee structures established under the Comprehensive Agreement, and will provide the opportunity for adequate consultation to occur.
Nyiyaparli People	55.	There is concern in relation to the long time period for the SEA process but relatively short period for the Derived Proposal – noting that all of the detail is in the Derived Proposal. The consultation period for the SEA is long, but the consideration of issues is high level. Our concerns also lie in the detail, including	BHP Billiton Iron Ore is committed to undertaking scheduled as well as targeted consultation with the Nyiyaparli People in order to provide information about our current and proposed activities. This will include consultation on the identification

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		individual water holes and smaller scale features. The Derived Proposal process does not afford us much time to assess and we are very dependent upon BHPBIO's commitments to consult with us to understand what is being proposed.	of opportunities for Nyiyaparli People involvement in data collection and management activities. At first opportunity we will make Derived Proposal, Management Plan and Mine Closure Plan information available for consideration by the Nyiyaparli People. This will be in advance of submission to regulatory authorities, through existing committee structures established under the Comprehensive Agreement, and will provide the opportunity for adequate consultation to occur. A more detailed explanation of the Derived Proposal process is provided in Section 4.2 of this Supplementary Report. A Derived Proposal template was also provided in Appendix 11 of the PERSP, which included a section (Section 4) on what consultation will be undertaken for future proposals.
Nyiyaparli People	56.	Nyiyaparli People would like BHPBIO to develop the 'best practice mine' concept to include matters of Indigenous importance and work with the Nyiyaparli People to develop this from the planning stage of the first Derived Proposal in Nyiyaparli Country. Nyiyaparli People would like to be involved in the baseline environmental work to include surveys for bush medicine and bush tucker for any Derived Proposals in Nyiyaparli country. The EP Act does not consider bush tucker and bush medicine. These aspects are of significance and considered important to the Traditional Owners given the scale of the SEA Proposal. The	BHP Billiton Iron Ore is committed to working with the Nyiyaparli People in order to incorporate the key values, considerations and practices into the way we work for our current and proposed activities. This will include consultation on the identification of opportunities for Nyiyaparli People involvement in data collection and management activities. BHP Billiton Iron Ore understands the value of bush tucker and bush medicine and the Aboriginal values associated with this. As a result, BHP Billiton Iron Ore has undertaken additional work in considering impacts to key rock pool areas which may provide further benefits to bush tucker.

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		potential cumulative impacts within the Nyiyaparli claim area on bush medicine and bush tucker resources mean that some of these resources may be eliminated or inaccessible the Nyiyaparli. These are matters that impact upon the ability to support and apply Nyiyaparli culture to our traditional lands - to which our access is already limited. Nyiyaparli People believe that with adequate planning and cooperation, their input can be part of baseline environmental surveys and issues can be incorporated into BHPBIO mine planning to avoid, minimise and offset. This approach would be similar to the processes applied to conservation significant species such as Priority Flora and fauna habitat. The Nyiyaparli People would like to see actions that specifically protect these features to ensure that they are retained at appropriate levels within their claim area. Over the course of long term mining, the identification, avoidance minimisation and rehabilitation of these aspects where practicable is expected to significantly improve outcomes for Traditional Owners. The Nyiyaparli People recognise that this is not required under the EP Act as it stands.	Refer to Section 4.2.1 and Appendix 1 of this Supplementary Report for further information. The Regional Management Approach, detailed in Chapter 12 of the PERSP, included description of the mitigation hierarchy. In all instances, we will first seek to avoid significant impacts to the environment. Where avoidance is not possible, or only possible in part, minimisation is the next-preferred strategy. This may include minimisation of footprint, or the utilisation of mitigation measures from the Management Toolkits. We will engage with Traditional Owners on the development of this approach for our activities, and to further understand the significance of native plants and animals to Indigenous values. BHP Billiton Iron Ore continues to commit to regular engagement of Traditional Owners, including the potential for involvement in baseline surveys as applicable.
Nyiyaparli People	57.	*Integrating factors (offsets and rehabilitation and decommissioning)* The SEA will provide preliminary approval for BHP Billiton Iron Ore to clear native vegetation of around 110,000 ha. The quantity and quality of rehabilitation in the Pilbara is, at best, variable (EPA 2014). Improvements in the amount and quality of	Since lodgement of the PERSP for public review, development of the Pilbara Strategic Conservation Fund has been initiated by the OEPA. BHP Billiton Iron Ore has allowed for contributions to the fund in its offsets approach (Section 8.5.3 of the PERSP). BHP Billiton Iron Ore has and will continue to invest strongly in improving rehabilitation reliability and quality. The

Submitter	Issue Number	Submission and/or issue	Response to comment
		rehabilitation is required in the Pilbara. This is expected to require significant investment in research and development. Nyiyaparli supports the adoption of Mine Closure Plans by BHP Billiton Iron Ore. Nyiyaparli notes that the Government is accruing funds for conservation offsets in the Pilbara and seeks consideration and involvement of Traditional Owners. If mining companies do not improve their mine rehabilitation, large areas of land will be left in a condition with limited plant diversity and fauna habitat. Whilst the overall biodiversity of the Pilbara may not be compromised, the value of this land for post-mining land use can be expected to be lower. Investment in improving the reliability and quality of mine rehabilitation can be expected to improve long term outcomes. Mine Closure Plans are a good means for the Company to be clear about how it plans to leave the mine and are able to inform the Community about the key issues and Company plans. Traditional Owners' knowledge of Country and capability to perform services is expected to be useful in planning and implementing offsets.	framework to support this includes the regional management approach, guiding principles for rehabilitation and decommissioning (p357 PERSP including adaptive management) and the Rehabilitation and Decommissioning Toolkit (Figure 70 PERSP). Examples of work to date (and ongoing) are provided in the PERSP including: • Restoration Seed Bank • Case Study 3: Artificial habitat trials (Ghost bat caves) • Case Study 10: Rehabilitation trials • Case Study 11: Acid mine drainage • Case Study 12: Below water table mining • Case Study 13: overburden storage areas • Case Study 14: Post mining land use At first opportunity we will make future proposal submissions, Management Plans and Mine Closure Plan information available for consideration by the Nyiyaparli People. This will be in advance of submission to regulatory authorities, through existing committee structures established under the Comprehensive Agreement, and will provide the opportunity for adequate consultation to occur.
Nyiyaparli People	58.	*Cumulative Impacts* The Nyiyaparli People are concerned about the cumulative impacts on water quantity and quality from the SEA Proposal.	BHP Billiton Iron Ore acknowledges the importance of water management in a semi-arid climate such as the Pilbara and ensures sustainable water management practices in its operations.

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		The Nyiyaparli People see a lot of dewatering and water use in the Pilbara and does not have a sense of how much is acceptable and how this issue is managed by Government.	When we undertake dewatering, it is for the purposes of accessing ore which is located at depths below the water table. The rate and volume of dewatering are controlled such that the amount of groundwater drawdown is minimised as far as practicable to allow us to meet our operational needs. In accordance with regulatory and licence requirements, we undertake ecological asset monitoring and we establish performance criteria to maintain ecological receptors. The DoW issues Groundwater Abstraction (5C Licence) licences and the DER issues licences for discharges to the environment (Works Approval /Licences). These licences will be issued with environmental requirements that BHP Billiton Iron Ore will need to meet. We report annually on our compliance with regulatory requirements, in our Annual Environmental Report. This is publicly available on our website. BHP Billiton Iron Ore will continue to engage with the Nyiyaparli People through the existing committee structures established under the Comprehensive Agreement, and will provide the opportunity for adequate consultation to occur.
Nyiyaparli People	59.	*Impacts on Rock pools and Waterholes* The SEA cumulative impact assessment misses the potential impact on rock pools and waterholes in the Hamersley, Chichester, and Ophthalmia Ranges. They are small scale by critical features in the landscape of great importance to flora and	BHP Billiton Iron Ore acknowledges the inherent connection between water and ecological function. In response to a request by the Nyiyaparli People, we have undertaken an additional study to provide further clarity on the environmental values of rock pool habitats such as those in

Submitter	Issue Number	Submission and/or issue	Response to comment
		fauna. Individual pools and waterholes have been mapped and are clearly part of the ecosystem (CSIRO 2015). Whilst impacts on an individual rock pool/waterhole may not be significant, the combined and cumulative impact on these features is considered by the Nyiyaparli People to be significant. They are a key feature of the biology of the Hamersley, Chichester and Ophthalmia Ranges and have not been identified as an issue or assessed in the PER. The cumulative impacts on these key features should be part of the assessment. The Nyiyaparli People note that BHPBIO is scoping additional work to address the issue of the potential impact on rock pools and waterholes. Nyiyaparli People request that the detailed information on impacts to individual rock pols/waterholes and cumulative impacts also be specifically considered in BHPBIO consultation and planning for any Derived Proposals.	EHU3 and EHU4. The results of the work are presented in Section 4.3 and Appendix 1 to this Supplementary Report.
Nyiyaparli People	60.	*Fortescue Marsh* The Nyiyaparli People are concerned for the future of Fortescue Marsh. There is a significant amount of mining activity and associated dewatering, re-injection and surplus water discharge in the Fortescue Marsh catchment area. The SEA will provide preliminary authorisation for a large increase. BHPBIO has completed some useful cumulative impact assessment modelling of the Marsh, and EPA has reported on management of the	BHP Billiton Iron Ore acknowledges the inherent connection between water and ecological function, in particular at Fortescue Marsh. The studies undertaken for the PERSP (Appendix 7 to the PERSP) demonstrated that at present (baseline scenario) the EHUs in the Fortescue Marsh region are subject to negligible change from impact to groundwater or to surface water relative to the size of the Fortescue River Catchment. With future development by third party proponents, the potential for impact is higher with an emphasis on

Submitter	Issue Number	Submission and/or issue	Response to comment
		Marsh. It is not clear to the Nyiyaparli who is responsible for managing the March, there is no clear monitoring program, data reported and no critical thresholds identified.	management measures being required. BHP Billiton Iron Ore considers that by adopting business as usual management practices, our contribution to any impact on Fortescue Marsh will be negligible. This will be verified for future proposals within this vicinity. BHP Billiton Iron Ore is working with Government and stakeholders to build a better understanding of the function of the Marsh and is committed to participating in future initiatives. BHP Billiton Iron Ore will continue to engage with the Nyiyaparli People on Fortescue Marsh through the existing committee structures established under the Comprehensive Agreement, and will provide the opportunity for adequate consultation to occur.
Nyiyaparli People	61.	*Pit lakes* Nyiyaparli People understand that mining will leave pit voids at many mines. The Nyiyaparli People are concerned about the water quality and long term cumulative impacts that pit lakes may have on the environment. Pit lakes will evaporate and concentrate salts leading to declining water quality. There is a risk that the lakes may become acidic and toxic to wildlife.	We recognise the potential issues associated with pit lakes and these risks were discussed in PERSP in the impact assessment for flora and vegetation, water, and rehabilitation and decommissioning. Potential impacts of pit lakes can have both a positive and a negative impact on flora and as such will need to be reviewed on a site by site basis. In any event, impacts can be managed and BHP Billiton Iron Ore does not predict unacceptable impacts as a result of pit lakes. As such, more specific detail regarding the mitigation and/or management approach to potential pits lakes will be detailed at Derived Proposal stage as necessary for individual project development.

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			Consultation approach for Mine Closure Plans will continue through the existing committee structures established under the Comprehensive Agreement, and will provide the opportunity for adequate consultation to occur.
Nyiyaparli People	62.	BHP Billiton Iron Ore refers to standard management practices including Regional Management Strategies (RMS) in SEA documentation but these are not accessible for comment or input in the SEA. It is difficult to know what BHPBIO is going to do to manage the key environmental factors.	The Regional Management Approach (Section 12 of the PERSP) now replaces the RMSs that were discussed in early consultation with the Nyiyaparli People. Associated Management Plans are to be developed at the Derived Proposal stage, as well as the details of standard management practices being provided. BHP Billiton Iron Ore continues to commit to regular engagement of Traditional Owners on the development of these through existing committee structures established under the Comprehensive Agreement.
Nyiyaparli People	63.	There are concerns raised about the failure of the Germano Mine in Brazil and seeking reassurance that incidents such as this will not happen in the Pilbara. Tailings storage facilities generally represent the highest risk to human life and environmental damage on a mine site. Whilst the detailed plans for any such facility are only expected to be available in a Derived Proposal, an understanding of how risks are managed may provide some comfort.	Western Australia Iron Ore currently has one operational tailings storage facility at Mt Whaleback. We can assure the community this facility is the subject of a comprehensive management regime including frequent monitoring. As the operator, we assess and manage the risks of facilities like this in line with our risk management framework. Consultation approach for Risk Management will be placed on the agenda for the next (and subsequent if not agreed) Nyiyaparli/BHP Billiton Iron Ore Environment Sub Committee meeting.

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Banjima	64.	The Banjima People do not object to the BHP Billiton Iron Ore Strategic Proposal. The Banjima People wish to advise the Environmental Protection Authority that there are a number of 'Exclusion Zones' which are places or sites of particular cultural and/or environmental significance to the Banjima People. The Exclusion Zones are treated differently under the Comprehensive Agreement with varying degrees of protection according to the Comprehensive Agreement with BHP Billiton entered into in October 2015.	BHP Billiton Iron Ore acknowledges the significance of Aboriginal heritage values in the Pilbara region and continues to commit to regular engagement of Traditional Owners as well as targeted consultation with the Banjima in order to provide information about our current and proposed activities. This will include consultation on the identification of Exclusion Zones. Due to the confidential nature of the Indigenous Land Use Agreements, BHP Billiton Iron Ore will provide to EPA the outcomes of engagement relating to heritage values, rather than providing specific information relating to Exclusion Zones. At first opportunity we will make Derived Proposal, Management Plan and Mine Closure Plan information available for consideration by the Banjima People. This will be in advance of submission to regulatory authorities, through existing committee structures established under the Comprehensive Agreement, and will provide the opportunity for adequate consultation to occur.

3 TRADITIONAL OWNER ENGAGEMENT

3.1 CONSULTATION BACKGROUND

Consultation with the Native Title parties identified as key stakeholders was a critical component of the PERSP development. Consultation has been undertaken with parties whose land is directly physically impacted by implementation of the Strategic Proposal including the Kariyarra, Nyiyaparli, Palyku, Banjima, Ngarlawangga and Yinhawangka People.

BHP Billiton Iron Ore has entered into land use agreements with the Nyiyaparli, Banjima and Yinhawangka Native Title parties; these agreements provide certainty about future tenure requirements beyond the existing exploration and mining operations in the areas.

To assist the engagement with Traditional Owners during preparation of the PERSP, an independent environmental consultant was engaged through Yamatji Marlpa Aboriginal Corporation (YMAC) to give independent advice in relation to the Strategic Proposal and consult with the parties. Preston Consulting was engaged by YMAC as an independent environmental advisor to review, summarise, and consult with the relevant parties regarding the Proposal. The Proposal documentation includes studies and documents prepared for approval under both the EP Act and EPBC Act.

Initial consultation on the Proposal addressed issues such as:

- What is the Strategic Environmental Assessment?
- Why is BHP Billiton Iron Ore doing it?
- What will it cover?
- How long will it take?
- What happens for future proposals?
- What was the outcome of the document review?

Subsequent discussions identified issues of concern and interest to each of the groups. These issues are discussed further below (Section 3.3).

A summary of the consultation which addressed the Strategic Proposal is provided in Table 2. Dates in bold are those consultation events solely focused on the Strategic Proposal.

Table 2: Summary of Strategic Proposal consultation with Native Title parties

CONSULTATION DATE	TOPICS COVERED
Nyiyaparli Group	
12 September 2012	General Strategic Proposal Overview (Presentation)
27 March 2013	Written Strategic Proposal update regarding progress to date – focus upon process Presentation on Water Management
12 September 2013	Written Strategic Proposal update re progress to date – focus upon process
13 March 2014	General Strategic Proposal Overview (Presentation)
18 September 2014	Written Strategic Proposal update re progress to date – focus upon process
30 January 2015	BHP Billiton Iron Ore Environment Team meeting with Nyiyaparli Regional closure and rehabilitation approach Current approvals General discussion on the Strategic Proposal – detailed presentation to be provided
1 April 2015	Site visit to a working mine to look at closure and rehabilitation
14 April 2015	Introduced the proposal for an Independent Environmental Consultant to assist Traditional Owner groups with Strategic Proposal documents. Presented on Strategic Proposal with focus on what the Strategic Proposal is and potential flora and fauna and visual impacts. Discussed the above site visit. Presented on water management.
10 June 2015	Presentation to discuss current approvals and key findings. Confirmation of the engagement of the Independent Environmental Consultant. Update on the status of the Strategic Proposal.
19 August 2015	Presentation of key Strategic Proposal findings by an Independent Environmental Consultant as part of a process to identify key environmental issues of concern to Traditional Owners.
12 October 2015	Presentation to discuss current approvals and key findings. Update on the status of the Strategic Proposal.
17 November 2015	Presentation by BHP Billiton Iron Ore on key environmental issues raised at the meeting on 19 August 2015. Separate discussions with the Independent Environmental Consultant on BHP Billiton Iron Ore's response.
2 March 2016	Update on the status of the Strategic Proposal.
30 May 2016	Presentation of key Strategic Proposal issues by the Independent Environmental Consultant. Presentation by BHP Billiton Iron Ore on key environmental issues raised at the meeting on 17 November 2015. Separate discussions with the Independent Environmental Consultant on BHP Billiton Iron Ore's response.

