Greater Paraburdoo Iron Ore Hub – APP-0001323

Environmental Review Document 

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| Proposal information  |
| Proposal name  Greater Paraburdoo Iron Ore Hub |
| Type of proposal *(aka what type of proposal is being referred)* Refer a proposal |
| Proposal description Hamersley Iron Pty Limited (the Proponent) operates the existing Paraburdoo and Eastern Range iron ore mines which are located approximately 6 km south of the town of Paraburdoo in the Pilbara Region of Western Australia (WA) (Figure ES 1). The Proponent proposes to sustain production by expanding these existing operations and also developing a new deposit at Western Range. These developments collectively make up the Greater Paraburdoo Iron Ore Hub (the Proposal). This Proposal is an integral part of the Rio Tinto Group (Rio Tinto) integrated network of iron ore mines in the Pilbara. |
| Referrer information |
| **Who referred the proposal** *(aka proponent, third party or DMA)* Proponent |
| Name of the referrer  Ebony Zhang |
| Contact details 14 fake streetFake suburb, No 1234Fake |
| Proponent information |
| Name of the proponent/s Ebony Zhang |
| ABN/ACN No.   |
| Contact details 14 fake streetFake suburb, No 1234Fake |
| Decision-making authorities  |
| DMA 1: Hon. Dave Kelly* Organisation: Minister for Water
* Legislation: Rights in Water and Irrigation Act 1914
* Approval required: Groundwater will be abstracted for use during construction. The relevant types of approval to ensure damage is mitigation are:
* Section 5C license to take water.
* Section 26D licence to construction or alter a well.
* Mitigation of impacts: Approval under the RiWi Act is necessary to ensure unacceptable impacts on water is not observed. The Minister for Water will only sign off on the proposal if the expected or potential damage on water resources in acceptable.

DMA 2: Hon. Dr Tony Buti* Organisation: Minister for Aboriginal Affairs
* Legislation: Aboriginal Heritage Act 1972
* Approval required: s. 16 authorisation to enter, excavate, examine or remove anything on an Aboriginal site.
* s. 18 consent where impact on an Aboriginal site is unavoidable.
* Mitigation of impacts: Approval under the AH Act will ensure unacceptable impacts or risks are not placed on sites of Aboriginal heritage.

DMA 3: Hon. Reece Whitby* Organisation: Minister for Environment
* Legislation: Biodiversity Conservation Act 2016
* Approval required: Licencing associated with fauna and flora surveys and research
* Fauna Handling licence
* Mitigation of impacts: Approval can ensure unacceptable impacts or risk are not placed on fauna or flora with regard to biological surveys.
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| Tenure and Local Government approvals |
| Local Government Authority in which the proposal is located.Shire of Ashburton |
| Rezoning detailsYes |
| Current land usePastoral land (4000 ha) - Ashburton Downs Station, Minimer Station and Rocklea Station. Unallocated crown land (100 ha) |
| Legal access requirements  |
| Tenure Details:* Activity: Land access
* Land tenure/access: General purpose lease - G 47/1254
* Type of approval & regulating legislation

The Proposal is located within the area covered by the State Agreement Iron Ore (Hamersley Range)Agreement Act 1968 (Paraburdoo) (Paraburdoo State Agreement). A State Agreement is a legal contractbetween the Western Australian Government and a Proponent of a major project within the boundariesof Western Australia (WA). A State Agreement details the rights, obligations, terms and conditions fordevelopment of a specific project.1 |
| Consultation |
| Key Stakeholder Table:

|  |  |  |
| --- | --- | --- |
| Name | Organisation | Role |
| Yinhawangka Traditional Owners | Yinhawangka Aboriginal Corporation (YAC) | Representative for the YAC.  |
| Kenn Donohoe | Shire of Ashburton | CEO  |
| John Smith | Mininer Pastoral Station | Owner of Mininer Pastoral Station  |

 |
| Describe Stakeholders Stakeholders were largely the same from the previous mine site proposal. The proponent has used its best judgement to assess these stakeholders and have includedOne new pastoral station was included in stakeholder engagement, Turee Creek Pastoral Station, as land on this station did not intersect with previous mining operations. |
| Consultation register:* Yinhawangka Aboriginal Corporation
	+ Date of consultation: 13.08.2019
	+ Interactions and outcomes

Presented overview of proposed developments at Greater Paraburdoo.Rio Tinto confirmed 14-16W and 20W pits designed and management to avoid rockfall intoPirraburdu Creek. Mine layout avoids Gardagarli and Garrabagarrangu, and significant watercourses. Below water table pit voids at WR discussed.Outcomes:Rio Tinto to further assess potential pit lake at WR.* JTSI
	+ Date of consultation:
	+ Interactions and outcomes

The proponent doesn't feel it was necessary to consult with JTSI as the risks proposed by this proposal can be managed by DWER and DMIRS.* YAC
	+ Date of consultation: 19.03.2019
	+ Interactions and outcomes

Presented overview of proposed developments at Greater Paraburdoo. Focus on waterrelated issues, Management of 14-16W and 20W deposits to minimise impact onPirraburdu Creek. Rio Tinto acknowledgesimportance of management tominimise impacts of 14-16W and20W on Pirraburdu Creek.* YAC
	+ Date of consultation: 26.09.2018
	+ Interactions and outcomes

EPBC Act referral documentation for this Proposal provided to the YAC and Yinhawangka People for comment.YAC provided comments on 28 November 2019 confirming the consultation referred to in the referral took place and that they encourage continued open consultation with emphasis on the protection of identified ethnographic and archaeological sites potentially impacted in the development envelope. |
| Consultation summary The Proponent has undertaken stakeholder consultation during Proposal design phases and consultationwith key stakeholders will continue throughout the assessment phase of the Proposal. Activitiesundertaken to date include:• identification and, if possible, resolution of issues that affect stakeholders;• issuing communication to stakeholders;• establishing and maintaining relationships with relevant local groups such as Traditional Owners,pastoral leaseholders and local government; and• managing the Proponent’s database of stakeholders |
| Lead agency status and relevant information |
| * Lead agency status (yes/no): No
* Type of lead agency status: Complex
* Case Manager details
	+ Department:
	+ Name:
	+ Email:
	+ Phone:
 |
| Commonwealth Government approvals  |
| * Actions that may be or are a controlled action under the EPBC Act (yes/no): Yes
* Referral to the Commonwealth (yes/no) : Yes
	+ Date of referral: 12.06.2018
	+ EPBC Reference number: 2018/8341
	+ Decision made (yes/no): Yes
		- Controlled or not a controlled action: Controlled
		- Bilateral/Accredited assessment details
* Approvals required from other Commonwealth Government department’s (yes/no): Yes
	+ Details of approvals required

DAWE identified species and communities with the potential to be significantly impacted by the Proposal including, but not limited to:• Northern Quoll;• Ghost Bat;• Pilbara Leaf-nosed Bat; and• Pilbara Olive Python.The significance, with respect to relevant EPBC Act guidance, of potential impacts from the Proposal on MNES is addressed separately in this ERD (Section 10). The EPA is assessing the Proposal as an accredited assessment on behalf of the Commonwealth under s. 87 of the EPBC Act. This assessment provides for a single environmental assessment processconducted by the State. At the completion of the assessment the EPA’s Report is provided to the DAWEassessing the likely impacts of the Proposal on MNES. DAWE is also expected review the response to submissions on the ERD. |
| Environmental Review |
| Alternatives |
| Description of alternative considerations:* Alternative 1:
	+ Type: Location
	+ Description:

123* + Description of the changes to impacts and mitigations:

123* Alternative 2:
	+ Type: No Development
	+ Description:

The Proposal is the only viable option to sustain the current iron ore production from the GreaterParaburdoo Hub (currently around 25 Mt/a) whilst also continuing to utilise existing infrastructure and processing facilities. The Proposal will extend the life of the existing operations within the Greater Paraburdoo Hub for approximately 20 years and is critical to sustain the town of Paraburdoo and morebroadly the Proponent’s business activities in the Pilbara region.The Proposal will result in economic benefits for Australia and Western Australia through:• contribution to the value of mineral exports;• royalties and taxation payments;• capital investment;• sustaining direct and indirect employment opportunities in the region; and• sustaining demand for goods and services supporting the regional economy.The ongoing activities of the Proponent, and more broadly Rio Tinto, in the Pilbara will continue to supportsocial and economic development projects, including:• continued education, training, employment and business opportunities for local people, includinglocal Aboriginal people; and• continued funding for a range of organisations in the region, including sporting and cultural groups.The Proposal will continue to make use of Rio Tinto’s existing infrastructure, including ports and railway, power, communications and road networks. This will reduce the extent of new infrastructure required and result in a smaller disturbance footprint than would otherwise be required for a greenfields Proposal of this scale.* + Description of the changes to impacts and mitigations:

If no development alternative is chosen, the impacts will be as listed above. No mitigation strategies would be needed.* Alternative 3:
	+ Type: Technology
	+ Description:

A number of pit designs and waste dump designs/locations were evaluated as part of the mine planning process; to avoid as far as practicable, the following:• important habitat for significant terrestrial fauna and Matters of National Environmental Significance(MNES) (specifically for Ghost Bat, Pilbara Leaf-nosed Bat, Northern Quoll and Pilbara Olive Python);• physical disturbance to threatened flora species;• physical disturbance to ephemeral creeklines including Seven Mile Creek and Pirraburdu Creek;• physical disturbance to significant ephemeral surface water pools; and• significant ethnographic and/or archaeological sites.* + Description of the changes to impacts and mitigations:

The chosen pit designs are proposed as they have the most efficient locations for iron ore in the region. |
| Aspects |
| Element 1: open pit(s) (above water table)-801* Associated activity element 1: Clearing of native vegetation
* Aspect
	+ Aspect type: Clearing of vegetation
	+ Aspect title: Clearing of vegetation
* Aspect
	+ Aspect type: Clearing of vegetation
	+ Aspect title: Clearing of vegetation
* Associated activity element 2: Excavation and blasting of rock/ore
* Aspect
	+ Aspect type: Vibration
	+ Aspect title: Vibration
* Aspect
	+ Aspect type: Vibration
	+ Aspect title: Vibration
* Associated activity element 3: Mine pit backfill
* Associated activity element 4: Mine pit revegetation

Element 2: processing plant-801* Associated activity element 1: Clearing native vegetation
* Aspect
	+ Aspect type: Clearing of vegetation
	+ Aspect title: Clearing of vegetation
* Aspect
	+ Aspect type: Clearing of vegetation
	+ Aspect title: Clearing of vegetation
* Associated activity element 2: Decommissioning and removal of processing plant.
* Associated activity element 3: Processing ore
* Aspect
	+ Aspect type: Vibration
	+ Aspect title: Vibration
* Aspect
	+ Aspect type: Vibration
	+ Aspect title: Vibration
* Associated activity element 4: Revegetation

Element 3: stockpile topsoil-801* Associated activity element 1: Clearing of native vegetation
* Associated activity element 2: Rehabilitation of topsoil
* Associated activity element 3: Storage of topsoil

Element 4: supporting Infrastructure (eg offices, workshops, hardstand)-801* Associated activity element 1: Clearing of Native Vegetation
* Aspect
	+ Aspect type: Clearing of vegetation
	+ Aspect title: Clearing of vegetation
* Aspect
	+ Aspect type: Clearing of vegetation
	+ Aspect title: Clearing of vegetation
* Associated activity element 2: Construction of supporting infrastructure
 |
| Mitigations |
| Mitigation 1* Description