CONSULTATION DATE	TOPICS COVERED
7 September 2016	Consultation on issues raised in the Nyiyaparli PERSP submission Discussion on consideration of Indigenous issues in project development Presentation to discuss current approvals and key findings. Update on the status of the Strategic Proposal.
20 September 2016	Pilbara site visit to BHP Billiton Iron ore operations. Targeted discussion on water management and rehabilitation
Yinhawangka Group	
3 November 2014	Presentation on Water Management Presentation on the Strategic Proposal Talking with the Yinhawangka
27 August 2015	Presentation on Water Management Presentation on the Strategic Proposal Talking with the Yinhawangka Presentation of key Strategic Proposal findings by an Independent Environmental Consultant as part of a process to identify key environmental issues of concern to Traditional Owners
21 October 2015	Presentation by BHP Billiton Iron Ore on key environmental issues raised at the meeting on 27 August 2015. Separate discussions with the Independent Environmental Consultant on BHP Billiton Iron Ore's response.
Ngarlawangga Group	
28 August 2015	Presentation on the Strategic Proposal Talking with the Ngarlawangga Presentation of key Strategic Proposal findings by an Independent Environmental Consultant as part of a process to identify key environmental issues of concern to Traditional Owners
14 October 2015	Presentation by BHP Billiton Iron Ore on key environmental issues raised at the meeting on 28 August 2015. Separate discussions with the Independent Environmental Consultant on BHP Billiton Iron Ore's response.
10 December 2015	Presentation by BHP Billiton Iron Ore on its response to additional issues raised following the meeting on 14 October 2015. Separate discussions with the Independent Environmental Consultant on BHP Billiton Iron Ore's response.
Banjima Group	
2 December 2014	Presentation on Water Management Presentation on the Strategic Proposal Talking with the Banjima
23 September 2015	Presentation on the Strategic Proposal Talking with the Banjima Presentation of key Strategic Proposal findings by an Independent Environmental Consultant as part of a process to identify key environmental issues of concern to Traditional Owners
13 April 2016	Presentation of key Strategic Proposal findings by an Independent Environmental Consultant. Presentation by BHP Billiton Iron Ore on key environmental issues raised at the meeting on 23 September 2015. Separate discussions with the Independent Environmental Consultant on BHP Billiton Iron Ore's response.

CONSULTATION DATE	TOPICS COVERED
26 May 2016	Presentation to discuss current approvals
14 September 2016	Presentation to discuss current approvals and key findings. Discussion on future consultation approach Discussion on consideration of Indigenous issues in project development Update on the status of the Strategic Proposal.
Palyku Group	
16 November 2015	Presentation of key Strategic Proposal findings by an Independent Environmental Consultant as part of a process to identify key environmental issues of concern to Traditional Owners.
Kariyarra Group	
12 November 2015	Presentation on the Strategic Proposal Presentation of key Strategic Proposal findings by an Independent Environmental Consultant as part of a process to identify key environmental issues of concern to Traditional Owners

A key outcome from this consultation has been the development of a structured engagement framework between BHP Billiton Iron Ore and the agreement signatories on how Indigenous considerations are incorporated into future proposals. These issues go beyond those typically considered during project approvals, including things such as bush food, bush medicine and ephemeral rock pools.

In consultation with the groups, BHP Billiton Iron Ore has committed to early engagement starting at project inception, linking to key project and approval milestones, and continuing through until closure and rehabilitation. Subject to the individual proposals, these milestones may include:

Project inception/Pre-feasibility study: Once internal project investigations have commenced, relevant parties will be consulted to inform concept development including options assessment and baseline environmental surveys.

Project development/Feasibility study: Once a preferred option has been identified, groups would be consulted regarding development of project layouts, environmental studies and the environmental management measure options considered.

Environmental approval lodgement: Prior to the environmental reports being completed, findings would be presented to relevant parties for comment and consideration of feedback. Specific management measures would be identified at this time.

Confirmation of environmental approvals: Once a Derived Proposal has been declared, BHP Billiton will report back to the group on the conditions set, and consult on finalisation of any management plans and secondary approvals as relevant.

Mine closure plan: Relevant groups will be consulted during preparation of detailed mine closure plans, typically updated every 3 – 5 years over the life of the mine. Rehabilitation objectives will be considered in these plans.

For each future proposal, BHP Billiton will work with the relevant groups to identify Indigenous considerations and to incorporate these in project development. A key part of this engagement will be consultation on how the mitigation hierarchy is applied to these considerations. Management of these issues will be tracked and

reported to the groups through the existing committee structures established under the relevant land use agreements.

3.2 LAND MANAGEMENT APPROACH

The above framework forms part of BHP Billiton's overall approach to manage and protect Aboriginal heritage in compliance with the *Aboriginal Heritage Act 1972* and the *Environmental Protection Act 1986*. This holistic approach to management of archaeological, ethnographic and environmental considerations addresses the fundamentals of the mitigation hierarchy and is based on the Land Use Agreements with Nyiyaparli, Banjima and Yinhawangka Native Title parties. The key elements of the approach are discussed below and shown in Figure 2.

3.2.1 COMPREHENSIVE INDIGENOUS LAND USE AGREEMENTS

These agreements provide certainty about future tenure requirements beyond the existing lease and mining operations in the areas. As part of these agreements, BHP Billiton Iron Ore and the Native Title parties have agreed to specific cultural heritage commitments in relation to the management of heritage sites, including the recognition, mapping and capture of places of ethnographic importance (referred to as 'confidential areas'). In some cases BHP Billiton Iron Ore has made the contractual commitment to avoid these areas. BHP Billiton Iron Ore will seek to avoid impacts to these confidential areas under future Derived Proposals in line with its obligations under the agreements.

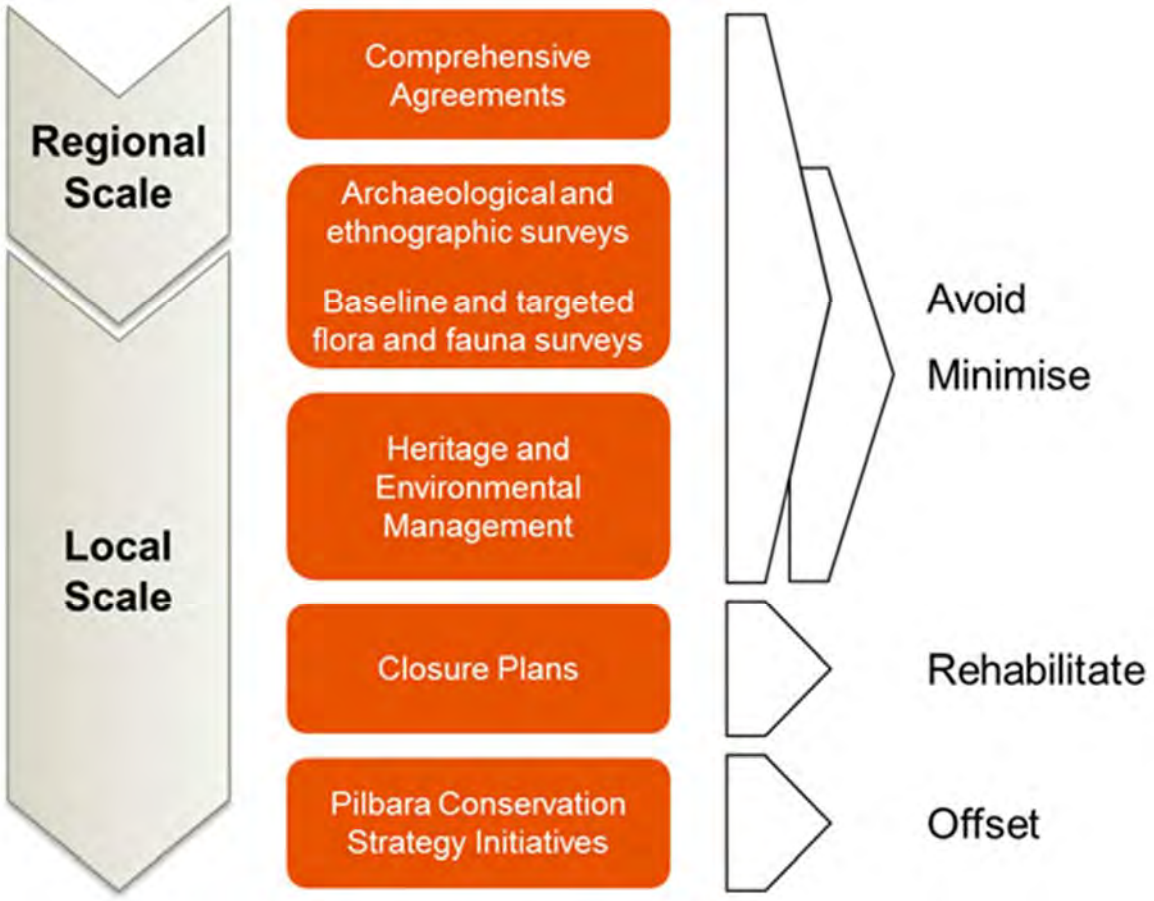

Figure 2. Comprehensive Land Management Approach

3.2.2 BASELINE SURVEYS

BHP Billiton Iron Ore has conducted large-scale archaeological and ethnographic surveys to identify places of cultural and/or scientific significance. These surveys are ongoing and undertaken with participation by the relevant Native Title parties of the area. The engagement of Native Title parties is guided by Heritage Protocols between the parties and BHP Billiton Iron Ore as set out in the Comprehensive Agreements.

Similarly, baseline and targeted flora and fauna surveys are undertaken to inform environmental approvals and management. These surveys are undertaken in line with the Western Australian EPA's Guidance Statement No. 51, as well as other relevant EPA position statements, and are generally in line with the recently released Technical Guide - Flora and Vegetation Surveys for Environmental Impact Assessment. BHP Billiton Iron Ore will engage with relevant Native Title parties in identifying indigenous considerations relevant to these surveys, including bush food and bush medicine.

3.2.3 HERITAGE AND ENVIRONMENTAL MANAGEMENT

BHP Billiton Iron Ore manages and protects Aboriginal heritage in compliance with the State and Federal legislation. Potential impacts to heritage sites are managed through BHP Billiton Iron Ore's internal heritage management processes. These processes are based on guidelines drafted by the Department of Aboriginal Affairs (DAA) and include measures to identify significant heritage sites during planning phases so as to avoid or minimise potential heritage impacts. If any heritage site cannot practically be avoided, BHP Billiton Iron Ore will consult with the relevant Aboriginal group and seek consent from the Minister under section 18 of the *Aboriginal Heritage Act 1972* prior to undertaking any activities that may disturb the site.

BHP Billiton's environmental governance hierarchy is comprised of three tiers: Corporate level, Asset (business, e.g. Iron Ore) level and Operation (site) level. At the Asset level, BHP Billiton Iron Ore's Environmental Management System (EMS), which includes regional strategies and plans, is the governance system that addresses environmental outcomes for the Pilbara region. The specific mitigation response for any future proposal will be developed as BHP Billiton Iron Ore prepares the referral for a Derived Proposal. The framework for the mitigation response will be determined by the conditions set at the Strategic Proposal stage. Using contemporary conditions as a guide, the Strategic Proposal conditions are likely to set out the requirements for development of factor-specific outcomes as part of a management plan. Relevant Native Title parties will be consulted in the development of these management plans.

3.2.4 MINE CLOSURE PLANS

A mine closure plan will be prepared, as required, for each Derived Proposal and will provide completion criteria and closure options, for the Derived Proposal supported by preliminary mine designs, geochemical waste characterisation, and conceptual and numerical hydrological modelling. Throughout the operations phase, iterations of the mine closure plan will progressively refine the closure options with available data, enabling detailed designs and completion criteria to be developed and progressive rehabilitation works to occur. As mining draws to a close, the detailed closure designs will be executed, and the site will move into the post-closure period of monitoring, reporting, completion and sign off. In all cases, the focus for the application of the relevant controls is on achieving the defined completion criteria and following the mitigation hierarchy of control.

Relevant Native Title parties will be consulted in the development of these plans and Indigenous considerations will be incorporated into the plan as appropriate. This may include the identification and inclusion of appropriate bush food and bush medicine plants into the rehabilitation seed mix.

3.2.5 ENVIRONMENTAL OFFSETS

Where significant residual impacts are identified following application of the mitigation hierarchy, BHP Billiton Iron Ore will provide environmental offsets. The EPA has proposed the establishment of a strategic conservation initiative for the Pilbara as a mechanism to pool offset funds to achieve broad-scale biodiversity conservation outcomes. The initiative would align with principle 6 of the Western Australian Environmental Offsets Policy to focus offsets on longer-term strategic outcomes. Development of the Pilbara Strategic Conservation Fund was recently announced by the Minister for Environment and the underlying Regional Conservation Strategy will be jointly developed with the Department of Parks and Wildlife.

While the fund has yet to be endorsed by the Western Australian Government and the mechanics and governance of the fund have not been developed, BHP Billiton Iron Ore endorses the fund in principle as the mechanism through which it will meet its environmental offset obligations for the Strategic Proposal. BHP Billiton Iron Ore will reserve commitment to the fund until such time as these arrangements are in place.

On-ground initiatives for delivery of environmental offsets may include feral animal control, weed management and fire management; all of which align with issues raised by Traditional Owners.

3.3 KEY ISSUES RAISED BY TRADITIONAL OWNERS

The consultation meetings with each of the groups covered a wide range of issues of interest and concern. These issues included an array of environmental aspects relevant to the Strategic Proposal and a number of social and economic matters outside the scope of the Strategic Proposal but which are important to the ongoing relationship with BHP Billiton. This section addresses key issues raised in consultation which are relevant to the Strategic Proposal process.

BHP Billiton Iron Ore has committed to ongoing consultation on all matters of importance to the groups through the committee processes established as part of the land use agreements mentioned above. Central to this will be how matters of Indigenous significance are considered in mine planning and the application of the mitigation hierarchy.

The key common environmental issues raised by the groups were:

- Water;
- Mine rehabilitation;
- Impacts on bush tucker and bush medicine;
- Impacts on flora and fauna; and
- Scale of disturbance/cumulative impacts.

These issues were addressed during the engagement and have been documented by the independent environmental consultant in an internal report to YMAC and the individual groups. We continue to engage and consult with Traditional Owners on these key common issues.

Given the scale and duration of the approval, the groups all recognised the significance of future consultation and approvals process in addressing these issues and concerns. Many questions were raised about the future process, the ability of the groups to have input and the perception that the only formal opportunity will be the seven day consultation when a referral is submitted. As set out in Section 3.1, BHP Billiton has committed to early consultation well before a referral would be submitted.

The consultation also identified a number of other issues including climate change, cumulative impacts, dust and noise, feral species, fire regimes, the public comment process, environmental offsets and recreational impacts amongst others. All issues raised in the Strategic Proposal consultation process will form the basis of

ongoing consultation with the groups through the existing committee structures established under the relevant agreements.

3.3.1 WATER

The consultation feedback on general water matters in the Strategic Proposal is summarised as follows:

- The water assessment was very broad (completed over a large area) and high level. The methodology of using ecohydrological units to focus on sensitivity and conservative assumptions regarding groundwater drawdown and surface water flow changes provided confidence that BHP Billiton Iron Ore was addressing the issues in a meaningful way. There was consistently concern that smaller scale impacts such as impacts on individual rock pools would only be dealt with at the Derived Proposal level, and was not considered in the assessments completed;
- The above often led to concern about the Derived Proposal development, assessment and approval process with a public comment period of only one week. This scenario reinforced to the groups that they are reliant on BHPB to deliver on consultation commitments in the development of the Derived Proposals. The very brief public review period was of concern in relation to water as the timing of that period may not be acceptable to the Traditional Owners and/or other interested third parties;
- The Fortescue Marsh was recognised as important by several groups and the interconnection of the land and water was noted and was a matter of concern. The linkages and reliance upon other groups in stewardship of broader scale features such as the Marsh was raised by several groups;
- The groups consistently expressed a desire to be informed about water management activities and impacts via regular briefings; and
- One group expressed a desire to better understand how water moves through the landscape recognising the expertise and understanding that mining companies had access to and acknowledging that groundwater movement and impacts may take some time to express.

Other specific issues were raised in regards to:

- Changes to groundwater levels (quantity);
- Changes to groundwater quality;
- Changes to surface water flows (quantity);
- Changes to surface water quality;
- Pit lakes;
- Acid mine drainage;
- Management of excess water; and
- Water management practices.

The groups consistently raised the role that small or isolated waterholes and springs play in supporting native fauna. They often contain water longer than larger waterholes and are the last refuge in a drought. The groups understood that the protection of individual water holes will be addressed in Derived Proposals and look forward to being consulted about them for any particular area in the preparation and planning phase prior to the preparation of any Derived Proposals on their country. The groups sought reassurance that impacts on local water holes will be investigated and details for management measures will be determined and communicated to the groups prior to approval being sought.

BHP Billiton Iron Ore Response

BHP Billiton Iron Ore recognises the importance of water to the Native Title groups and is committed to undertaking scheduled as well as targeted consultation with the groups in order to provide information about and to incorporate the key indigenous values, considerations and practices into the way we manage water on our current and proposed activities. BHP Billiton Iron Ore acknowledges the importance of water management in a semi-arid climate such as the Pilbara and the inherent connection between water and ecological function, in particular at Fortescue Marsh.

When we undertake dewatering, it is for the purposes of accessing ore which is located at depths below the water table. The rate and volume of dewatering are controlled such that the amount of groundwater drawdown is minimised as far as practicable to allow us to meet our operational needs.

In accordance with regulatory and licence requirements, BHP Billiton Iron Ore undertakes ecological asset monitoring and we establish performance criteria to maintain ecological receptors. The Department of Water issues Groundwater Abstraction (5C Licence) licences and the Department of Environment Regulation issues licences for discharges to the environment (Works Approval/Licences). These licences will be issued with environmental requirements that BHP Billiton Iron Ore will need to meet. We report annually on our compliance with regulatory requirements, in our Annual Environmental Report. This is publicly available on our website.

In response to the questions on the ecological value of isolated rock pools, we have undertaken an additional study to provide further clarity on the environmental values of rock pool habitats. The results of the work are presented in Section 4.3 and Appendix 1 to this Supplementary Report.

We also recognise the potential issues associated with pit lakes and these risks were discussed in PERSP in the impact assessment for flora and vegetation, water, and rehabilitation and decommissioning. Potential impacts of pit lakes can have both a positive and a negative impact on flora and as such will need to be reviewed on a site by site basis. In any case, impacts can be managed and BHP Billiton Iron Ore does not predict unacceptable impacts as a result of pit lakes. As such, more specific detail regarding the mitigation and/or management approach will be detailed at Derived Proposal stage, including in the Mine Closure Plan, as necessary for individual project development.

At the first opportunity we will make future Derived Proposal, management plans and Mine Closure Plan information available for consideration by the relevant groups. This will be in advance of submission to regulatory authorities, through existing committee structures established under the Comprehensive Agreements, and will provide the opportunity for adequate consultation to occur and feedback to be sought prior to submission. Central to this engagement will be how matters of Indigenous significance are considered in mine planning and details on how the mitigation hierarchy has been applied.

3.3.2 MINE REHABILITATION

During the consultation process BHP Billiton Iron Ore provided presentation materials to the groups on future disturbance, mine rehabilitation and decommissioning. The scale of the disturbance, length of time of the approval and current status of rehabilitation practice and outcomes highlighted mine rehabilitation as a key issue to the groups. The ensuing discussions confirmed this, and generally noted a desire to become more involved in rehabilitation planning and works. Some of these comments were directed more at education and training and business opportunities. There was also concern expressed about what impact climate change may have on mine rehabilitation.

The consultation feedback on mine rehabilitation is summarised as follows:

- Mine rehabilitation and decommissioning was always noted as a key issue for the Traditional Owners;
- The role that Traditional Owners can play in mine rehabilitation and decommissioning was always queried;

- There were often queries about the process for mine closure planning and approvals and what process applies in relation to submission and the EPA approval process of Mine Closure Plans. BHP Billiton Iron Ore confirmed that they were committed to the preparation and submission of Mine Closure Plans in accordance with guidelines from the Department of Minerals and Petroleum (DMP). There were queries regarding the legal enforceability of Mine Closure Plans;
- All groups expect to be consulted on the Mine Closure Plans and seek to ensure that BHP Billiton Iron Ore address potential indirect impacts to improve rehabilitation and ensure Healthy Country going forward. BHP Billiton Iron Ore gave an undertaking that even though this was not required for State Agreement Act land, they would prepare the relevant proposals for submission to the Government in accordance with the regulations governing Mine Closure Plans, including State Agreement Act tenure, after consultation with Traditional Owners;
- As part of rehabilitation, all groups would like to see studies extended to include surveys on bush tucker and bush medicine with the possibility of establishing a seed bank prior to mining;
- All groups expressed a desire to be consulted on the collection of Indigenous specific information that may be relevant to mine approvals, mine rehabilitation and decommissioning;
- One group raised and developed the concept for the application of the “Leading Practice Mining” model to minimise the risks of rehabilitation and decommissioning outcomes being unable to support the ongoing traditional uses of the land; and
- The groups expect that BHP Billiton Iron Ore will provide them with briefings on studies relevant to rehabilitation and decommissioning for any Derived Proposals with sufficient time to interpret, consider and provide feedback to BHP Billiton Iron Ore prior to the submission of any Derived Proposal prepared within their claim area.

BHP Billiton Iron Ore Response

BHP Billiton Iron Ore recognises the importance of early, open and regular engagement with the Native Title groups on mine closure and rehabilitation projects on their country. We have committed to preparation of Mine Closure Plans to meet contemporary requirements from the relevant regulatory agencies.

At the first opportunity, we will make future Derived Proposal, management plan and Mine Closure Plan information available for consideration by the relevant groups. This will be in advance of submission to regulatory authorities, through existing committee structures established under the Comprehensive Agreements, and will provide the opportunity for adequate consultation to occur and feedback to be sought.

Central to this engagement will be how matters of Indigenous significance are considered in mine planning and details on how the mitigation hierarchy has been applied.

3.3.3 IMPACTS ON BUSH TUCKER AND BUSH MEDICINE

The consultation feedback on bush tucker and bush medicine is summarised as follows:

- All groups queried what assessment was made on the presence and impact on bush tucker in the region;
- Following discussion about the legal framework for the environmental impact assessment, the groups noted that the legislative requirement is to assess Threatened and Endangered species which include, northern quoll; Pilbara olive python; greater bilby; Pilbara leaf-nosed bat and the crest-tail mulgara. The SEA does not address animals considered to be bush tucker as these are not considered endangered. It was noted by several groups that the impacts on bush tucker such as kangaroos, emus, etc. has a greater effect on the Traditional Owners than the impacts on some protected species such as the Northern quoll;

- All groups expressed concern about the indirect impacts on bush tucker/medicine from changes to water regimes not being identified in the SEA;
- All groups generally questioned whether BHP Billiton Iron Ore could survey and include observations of bush medicine and make this information available to Traditional Owners. They noted that such work would require input from the Traditional Owners on the surveys;
- All groups expressed concern regarding bush medicine in that bush medicine plants are not protected;
- The groups would like to see greater Traditional Owner involvement in mine planning and rehabilitation. This should include the consideration of bush medicine and bush tucker species, seed collection and use of excess water to grow native flora (useful for rehabilitation of mine sites), the incorporation of Traditional Owner knowledge into rehabilitation;
- One group feels that the current legislation and environmental impact assessment does not consider Traditional Owner values for bush tucker and bush medicine. The group would like to see the process consider the distribution and significance of bush tucker and bush medicine plants as being of sufficient significance that BHP Billiton Iron Ore would specifically map distributions, assess potential impacts, and then avoid, mitigate or offset, as is done for conservation significant species; and
- Groups recognised that the information exchange required may have some cultural and legal issues to identify and resolve. The groups encourage BHPB to consider the use of an ethno-botanist and the development of a longer term relationship and understanding of this issue between the groups and BHP Billiton Iron Ore such that it can be incorporated into any surveys completed in preparation for a mining operation on Country.

BHP Billiton Iron Ore Response

BHP Billiton Iron Ore understands the value of bush tucker and bush medicine and the Aboriginal values associated with this. As a result, BHP Billiton Iron Ore has undertaken additional work in considering impacts to key rock pool areas which may provide further benefits to bush tucker. Refer to Section 4.3 and Appendix 1of this Supplementary Report for further information.

The Regional Management Approach, detailed in Chapter 12 of the PERSP, included description of the mitigation hierarchy. In all instances, we will first seek to avoid significant impacts to the environment. Where avoidance is not possible, or only possible in part, minimisation is the next-preferred strategy. This may include minimisation of footprint, or the utilisation of mitigation measures from the Management Toolkits. We will engage with Traditional Owners on the development of this approach for our activities, and to further understand the significance of native plants and animals to Indigenous values. Central to this engagement will be how matters of Indigenous significance are considered in mine planning and details on how the mitigation hierarchy has been applied.

3.3.4 IMPACTS ON FLORA AND FAUNA

The initial engagement with Traditional Owners focused on showing the outcome of some key fauna habitat modelling to indicate the potential impacts predicted by the work completed by BHP Billiton Iron Ore for the Strategic Proposal. The presentation materials usually resulted in questions about bush tucker and bush medicine. An explanation was often given about the basis of the EP Act – and its focus on ensuring that no species or ecological community is made extinct. This explanation often appeared to assist the groups to understand why the EP Act does not afford protection to bush tucker and bush medicine.

The BHP Billiton Iron Ore presentation materials used in the second consultation sessions included maps of vegetation, fauna habitat, conservation significant flora and fauna and used a three tier management hierarchy. Whilst the presentation materials remained silent on bush tucker and bush medicine, they were an issue identified in the scoping meetings with YMAC. This was reinforced in the consultation meetings with a number of questions and comments relating to bush tucker and bush medicine.

The consultation feedback on flora and fauna is summarised as follows:

- All groups wished to be consulted and involved on the potential impacts to flora and fauna and ways to preserve and document the information;
- Usually, more information was requested on flora and fauna including:
    - maps showing the impact on flora and fauna;
    - list of species of animals on the country;
    - how relocation of animals occurs and who is responsible for it;
- One group queried if BHP Billiton Iron Ore will create refuges for species such as the northern quoll and if so, will it form part of BHP Billiton Iron Ore offset package?
- The groups noted that management of flora and fauna is via BHP Billiton Iron Ore's Management Plans. The groups request that they be involved in the development of the Management Plans through having input that may include attending surveys and involvement in rehabilitation.

BHP Billiton Iron Ore Response

The Regional Management Approach, detailed in Chapter 12 of the PERSP, included description of the mitigation hierarchy. In all instances, we will first seek to avoid significant impacts to the environment. Where avoidance is not possible, or only possible in part, minimisation is the next-preferred strategy. This may include minimisation of footprint, or the utilisation of mitigation measures from the Management Toolkits. We will engage with Traditional Owners on the development of this approach for our activities, and to further understand the significance of native plants and animals to Indigenous values and how matters of Indigenous significance are considered in mine planning and details on how the mitigation hierarchy has been applied.

3.3.5 SCALE OF DISTURBANCE/CUMULATIVE IMPACTS

The BHP Billiton Iron Ore presentation materials and documentation made the potential scale and extent of the Strategic Proposal very clear. Presentation of the maps showing potential BHP Billiton Iron Ore and third party disturbance areas usually stimulated comment and discussion about the extent of the footprint. The groups were advised that the upside of considering the long term mine plans was that it did indicate how important rehabilitation and mine closure would be, and was likely to stimulate a better assessment and discussion than if the approvals were requested one mine at a time.

The consultation feedback on the scale of the disturbance footprint is summarised as follows:

- There was concern expressed by all groups about the level of disturbance when the 100 year disturbance slide was presented. Concern was expressed from one Group that mountains/hills will disappear and rock holes will dry up and that there would be "nothing left";
- The groups advised that it is critical that BHP Billiton Iron Ore avoid, minimise and offset environmental impacts. The groups expect that BHP Billiton Iron Ore will demonstrate how it applies the mitigation hierarchy in relation to any Derived Proposals. This point also related to the consultation process that BHP Billiton Iron Ore indicated that it is committed to prior to submission of a Derived Proposal.

BHP Billiton Iron Ore Response

The Regional Management Approach, detailed in Chapter 12 of the PERSP, included description of the mitigation hierarchy. In all instances, we will first seek to avoid significant impacts to the environment. Where avoidance is not possible, or only possible in part, minimisation is the next-preferred strategy. This may include minimisation of footprint, or the utilisation of mitigation measures from the Management Toolkits. We will engage with Traditional Owners on the development of this approach for our activities, and to further integrate Indigenous values in this process. Central to this engagement will be how matters of Indigenous significance are considered in mine planning and details on how the mitigation hierarchy has been applied.

4 ADDITIONAL INFORMATION PROVIDED

4.1 KEY CHARACTERISTICS AND MANAGEMENT

In its summary of the matters raised in submissions on the draft Public Environmental Review, the OEPA requested BHP Billiton Iron Ore review the key characteristics of the proposal as per Environmental Assessment Guideline 1 *Defining the Key Characteristics of a Proposal*. A Key Characteristics Table will be drafted and is expected to form the basis for definition of future proposals under the Pilbara Expansion Public Environmental Review Strategic Proposal, subject to Ministerial Conditions.

The management approach for Key Environmental Assets and Species is summarised below and will be detailed in future proposals.

Table 3: Key asset tier definitions and management objectives

TIER	ASSET TIER DEFINITION	MANAGEMENT OBJECTIVE
Tier 1	Assets that are directly protected under Commonwealth or state legislation or recognised as having specific conservation significance under a formal international ranking system. At the time of writing, these include assets listed under the Ramsar convention; by the IUCN as a Category Ia, Ib, II, III or IV reserve[1]; under the United Nations Educational, Scientific and Cultural Organization World Heritage list; or specially protected (as having specific conservation importance) under state or Commonwealth law. state-listed TECs and permanent rock pools are also included. BHP Billiton Iron Ore considers these assets to have the highest priority for management consideration.	BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[2]; • Address key asset management in a Management Plan; and • Where relevant, offset residual impact in accordance with the Regional Offset Plan to the satisfaction of the CEO of the Office of the EPA.
Tier 2	Assets that have no direct level of legislative protection for environmental purposes but that may be of conservation interest, for which BHP Billiton Iron Ore will undertake further consideration on a case-by-case basis to determine management priority. At the time of writing, these include ESAs[3], state-listed PECSs, ephemeral rock pools, wetlands listed in A Directory of Important Wetlands in Australia (Environment Australia 2001), and proposed conservation estate identified from 2015 pastoral lease exclusion areas. This tier may include IUCN Category V and VI protected areas, depending on the values and objectives of the specific reserve.	BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[2]; • Where relevant, address key asset management in a Management Plan; and • Where relevant, offset residual impact in accordance with the Regional Offset Plan to the satisfaction of the CEO of the Office of the EPA.
Tier 3	Assets that have no formal level of protection for conservation purposes or foreseeable level of future protection. BHP Billiton Iron Ore considers these assets to have the lowest priority for management.	BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[2]; and • Where relevant, address key asset management in a management plan.

1. Objectives for IUCN Category V and VI protected areas are to maintain human/environment interactions and the sustainable use of natural resources. These objectives are not wholly consistent with the conservation of environmentally significant values; hence, they are not included in Tier 1 as a default position.
2. 'Acceptable level' is defined as per the EPA's significance framework in Environmental Assessment Guideline 9 (EPA 2015b); thus, BHP Billiton Iron Ore considers an 'acceptable level' of impact to be a level of residual impact that meets the EPA's objectives for that environmental factor.
3. Excluding ESAs that are declared for the purposes of buffering a species (e.g. buffering the location of a single DRF occurrence), as species are categorised separately.

Table 4: Significant species tier definitions and management objectives.

TIER	SPECIES TIER DEFINITION	MANAGEMENT OBJECTIVE
Tier 1	At the time of writing, species under threat are species that are listed under IUCN Red-list threatened categories or the EPBC Act as Critically Endangered, Endangered and Vulnerable, (i.e. Threatened species), and species listed under Schedules 1 to 4 of the WC Act. BHP Billiton Iron Ore considers these species to have the highest priority for management consideration.	BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[1]; • Address significant species management in a Management Plan; and • Where relevant, offset residual impact in accordance with the Regional Offset Plan to the satisfaction of the CEO of the Office of the EPA.
Tier 2	Species that have no formal level of legislative protection as 'threatened' within Western Australia but for which BHP Billiton Iron Ore will undertake further consideration on a case-by-case basis to determine management priority. Includes species known to be under threat or newly discovered or undescribed species, including SREs. At the time of writing, these are species listed under international conventions (e.g. Japan–Australia Migratory Bird Agreement), as Marine or Migratory under the EPBC Act, species listed under Schedule 5 to 7 of the WC Act or Priority species.	BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[1]; • Where relevant, address significant species management in a Management Plan; and • Where relevant, offset residual impact in accordance with the Regional Offset Plan to the satisfaction of the CEO of the Office of the EPA.
Tier 3	Species that have no formal level of protection for conservation purposes or foreseeable level of future protection. BHP Billiton Iron Ore considers these species to have the lowest priority for management.	BHP Billiton Iron Ore shall: • Where relevant, mitigate risks to an acceptable level[1]; and • Where relevant, address species management in a management plan.

1. 'Acceptable level' is defined as per the EPA's significance framework in Environmental Assessment Guideline 9 (EPA 2015d); thus, BHP Billiton Iron Ore considers an 'acceptable level' of impact to be a level of residual impact that meets the EPA's objectives for that environmental factor.

4.2 DERIVED PROPOSAL PROCESS

Submissions received requested that further information be provided regarding the process undertaken by the EPA in declaring a proposal a Derived Proposal under the Pilbara Expansion PERSP (Issue Numbers 41, 43, and 53). There was uncertainty regarding the nature of the information which would be provided to EPA, and the process in determining how a proposal is to be declared derived.

Appendix 11 of the PERSP provided a Derived Proposal Template. BHP Billiton Iron Ore would, for any proposed developments or activities, address the requirements of the template in determining management approaches for these activities to meet the environmental objectives. A summary of the EPA declaration process is shown in Figure 3.

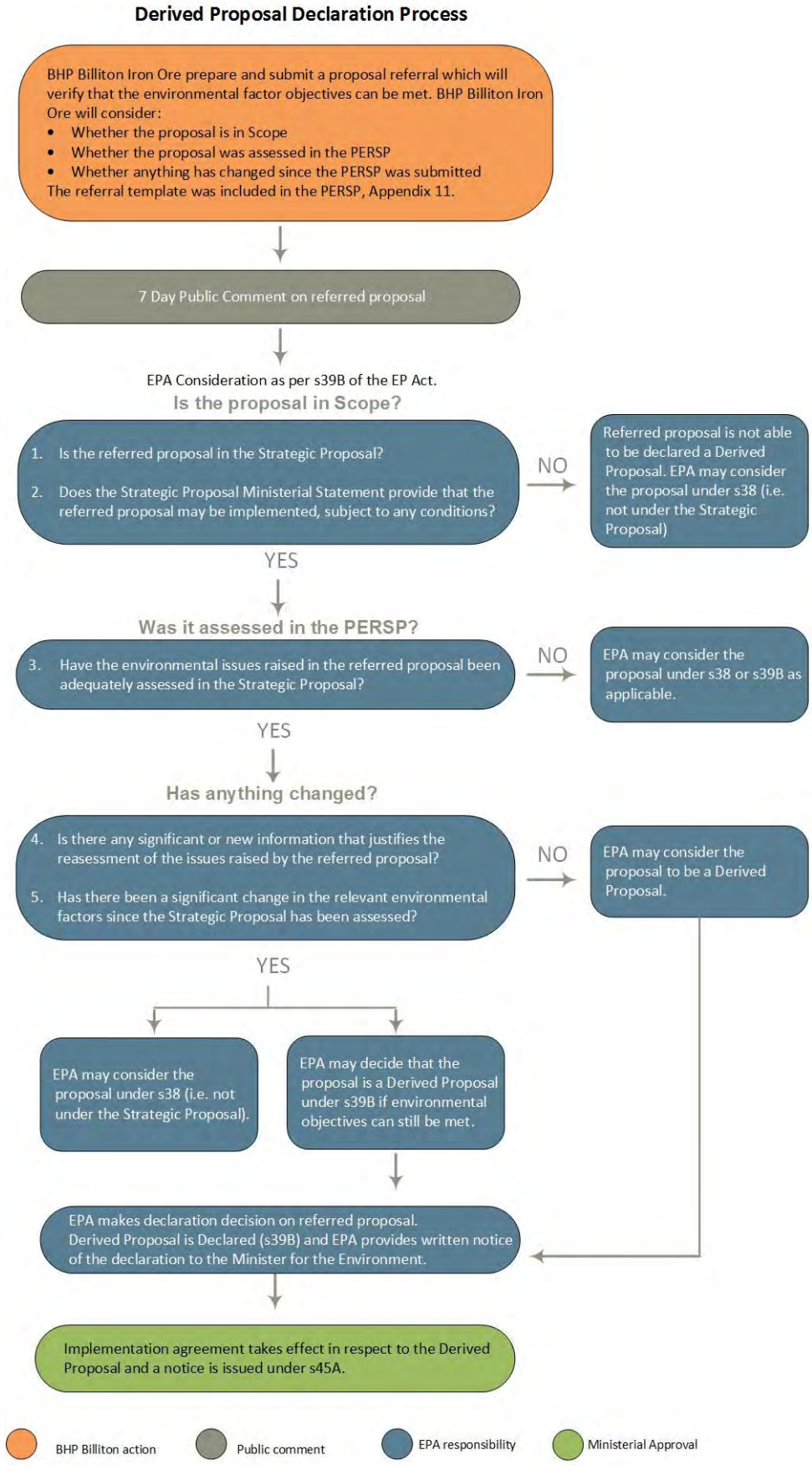

Figure 3: Derived Proposal Declaration Process

4.2.1 STAKEHOLDER CONSULTATION

BHP Billiton Iron Ore undertakes regular and ongoing stakeholder engagement as part of its core business activities. Our Communications, Community and External Engagement Policy (Our Requirements) sets out the Company's approved mandatory and minimum performance requirements for community engagement (BHP Billiton 2016). BHP Billiton aims to facilitate regular, open and honest dialogue to understand expectations, concerns and interests of stakeholders and to incorporate them into business planning to help build strong, mutually beneficial relationships.