Aligning the development envelope with areas already cleared.* Related aspects:
	+ Clearing of vegetation
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| Environmental factors |
| Legislative context  |
| Local and Regional context  |
| Potentially significant environmental factors for the proposal:* Air quality (yes/no): No
* Benthic communities and habitats (yes/no): No
* Coastal processes (yes/no): No
* Flora and vegetation (yes/no): Yes
* Greenhouse gas emissions (yes/no): No
* Human health (yes/no): No
* Inland waters (yes/no): Yes
* Landforms (yes/no): No
* Marine environmental quality (yes/no): No
* Marine fauna (yes/no): No
* Social surroundings (yes/no): Yes
* Subterranean fauna (yes/no): Yes
* Terrestrial environmental quality (yes/no): No
* Terrestrial fauna (yes/no): Yes
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| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Air quality |
| Environmental objective  |
| Description of receiving environment No impact to air quality is expected. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Benthic communities and habitats |
| Environmental objective  |
| Description of receiving environment The proposal is not located near benthic habitats and no impact is expected. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Coastal processes |
| Environmental objective  |
| Description of receiving environment The proposal is not located near the coast and no impact is expected. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Flora and vegetation |
| Environmental objective  |
| Description of receiving environment Previous studiesA number of flora and vegetation surveys have been undertaken in the Development Envelope andsurrounding area. The flora and vegetation values considered in this ERD have been primarily derivedfrom two reports (Astron 2018a, b) which summarise and amalgamate all historical survey information.Greater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 37A subsequent desktop and field investigation for riparian vegetation and Groundwater DependantEcosystems (GDEs) was undertaken by Rio Tinto using information provided in Astron (2018a, b) tocharacterise and define the riparian vegetation values in the Development Envelope and within 100 kmof the Development Envelope (Rio Tinto 2020a).All flora and vegetation surveys have been conducted in accordance with the following guidance, whererelevant:• Position Statement No. 3 (EPA 2002);• Guidance Statement No. 51 (EPA 2004);• Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA2016c); and• Environmental Factor Guideline - Flora and Vegetation (EPA 2016b).Table 5-1 and Figure 5-1 summarise the flora and vegetation investigations undertaken for the Proposal.Key flora and vegetation studies are provided in Appendix 4. VegetationIBRA regionsVegetation occurring within the region was mapped at a broad scale (1:1,000,000) during the 1970s(Beard 1979; Astron 2018b). This dataset formed the basis of several regional mapping systems,including the biogeographical region dataset (IBRA) for Western Australian physiographic regions(DotEE 2017).The IBRA regions (Figure 2-5) represent a landscape-based approach to classifying the land surface,including attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna.The Development Envelope occurs at the boundary of the Pilbara and Gascoyne bioregions, of which 5%to 15% is represented in the national reserve system (DotEE 2017).The Development Envelope occurs within the Hamersley subregion of the Pilbara bioregion and theAshburton subregion of the Gascoyne bioregion. These subregions are described as:• Hamersley subregion of the Pilbara bioregion (Hamersley PIL3): dissected bold plateaux and rangesof flat lying, moderately folded sandstone and quartzite with vegetation described as mulga lowwoodland over tussock grasses occurring on fine textured soils in valley floors, with scattered snappygum (Eucalyptus leucophloia) over Triodia brizoides on skeletal soils of the ranges.• Ashburton subregion of the Gascoyne bioregion (Ashburton GAS1): Mountainous range countrydivided by broad flat valleys of shales, sandstones and conglomerates with vegetation described amulga or snakewood low woodlands over hardpans, with low mixed shrublands on hills and areassupporting large areas of Triodia.The Hamersley subregion covers an area of approximately 6.2 million hectares and has significantmineral resources associated with the ranges. The Ashburton subregion, which is not as rich in mineralresources, encompasses an area of approximately four million hectares.The Pilbara bioregion is largely undeveloped, with natural characteristics such as stony mantles, andextensive level plains with a tall shrub stratum that protect it from inappropriate land use practices (vanVreeswyk et al. 2004). As a result, extensive areas of the Pilbara remain much as they were arrival ofEuropean settlers and vegetation in these areas is ranked as being in good to excellent condition.Land systemThe Department of Primary Industries and Regional Developments (DPIRD) (previously known as theDepartment of Agriculture and Food), has comprehensively described and mapped the biophysicalresources of the Pilbara region including soil and vegetation condition, as part of the rangeland resourcesurveys (Astron 2018b). As part of this process an inventory of land system units, the Pilbara RegionalInventory was established based on landform, soil, vegetation, drainage characteristics and condition.According to this mapping, 11 land systems occur within the Development Envelope (Table 5-2 andFigure 2-5) with greater than 50% of the Development Envelope mapped as Newman land system. Vegetation associationsFour pre-European vegetation association units (82, 181, 567 and 163) are associated with vegetationwithin the Development Envelope (Figure 5-2).Table 5-3 summarises the current and pre-European extent of these four vegetation associations in thePilbara and Gascoyne bioregions, and within the Development Envelope. All pre-European vegetationassociations have more than 99% of their pre-European extent remaining across the Pilbara andGascoyne bioregions. Local vegetation mappingVegetation within the Development Envelope is consistent with similar landforms in the broaderHamersley and Gascoyne subregions, and comprises remnant native vegetation with some highlydisturbed and cleared areas (Astron 2018b).A total of 28 vegetation units encompassing 13,875 ha were recorded within the Development Envelope(Astron 2018a, b). The balance of the Development Envelope has been cleared. Dominant vegetationtypes in the Development Envelope include the following:• AanAprAteTe: Acacia aneura sens. lat., A. pruinocarpa tall open shrubland over A. tetragonophyllascattered shrubs over Triodia epactia hummock grassland covering 2,729.8 ha.• AteAsyERcTe: Acacia tetragonophylla, A. synchronicia scattered tall shrubs over Eremophilacuneifolia scattered shrubs over Triodia epactia hummock grassland covering 1,662.9 ha.• AprGbERsppTe: Acacia pruinocarpa, Grevillea berryana tall open shrubland over Eremophila fraserisubsp. fraseri, E. canaliculata, E. cuneifolia scattered low shrubs over Triodia epactia hummockgrassland covering 1,328.4 ha.Vegetation types and their extents within the Development Envelope are outlined in Table 5-4 andpresented in Figure 5-3.Vegetation significanceVegetation units have been defined as regionally significant on the basis that they contain or form part ofTECs or PECs; however, no TECs or PECs occur within the Development Envelope, and hencevegetation within the Development Envelope have been classified as having local conservationsignificance.Vegetation of local conservation significance was scaled based on the following criteria:• High local significance: associated with TECs or PECs (none occur within Development Envelope).• Moderate local significance: corresponds with a subregional ‘ecosystem at risk’; associated withlocal/major drainage systems supporting potential riparian vegetation/GDEs, has a role as a refugeand/or provides an important function required to maintain ecological integrity of a significantecosystem.• Low to moderate: likely to be restricted in distribution and potentially endemic to the area.• Low significance: not locally or regionally restricted.Cleared areas were determined to have negligible local conservation significance.Threatened and Priority ecological communities and vegetation of regional significanceNone of the vegetation units mapped within the Development Envelope represent TECs listed under theCommonwealth EPBC Act or State BC Act, or PECs listed by DBCA and; therefore, no vegetation unitshave been rated as regionally significant or of high local significance.Ecosystems at risk and vegetation of moderate local significanceFive vegetation units within the Development Envelope were identified to be of moderate localconservation significance: D1, D3, D6, D7, and D8, (Figure 5-3).The Biodiversity Audit for Western Australia 2002 (DCLM 2002) reviewed the nature conservation issuesrelevant to each of Western Australia’s 53 biogeographical subregions. A number of ecologicalcommunities were identified in the Pilbara subregion in the audit as ‘ecosystems at risk’, but which havenot been given a formal TEC or PEC status. All vegetation types identified as potentially corresponding with ecosystems at risk or associated with riparian vegetation have been assigned a moderate localsignificance.In the Hamersley subregion part of the Development Envelope, ‘ecosystems at risk’ include(Astron 2018a, b):• ‘Lower-slope mulga’; and• ‘All major ephemeral watercourses’.In the Ashburton subregion part of the Development Envelope, ‘ecosystems at risk’ include (Astron 2018a,b):• ‘Wetland systems of the Ashburton and Lyons drainage’; and• ‘Mulga creekline alluvial plains of Ashburton’.The D3 vegetation unit may correspond with the Ashburton subregion ‘Ecosystem at risk’ ‘Mulga creeklinecommunity, alluvial plains of Ashburton‘; however, is widely distributed and generally characterised byminor drainage lines. Vegetation unit D1 was also identified by Astron (2018a) to correspond with theAshburton subregion ‘ecosystem at risk’ ‘Mulga creekline community, alluvial plains of Ashburton’.Vegetation unit D8, which represents the larger drainage lines within the Development Envelope, isdefined by presence of woodlands of the facultative phreatophytic species Eucalyptus victrix and is alsoassociated with another facultative phreatophyte, Eucalyptus camaldulensis. Despite this vegetationbeing partially degraded through weed invasion, the D8 unit, together with D1 and D3, may represent an‘ecosystem at risk’ within the broad ‘Wetland systems of the Ashburton and Lyons drainage’ and ’majorephemeral watercourses/wetland systems‘ categories of the Pilbara subregion and, in the case of D8only, a potential GDE (Astron 2018a).The D7 vegetation unit occurs on major drainage lines that supported the potential Ground DependentEcosystem (GDE) species Eucalyptus camaldulensis, E. victrix and Sesbania formosa and; therefore,considered by Astron (2018b) to have conservation significance at a local scale.The D6 vegetation unit occurs on the deeper incised gullies and gorges in the Eastern Range and DoggersGorge sections of the Development Envelope (Figure 5-3). This habitat supports several conservationsignificant flora taxa including Eremophila sp. Hamersley Range (K. Walker KW 136) (Priority 3 [P3]),Hibiscus campanulatus (P1), Grevillea saxicola (P3), Sida sp. Barlee Range (S. van Leeuwen 1642) (P3)and ‘Solanum sp. (indet.)’ (Astron 2018b). These priority flora species are described in Section 5.3.3).The D6 vegetation unit may act as a refuge for fire sensitive species and other species that prefer rockysubstrate, or areas containing a moderate amount of moisture (mesic) habitats (Astron 2018a). Due tothe potential that this vegetation may act as a refuge for fire sensitive species the D6 vegetation unit hasmoderate local conservation significance (Table 5-4).Vegetation of low to moderate local significanceVegetation units P3, H6 and H7 were mapped within the Development Envelope (Astron 2018a). Thesevegetation units were considered by Astron (2018a) as not likely to occur elsewhere in the local regionand may be locally restricted or endemic to the local area (Astron 2018a). These units do not correspondto any described vegetation type of conservation significance.Valleys and lower slopes north of the Eastern Range operations in the Development Envelope containoccurrences of the P8 vegetation unit (Figure 5-3). This unit does not support conservation significantflora or resemble any described TEC or PEC; however, the presence of Acacia xiphophylla (snakewood)on slopes and the understorey assemblage of low shrubs dominated by Frankenia spp. and chenopods,particularly Tecticornia disarticulata, was considered unusual by Astron (2018b). The P8 vegetation unitoccurs across a relatively small range within the north-eastern border of the Development Envelope(Astron 2018a). Therefore, the P8 vegetation unit has been assigned a low to moderate local significance. All other vegetation units recorded in the Development Envelope represent vegetation expected on similarlandforms in the broader Hamersley and Ashburton subregions and are not considered by Astron (2018b)to be locally restricted or of local conservation significance.The vegetation units and their local significance is outlined in Table 5-4 and presented in Figure 5-4Vegetation conditionThe condition of the native vegetation within the Development Envelope ranges from Excellent toCompletely Degraded (Astron 2018a, b) as outlined in Table 5-5.Vegetation condition within the Development Envelope has been influenced by a history of disturbancefrom mining and pastoral land uses. Weed species diversity and densities are high in areas associatedwith drainage features, tracks and historically disturbed sites. Weed diversity and abundance was highestin drainage lines and alluvial plains (Astron 2018b). There is also evidence of recent (i.e. in the last twoyears) fire throughout large areas in the southeast of the Development Envelope (Astron 2018b).Areas mapped as Completely Degraded have been excluded from the vegetation impact assessment ofthis Proposal as they no longer represent any form of intact native vegetation.Figure 5-5 presents vegetation condition mapped within the Development Envelope Riparian vegetation and Groundwater Dependent Ecosystems (GDEs)Riparian vegetation within the Development Envelope is associated with drainage lines and conditionranges from Degraded to Excellent (Astron 2018b). The riparian vegetation associated with Seven Mileand Pirraburdu creeks has high weed abundance and diversity and are primarily considered in Poor andDegraded condition.Groundwater Dependent Ecosystems (GDE) are characterised by the presence of species that rely ongroundwater, known as phreatophytes. Phreatophytes may be classified as either obligate (highlydependent) or facultative (opportunistic) phreatophytes depending on their reliance on groundwater. It isnoted that riparian vegetation is only groundwater dependent where there are shallow watertables.The tree species Melaleuca argentea (obligate phreatophyte), Eucalyptus camaldulensis subsp. refulgens(facultative phreatophyte) and Eucalyptus victrix (facultative phreatophyte or vadophyte) are the threemost common phreatophytic species within riparian systems of the Pilbara bioregion. Due to itsdependence on groundwater, the obligate phreatophyte Melaleuca argentea is considered the bestindicator of consistently shallow groundwater or permanent (perennial) surface water; however, thisspecies is not present in the Development Envelope. Eucalyptus camaldulensis is one of the most broadlydistributed eucalypts in Australia and commonly occurs along ephemeral creeklines in the Pilbara; thisspecies is present in the Development Envelope at Pirraburdu and Seven Mile creeks. Of the 28vegetation units present within the Development Envelope, two vegetation types (D7 and D8) wereconsidered by Astron (2018a, b) as potential GDEs due to the presence of an assemblage of vegetationthat is likely to be dependent on groundwater.Rio Tinto have undertaken field investigations and mapped riparian vegetation in further detail in andaround the Development Envelope, including Pirraburdu and Seven Mile creeks to refine and characteriseriparian vegetation and potential GDEs. A total of 36 riparian vegetation units covering 6,344 ha wereidentified within 100 km of the Development Envelope (Rio Tinto 2020a). Of which, 680 ha(comprising 21 riparian vegetation units) are represented within the Development Envelope. Vegetationunits rated as likely to be groundwater dependent included Woodland to Open Forest communitiesdominated by obligate phreatophytes or co-dominated by obligate and facultative phreatophytes,principally dominate overstorey of Eucalyptus camaldulensis.The assessment concluded the following four areas within Seven Mile Creek, Pirraburdu Creek and TureeCreek as mostly likely to support GDEs (Rio Tinto 2020a):• “C1” (broadly, Open Forest to Woodland with Melaleuca argentea present) riparian vegetation ofTuree Creek, outside and to the southeast of the Development Envelope.• “C2” (Open Forest to Woodland with Eucalyptus camaldulensis present) riparian vegetation of SevenMile Creek, from south of the Paraburdoo townsite to the point the creek dissects the Paraburdoorange adjacent to the existing 4E pit.• “C2” riparian vegetation of Pirraburdu Creek, covering a stretch of approximately 4.5 km runningsouth from, and including, Ratty Springs.• Scattered small spring type features broadly present to the north and north east of the GDE studyarea in Doggers Gorge and other rocky/hilly habitats on smaller drainage lines most likely to haveescaped grazing disturbance and which potentially hold fewer common assemblages than generallyinhabit high energy drainage systems.There are no C1 vegetation units located within the Development Envelope. these are all associated withTuree Creek. The C2 communities highly dependent on groundwater comprises 62.4 ha in theDevelopment Envelope (Table 5-6).The riparian and GDE vegetation communities of Seven Mile Creek, south of the Paraburdoo townsiteadjacent to the existing mine operation, has been subject to historical surplus water discharge andrepresents ‘augmented’ vegetation. That is, the vegetation has been altered from its original state due tothe artificial water sources and is potentially denser and more extensive than prior to dischargeGreater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 61commencing from existing operations. The vegetation in this area has also been modified by historicalland use such as grazing, and proximity to the townsite. Areas not subject to surplus mine waterdischarge, such as Ratty Springs and Pirraburdu Creek, have less extensive and persistent riparianvegetation.Table 5-6 outlines the area of highly groundwater dependent GDE vegetation communities within theDevelopment Envelope. Figure 5-6 presents riparian and GDE vegetation units in the DevelopmentEnvelope. |
| Potential key environmental factor (yes/no – if no the justification is provided)Yes |