During development of the Strategic Proposal, BHP Billiton Iron Ore has undertaken targeted stakeholder and community engagement based on interest and proximity to the project location. BHP Billiton Iron Ore will continue to engage with stakeholders throughout the development of Ministerial Conditions and for potential Derived Proposal developments under the Strategic Proposal. A summary of the key stakeholders identified for the Strategic Proposal is provided in Table 5. It should be noted that while the formal public comment period for Derived Proposals is a 7 day period, BHP Billiton Iron Ore will engage with relevant key stakeholders during the development of Derived Proposals, providing opportunity for input and consideration.

Table 5: Strategic Proposal key stakeholders

STAKEHOLDER GROUP	KEY REPRESENTATIVES OR MEMBERS
State Government	
WA Ministers	Premier, Minister for Tourism; Science Minister for State Development; Transport; Innovation Minister for Environment; Heritage Minister for Mines and Petroleum Minister for Water Minister for Regional Development; Lands Other ministers as required
Government-owned Corporations and Organisations	Pilbara Development Commission
Opposition	Leader of the Opposition; Shadow Ministers; other relevant members
Elected Representatives	Member for Pilbara Members for Mining and Pastoral Region

STAKEHOLDER GROUP	KEY REPRESENTATIVES OR MEMBERS
Agencies and Departments	Department of Environment Regulation Department of Parks and Wildlife Department of Aboriginal Affairs Department of Mines and Petroleum Department of Planning Department of Premier and Cabinet Department of Regional Development Department for State Development Department of Transport Department of Water Office of the Environmental Protection Authority Port Hedland Port Authority
Commonwealth Government	
Ministers	Minister for the Environment (Decision-making Authority for the Proposal)
Departments	Department of the Environment and Energy (formerly DotE)
Commonwealth Members	Key Commonwealth Members, WA Commonwealth Members, WA Senators
Local Government	
Local Organisations	Pilbara Regional Council
Towns and Shires	Town of Port Hedland Shire of East Pilbara Shire of Ashburton
Community	
Community Groups and Associations	Newman Community Consultative Group Port Hedland Community Consultative Group Newman Visitor Centre
Local Residents	Newman community Port Hedland community Jigalong and other Aboriginal communities

STAKEHOLDER GROUP	KEY REPRESENTATIVES OR MEMBERS
Traditional Owners, Native Title Claimants, and Representative Bodies	Banjima Native Title Aboriginal Corporation Banjima Implementation Committee Kariyarra people Karlka Nyiyaparli Aboriginal Corporation Nyiyaparli Implementation Committee Ngarlawangga people Palyku people Yinhawangka Aboriginal Corporation Yinhawangka Implementation Committee Yamatji Marlpa Aboriginal Corporation
Non-Government Organisations (NGOs)	
Environment NGOs	Care for Hedland Environmental Association Conservation Council of Western Australia Gondwanalink Greening Australia Rangelands Natural Resource Management Group Wildflower Society of Western Australia
Industry	
Peak Bodies	Chamber of Minerals and Energy Newman Chamber of Commerce and Industry Port Hedland Chamber of Commerce and Industry
Industry Association	Association of Mining and Exploration Companies
Landholders	
Landholders	Pastoral leaseholders and managers
Media	
News Media	National, state and local news media (particularly, The Australian, The West Australian, Pilbara Echo, North West Telegraph)
Other	
Independent Agencies	Commonwealth Scientific and Industrial Research Organisation (CSIRO)

4.2.2 FEDERAL APPROVAL

To allow for consideration of environmental attributes at a federal level, a strategic assessment was also conducted in accordance with Part 10 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The jurisdiction of the Commonwealth strategic assessment process is limited to MNES. Approval can only be granted if the Minister considers that the proponent has adequately identified and addressed potential impacts

to MNES, addressed requirements set out in the Agreement with the relevant Commonwealth Minister and provided for any modifications recommended by the Minister. At a broad level, the Commonwealth strategic assessment process occurs in two stages:

- Assessment and endorsement of a 'policy, plan or program' (the Program); and
- Approval of actions (or classes of actions) associated with the Program that will occur over time.

The Commonwealth approval approach is independent of the State approval requirements, and both approvals are required before substantial development can occur.

The alignment between the Commonwealth and State approval approaches is shown in Figure 4.

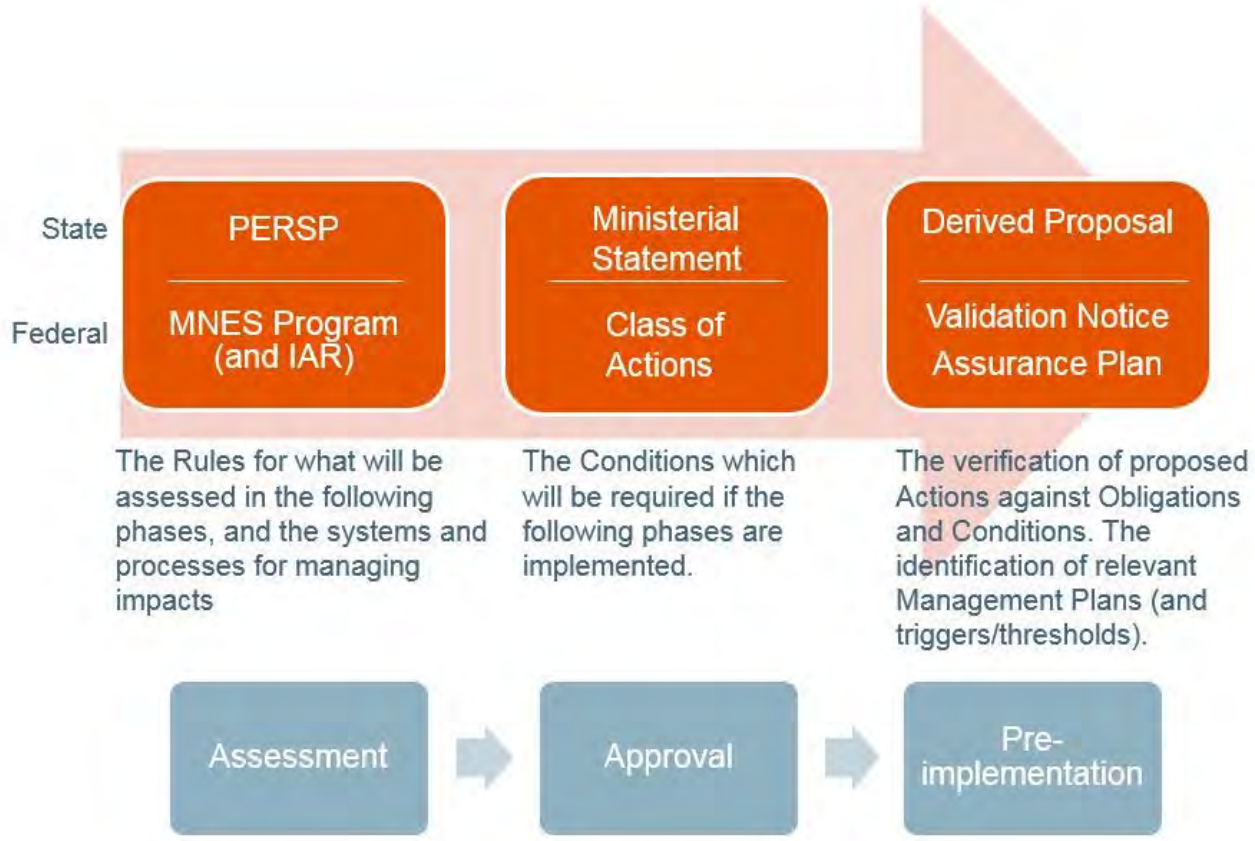

Figure 4: Alignment between State and Federal Approval Approaches

The Program will have effect for 120 years from the date of the Approval, subject to the review processes described Section 4.2.2.1.

4.2.2.1 FEDERAL IMPLEMENTATION FRAMEWORK

The implementation framework provides the processes that enable effective delivery of the Program throughout its life. The framework is comprised of two plans: the Assurance Plan and Offsets Plan. The plans will be developed in accordance with the Program and will be submitted to the Department for the Minister's approval. The Implementation Framework is subject to review every five years. Together with annual reporting requirements the implementation framework enables the Department to monitor performance against the Program. The environmental outcomes and objectives are enforceable through conditions attached to the approval of the classes of actions of the Program.

The purpose of the Assurance Plan is to define the governance processes to ensure that all activities are undertaken in accordance with the Program. In consultation with the Department, BHP Billiton will develop an

objective for each MNES. Each objective will be based on the Department's *Standards for Accreditation of Environmental Approvals under the EPBC Act* (2014) or other applicable Departmental Policy and will set out an environmental standard that:

- supports the Commonwealth Government's intended outcomes for each Matter;
- is consistent with the principles of ecologically sustainable development; and
- will not result in unacceptable or unsustainable impacts on each Matter.

Specific outcomes will be developed which define the circumstances in which impacts on the Matter will be avoided, mitigated and/or offset.

The purpose of the Offsets Plan is to ensure that appropriate offsets are applied to address significant residual impact(s) of actions at an appropriate time. The Offsets Plan will be prepared in line with the following guiding principles:

- is regional/landscape in scale and relevant to the Strategic Assessment Area;
- wherever possible, meets the requirements of both the State and Commonwealth offset obligations;
- implements conservation actions in a coordinated way based on clearly documented investment decisions and targeted outcomes;
- focuses on priority biodiversity issues (key threatening processes) in the region through the delivery of on-ground initiatives which are proportionate to potential residual impacts;
- provides opportunities for partnerships between government, industry, landholders and Aboriginal communities;
- is transparent, with robust governance arrangements that can be readily measured, monitored and audited; and
- will be applied within an adaptive management framework.

4.3 ROCK POOL VALUES

During the PERSP public review, Traditional Owners identified that small scale ecohydrological features such as gorges in the uplands areas of the Newman land system often support rock pools that may have ecological significance to fauna (Issue Number 56 and 59). Specifically, these included Ecohydrological Units (EHUs) such as the upland transitional drainages (EHU 3) and upland channel zones (EHU 4) described in the PERSP (Section 8.2.2 of the PERSP).

As a result, BHP Billiton Iron Ore has undertaken an additional study to provide further clarity on the environmental values of rock pool habitats such as those in EHU3 and EHU4. The results of the work are presented in Appendix 1 to this Supplementary Report.

The study explores the values of permanent and semi-permanent pools to terrestrial vertebrate fauna and reviews the character and basic hydrological processes of permanent and semipermanent rock pools.

Rock pools are common features of gorges in the Hamersley and Chichester subregions of the Pilbara. Terrestrial vertebrates may be reliant on rock pools to varying degrees, depending on their life history and physiology, in combination with the rock pool characters. In most cases, rainfall is the driving variable that determines the amount of water entering rock pools. The rate of rock pool drying is dependent on the form of the rock pool, the rate of evaporation, location within the landscape (e.g. sheltered by rock faces and plants), and animal use. During drying times, vertebrates continue to utilise available resources and aquatic and/or riparian vegetation grows (White 2009).

The study found that while few species are exclusively dependent on rock pools, ephemeral rock pools (when present) would have local importance, while permanent rock pools would have regional importance, as they represent hot spots for species diversity and abundance, and act as important refugia in an arid landscape.

The main species occurring within the study area that would have some requirement for rock pools are summarised as follows, with full details provided in Appendix 1 of this Supplementary Report.

Ground-dwelling mammals: Pilbara ground-dwelling mammals typically exhibit reduced daily requirements for water as they are adapted to reduced water availability.

Bats: water availability (both permanent and ephemeral) is important to the survival of the majority of bat species and as such, they are considered as being highly dependent on rock pool habitats in the environment.

Reptiles and amphibians: While most reptiles would have a low level of dependence on rock pools, the Pilbara Olive Python (*Liasis olivaceus barroni*) would have a medium dependence. The key amphibians that are likely to occur in the Newman land system of the study area would be highly dependent on rock pools.

Birds: Depending on ecological and physiological adaptations, Pilbara birds may be broadly considered to be either water dependent or water independent.

The study found that the following fauna species could potentially have a Medium-High dependency on rock pool habitats:

- Pilbara Leaf-nosed Bat
- Common Sheath-tailed Bat
- Hill's Sheath-tailed Bat
- Finlayson's Cave-bat
- Pilbara Olive Python
- Little Red Tree Frog
- Gorge Toadlet
- Pilbara Toadlet
- Spinifex Pigeon
- Diamond Dove
- Budgerigar
- Western Bowerbird
- Grey-headed Honeyeater
- Little Woodswallow
- Torresian Crow
- Zebra Finch
- Painted Finch
- Star Finch

BHP Billiton Iron Ore is committed to further engagement with Traditional Owners to further develop an understanding of species which may be dependent on these environments, and the heritage values associated with them.

As a result of the issue being raised by Traditional Owners, and in response to the potential importance of these features in the ecological landscape, BHP Billiton Iron Ore will undertake to manage permanent rock pools as Tier 1 Assets, and ephemeral rock pools as Tier 2 Assets as summarised in Table 6.

Table 6: Key asset tier definitions and management objectives

TIER	ASSET TIER DEFINITION	ROCK POOL	MANAGEMENT OBJECTIVE
Tier 1	Assets that are directly protected under Commonwealth or state legislation or recognised as having specific conservation significance under a formal international ranking system. At the time of writing, these include assets listed under the Ramsar convention; by the IUCN as a Category Ia, Ib, II, III or IV reserve[1]; under the United Nations Educational, Scientific and Cultural Organization World Heritage list; or specially protected (as having specific conservation importance) under state or Commonwealth law. state-listed TECs are also included. BHP Billiton Iron Ore considers these assets to have the highest priority for management consideration.	Permanent	BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[2]; • Address key asset management in a Management Plan; and • Where relevant, offset residual impact in accordance with the Regional Offset Plan to the satisfaction of the CEO of the Office of the EPA.
Tier 2	Assets that have no direct level of legislative protection for environmental purposes but that may be of conservation interest, for which BHP Billiton Iron Ore will undertake further consideration on a case-by-case basis to determine management priority. At the time of writing, these include ESAs[3], state-listed PECSs, wetlands listed in A Directory of Important Wetlands in Australia (Environment Australia 2001), and proposed conservation estate identified from 2015 pastoral lease exclusion areas. This tier may include IUCN Category V and VI protected areas, depending on the values and objectives of the specific reserve.	Ephemeral	BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[2]; • Where relevant, address key asset management in a Management Plan; and • Where relevant, offset residual impact in accordance with the Regional Offset Plan to the satisfaction of the CEO of the Office of the EPA.
Tier 3	Assets that have no formal level of protection for conservation purposes or foreseeable level of future protection. BHP Billiton Iron Ore considers these assets to have the lowest priority for management.		BHP Billiton Iron Ore shall: • Mitigate risks to an acceptable level[2]; and • Where relevant, address key asset management in a management plan.

1. Objectives for IUCN Category V and VI protected areas are to maintain human/environment interactions and the sustainable use of natural resources. These objectives are not wholly consistent with the conservation of environmentally significant values; hence, they are not included in Tier 1 as a default position.
2. 'Acceptable level' is defined as per the EPA's significance framework in Environmental Assessment Guideline 9 (EPA 2015b); thus, BHP Billiton Iron Ore considers an 'acceptable level' of impact to be a level of residual impact that meets the EPA's objectives for that environmental factor.
3. Excluding ESAs that are declared for the purposes of buffering a species (e.g. buffering the location of a single DRF occurrence), as species are categorised separately.

By managing these areas as Tier 1 and Tier 2 Key Assets, BHP Billiton Iron Ore will mitigate any risks to rock pool habitats to an acceptable level.