| EPA policy and guidance Previous studiesA number of flora and vegetation surveys have been undertaken in the Development Envelope andsurrounding area. 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The Ashburton subregion, which is not as rich in mineralresources, encompasses an area of approximately four million hectares.The Pilbara bioregion is largely undeveloped, with natural characteristics such as stony mantles, andextensive level plains with a tall shrub stratum that protect it from inappropriate land use practices (vanVreeswyk et al. 2004). As a result, extensive areas of the Pilbara remain much as they were arrival ofEuropean settlers and vegetation in these areas is ranked as being in good to excellent condition.Land systemThe Department of Primary Industries and Regional Developments (DPIRD) (previously known as theDepartment of Agriculture and Food), has comprehensively described and mapped the biophysicalresources of the Pilbara region including soil and vegetation condition, as part of the rangeland resourcesurveys (Astron 2018b). 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Therefore, the P8 vegetation unit has been assigned a low to moderate local significance. All other vegetation units recorded in the Development Envelope represent vegetation expected on similarlandforms in the broader Hamersley and Ashburton subregions and are not considered by Astron (2018b)to be locally restricted or of local conservation significance.The vegetation units and their local significance is outlined in Table 5-4 and presented in Figure 5-4Vegetation conditionThe condition of the native vegetation within the Development Envelope ranges from Excellent toCompletely Degraded (Astron 2018a, b) as outlined in Table 5-5.Vegetation condition within the Development Envelope has been influenced by a history of disturbancefrom mining and pastoral land uses. Weed species diversity and densities are high in areas associatedwith drainage features, tracks and historically disturbed sites. Weed diversity and abundance was highestin drainage lines and alluvial plains (Astron 2018b). There is also evidence of recent (i.e. in the last twoyears) fire throughout large areas in the southeast of the Development Envelope (Astron 2018b).Areas mapped as Completely Degraded have been excluded from the vegetation impact assessment ofthis Proposal as they no longer represent any form of intact native vegetation.Figure 5-5 presents vegetation condition mapped within the Development Envelope Riparian vegetation and Groundwater Dependent Ecosystems (GDEs)Riparian vegetation within the Development Envelope is associated with drainage lines and conditionranges from Degraded to Excellent (Astron 2018b). The riparian vegetation associated with Seven Mileand Pirraburdu creeks has high weed abundance and diversity and are primarily considered in Poor andDegraded condition.Groundwater Dependent Ecosystems (GDE) are characterised by the presence of species that rely ongroundwater, known as phreatophytes. Phreatophytes may be classified as either obligate (highlydependent) or facultative (opportunistic) phreatophytes depending on their reliance on groundwater. It isnoted that riparian vegetation is only groundwater dependent where there are shallow watertables.The tree species Melaleuca argentea (obligate phreatophyte), Eucalyptus camaldulensis subsp. refulgens(facultative phreatophyte) and Eucalyptus victrix (facultative phreatophyte or vadophyte) are the threemost common phreatophytic species within riparian systems of the Pilbara bioregion. Due to itsdependence on groundwater, the obligate phreatophyte Melaleuca argentea is considered the bestindicator of consistently shallow groundwater or permanent (perennial) surface water; however, thisspecies is not present in the Development Envelope. 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Vegetationunits rated as likely to be groundwater dependent included Woodland to Open Forest communitiesdominated by obligate phreatophytes or co-dominated by obligate and facultative phreatophytes,principally dominate overstorey of Eucalyptus camaldulensis.The assessment concluded the following four areas within Seven Mile Creek, Pirraburdu Creek and TureeCreek as mostly likely to support GDEs (Rio Tinto 2020a):• “C1” (broadly, Open Forest to Woodland with Melaleuca argentea present) riparian vegetation ofTuree Creek, outside and to the southeast of the Development Envelope.• “C2” (Open Forest to Woodland with Eucalyptus camaldulensis present) riparian vegetation of SevenMile Creek, from south of the Paraburdoo townsite to the point the creek dissects the Paraburdoorange adjacent to the existing 4E pit.• “C2” riparian vegetation of Pirraburdu Creek, covering a stretch of approximately 4.5 km runningsouth from, and including, Ratty Springs.• Scattered small spring type features broadly present to the north and north east of the GDE studyarea in Doggers Gorge and other rocky/hilly habitats on smaller drainage lines most likely to haveescaped grazing disturbance and which potentially hold fewer common assemblages than generallyinhabit high energy drainage systems.There are no C1 vegetation units located within the Development Envelope. these are all associated withTuree Creek. The C2 communities highly dependent on groundwater comprises 62.4 ha in theDevelopment Envelope (Table 5-6).The riparian and GDE vegetation communities of Seven Mile Creek, south of the Paraburdoo townsiteadjacent to the existing mine operation, has been subject to historical surplus water discharge andrepresents ‘augmented’ vegetation. That is, the vegetation has been altered from its original state due tothe artificial water sources and is potentially denser and more extensive than prior to dischargeGreater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 61commencing from existing operations. The vegetation in this area has also been modified by historicalland use such as grazing, and proximity to the townsite. Areas not subject to surplus mine waterdischarge, such as Ratty Springs and Pirraburdu Creek, have less extensive and persistent riparianvegetation.Table 5-6 outlines the area of highly groundwater dependent GDE vegetation communities within theDevelopment Envelope. Figure 5-6 presents riparian and GDE vegetation units in the DevelopmentEnvelope. |
| Description of environmental impacts Previous studiesA number of flora and vegetation surveys have been undertaken in the Development Envelope andsurrounding area. 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Eucalyptus camaldulensis is one of the most broadlydistributed eucalypts in Australia and commonly occurs along ephemeral creeklines in the Pilbara; thisspecies is present in the Development Envelope at Pirraburdu and Seven Mile creeks. Of the 28vegetation units present within the Development Envelope, two vegetation types (D7 and D8) wereconsidered by Astron (2018a, b) as potential GDEs due to the presence of an assemblage of vegetationthat is likely to be dependent on groundwater.Rio Tinto have undertaken field investigations and mapped riparian vegetation in further detail in andaround the Development Envelope, including Pirraburdu and Seven Mile creeks to refine and characteriseriparian vegetation and potential GDEs. A total of 36 riparian vegetation units covering 6,344 ha wereidentified within 100 km of the Development Envelope (Rio Tinto 2020a). Of which, 680 ha(comprising 21 riparian vegetation units) are represented within the Development Envelope. Vegetationunits rated as likely to be groundwater dependent included Woodland to Open Forest communitiesdominated by obligate phreatophytes or co-dominated by obligate and facultative phreatophytes,principally dominate overstorey of Eucalyptus camaldulensis.The assessment concluded the following four areas within Seven Mile Creek, Pirraburdu Creek and TureeCreek as mostly likely to support GDEs (Rio Tinto 2020a):• “C1” (broadly, Open Forest to Woodland with Melaleuca argentea present) riparian vegetation ofTuree Creek, outside and to the southeast of the Development Envelope.• “C2” (Open Forest to Woodland with Eucalyptus camaldulensis present) riparian vegetation of SevenMile Creek, from south of the Paraburdoo townsite to the point the creek dissects the Paraburdoorange adjacent to the existing 4E pit.• “C2” riparian vegetation of Pirraburdu Creek, covering a stretch of approximately 4.5 km runningsouth from, and including, Ratty Springs.• Scattered small spring type features broadly present to the north and north east of the GDE studyarea in Doggers Gorge and other rocky/hilly habitats on smaller drainage lines most likely to haveescaped grazing disturbance and which potentially hold fewer common assemblages than generallyinhabit high energy drainage systems.There are no C1 vegetation units located within the Development Envelope. these are all associated withTuree Creek. The C2 communities highly dependent on groundwater comprises 62.4 ha in theDevelopment Envelope (Table 5-6).The riparian and GDE vegetation communities of Seven Mile Creek, south of the Paraburdoo townsiteadjacent to the existing mine operation, has been subject to historical surplus water discharge andrepresents ‘augmented’ vegetation. That is, the vegetation has been altered from its original state due tothe artificial water sources and is potentially denser and more extensive than prior to dischargeGreater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 61commencing from existing operations. The vegetation in this area has also been modified by historicalland use such as grazing, and proximity to the townsite. Areas not subject to surplus mine waterdischarge, such as Ratty Springs and Pirraburdu Creek, have less extensive and persistent riparianvegetation.Table 5-6 outlines the area of highly groundwater dependent GDE vegetation communities within theDevelopment Envelope. Figure 5-6 presents riparian and GDE vegetation units in the DevelopmentEnvelope. |
| Environmental Values Impact Assessments:Value : Aluta quadrata* Characterisation