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6 APPENDICES

Appendix 1: Strategic Proposal Impact Assessment for Rock Pool Values

Biota Environmental Sciences

Rock Pool Fauna Values of the BHPBIO Strategic Environmental Assessment Area

Prepared for BHP Billiton Iron Ore

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Rock Pool Fauna Assessment

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1.0 Executive Summary

During consultation relating to BHP Billiton Iron Ore's (BHPBIO) Strategic Environmental Assessment (SEA), Traditional Owners identified that small-scale ecohydrological features, such as gorges in the uplands areas of the Newman land system often support rock pools that may have ecological significance to fauna. Specifically, these included Ecohydrological Units (EHUs) such as the upland transitional drainages (EHU 3) and upland channel zones (EHU 4) described in the Public Environmental Review Strategic Proposal (PERSP) (BHPBIO 2016a).

As a result, Biota Environmental Sciences was engaged to undertake a desktop review of vertebrate fauna use of permanent and ephemeral rock pools in these upland settings in arid and semi-arid areas, including the Pilbara. The review aimed to assess the value of upland rock pools to fauna assemblages, specifically those occurring on the Newman land system, and evaluate the ecosystem function that higher elevation rock pools perform in maintaining these faunal assemblages.

Harsh climatic conditions and scarce availability of free water, which are typical of arid and semi-arid areas such as the Pilbara, have selected for a specialised assemblage of fauna with high tolerances to environmental stressors. The notion that arid adapted fauna have a critical dependence on free water year round is therefore counterintuitive, as arid adaptations evolved as a result of the arid landscape in which the species persist. The ways in which fauna species may utilise water within rock pools therefore varies depending on their functional significance in the species' survival. Some fauna may rely directly on rock pools for survival (a primary utilisation), while other species may utilise indirect resources associated with rock pools (a secondary utilisation).

In the Pilbara, the hydrological contribution of surface water inputs to upland rock pools varies both spatially and temporally. This, coupled with the physical characteristics of the pool and the local landscape setting, determines the length of inundation, resulting in two ecological classes of rock pool: ephemeral or permanent.

Three categories were developed to describe how a species might utilise rock pools, based on the type of rock pool use (primary/secondary). These categories were:

1. Obligate: primary or secondary utilisation of rock pools is key to the survival of a species.
2. Facultative: primary or secondary utilisation of rock pools is optional or opportunistic, and not specifically required for a species' survival.
3. Not required: primary or secondary types of rock pool utilisation do not constitute a function of a species' basic biology.

Based on the categorisation of rock pool use, species ecology and known fauna distributions, a set of three classifications, with supporting criteria, were developed to categorise the level of dependence that particular species may have on the presence of rock pools and their associated attributes (Table 1.1).

This framework for rock pool use and dependence was applied to the suite of species that are known to occur on the Newman land system and either occupy gorge habitats, or use resources (such as rock pools) within gorge habitats. This suite of species included conservation significant species known to occur within the PERSP Project Definition Boundary. Species determined to have a high to medium dependency on permanent and ephemeral rock pools are listed below in Table 1.1.

Table 1.1: Species determined to have a medium or high dependency on rock pools (listed by Conservation Significance, then by level of dependency).

	Common Name	Species Name	Conservation Status	Dependency on Rock Pools
Bats	Pilbara Leaf-nosed Bat	*Rhinonicteris aurantia*	Schedule 3 / Vulnerable	High – need to drink frequently, and forage for invertebrates over water surfaces.
	Common Sheath-tailed Bat	*Taphozous georgianus*	–	
	Hill's Sheath-tailed Bat	*Taphozous hilli*	–	
	Finlayson's Cave-bat	*Vespadelus finlaysoni*	–	
Reptiles and Frogs	Pilbara Olive Python	*Liasis olivaceus barroni*	Schedule 3 / Vulnerable	Medium – predates on mammals, bats, birds, reptiles and frogs, which are captured by striking from a submerged position in water. However, also often recorded in rocky habitat away from water.
	Little Red Tree Frog	*Litoria rubella*	–	High – mate and deposit eggs in water; tadpoles complete metamorphosis in water.
	Gorge Toadlet	*Pseudophryne douglasi*	–	
	Pilbara Toadlet	*Uperoleia saxatilis*	–	
Birds	Spinifex Pigeon	*Geophaps plumifera*	–	High – need to drink frequently.
	Diamond Dove	*Geopelia cuneata*	–	
	Budgerigar	*Melopsittacus undulatus*	–	
	Western Bowerbird	*Ptilonorhynchus guttatus*	–	
	Grey-headed Honeyeater	*Lichenostomus keartlandi*	–	
	Little Woodswallow	*Artamus minor*	–	
	Torresian Crow	*Corvus orru*	–	
	Zebra Finch	*Taeniopygia guttata*	–	
	Painted Finch	*Emblema pictum*	–	
	Star Finch	*Neochmia ruficauda*	–	High – needs to drink frequently, and shelters in aquatic vegetation growing in rock pools.

Few Pilbara fauna species would rely specifically on upland Newman land system rock pools, as their arid adaptions have enabled them to persist in the absence of reliable water availability. The exceptions to this are those fauna that use free water exclusively for key life history stages or ecophysiological demands, such as amphibians, some bats and surface water-dependent birds. However, none of these fauna are restricted to upland gorge habitats where rock pools occur, as they would also use free water available in lowland creeks and rivers.

Nevertheless, upland rock pools may be locally or regionally significant as they do provide resources that are utilised by fauna for key ecological activities such as drinking, reproduction, foraging, shelter and refugia. It is the combination of these resources and the setting of rock pools within a landscape that determines the overall value of a rock pool, and some rock pools would be more significant than others. Isolated rock pools may be locally significant, as they represent hotspots for species richness and abundance. Ephemeral pools are likely to have local significance when present, as they represent temporary drinking, breeding and foraging resources, and may also provide important connective refugial habitats that enable species to disperse and occupy previously unfavourable habitats. Permanent pools in upland settings are regionally uncommon, and are therefore likely to be of elevated significance as the physical characteristics and nature of water permanency has shaped the local habitat, in turn influencing the fauna that may utilise it.

In conclusion, while few species are exclusively dependent on rock pools, ephemeral rock pools (when present) would have local significance, while permanent rock pools would have regional significance, as they represent local hot spots for species diversity and abundance, and function as important refugia during drought periods in a typically arid landscape.

It is recommended that proposals for the future construction and/or expansion of iron ore mining areas within the context of BHPBIO's SEA take into consideration appropriate management of process that may result in impacts to rock pools and their associated ecological attributes. To this end, Biota recommends that wherever practicable, the following management practices are considered:

1. Installation of appropriately sized and located culverts or other drainage treatments in upland areas to maintain natural surface hydrology providing inputs to gorge habitats.
2. Manage the input of sediment or other potential contaminants into uplands surface waters that have the potential to drain into rock pools, via cut-off drains, detention basins or other appropriate run-off settlement treatments.
3. Controls for the potential introduction of non-native flora and fauna via altered access to gorge systems and associated rock pools, including taxa that may be distributed via surface water run-off.

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2.0 Introduction

2.1 Project Background and Study Area

During consultation relating to BHPBIO's SEA, Traditional Owners identified that small-scale ecohydrological features such as gorges in the uplands areas of the Newman land system often support rock pools that may have ecological significance to fauna. Specifically, these features included Ecohydrological Units (EHUs) such as the upland transitional drainages (EHU 3) and upland channel zones (EHU 4) described in the PERSP (BHPBIO 2016a). These areas are located in the Hamersley and Chichester Ranges, and constitute the study area for the purposes of this report. BHPBIO has mapped these features and the available data suggest that they are reasonably common in the PERSP Project Definition Boundary.

These EHUs and associated rock pools are a key feature of the conservation reserves elsewhere in the Pilbara (e.g. Karijini National Park) and play a significant role in indigenous culture. Given that water gathers on a local scale in the Pilbara, Traditional Owners consider such rock pool areas to be of environmental significance, as ephemeral or permanent rock pools may be influential on fauna distributions.

The Traditional Owners consulted have concerns that potential impacts may not have been fully identified at the strategic level, thereby not accounting for potential impacts on conservation significant species, as well as the impacts the loss of these habitats could have on other vertebrate fauna from a wider perspective (Preston Consulting 2016).

2.2 Study Objectives and Scope

Biota Environmental Sciences (Biota) was engaged to undertake a desktop review of vertebrate fauna use of permanent and ephemeral rock pools in upland settings within the PERSP Project Definition Boundary. The review aimed to assess the value of rock pools to fauna assemblages associated with upland habitat areas of the Newman land system, and to evaluate the ecosystem function such rock pools perform in maintaining these faunal assemblages.

The format of this review is structured to address the specific aims of this scope, which were:

1. Conduct a comprehensive desktop review of any existing literature and studies relevant to the ecohydrology of permanent and ephemeral rock pools, and terrestrial vertebrate fauna use of these habitats, and document the methods used to do so (see Section 3.0).
2. Review the character and basic hydrological processes of ephemeral and permanent rock pools identified within the EHUs 3 and 4, as defined within the PERSP (Section 4.0).
3. Explore the values of ephemeral and permanent rock pools to terrestrial vertebrate fauna, particularly in arid and semi-arid regions, including the Pilbara bioregion (Section 5.0).
4. Develop a multi-criteria approach to classifying a typical vertebrate fauna assemblage of the Newman land system into categories that reflect a species' dependence on free water in the environment, based on available information of species' biology, resource requirements and water ecophysiology (Section 6.0).
5. Assess the relative dependence on rock pools of this typical vertebrate fauna assemblage, with a focus on conservation significant fauna known to occur within the PERSP Project Definition Boundary (Section 7.0).
6. Assess the local and regional ecological value of ephemeral and permanent rock pools (Section 8.0).

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3.0 Desktop Review Methodology

3.1 Collation of Database Records

In order to understand how rock pools may be of value to vertebrate fauna inhabiting the Newman land system, it was important to first identify the suite of fauna that are likely to occur in such habitats. This was achieved by collating information from Biota's internal database of all fauna species that have been recorded from the Newman land system in the Pilbara bioregion since 2005. A total of 153 survey sites from 21 projects were included in this review. The results of this collation are presented in Appendix 1. For the purpose of this report, these records were consolidated to identify a subset of species that occupy gorge habitats, or that may use resources (such as rock pools) in gorge habitats on occasion.

In addition, conservation significant species identified in the PERSP Flora and Vertebrate Fauna Screening Assessment (BHPBIO 2016b) that are known to occupy gorge habitats or use rock pools within the Newman land system were included in this review. The dependency on rock pools of these conservation significant species and species identified from biota's database collation, are discussed in Section 7.0 and Appendix 3.

3.2 Literature Review

The following literature sources were reviewed to address the objectives of this study:

- Wetland Values of the Eastern Pilbara – distribution and diversity of ecohydrological assets (Coughran et al. 2013);
- Wetland Values of the Eastern Pilbara – an ecohydrological assessment of surface water, floodplain, marsh and aquifer features, and associated ecological values (Coughran et al. 2014);
- SEA Hydrology: Ecohydrological Change Assessment (BHPBIO 2016c) ;
- Pilbara Strategic Assessment: Flora and Vertebrate Fauna Screening Assessment (BHPBIO 2016b); and
- publicly available published journals and articles.

3.3 Nomenclature

As outlined in the technical guide for fauna surveys prepared jointly by the EPA and the then Department of Environment and Conservation (EPA and DEC 2010), species nomenclature for mammals, reptiles and amphibians follows that of the WA Museum fauna taxonomic checklist (last published in August 2016). Similarly, species nomenclature for avifauna follows that of Christidis and Boles (2008).

3.4 Conservation Significance Framework

Threatened fauna are those native species that are rare, threatened with extinction or have high conservation value, and are deemed to be in need of special protection under either the WA *Wildlife Conservation Act 1950,* as published in the Wildlife Conservation (Specially Protected Fauna) Notice (most recently, State of Western Australia 2015), or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). Migratory species are also protected under the EPBC Act as species of national environmental significance. The Department of Parks and Wildlife also maintains a list of Priority species that have not been assigned statutory protection under the *Wildlife Conservation Act 1950,* but are considered to require further evaluation or monitoring. Appendix 2 details the categories of conservation significance recognised under these three frameworks.

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4.0 Rock Pools in the Pilbara Landscape

4.1 Background

The Pilbara experiences an arid to tropical climate, typified by a hot, wet summer and a mild, dry winter. Although rainfall in the Pilbara is sporadic and can occur at any time of the year, the greatest precipitation occurs during the summer months. As a result, for many months of the year surface water is restricted to localised reservoirs such as permanent rock pools and springs (Woinarksi et al. 2007).

The scarcity of water and harsh climatic conditions that typify Australian arid and semi-arid zones, such as the Pilbara, have in turn shaped the fauna and flora assemblages within these regions (Catullo and Keogh 2014). Most arid zone fauna exhibit a variety of adaptations to cope with life in arid landscapes. Examples include: nocturnal activity, seeking shelter in thermal refugia such as burrows, roosts or dens, eliminating the need to drink by obtaining preformed water from food, altering diurnal activity to cooler parts of the day to reduce water requirement for thermoregulation, exhibiting low basal metabolic rates, excreting concentrated urine and dry faeces, and employing nasal counterflow (Fisher et al. 1972, Morton et al. 1989, Watts and Kemper 1989, Nagy and Bradshaw 2000, Withers and Cooper 2009, Field and Wroe 2012). The notion that arid adapted fauna have a critical dependence on free water year round is therefore counterintuitive, as arid adaptations evolved as a result of the arid landscape in which the species persist.

4.2 Definitions

For the purposes of this report, rock pools are defined as aquatic ecosystems associated with weathered depressions or holes in rock outcrops, which hold water following rainfall events or from spring contributions (Coughran et al. 2014).

Rock pools have been identified as components of EHUs 3 and 4, which are defined in the PERSP as:

- *EHU 3 – Upland transitional areas: drainage floors within EHUs 1 and 2* (upland source areas including hills, mountains, plateaux, dissected slopes and plains) *that accumulate surface flows from up-gradient.*
- *EHU 4 – Upland channel zones: channel systems of higher-order streams that are typically flanked by EHU 3 and dissect EHUs 1 and 2.*

4.3 Characteristics

4.3.1 Water Source

Water catchment in rock pools within EHUs 3 and 4 is associated with surface water inputs only, as these landscape features are disconnected from groundwater (Coughran et al. 2014, BHPBIO 2016c). Rock pools are filled by periodic inflows of water via direct rainfall and localised drainage, where rock faces funnel water into holes and depressions (White 2009, Coughran et al. 2014). Rock pools may also be 'spring fed' systems, where water flow is driven by rainfall recharge from the upland sections of adjacent ranges and resultant hydraulic head differential, rather than by deep groundwater diverted to the surface (Rio Tinto 2013).

The hydrological contribution of surface water into rock pools varies spatially and temporally (BHPBIO 2016c). This, coupled with the physical character of the pool, the nature of its use, and the local environment, determines the length of inundation, resulting in two classes of rock pool: ephemeral or permanent.

4.3.2 Physical Attributes

Depressions and holes that ultimately form rock pools originate through chemical weathering and erosion; either water erosion of fractures in rocks, or carbonic acid erosion of small depressions from the decomposition of trapped plant material (White 2009). These processes result in a similar geomorphology of the rock pool, with variations in depth and surface shape (Brendonck et al. 2010).

The literature outlines two broad forms of rock pools:

- Pit-shaped rock pools – typically hemispherical in dimension, with a circular shape and large depth to surface area ratio. Pit-shaped rock pools often contain water for extended periods or throughout the year, even in very arid regions (White 2009, Jocque et al. 2010).
- Pan-shaped rock pools – typically flat-floored, with sloping sidewalls and small depth to surface area ratio. Pan-shaped rock pools have irregular outlines, and it is common for weathering and erosion to lead to fusion of neighbouring pools, resulting in larger, more complex shaped pools (White 2009, Brendonck et al. 2010, Jocque et al. 2010).

Chemical conditions of rock pool water are largely influenced by the shape of the rock pool. Following inundation, pools are generally characterised by low conductivity and high nutrient concentration, however concentrations decline quickly due to nutrient uptake by organisms (Jocque et al. 2010). Shallower pools have poor buffering capacities to changes in the environment, such that the temperature of the water closely follows that of the ambient temperature, while pH and dissolved oxygen show large diurnal fluctuations (Brendonck et al. 2010).

4.3.3 Vegetation Structure

Rock pools are common features of gorges in the Hamersley and Chichester subregions of the Pilbara. These gorge habitats are typically incised through banded ironstone, forming sheer, steep-sided valleys and scree and boulder strewn slopes (George et al. 2011). Such gorges often act as refugia from fire, allowing many relictual plant species to persist in them (George et al. 2011). Such flora include native figs (*Ficus brachypoda, F. virens*); kurrajongs (*Brachychiton acuminata, B. gregorii*); native cypress (*Callitris columellaris*); the wing-nut tree (*Terminalia canescens*); and the wonga wonga vine (*Pandorea pandorana*) (George et al. 2011).

Growing in water in rock pools themselves, aquatic perennials such as species of *Typha* are common. Other vegetation occurring in gorge habitats includes species typical of upland areas, including *Eucalyptus, Corymbia, Acacia* and *Triodia* species.

4.3.4 Ecological Processes

Terrestrial vertebrates may be reliant on rock pools to varying degrees, depending on their life history and physiology, in combination with the rock pool characters (see Section 5.0). In most cases, rainfall is the driving variable that determines the amount of water entering rock pools. The rate of rock pool drying is dependent on the form of the rock pool, the rate of evaporation, location within the landscape (e.g. sheltered by rock faces and plants), and animal use. During this time, vertebrates continue to utilise available resources and aquatic and/or riparian vegetation grows (White 2009).

4.4 Temporal and Spatial Significance

In arid and semi-arid regions, rock pools are often ephemeral and constitute a temporary habitat or temporary resource due to sporadic rainfall and high evaporation rates (Brendonck et al. 2010). In the Pilbara, the occurrence and persistence of water filled rock pools is also unpredictable. Such unpredictability can influence species composition and population dynamics. Where free water is no longer available, some species may go locally extinct or migrate to other, more productive areas. By comparison, when water is locally abundant, many semi-arid fauna species exhibit eruptive population dynamics, where increases in primary

productivity lead to increases in reproduction and survivorship, and subsequent landscape wide dispersal (Pavey et al. 2015).

The spatial occurrence of rock pools within the landscape can also influence the species assemblages present. Where rock pools occur in isolation in a landscape, species richness and abundance are generally higher, because the resources associated with water are highly sought commodities in respect to fauna (Masini and Walker 1989, Korine et al. 2016). As a result, isolated pools may have local significance. However, where there are many rock pools distributed in close proximity, mobile species may disperse more widely throughout the landscape, leading to a decrease in the richness of species surrounding the rock pools (Masini and Walker 1989, Korine et al. 2016).

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5.0 Fauna and Rock Pools

5.1 Types of Utilisation

All vertebrates in arid environments face two major stressors; limited availability of free water year round, and harsh environmental conditions that accentuate water loss through evaporation (Chew 1961). Despite this, many arid and semi-arid adapted fauna have overcome these problems through adaptations such as behavioural avoidance of extreme environmental conditions, physiological adaptations to conserve water loss, and temporary tolerance of high body temperature (Chew 1961). Depending on their adaptations, the ways in which fauna may utilise rock pools may also vary. Some fauna may depend on rock pools for key life history stages or ecophysiological demands (a primary utilisation), where other species may utilise indirect resources associated with rock pools (a secondary utilisation). The types of primary and secondary uses of rock pool habitats by fauna are described below.

5.1.1 Rock Pool Primary Utilisation

5.1.1.1 Thermoregulation/Water Balance

In arid environments, two major physiological problems facing fauna are obtaining sufficient water for bodily function, and keeping body temperatures regulated to maintain homeostasis (Schmidt-Nielsen and Schmidt-Nielsen 1952). Fauna in arid environments are exposed during summer to considerable heat gain from solar radiation, thermal radiation and high air and wind temperatures (Cain et al. 2005). In addition, fauna also lose water through evaporation, excretion of faeces and urine, and through foraging for and consuming food (Kotler et al. 1998, Cain et al. 2005). These factors all contribute to an animals' ability to thermoregulate and maintain water balance. Rock pools may offer fauna a way to thermoregulate and to maintain water balance through the provision of free water for drinking. Examples of species that would drink free water when available include the Dingo (*Canis dingo*), Euro (*Osphranter robustus*) and Rothschild's Rock-wallaby (*Petrogale rothschildi*) (see Section 7.1; and Table 1 in Appendix 3).

5.1.1.2 Reproduction

Out of all terrestrial vertebrate groups, only the amphibians and turtles are semi-aquatic fauna that require standing water for reproduction. Pilbara amphibians occurring in the Newman land system, such as the Little Red Tree Frog (*Litoria rubella*),the Gorge Toadlet (*Pseudophryne douglasi*) the Pilbara Toadlet (*Uperoleia saxatilis*), may utilise water in rock pools for the purposes of mating or to complete part of their life cycles (such as larval development) (see Section 7.3.2; and Table 3 in Appendix 3).

5.1.2 Rock Pool Secondary Utilisation

5.1.2.1 Foraging and Predation

Invertebrates constitute prey for many species of insectivorous birds, ground-dwelling mammals, bats, amphibians and reptiles (see Section 7.0; and Appendix 3 for specific examples). Rock pools often exhibit high concentrations of invertebrate biomass, as many terrestrial invertebrates require water to complete early phases of their life cycles. At rock pools, the invertebrate biomass available to vertebrates is related to the length of inundation of the pool, and presence of other fauna (Jocque et al. 2010). Ephemeral, short-lived pools exhibit lower invertebrate species diversity than permanent pools (Jocque et al. 2010). The presence of aquatic fauna such as tadpoles often enhances primary productivity and macro-invertebrate richness, due to an increase of nutrient availability as a result of sediment processing (White 2009).

Some vertebrate species may also forage around rock pools for vegetation that grows in association with moister areas; for example, the Northern Quoll (*Dasyurus hallucatus*) may forage for figs, while macropods may forage for grasses.

Additionally, in a largely dry, resource poor environment, rock pools can exhibit concentrations of vertebrate biomass foraging and drinking, which in turn provides a greater abundance of prey for predatory fauna (Pavey et al. 2015). Examples of species that may predate on vertebrates attracted to rock pools include the Dingo (*Canis dingo*) (see Section 7.1.4; Table 1 of Appendix 3) and Pilbara Olive Python (*Liasis olivaceus barroni*) (see Section 7.3.1; Table 3 of Appendix 3).

The relationships between the physical characteristics of the rock pool habitat, the invertebrate biomass they support, and the subsequent vertebrate foraging and predation, indicate that some types of rock pools will be more ecologically significant than others.

5.1.2.2 Shelter

The habitats immediately surrounding rock pools are often congruous with habitat preferences of many fauna species. Dense vegetation often grows in substrates surrounding pools and rocky outcrops due to extra surface run-off (Jocque et al. 2010), which in turn provides protective shelter for diurnal bird species such as the Australian Painted Snipe (*Rostratula australis*), Painted Finch (*Emblema pictum*), Western Bowerbird (*Ptilonorhynchus guttatus*) and Grey Shrike-thrush (*Colluricincla harmonica*) (see Section 7.4; Table 4 in Appendix 3), as well as reptile species such as *Gowidon longirostris* (see Section 7.3.1; Table 3 of Appendix 3). Some species of bird, such as the Star Finch (*Neochmia ruficauda*), would rely exclusively on habitat provided by aquatic vegetation growing in some rock pools (Section 7.4; Table 4 in Appendix 3).

Sheltered gorges are also largely protected from fire and wind, allowing deep leaf litter to accumulate beneath plants growing adjacent to rock pools. These microhabitats would be used as shelter by some species of reptile such as *Lerista zietzi* (Section 7.3.1; Table 3 of Appendix 3) and *Eremiascincus* sp. "gorgeous" (a recently recognised species that has not yet been formally described).

5.1.2.3 Refugia

Elevated topographic relief typical of gorges provides complex, sheltered habitats that often represent the best niche for moisture conservation in an otherwise arid landscape (Slayter et al. 2007). Rock pools in these gorge habitats contribute to moisture availability, as local humidity is increased around densely vegetated water bodies. In addition, gorge habitats often impede the spread of fire (Slayter et al. 2007), and as such are largely protected from fire or the consequences of fire. As a result of climatic perturbations such as fire, extreme heat or drought, rock pools and associated habitats provide more mesic conditions that act as refugia for species. In this context, mammals such as macropods and bats would utilise rock pools as refugia (see Sections 7.1 and 7.2), along with bird species belonging to water dependent families such as the Columbidae, Psittacidae, Meliphagidae, Estrildidae, Casuariidae, Glareolidae, Hirundinidae, Artamidae, Monarchidae, Ptilonorhynchidae and Corvidae (see Section 7.4.2).

6.0 Framework for Rock Pool Use

6.1 Categorisation of Use

Based on the type of rock pool use (primary or secondary), a species may either have a facultative or obligate dependence on rock pools. The following three categories are used to describe this manner of use, and are further applied to specific species in Appendix 3:

1. Obligate: primary or secondary utilisation of rock pools is key to the survival of a species.
2. Facultative: primary or secondary utilisation of rock pools is optional or opportunistic, and not required specifically for a species' survival.
3. Not required: primary or secondary types of rock pool utilisation do not constitute a function of a species' basic biology.

6.2 Classification of Dependence

Based on the categorisation of rock pool use (Section 6.1), in addition to species ecology and known fauna distributions, a set of classifications and criteria were developed to further outline the level of dependence that a species may have on the presence of rock pools and their associated attributes (Table 6.1).

Table 6.1: Criteria used to assign species dependence on rock pools.

Dependence	Criteria
Low	• Primary and secondary types of rock pool use are categorised as 'Not Required' or 'Facultative'. • The species has a generalist habitat requirement, and is unlikely to rely solely upon gorge habitats or their associated resources.
Medium	• One or more secondary types of rock pool utilisation are categorised as 'Obligate'. • The species is not restricted to gorge habitats, but the resources provided by these habitats may be utilised by the species on occasion.
High	• One or more primary types of utilisation are categorised as 'Obligate' and the range of the species is confined around rock pools in gorge habitats.

6.3 Fauna Assemblage in Newman Land System

The collation of Biota's records of fauna recorded from the Newman land system resulted in an expected assemblage of 18 species of ground-dwelling mammal, 13 bat species, 61 reptile species, 2 frog species and 80 species of avifauna (birds) (Appendix 1). A subset of these species, comprising six species of ground-dwelling mammal, five bat species, 15 reptile species, three frog species and 17 avifauna species, were identified to occupy gorge habitats, or use resources (such as rock pools) within gorge habitats (see Appendix 3). Eight of these species were conservation significant species identified in the PERSP Flora and Vertebrate Fauna Screening Assessment (BHPBIO 2016b), including the Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), Ghost Bat (*Macroderma gigas*), Pilbara Barking Gecko (*Underwoodisaurus seorsus*), Pilbara Olive Python (*Liasis olivaceus barroni*), Grey Falcon (*Falco hypoleucos*), Peregrine Falcon (*Falco peregrinus*) and Australian Painted Snipe (*Rostratula australis*).

The tables in Appendix 3 depict the categorisations of rock pool use and subsequent classification of dependence based on the framework outlined in Sections 6.1 and 6.2 for the subset of species, including those conservation significant species listed above, that may have some requirement for rock pools.

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7.0 Dependency of Fauna on Rock Pools

The main species occurring within the study area that would have some requirement for upland rock pools are listed in Appendix 3. Each major fauna group is discussed in the following sections.

7.1 Ground-dwelling Mammals

Pilbara ground-dwelling mammals typically exhibit reduced daily resource requirements and a higher water economy (the ratio between metabolic water production and evaporative water loss) compared to mammals adapted to more mesic environments where free water is readily available. Desert marsupials require 35% less energy and water, while desert eutherians require 30% less energy and 50% less water (Nagy and Bradshaw 2000, Withers and Cooper 2009). The ways in which ground-dwelling mammals have adapted to reduced and sporadic availability of water in arid and semi-arid environments, and their use of water resources when these are available, are discussed in Sections 7.1.1 to 7.1.4 for the family groups identified in Table 1 of Appendix 3.

7.1.1 Dasyuridae

The Dasyuridae are a family of small to medium-sized carnivorous and insectivorous marsupials, generally referred to as dasyurids. A substantial component of Australia's arid zone fauna comprises the dasyurids (Withers and Cooper 2009). Most arid zone dasyurids can go their whole life without ingesting water, because of their diet preferences and physiological adaptations. Generalist diets of invertebrates, small vertebrates and fruit are high in preformed water, meaning that arid-adapted dasyurids experience little difficulty in obtaining sufficient free water directly from their food, thus eliminating their dependency on free water in the environment (Morton et al. 1989, Schmidt et al. 2009).

Other adaptions including short-term daily torpor, nocturnal activity, huddling in groups, use of nests, and concentrated urine excretion, have energetic and water saving benefits that allow dasyurids to persist in challenging environments without access to free water (Morton et al. 1989, Schmidt et al. 2009). In addition, the small body size of many dasyurids allows them to occupy refugia, such as small crevices in boulder piles, that other larger animals cannot use (Withers and Cooper 2009).

Permanent and ephemeral rock pools would be locally important as they support high concentrations of invertebrate and vertebrate biomass and fruiting vegetation, in turn providing food for dasyurid species occupying these habitats. In this context, the abundance of food available at rock pools might be more significant to dasyurids than the presence of rock pools themselves (although food abundance around rock pools is inherently related to water presence).

7.1.2 Macropodidae

The Macropodidae family comprises large marsupials including the kangaroos and wallabies, which are broadly referred to as macropods. The water requirements for arid-adapted macropods are low, as they are herbivorous and obtain the majority of their water needs from preformed water present in plants (Ayliffe and Chivas 1990). As such, they do not require year-round access to free water, however they will drink water if it is available, particularly during the dry season (Pearson 2013). Many macropods reduce their water requirements by restricting activity to late afternoon and night, and resting in shaded refuges during the heat of the day (Pearson 2013). For macropods, permanent and ephemeral rock pools may have local significance as refugia and drinking resources during the dry season when primary productivity is low, or during periods of drought.

7.1.3 Muridae

The Muridae family comprises rodents, which include rats and mice. These are referred to as murids. Arid adapted murids in Australia can also exist without relying upon free water. Water balance is maintained through excretion of highly concentrated urine, restricting activity to night time, seeking shelter in burrows or rock crevices, and obtaining preformed water from granivorous or insectivorous diets (Watts and Kemper 1989). These adaptations mean that murids have little reliance on free water in their habitat, thus rock pool presence may not be significant for this group of taxa. Despite this, food availability associated with rock pools may be important.

7.1.4 Canidae

The Canidae family in Western Australia comprises the Dog, Dingo and Red Fox, of which the Dingo is most common in the Pilbara. The Dingo is a water-limited species, predominantly occurring in habitats with access to free water (Allen 2012). Dingoes do not always need free water to persist when they can obtain sufficient water requirements from their prey, however during hot, dry conditions when prey is scarce, they frequently drink free water, and concentrate activity around water due to a higher concentration of prey around these areas (Allen 2012, Letnic et al. 2012). The presence of rock pools, particularly permanent pools, would be locally significant to Dingoes particularly during the dry season, although they are classified as having an overall low dependence on rock pool presence.

7.2 Bats

Ephemeral and permanent water in arid landscapes are important to the survival of the majority of bat species, and most of the key bat species in the study area would be considered highly dependent on rock pools (see Table 2 in Appendix 3). This reliance on free water is discussed in Sections 7.2.1 to 7.2.3 below.

7.2.1 Foraging and Drinking

As most bat species experience water loss during roosting, and have high energy expenditure while foraging, they often drink free water immediately after emerging from roost sites (Russo et al. 2012, Korine et al. 2016). The exception to this is the Ghost Bat, which may be able to maintain water balance without access to free water (Hudson and Wilson 1986). Insectivorous bats also tend to forage over water, as water sources attract a higher abundance of invertebrates (Korine et al. 2016). As a result, bat activity and species richness is higher around bodies of water (Lumsden and Bennett 1995). Furthermore, water bodies with calm surfaces tend to have higher bat activity than those with flowing water, as echolocation signals are less cluttered (Korine et al. 2016). As such, all ephemeral and permanent rock pools are likely to be of local importance to bat species inhabiting roosts in close proximity, as they would provide key resources which may influence their survival, activity and distribution.

7.2.2 Rock Pool Size and Accessibility

Bats drink water on the wing, by gliding over the water surface and skimming water to drink. Smaller bats (for example the Pilbara Leaf-nosed Bat, *Rhinonicteris aurantia*) are better equipped to manoeuvre over smaller pools to drink and forage, while larger species (for example the Ghost Bat, *Macroderma gigas*) require water bodies with larger surface areas for drinking and foraging (Korine et al. 2016). Species richness and activity have been found to increase with larger pool sizes (Razgour et al. 2010). All shapes and sizes of rock pools therefore provide key resources for bats, and as such have local importance for those species inhabiting roosts close to rock pools, but larger pools may perhaps have elevated importance.

7.2.3 Spatial and Temporal Significance

The location of water bodies within a landscape can directly influence the distribution of bats. For example, roost sites of many species often occur close to water sources, in order to minimise the energy required to reach foraging and drinking sites (Korine et al. 2016). This is thought to be particularly true for maternity colonies, as female bats often choose roost sites with high ambient temperature, which helps them to conserve energy required for gestation of young during torpor (Korine et al. 2016). In such cases, evaporative water loss is high, which is another factor that may influence the distance of roost sites to available water.

Studies have found that species richness and activity are equivalent between ephemeral and permanent pools, however when ephemeral pools dry, bat activity significantly reduces at these sites (Korine and Pinshow 2004, Razgour et al. 2010). During periods of drought or during the dry season, permanent pools become more significant in the landscape. One long-term study of bat captures at a permanent drinking site found that abundance was significantly lower during non-drought years, as bats were more dispersed through the landscape, whereas in drought years bat abundance was significantly higher at the permanent water source (Geluso and Geluso 2012).

7.3 Herpetofauna

The term herpetofauna refers to the reptiles (Section 7.3.1) and amphibians (Section 7.3.2) of an area. Rock pools and their surrounding habitat are resources utilised by both reptiles and amphibians, but for different reasons. The ecohydrological significance of rock pools to both of these taxonomic groups is discussed in the sections below. While most reptiles would have a low level of dependence on rock pools, the Pilbara Olive Python (*Liasis olivaceus barroni*) has been ranked as having a medium dependence (see Table 3 in Appendix 3). The key amphibians that are likely to occur in the Newman land system of the study area would be highly dependent on rock pools (Table 3 in Appendix 3).

7.3.1 Reptiles

Within Western Australia, the reptiles include species of crocodile, turtle, gecko, flap-footed lizards, skinks, dragons, monitors and snakes. Unlike some birds and most bats, reptile assemblages in the Pilbara are not typically linked to riparian habitats (Doughty et al. 2011). This is thought to be the result of past climatic cycles, where repeated arid phases caused severe drying in the Pilbara, driving the adaptation of reptiles to arid landscapes (Doughty et al. 2011). Any reptiles that once may have had a consistent reliance upon permanent waterways and associated vegetation would have been selected against and replaced with the suite of reptile fauna currently persisting in the Pilbara. This would also hold true for reptile assemblages common to gorge habitats and associated rock pools.

These fauna, instead of being strongly linked to the presence of rock pools themselves, are strongly linked to habitats commonly associated with rock pools, and the resources provided by them. Reptiles in these habitats often forage for invertebrates and vertebrates around rock pools, and shelter in cracks and crevices in associated rocky areas. However, an exception to this is the Pilbara Olive Python, which does show a strong affinity for rocky areas, riparian systems and permanent rock pools (DSEWPaC 2011). This species utilises rock pools and other watered habitats to hunt for prey that is attracted to water (Department of the Environment 2016a), such as rock wallabies, euros, bats, birds, reptiles and frogs, which are captured by striking from a submerged position in water (Department of the Environment 2016a). As such, rock pools, and particularly permanent rock pools, would be locally significant to the Pilbara Olive Python as they represent key foraging and shelter resources, particularly in areas away from waterways.