Aluta quadrata (Threatened)The Proposal will result in the clearing of up to approximately 5,179 individuals of the Western Rangepopulation. There will be no impacts to the Paraburdoo or Channar populations as a result of theProposal. A. quadrata individuals will be directly impacted within an approximate 14.6 ha area withinthe conceptual footprint. A further approximately 467 individuals may be affected by edge effects. Thisnumber assumes 50% loss of individuals within 30 m of the conceptual footprint. It is not expected thatmortality of 50% of individuals will occur but this loss has been included in the impact assessment asindication of the area at risk. Monitoring of the A. quadrata population at Channar to date appears toshow the population has remained stable, with plants persisting adjacent to and downstream of themining operations with some individuals occurring in areas of historic disturbance such as windrows(Plate 1)The predicted loss of A. quadrata equates to:• 18.1% direct and 19.7% total (direct and potential indirect) loss of the Western Range population.• 17.4% direct and 19.0% total (direct and potential indirect) loss of individuals in the DevelopmentEnvelope.• 12.6% direct and 13.7% total (direct and potential indirect) loss of the total known population.The proposed loss of these A. quadrata individuals at the Western Range population is consideredsignificant; however, the proposed loss will not elevate the current listing of A. quadrata fromEndangered to Critically Endangered (i.e. in extremely high risk of extinction in the wild) based on theInternational Union for Conservation of Nature (IUCN) listing criteria. The area of occupancy of thethree known meta-populations of A. quadrata will not be reduced by the Proposal (Figure 5-10).The Proponent will implement mining exclusion zones at Western Range that will capture 79% of therecorded A. quadrata population at Western Range (refer to Section 5.7). These mining exclusion zoneswill ensure that impacts to A. quadrata associated with this Proposal are not greater than predicted.Additionally, the east-west extent of the Western Range population will not be significantly fragmentedand; therefore, the genetic diversity within the Western range population will not be significantly reduced.Two pods of ore will be sterilised to minimise direct and indirect impacts to A. quadrata, avoidfragmentation of the exclusion zones, and maximise the percentage of the species captured withinmining exclusion zones* Impacts
* Mitigation effect
* Residual impacts quantity, volume or extent