7.3.2 Amphibians

The amphibians in Western Australia include species of burrowing frogs and tree frogs. Amphibians rely on the presence of water for at least part of their life cycle. Many arid adapted amphibians are capable of aestivating through the dry season and periods of drought by seeking

shelter in humid and wet refuges such as tree hollows and water bores, or burrowing into moist substrates (Coughran et al. 2014). When sufficient water is present (e.g. after rainfall, or at permanent water sources), Pilbara frog species mate and deposit eggs in or around water, and the ensuing tadpole phase is considered the obligate aquatic phase of a frog's life cycle (Coughran et al. 2014). Where water persistence is unreliable, some species such as the Little Red Tree Frog (*Litoria rubella)* exhibit fast development (37-38 days) in small ephemeral bodies of water (Anstis 2013). All types of ephemeral and permanent rock pools would therefore be significant to the reproduction of Pilbara frog species.

7.4 Avifauna

Avifauna refers to all bird species. Most arid zone birds are primarily diurnal, and as a consequence face a significant challenge in maintaining water balance and thermoregulation, as they are exposed to extreme ambient temperatures. Depending on ecological and physiological adaptations, Pilbara birds may be broadly considered to be either water dependent or water independent. The nature of rock pool use and the spatial and temporal significance of rock pools to Pilbara birds is discussed in Sections 7.4.1 to 7.4.3 below, while dependence rankings for key species in the study area are provided in Table 4 of Appendix 3.

7.4.1 Spatial and Temporal Significance

In a report on the inland waters of the Pilbara (Masini and Walker 1989), it was found that permanent and semi-permanent water bodies exhibited greater bird species diversity than ephemeral water bodies. Similarly, both ephemeral and permanent rock pools would be important to species diversity in a landscape, although the presence of permanent pools would be the most significant to local bird populations. The proximity of pastoral stations in relation to rock pool locations would also influence bird species diversity and abundance, as these artificial watering points may reduce dependency on natural water sources (White 2009).

During the wet season, when both ephemeral and permanent water sources are available, many bird species are likely to range more widely across the landscape (Masini and Walker 1989). In contrast during the dry season, when ephemeral water bodies are dry, the occurrence of many species would contract to permanent water, or individuals would migrate to other more productive areas (Masini and Walker 1989).

7.4.2 Water Dependent Avifauna

In a study on the drinking patterns of Australian desert adapted birds (Fisher et al. 1972), 40% of all birds surveyed were placed in a 'water dependent' category, which described birds whose distribution was critically linked to the availability of free water. The ecological and physiological factors common to most species in the water dependent category included granivorous diet, reduced mobility and high activity. A diet of seed, such as that of the Zebra Finch, Star Finch, Budgerigar and Spinifex Pigeon, usually has a low water content, so these species need to drink frequently to maintain water balance (Fisher et al. 1972).

Additionally, species that have low mobility and cannot fly long distances to water, such as the Spinifex Pigeon (see Appendix 1), are restricted to areas mostly near permanent water (Fisher et al. 1972). Some birds, such as the honeyeaters, swallows and woodswallows, depend on drinking free water to counteract high evaporative water loss (Fisher et al. 1972). The study concluded that the following bird families were dependent on water: Columbidae (pigeons and doves), Psittacidae (parrots), Meliphagidae (honeyeaters), Estrildidae (finches), Casuariidae (emu), Glareolidae (pratincoles), Hirundinidae (swallows and martins), Artamidae (woodswallows, butcherbirds, magpie and currawongs), Monarchidae (monarchs and flycatchers), Ptilonorhynchidae (bowerbirds) and Corvidae (crows and ravens) (Fisher et al. 1972). For bird species in these families, the presence of water in ephemeral and permanent rock pools is likely to be of local significance to their distribution and survival.

7.4.3 Water Independent Avifauna

In the same study on the drinking patterns of Australian desert adapted birds, 60% of all birds surveyed were placed in a 'water independent' category (Fisher et al. 1972). The commonalities displayed between bird species in this category included insectivorous and carnivorous diets, high mobility, convective heat transfer and nomadic/migratory movement patterns. Insectivores and carnivores obtain large amounts of preformed water from their food, thus reducing their dependency on free water (Fisher et al. 1972).

Additionally, highly mobile species, such as birds of prey and cockatoos, are able to travel long distances without being restricted to the vicinity of water (Fisher et al. 1972). Some taxa, such as falcons, hawks and eagles, are able to fly high and ride thermal currents and lose heat through convection to the cooler surrounding air, thus reducing their need to drink to thermoregulate (Fisher et al. 1972). Other birds, such as the waterbirds common to the Pilbara, are typically migratory or nomadic, and disperse over wide areas in response to water availability (Masini 1988, Masini and Walker 1989). During dry seasons, permanent rock pools may come under increased pressure from concentrations of waterbirds.

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8.0 Value of Rock Pools

Few Pilbara fauna species would rely specifically on upland Newman land system rock pools, as their arid adaptions have enabled them to persist in the absence of reliable water availability. The exceptions to this are those fauna that use free water exclusively for key life history stages or ecophysiological demands, such as amphibians, some bats and surface water-dependent birds. However, none of these fauna are restricted to upland gorge habitats where rock pools occur, as they would also use free water available in lowland creeks and rivers.

Nevertheless, rock pools may be locally or regionally significant as they do provide resources that are utilised by fauna for key ecological activities: free water is used for drinking or reproductive activity; dense vegetation and leaf litter is used for shelter; concentrations of invertebrates and vertebrates are foraged for and predated upon; and a localised mesic habitat provides refugia. It is the combination of these resources that would determine the overall value of a rock pool, and some rock pools would be more significant than others.

For example, permanent rock pools in upland settings may have regional significance as they are typically uncommon, and the physical characteristics and nature of water permanency are likely to have shaped the local habitat, in turn influencing the fauna that may use it. Pit-shaped, permanent pools may collect the sparse soil displaced from upland areas over time, leading to the development of a aquatic benthos profile over time. This would provide a substrate for aquatic vegetation to grow in, in turn providing shelter for amphibians and species of bird such as the Star Finch. Permanent pools may also support more complex, dense vegetation, thereby providing shelter for some birds. More dense vegetation associations may result in more leaf litter being available, thence providing shelter and foraging habitat for some reptiles. A high invertebrate biomass is also associated with permanent water, providing abundant food for birds, ground-dwelling mammals, bats, amphibians and reptiles. Permanent water available year-round provides a drinking resource which is required by water-dependent birds, bats and larger mammals such as the macropods, which in turn provides a higher abundance of vertebrate prey for predatory fauna such as the Pilbara Olive Python.

By comparison, ephemeral pools may have local significance when present in upland settings, as they provide temporary drinking, breeding and foraging resources, and also provide important connective refugial habitat that enables species to disperse and occupy previously unfavourable habitats.

In conclusion, while few species are exclusively dependent on rock pools, ephemeral rock pools (when present) would have local significance, while permanent rock pools would have regional significance, as they represent local hot spots for species diversity and abundance, and function as important refugia during drought periods in a typically arid landscape.

It is recommended that proposals for the future construction and/or expansion of iron ore mining areas within the context of BHPBIO's SEA take into consideration appropriate management of process that may result in impacts to rock pools and their associated ecological attributes. To this end, Biota recommends that wherever practicable, the following management practices are considered:

1. Installation of appropriately sized and located culverts or other drainage treatments in upland areas to maintain natural surface hydrology providing inputs to gorge habitats.
2. Manage the input of sediment or other potential contaminants into uplands surface waters that have the potential to drain into rock pools, via cut-off drains, detention basins or other appropriate run-off settlement treatments.
3. Controls for the potential introduction of non-native flora and fauna via altered access to gorge systems and associated rock pools, including taxa that may be distributed via surface water run-off.

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9.0 Glossary

Biota	Biota Environmental Sciences.
BHPBIO	BHP Billiton Iron Ore.
EHU	Ecohydrological Unit as per the PERSP: *landscape elements with broadly consistent and distinctive ecohydrological attributes*.
EHU 3	As per the PERSP: *Upland transitional areas: drainage floors within EHUs 1 and 2* (upland source areas including hills, mountains, plateaus, dissected slopes and plains) *which tend to accumulate surface flows from up-gradient.*
EHU 4	As per the PERSP: *Upland channel zones: channel systems of higher-order streams which are typically flanked by EHU 3 and dissect EHUs 1 and 2.*
Ephemeral	Water persistence in rock pools is transitory, exists for only a relatively brief period following rainfall events.
Permanent	Water persistence is year-round.
PERSP	Public Environmental Review Strategic Proposal (BHPBIO 2016a).
SEA	Strategic Environmental Assessment.

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10.0 References

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Appendix 1

Typical Fauna Assemblage of the Newman Land System

Ground-dwelling Mammals

Family	Species Name	Common Name
Dasyuridae	*Dasykaluta rosamondae*	Kaluta
	Dasyurus hallucatus	Northern Quoll
	Ningaui timealeyi	Pilbara Ningaui
	Planigale ingrami	Long-tailed Planigale
	Planigale maculata	Common Planigale
	Pseudantechinus woolleyae	Woolley's Pseudantechinus
	Sminthopsis macroura	Stripe-faced Dunnart
Macropodidae	*Osphranter robustus*	Euro, Biggada
	Osphranter rufus	Red Kangaroo, Marlu
	Petrogale rothschildi	Rothschild's Rock-wallaby
Muridae	*Mus musculus*	House Mouse
	Notomys alexis	Spinifex Hopping-mouse
	Pseudomys chapmani	Western Pebble-mound Mouse
	Pseudomys desertor	Desert Mouse
	Pseudomys hermannsburgensis	Sandy Inland Mouse
	Zyzomys argurus	Common Rock-rat
Canidae	*Canis familiaris/dingo*	Dog/Dingo
Equidae	*Equus asinus*	Donkey

Bats

Family	Species Name	Common Name
Rhinonycteridae	*Rhinonicteris aurantia*	Orange Leaf-nosed Bat
Megadermatidae	*Macroderma gigas*	Ghost Bat
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheath-tailed Bat
	Taphozous georgianus	Common Sheath-tailed Bat
	Taphozous hilli	Hill's Sheath-tailed Bat
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat
	Chaerephon jobensis	Greater Northern Free-tailed Bat
	Ozimops lumsdenae	Northern Free-tailed Bat
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat
	Chalinolobus morio	Chocolate Wattled Bat
	Nyctophilus geoffroyi	Lesser Long-eared Bat
	Scotorepens greyii	Little Broad-nosed Bat
	Vespadelus finlaysoni	Finlayson's Cave-bat

Herpetofauna

Family	Species Name	Common Name
Carphodactylidae	*Nephrurus wheeleri*	
	Underwoodisaurus seorsus	Pilbara Barking Gecko
Diplodactylidae	*Diplodactylus conspicillatus*	Variable Fat-tailed Gecko
	Diplodactylus savagei	Southern Pilbara Beak-faced Gecko
	Lucasium stenodactylum	
	Lucasium wombeyi	
	Oedura marmorata	Marbled Velvet Gecko
	Rhynchoedura ornata	Western Beaked Gecko
	Strophurus elderi	
	Strophurus wellingtonae	
Gekkonidae	*Gehyra pilbara*	
	Gehyra punctata	
	Gehyra variegata	
	Heteronotia binoei	Bynoe's Gecko
	Heteronotia spelea	Pilbara Cave Gecko
Pygopodidae	*Delma butleri*	
	Delma nasuta	
	Delma pax	
	Delma tincta	
	Lialis burtonis	
	Pygopus nigriceps	
Agamidae	*Amphibolurus longirostris*	
	Ctenophorus caudicinctus	Ring-tailed Dragon
	Ctenophorus isolepis	Military Dragon
	Ctenophorus scutulatus	
	Pogona minor	
Egerniidae	*Egernia formosa*	
	Tiliqua multifasciata	Central Blue-tongue
Eugongylidae	*Carlia munda*	
	Cryptoblepharus ustulatus	
	Menetia greyii	
	Morethia ruficauda	
Sphenomorphidae	*Ctenotus duricola*	
	Ctenotus grandis	
	Ctenotus helenae	
	Ctenotus pantherinus	Leopard Ctenotus
	Ctenotus rubicundus	
	Ctenotus rutilans	
	Ctenotus saxatilis	Rock Ctenotus
	Lerista bipes	
	Lerista jacksoni	
	Lerista muelleri	
	Lerista verhmens	
	Lerista zietzi	
Varanidae	*Varanus acanthurus*	Spiny-tailed Goanna
	Varanus brevicauda	Short-tailed Pygmy Goanna
	Varanus gouldii	Bungarra or Sand Goanna
	Varanus panoptes	Yellow-spotted Goanna
	Varanus pilbarensis	Northern Pilbara Rock Goanna
	Varanus tristis	Racehorse Goanna
Typhlopidae	*Anilios ammodytes*	
	Anilios grypus	

Family	Species Name	Common Name
Boidae	*Antaresia perthensis*	Pygmy Python
	Aspidites melanocephalus	Black-headed Python
	Liasis olivaceus barroni	Pilbara Olive Python
Elapidae	*Brachyurophis approximans*	
	Demansia psammophis	Yellow-faced Whipsnake
	Furina ornata	Moon Snake
	Pseudechis australis	Mulga Snake
	Pseudonaja modesta	Ringed Brown Snake
	Vermicella snelli	
Hylidae	*Litoria rubella*	Little Red Tree Frog
Myobatrachidae	*Pseudophryne douglasi*	Gorge Toadlet
	Uperoleia saxatilis	Pilbara Toadlet

Avifauna

Family	Species Name	Common Name
Phasianidae	*Coturnix ypsilophora*	Brown Quail
Columbidae	*Phaps chalcoptera*	Common Bronzewing
	Ocyphaps lophotes	Crested Pigeon
	Geophaps plumifera	Spinifex Pigeon
	Geopelia cuneata	Diamond Dove
	Geopelia striata	Peaceful Dove
Eurostopodidae	*Eurostopodus argus*	Spotted Nightjar
Accipitridae	*Elanus axillaris*	Black-shouldered Kite
	Haliastur sphenurus	Whistling Kite
	Milvus migrans	Black Kite
	Accipiter fasciatus	Brown Goshawk
	Accipiter cirrocephalus	Collared Sparrowhawk
	Aquila audax	Wedge-tailed Eagle
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco berigora	Brown Falcon
	Falco longipennis	Australian Hobby
	Falco hypoleucos	Grey Falcon
	Falco peregrinus	Peregrine Falcon
Otididae	*Ardeotis australis*	Australian Bustard
Rostratulidae	*Rostratula australis*	Australian Painted Snipe
Turnicidae	*Turnix velox*	Little Button-quail
Cacatuidae	*Eolophus roseicapillus*	Galah
	Nymphicus hollandicus	Cockatiel
Psittacidae	*Melopsittacus undulatus*	Budgerigar
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
	Chalcites osculans	Black-eared Cuckoo
	Cacomantis pallidus	Pallid Cuckoo
Strigidae	*Ninox novaeseelandiae*	Southern Boobook
Tytonidae	*Tyto javanica*	Eastern Barn Owl
Halcyonidae	*Dacelo leachii*	Blue-winged Kookaburra
	Todiramphus pyrrhopygius	Red-backed Kingfisher
	Todiramphus sanctus	Sacred Kingfisher
Meropidae	*Merops ornatus*	Rainbow Bee-eater
Ptilonorhynchidae	*Ptilonorhynchus guttatus*	Western Bowerbird
Maluridae	*Malurus splendens*	Splendid Fairy-wren
	Malurus leucopterus	White-winged Fairy-wren
	Malurus lamberti	Variegated Fairy-wren
	Stipiturus ruficeps	Rufous-crowned Emu-wren
Acanthizidae	*Smicrornis brevirostris*	Weebill
	Gerygone fusca	Western Gerygone
	Acanthiza robustirostris	Slaty-backed Thornbill
	Acanthiza uropygialis	Chestnut-rumped Thornbill
	Acanthiza apicalis	Inland Thornbill
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote
	Pardalotus striatus	Striated Pardalote
Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater
	Lichenostomus keartlandi	Grey-headed Honeyeater
	Lichenostomus penicillatus	White-plumed Honeyeater
	Purnella albifrons	White-fronted Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Acanthagenys rufogularis	Spiny-cheeked Honeyeater
	Sugomel niger	Black Honeyeater

Family	Species Name	Common Name
	Lichmera indistincta	Brown Honeyeater
	Melithreptus gularis	Black-chinned Honeyeater
Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
	Lalage sueurii	White-winged Triller
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler
	Colluricincla harmonica	Grey Shrike-thrush
	Oreoica gutturalis	Crested Bellbird
Artamidae	*Artamus personatus*	Masked Woodswallow
	Artamus cinereus	Black-faced Woodswallow
	Artamus minor	Little Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Cracticus nigrogularis	Pied Butcherbird
	Cracticus tibicen	Australian Magpie
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail
	Rhipidura leucophrys	Willie Wagtail
Corvidae	*Corvus bennetti*	Little Crow
	Corvus orru	Torresian Crow
Monarchidae	*Grallina cyanoleuca*	Magpie-lark
Petroicidae	*Petroica goodenovii*	Red-capped Robin
	Melanodryas cucullata	Hooded Robin
Megaluridae	*Cincloramphus mathewsi*	Rufous Songlark
	Eremiornis carteri	Spinifexbird
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird
Estrildidae	*Taeniopygia guttata*	Zebra Finch
	Neochmia ruficauda	Star Finch
	Emblema pictum	Painted Finch
Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit

Appendix 2

Conservation Significance Framework

1. Commonwealth EPBC Act

Fauna species of national environmental significance are listed under the Commonwealth EPBC Act, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'lower risk', consistent with IUCN categories (Department of the Environment 2016b):

Critically Endangered (CR): a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN): a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU): a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR): a taxon is Lower Risk when it has been evaluated, but does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. Conservation Dependent (CD). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. Near Threatened (NT). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. Least Concern (LC). Taxa which do not qualify for Conservation Dependent or Near Threatened.