15 Hectares* Residual impact

Loss of conservation significant floraspecies comprising:• Aluta quadrata (T) (5,179 individuals[within 14.6 ha of the conceptualfootprint] cleared and 467 individualspotentially impacted by indirectimpacts).* Significant residual impact (yes/no)

Yes* Justify significance

The Proponent recognises that the most important value for flora and vegetation is the Threatened Alutaquadrata. The Proposal has been amended to avoid and minimise impacts to A. quadrata as far aspracticable, and through the implementation of mining exclusion zones, 79% of the Western Range A.quadrata population will be protected from direct disturbance. This will ensure a viable, self-sustainingand genetically diverse A. quadrata population will persist at Western Range beyond the life of themining operation. The area of occupancy of the three known meta-populations of Aluta quadrata willnot change. Loss of conservation significant flora species comprising:• Aluta quadrata (T) (5,179 individuals from clearing, and 467 individuals potentially impactedby indirect impacts);* Cumulative impact

%253Cp%253ENo%2520mention.%253C%252Fp%253E* Environmental outcome

%253Cp%253EOffsets%2520are%2520proposed%2520for%2520these%2520significant%2520residual%2520impacts.%2520The%2520appropriateness%2520of%2520offsets%2520to%2520achieve%2520the%2520objective%2520of%2520counterbalancing%2520the%2520significant%2520residual%2520impacts%2520is%2520discussed%2520in%2520Section%252012.%2520The%2520Proponent%2520has%2520undertaken%2520comprehensive%2520baseline%2520studies%2520to%2520define%2520flora%2520and%2520vegetation%2520values%2520and%2520has%2520amended%2520the%2520Proposal%2520to%2520reduce%2520impacts%2520on%2520A.%2520quadrata%2520as%2520far%2520as%2520practicable.%2520The%2520Proponent%2520is%2520also%2520implementing%2520mining%2520exclusion%2520zones%2520for%2520the%2520protection%2520of%2520A.%2520quadrata%2520at%2520Western%2520Range%2520to%2520ensure%2520the%2520maintenance%2520of%2520a%2520self-sustaining%2520population%2520and%2520undertaking%2520ongoing%2520research%2520into%2520the%2520ecology%2520and%2520habitat%2520requirements%2520of%2520the%2520species.%2520Given%2520these%2520commitments%2520and%2520the%2520Proponents%2520past%2520performance%2520in%2520implementing%2520appropriate%2520mitigations%2520as%2520part%2520of%2520the%2520construction%2520and%2520operation%2520of%2520mining%2520projects%2520in%2520the%2520Pilbara%252C%2520the%2520Proponent%2520considers%2520that%2520the%2520Proposal%2520can%2520be%2520managed%2520to%2520meet%2520the%2520EPA%25E2%2580%2599s%2520objective%2520for%2520flora%2520and%2520vegetation.%253C%252Fp%253E* Justification