Migratory species are also protected under the EPBC Act as species of national environmental significance. Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. The list of migratory species consists of those species listed under the following international conventions:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
2. China-Australia Migratory Bird Agreement (CAMBA);
3. Japan-Australia Migratory Bird Agreement (JAMBA); and
4. Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

2. Western Australian *Wildlife Conservation Act 1950*

Classification of rare and endangered fauna under the WA *Wildlife Conservation Act 1950* recognises seven distinct schedules of taxa, as published in the *Wildlife Conservation (Specially Protected Fauna) Notice* (most recently State of Western Australia 2015):

Schedule 1: fauna that are rare or likely to become extinct as critically endangered fauna (CR).

Schedule 2: fauna that are rare or likely to become extinct as endangered fauna (EN).

Schedule 3: fauna that are rare or likely to become extinct as vulnerable fauna (VU).

Schedule 4: fauna presumed to be extinct (EX).

Schedule 5: birds that are subject to an agreement between the government of Australia and the governments of Japan, China and the Republic of Korea relating to the protection of migratory birds, and birds in danger of extinction, which are declared to be fauna in need of special protection (IA).

Schedule 6: fauna that is of special conservation need as conservation dependent fauna (CD). This category of species contains those taxa that do not meet the criteria for listing as threatened, but which are being maintained by specific management programs.

Schedule 7: Other specially protected fauna (OS). This category contains those taxa that are at risk from harvesting, or other human interactions, which have potential to affect their conservation status if not appropriately managed.

Department of Parks and Wildlife Priority Fauna

In addition, the Department of Parks and Wildlife maintains a list of Priority species that have not been assigned statutory protection under the *Wildlife Conservation Act 1950*. Species on this list are considered to be of conservation priority because there is insufficient information to make an assessment of their conservation status, or they are considered to be rare but not threatened and are in need of monitoring. Under this list, species are classified according to five Priority categories:

Priority 1: Taxa with few, poorly known populations on threatened lands
Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 2: Taxa with few, poorly known populations on conservation lands
Taxa that are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 3: Taxa with several, poorly known populations, some on conservation lands
Taxa that are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 4: Taxa in need of monitoring
Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

Priority 5: Taxa in need of monitoring
Taxa that are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

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Appendix 3

Analysis of Dependency of Key Fauna Species on Rock Pools

Table 1: Ground-dwelling mammal species categorisation of rock pool use and associated dependency on rock pools (O = obligate; F = facultative; NR = not required).

Family	Species Name	Common Name	Conservation Status	Ecology	Primary Utilisation		Secondary Utilisation			Dependence Classification
					Thermoregulation / Water Balance	Reproduction	Foraging / Predation	Shelter	Refugia	
Dasyuridae	*Dasyurus hallucatus*	Northern Quoll	Schedule 2 / Endangered	Preferred habitat comprises rocky areas in basalt hills, gorges, Banded Iron Stone formations of the Newman land system, mesas, high and low plateaus, lower slopes and stony plains. May forage for vertebrates, invertebrates, fruit and nectar around rock pools. Does not need to drink water or use habitat near rock pools for shelter or refugia. Nocturnal activity.	NR	NR	F	NR	NR	Low
	Pseudantechinus woolleyae	Woolley's Pseudantechinus		Occurs in rocky habitats with various vegetation associations. May forage for invertebrates around rock pools. Does not need to drink water or use habitat near rock pools for shelter or refugia. Activity patterns unknown, but may employ diurnal and nocturnal foraging.	NR	NR	F	NR	NR	Low
Macropodidae	*Osphranter robustus*	Euro		Prefers rocky hills, steep escarpments and stony rises. Shallow caves and rocky overhangs are key habitat components, and it may seek refugia around rock pools during extreme heat or drought periods. May graze on mixed vegetation around rock pools. Will drink free water when available. Crepuscular activity.	F	NR	F	NR	F	Low
	Petrogale rothschildi	Rothschild's Rock-wallaby		Occurs in a wide range of rock types, but rocky shelter with deep caves or crevices is critical to their survival. Mesic habitats provided by rock pools and gorges may be used for refugia. Forage on soft grasses, herbs and fruit, including figs, which may grow around rock pools. Will drink free water when available. Nocturnal activity.	F	NR	F	NR	F	Low
Muridae	*Zyzomys argurus*	Common Rock-rat		Habitat comprises rocky outcrops, riverine areas, open forest and woodlands with *Triodia*. May forage for vegetation, fungi, seeds and invertebrates around rock pools. Does not need to drink water or use habitat near rock pools for shelter or refugia. Nocturnal activity.	NR	NR	F	NR	NR	Low
Canidae	*Canis dingo*	Dingo		Occurs throughout a wide range of habitats over the entire Australian mainland. Access to free drinking water is a significant determinate of this species' distribution in arid habitats, and would drink water from rock pools. Predates on small and large mammals, birds, reptiles and insects, and concentrates activity around water bodies to hunt. Generally nocturnal hunter.	F	NR	F	NR	F	Low

Table 2: Bat species categorisation of rock pool use and associated dependency on rock pools (O = obligate; F = facultative; NR = not required).

Family	Species Name	Common Name	Conservation Status	Ecology	Primary Utilisation		Secondary Utilisation			Dependence Classification*
					Thermoregulation / Water Balance	Reproduction	Foraging / Predation	Shelter	Refugia	
Rhinonycteridae	*Rhinonicteris aurantia*	Pilbara Leaf-nosed Bat	Schedule 3/ Vulnerable	Roosts in caves and deep, abandoned mines with pooled water below the roost, or in areas where elevated temperature and humidity levels are maintained. Forages in riparian vegetation, gorges and gullies, and around water pools on predominantly flying invertebrates. Needs to frequently drink water. Nocturnal activity.	O	NR	F	NR	NR	High
Megadermatidae	*Macroderma gigas*	Ghost Bat	Schedule 3	Roosts in caves and disused mines. Opportunistic forager at night on small birds, mammals, reptiles and large insects, which often concentrate around rock pools. Does not need to frequently drink.	F	NR	F	NR	NR	Low
Emballonuridae	*Taphozous georgianus*	Common Sheath-tailed Bat		Occurs in a variety of habitats generally in rocky areas, where it roosts in crevices and caves. Forages at night over vegetation and water, predominantly on beetles and other invertebrates. Needs to frequently drink water.	O	NR	F	NR	NR	High
	Taphozous hilli	Hill's Sheath-tailed Bat		Roosts in abandoned mines, crevices and caves. Forages at night on invertebrates, which often concentrate over water in rock pools. Needs to frequently drink water.	O	NR	F	NR	NR	High
Vespertilionidae	*Vespadelus finlaysoni*	Finlayson's Cave-bat		Occurs throughout a variety of habitats, generally close to rocky areas where it roosts in caves, crevices and abandoned mines. Forages aerially at night; little is known about diet. Observed to forage through vegetation and commonly over waterholes. Needs to frequently drink water.	O	NR	F	NR	NR	High

* In this context, the dependence classification pertains to the species' roost proximity to rock pools, rather than the individual. For example, roost sites may only be occupied if they are located in close proximity to free water in rock pools, therefore the species would have a high dependence on rock pool presence.

Table 3: Herpetofauna species categorisation of rock pool use and associated dependency on rock pools (O = obligate; F = facultative; NR = not required).

Family	Species Name	Common Name	Conservation Status	Ecology	Primary Utilisation		Secondary Utilisation			Dependence Classification
					Thermoregulation / Water Balance	Reproduction	Foraging / Predation	Shelter	Refugia	
Carphodactylidae	*Underwoodisaurus seorsus*	Pilbara Barking Gecko	Priority 2	Occurs in the Hamersley Ranges, where it inhabits rocky areas with spinifex and low tree cover. Feeds on invertebrates, which often concentrate around water in rock pools. Nocturnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Diplodactylidae	*Oedura marmorata*	Marbled Velvet Gecko		Arboreal species inhabiting rocky areas. Feeds on invertebrates, which often concentrate around water in rock pools. Nocturnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Gekkonidae	*Gehyra punctata*			Rock inhabiting. May forage around rock pools for invertebrates. Nocturnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
	Gehyra variegata			Variety of habitats including woodlands, shrublands and rocky areas. May forage around rock pools for invertebrates. Nocturnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
	Heteronotia spelea	Pilbara Cave Gecko		Shelters in crevices, caves or beneath rocks. May forage around rock pools for invertebrates. Nocturnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Agamidae	*Gowidon longirostris*			Commonly seen on trunks and branches of trees or tall shrubs along gorges and watercourses. Feeds on invertebrates, may forage for food around rock pools. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
	Ctenophorus caudicinctus	Ring-tailed Dragon		Widespread throughout rocky ranges and outcrops. Feeds on invertebrates, which may be foraged for around rock pools. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Egerniidae	*Egernia formosa*			Occurs in rocky ranges and gorges. Feeds on invertebrates, which may be foraged for around rock pools. Nocturnal/crepuscular activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Eugongylidae	*Cryptoblepharus ustulatus*			Exclusively rock inhabiting. Feeds on invertebrates, may forage for food around rock pools. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
	Morethia ruficauda			Occurs in dry rocky areas. Feeds on invertebrates. Feeds on invertebrates, which may be foraged for around rock pools. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Sphenomorphidae	*Ctenotus saxatilis*	Rock Ctenotus		Widespread, occurring in rocky areas. Feeds on invertebrates, which may be foraged for around rock pools. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Varanidae	*Varanus acanthurus*	Spiny-tailed Goanna		Occurs in rocky ranges. Feeds on invertebrates and other reptiles. May forage for food around rock pools that exhibit high concentrations of invertebrates and vertebrates. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
	Varanus pilbarensis	Northern Pilbara Rock Goanna		Occurs in the Chichester Ranges, where it inhabits rocky areas, undulating granite and greenstone terrain, boulder piles, dissected plateaus, gorges and rocky hills. Feeds on invertebrates and small vertebrates. May forage for food around rock pools that exhibit high concentrations of invertebrates and vertebrates. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low

Family	Species Name	Common Name	Conservation Status	Ecology	Primary Utilisation		Secondary Utilisation			Dependence Classification
					Thermoregulation / Water Balance	Reproduction	Foraging / Predation	Shelter	Refugia	
Varanidae (cont.)	*Varanus hamersleyensis*	Southern Pilbara Rock Goanna		Strictly rock inhabiting. Occurs on banded ironstone rock faces and in gorges in the Hamersley Range. Shelters in overhangs, crevices and cavities. Feeds on invertebrates and small vertebrates, which it may forage for around rock pools. Diurnal activity. Does not need to drink water or use habitat near rock pools for shelter or refugia.	NR	NR	F	NR	NR	Low
Pythonidae	*Liasis olivaceus barroni*	Pilbara Olive Python	Schedule 3 / Vulnerable	Core habitat includes gorges, escarpments, rocky outcrops and rock holes. Shelters in caves, beneath boulders and in pools of water. Requires rock pools for capturing prey, including wallabies, birds and mammals, which are ambushed from a submerged position in water. Nocturnal activity. Does not need to drink water.	NR	NR	O	F	NR	Medium*
Hylidae	*Litoria rubella*	Little Red Tree Frog		Occurs across a wide range of habitats, usually associated with watercourses, ephemeral and permanent pools. Feeds on invertebrates, which may be foraged for around rock pools. Crepuscular / nocturnal activity. Requires water in rock pools for mating, depositing eggs and larval growth.	NR	O	F	O	NR	High
Myobatrachidae	*Pseudophryne douglasi*	Gorge Toadlet		Occurs in the Hamersley Range where it inhabits deep gorges and canyons with permanent springs or well-vegetated pools. Feeds on invertebrates, which may be foraged for around rock pools. Crepuscular / nocturnal activity. Requires water in rock pools for mating, depositing eggs and larval growth.	NR	O	F	O	NR	High
Myobatrachidae	*Uperoleia saxatilis*	Pilbara Toadlet		Restricted to the rocky Pilbara Craton where it inhabits rocky gorges and the banks of rocky creeks. Feeds on invertebrates, which may be foraged for around rock pools. Crepuscular / nocturnal activity. Requires water in rock pools for mating, depositing eggs and larval growth.	NR	O	F	O	NR	High

* The dependence classification for the Pilbara Olive Python has been considered only for those individuals occurring in gorge settings, as they are commonly associated with permanent rock pools and are dependent on these systems for predation. Although the species is found elsewhere in the Pilbara, however for the purpose of this report they have been assigned a medium dependence on rock pools given their conservation status.

Table 4: Avifauna species categorisation of rock pool use and associated dependency on rock pools (O = obligate; F = facultative; NR = not required).

Family	Species Name	Common Name	Conservation Status	Ecology	Primary Utilisation		Secondary Utilisation			Dependence Classification
					Thermoregulation / Water Balance	Reproduction	Foraging / Predation	Shelter	Refugia	
Columbidae	*Geophaps plumifera*	Spinifex Pigeon		Occurs in a wide range of habitats including rocky, hilly areas, scrubs, plains, woodlands and creek beds, and is often recorded near temporary water. Feeds on seeds that may be foraged for around rock pools or on major floodplains. Needs to frequently drink water. Diurnal activity.	O	NR	F	NR	F	High
Columbidae	*Geopelia cuneata*	Diamond Dove		Inhabits open savanna, mulga areas, spinifex grasslands, riparian woodland and gorges, and is usually found near water. Feeds on seeds that may be foraged for around rock pools. Needs to frequently drink water. Diurnal activity.	O	NR	F	NR	F	High
Falconidae	*Falco hypoleucos*	Grey Falcon	Schedule 3	Occurs in timbered plains, usually in tall trees adjacent to watercourses. Preys on birds, small mammals and invertebrates that may concentrate around rock pools. Rarely needs to drink water. Diurnal activity.	F	NR	F	NR	NR	Low
	Falco peregrinus	Peregrine Falcon	Schedule 7	Wide range of habitats including forest, woodlands, wetlands and open country. Preys on reptiles, birds, small mammals and invertebrates that may concentrate around rock pools. Rarely needs to drink water. Diurnal activity.	F	NR	F	NR	NR	Low
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	Schedule 2 / Endangered	Shallow terrestrial freshwater areas, often those that support emergent grass, sedges or reeds. Shelters in dense vegetation surrounding rock pools. Feeds on vegetation, seeds and invertebrates that may be foraged for around rock pools. Rarely needs to drink water. Diurnal activity.	F	NR	F	F	F	Low
Psittacidae	*Melopsittacus undulatus*	Budgerigar		Occurs in most habitat types, not far from water. Shelters in dense vegetation surrounding rock pools. Feeds almost exclusively on seeds, which may be foraged for around rock pools. Needs to frequently drink water. Diurnal activity.	O	NR	F	F	F	High
Halcyonidae	*Dacelo leachii*	Blue-winged Kookaburra		Occurs in open woodlands, swamps and around watered habitats. Feeds on invertebrates, reptiles, frogs, fish, small birds and mammals, that may concentrate around rock pools. Rarely needs to drink water. Diurnal activity.	F	NR	F	NR	NR	Low
Ptilonorhynchidae	*Ptilonorhynchus guttatus*	Western Bowerbird		Occurs in woodlands and rocky gorges near water. Shelters in dense vegetation surrounding rock pools. May forage around rock pools on fruit, invertebrates and seeds. Needs to frequently drink water. Diurnal activity.	O	NR	F	F	F	High
Acanthizidae	*Smicrornis brevirostris*	Weebill		Inhabits almost any wooded area. Forages in vegetation on invertebrates, may forage around rock pools. Rarely needs to drink water. Diurnal activity.	F	NR	F	NR	NR	Low
Meliphagidae	*Lichenostomus keartlandi*	Grey-headed Honeyeater		Occurs along ridges, uplands and undulating plateaus. Shelters in dense vegetation surrounding rock pools. Feeds on nectar, invertebrates, fruit and seeds, which it may forage for around rock pools. Needs to frequently drink water. Diurnal activity.	O	NR	F	F	F	High
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush		Inhabits forests and woodlands, commonly seen in gorge habitats. Shelters in dense vegetation surrounding rock pools. May forage around rock pools for invertebrates, small mammals, frogs, reptiles, fruit and seeds. Rarely needs to drink water. Diurnal activity.	F	NR	F	F	NR	Low
Artamidae	*Artamus minor*	Little Woodswallow		Commonly observed in a variety of habitats including gorges, escarpments, rainforests and grasslands. May forage around rock pools for invertebrates. Needs to frequently drink water. Diurnal activity.	O	NR	F	NR	F	High
	Cracticus nigrogularis	Pied Butcherbird		Occurs in forests and woodlands, commonly seen in gorge habitats. May forage around rock pools for small reptiles, mammals, frogs, birds and large invertebrates. Rarely needs to drink water. Diurnal activity.	F	NR	F	NR	F	Low
Corvidae	*Corvus orru*	Torresian Crow		Found in a range of habitats including forests and woodlands, shrublands, along watercourses and in rocky gorges. May forage around rock pools for seeds, fruit, invertebrates, eggs and carrion. Needs to frequently drink water. Diurnal activity.	O	NR	F	NR	F	High

Family	Species Name	Common Name	Conservation Status	Ecology	Primary Utilisation		Secondary Utilisation			Dependence Classification
					Thermoregulation / Water Balance	Reproduction	Foraging / Predation	Shelter	Refugia	
Estrildidae	*Taeniopygia guttata*	Zebra Finch		Occurs in a variety of habitats, mainly wooded grasslands adjacent to watered areas. Shelters in dense vegetation surrounding rock pools. May forage for invertebrates and seeds around rock pools. Needs to frequently drink water. Diurnal activity.	O	NR	F	F	F	High
	Neochmia ruficauda	Star Finch		Inhabits low dense grasslands and sedgelands bordering watered areas, and riparian vegetation growing in water in rock pools. Feeds on seeds, which may be foraged for around rock pools. Needs to frequently drink water. Diurnal activity.	O	NR	F	O	F	High
	Emblema pictum	Painted Finch		Occurs in most spinifex grassland habitat types near water, with a preference for rocky areas. Shelters in dense vegetation surrounding rock pools. May forage for seeds around rock pools. Needs to frequently drink water. Diurnal activity.	O	NR	F	F	F	High