%253Cp%253ENot%2520sure%253C%252Fp%253E |
| Offset explanation  |
| Application of the mitigation hierarchy The key environmental value for flora and vegetation is the Threatened flora species Aluta quadrata.The Proponent has taken measures to avoid and minimise impacts to A. quadrata as far as practicable.These measures include:• Significant changes to the optimal conceptual footprint to avoid/minimise impacts to A. quadrataincluding:• Changing the location of four ramps required for pit access from locations that directly impactedA. quadrata to locations that do not directly impact any recorded individuals (Figure 5-11;Figure 5-12).• Sterilising two pods of ore to reduce direct and indirect impacts to A. quadrata and fragmentationof habitat.• No A. quadrata individuals will be directly impacted by the placement of waste dumps, landbridges,stockpiles or other infrastructure. Direct impacts to A. quadrata individuals result only fromintersections with pits.• Establishment of mining exclusion zones that capture 79% of A. quadrata Western Rangepopulation.The primary objective of the mining exclusion zones is to ensure a viable, self-sustaining and geneticallydiverse A. quadrata population persists at Western Range beyond the life of the mining operation. TheProponent proposes to achieve this by ensuring there is no new direct disturbance from mining activitieswithin these zones, beyond the maintenance of existing tracks. Operational controls will include (butnot be limited to) Rio Tinto’s internal ground disturbance permit system that ensures proposed clearingboundaries are checked for potential interactions with mining exclusion zones prior to any clearingactivities being authorised. The mining exclusion zones for Aluta quadrata also encompass somemoderate local significance vegetation units. Mining exclusion zones for A. quadrata are presented inFigure 5-13.The Greater Paraburdoo Hub EMP addresses the key environmental factors which were determined bythe EPA as being relevant to the appropriate management of dewatering, surface water discharge,conservation significant vegetation communities and fauna species associated with the DevelopmentEnvelope. The EMP identifies:• mitigation strategies proposed to minimise impacts to significant environmental values;• environmental targets that the Proponent will use to monitor performance of the mitigation strategiesto ensure environmental objectives are met;• management and contingency actions aligned with the overall management approach; and• management actions that will be implemented in response to monitoring results.Table 5-16 demonstrates how the EPA’s mitigation hierarchy (avoid, minimise and rehabilitate) hasbeen applied during proposal design and in the development of appropriate mitigation and managementstrategies to address the key potential impacts on flora and vegetation.   |
| Assessment and significance of residual impacts Residual impacts from the Proposalinclude:• clearing up to 4,300 ha of nativevegetation in Good to Excellentcondition• clearing up to 156 ha of moderateconservation significant localvegetation units• clearing of approximately 27 ha ofPoor and Degraded GDE vegetation• clearing of 3 ha of riparian vegetationin Good condition.These residual impacts are significantand will be offset (refer to Section 12). Loss of conservation significant floraspecies comprising:• Aluta quadrata (T) (5,179 individuals[within 14.6 ha of the conceptualfootprint] cleared and 467 individualspotentially impacted by indirectimpacts).• Hibiscus campanulatus (P1) (203individuals cleared, and 100individuals potentially impacted byindirect impacts)• Sida sp. Barlee Range (S. vanLeeuwen 1642) (P3) (six individualscleared)• Goodenia sp. East Pilbara (A.A.Mitchell PRP 727) (P3) (107individuals cleared).• Grevillea saxicola (P3) (fiveindividuals cleared).• Ptilotus trichocephalus (P4) (983individuals cleared). |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Greenhouse gas emissions |
| Environmental objective  |
| Description of receiving environment The approved activitiescontribute the followingemissions (on average,based on data from 2014–2019) annually:• 107,433 tonnes of CO2equivalent (CO2-e)Scope 1 emissions.• 43,936 tonnes CO2-eScope 2 emissions.These emissions include theexisting Greater Paraburdoooperations, including theParaburdoo, Eastern Rangeand Channar operations. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Human health |
| Environmental objective  |
| Description of receiving environment No impact to human health is expected |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Inland waters |
| Environmental objective  |
| Description of receiving environment  The Proponent has conducted a number of hydrological and hydrogeological studies relating to theProposal. Table 8-1 summarises the technical studies undertaken. Key studies are provided inAppendix 8. RainfallRainfall in the Pilbara region is low and variable rainfall and occurs predominantly in summer throughlocalised thunderstorms and tropical depressions. Extreme rainfall events associated with tropicalcyclones can result in rainfall of over 200 mm within a 24 hour period, which can lead to large scalesheet flooding. Rainfall is typically greatest around the Hamersley Ranges and decreases with distancefrom the coast.The Paraburdoo Aero Bureau of Meteorology weather station (Station ID 7185) is located 15 km northeast of Paraburdoo mine. The 1974-2019 mean annual rainfall measured at Paraburdoo Aero is 323mm with a range of 03 mm to 598 mm, illustrating the high inter-annual variability (BoM 2019).Regional evaporation is considerably higher than rainfall, at approximately 3,000 mm/a, resulting inlimited permanent surface water features (Rio Tinto 2018c).8.3.3. Surface hydrology and regional contextThe Proposal is located in the Pilbara-Gascoyne drainage division, within the Ashburton River Basin,and the Development Envelope straddles the Six Mile Creek, Seven Mile Creek and Turee Creek subcatchments which are approximately 1,345 km2, 2,575 km2 and 6,910 km2respectively and account forapproximately 15% of the Ashburton River Basin (Rio Tinto 2019a) (Figure 8-1).   ParaburdooThe Paraburdoo section of the Proposal encompasses the Seven Mile Creek and Pirraburdu Creeknatural floodplains. Seven Mile Creek dissects the Development Envelope between the existing 4Eastand 4West pits at Paraburdoo, whilst Pirraburdu Creek enters the Development Envelope near RattySprings, flows east for 4 km before exiting the range between the existing 4W and 11W pits and headingsouth (Rio Tinto 2018c) (Figure 8-1). Approximate upstream catchments areas are 1,140 km2 for SevenMile Creek and 435 km2for Pirraburdu Creek.Ratty Springs is the only semi-permanent surface water feature in the Paraburdoo section of theProposal. Ratty Springs is supported by groundwater which expresses at the surface where thePirraburdu Creek catchment funnels through a 150 m wide gorge (Johnny’s Gorge) and persiststhroughout much of the year. Groundwater beneath Ratty Springs is hosted by two aquifers; a shallowalluvial aquifer, and a deep aquifer which consists of calcrete overlying weathered Fortescue Group.The calcrete outcrops in the creek bed; resulting in a surface expression of the alluvial aquifer at RattySprings in the form of small pools that persist throughout much of the year (Figure 8-2).   Surplus water from the existing operations is discharged to Seven Mile Creek at a rate of up to 0.8 GL/avia the licensed discharge point at Joe’s Crossing (excluded from this Proposal) (Figure 8-9). Dischargeto this site is infrequent, and the drainage line is typically dry (Rio Tinto 2019h). Surplus water from theParaburdoo processing plant is also discharged to Seven Mile Creek via the licensed Primary PlantDischarge Point (Figure 8-9). As discussed in Section 5, discharge from this location over many yearshas resulted in the augmentation of riparian vegetation in a localised section of Seven Mile Creekdownstream of the discharge point.Both Seven Mile and Pirraburdu Creeks are subject to flooding following periods of heavy rainfall,resulting in associated creek crossings linking Paraburdoo and Western Range becoming potentiallyimpassable for several days each year (Plate 2). Existing haul roads impede minor flows; however, major flows overtop the crossings. Peak flood depth observed in recent wet seasons was three metresin three hours for Pirraburdu Creek and two metres in one hour for Seven Mile Creek (Rio Tinto 2019a).Surface water samples have been collected within the Paraburdoo mining area since 2001 from anumber of surface water locations including (Figure 8-1):• Seven Mile Creek, 3 km north-east of the Paraburdoo mine site;• Kelly’s Pool, just north of Paraburdoo mine site and downstream of Seven Mile Creek monitoringsite;• Ratty Springs, and• Doggers Gorge.Long-term surface water monitoring data is available for Seven Mile Creek; however, there are temporalgaps in the monitoring data. Analysis shows pH levels ranging from 7.2 to 9 and had generally increasedfrom 2012 to 2015 (Rio Tinto 2019h). Salinity ranged from 800–2,000 mg/L TDS. However, a spike insalinity was recorded in August 2016 (3,900 mg/L), likely reflecting evapoconcentration as samplingoccurred towards the end of the dry season, with subsequent samples observing TDS levels returningto around approximately 2,000 mg/L.Kelly’s Pool has only been sampled since 2018; therefore, only has data available from three samplingoccasions (Rio Tinto 2019h). The pH was mildly alkaline and ranged from 8.2 – 8.6, salinity and majorions varied, and TDS ranged from 921 – 1520 mg/L. Surface water chemistry was comparable to SevenMile Creek monitoring site located upstream.Ratty Springs, located in Pirraburdu Creek, has lower salinity compared to upstream monitoring sitesaccording to the results of surface water samples collected in February and March of 2018 only(Rio Tinto 2019h).  Western RangeThe Western Range deposit straddles the upstream catchment divide between Six Mile and Seven MileCreek (Figure 8-1) (Rio Tinto 2018c, Rio Tinto 2019f). Surface water features occur within steeplyincised gullies along the ridgeline. These gullies form headwaters to Six Mile and Pirraburdu Creektributaries, forming a radial drainage pattern predominantly flowing in a southerly direction, eventuallyjoining the Ashburton River outside of the Development Envelope (Rio Tinto 2019a). Six Mile andPirraburdu creeks are ephemeral with surface water only occurring after intense rainfall events (RioTinto 2018c). Due to the steep topography at Western Range, surface water runoff in the gullies isexpected to have a relatively high velocity (Rio Tinto 2019f).Drainage patterns within the Western Range occurs within either lateral drainage lines, parallel to thedominant Brockman and Marra Mamba formation ridges, or transverse drainage lines runningperpendicular to the ridge (Rio Tinto 2019f). Surface water features such as pools are not typicallyassociated with sections of lateral drainage; these instead tend to form steep, pebbly and gravelly creekbeds with occasional boulders. Geological banding intersecting the transverse drainage lines influencesmany surface water features, with significant variations in hardness leading to the formation of large,sheer drops, high velocity flows and scour holes. These high velocity flows appear to have stripped outthe gravel layer leaving only exposed bedrock in gorges. Numerous small ephemeral pools have beenobserved in the Western Range gorges (Rio Tinto 2019a, f). Deeper, narrower gorges and large sheerdrops offering more shade tend to be associated with the larger of these pools, while the smaller poolshave been inclined to form on banded bedrock discontinuities and are typically more exposed to directsunlight. Surface water features within the Western Range are recharged through rainfall and in deeplyincised gullies may persist due to low evaporation. These pools are not expected to be connected toregional groundwater aquifers (Rio Tinto 2019f). No Western Range pools are thought to be ecologicallysignificant as none are large, permanent and groundwater-fed; rather they are ephemeral or intermittent,fed by surface runoff from the upper catchments, with some evaporating/infiltrating quickly in dry weatherand others persisting longer into November, likely to be replenished in the wet season. A few morepersistent surface water pools occur within deep, shady ephemeral drainage lines on the southern sideof Western Range, which fill and overflow during rainfall events (Plate 3).Surface water monitoring at Western Range began at the end of 2018 (Rio Tinto 2019a). Monitoringstations for identified surface water features have been established along Six Mile Creek consisting ofconductivity, pressure loggers with telemetry units and remote sensing cameras observing ponding afterlocalised rainfall events. The limited monitoring of six pools from Western Range has identified surfacewater as neutral (pH of 7.6 - 8.0) and very fresh (TDS of less than 300 mg/L). Concentrations of majorions were low (less than 100 mg/L) and concentrations of metals was also low (less than 0.05 mg/L)(Rio Tinto 2019h).     Eastern RangeSituated along the catchment divide of Seven Mile Creek and Turee Creek, surface water within EasternRange is influenced by steeply incised gullies within the ridgeline, as well as existing mining activity(Rio Tinto 2019h). No major creeks flow through the mine area; however, there are numerous incisedgullies that support ephemeral surface water pools (Rio Tinto 2019g).These include pools in the 24East, 32-37East and 42East gorges within the existing Eastern Rangeoperations, and eight additional ephemeral pools in two gorges identified by Rio Tinto (2019g) within theundeveloped portion of the Development Envelope east of Eastern Range.Doggers Gorge is a natural spring located just to the east of the Development Envelope and representsan important source of semi-permanent water near Eastern Range that will not be impacted by theProposal (Figure 8-1).Due to the elevated topography of this region these pools are not connected to deeper groundwater,which is estimated to be more than 100 metres below ground level (mbgl) in this area. The persistenceof the pools is likely to be ephemeral or intermittent (Rio Tinto 2019g). Recharge of the pools occursthrough direct infiltration or runoff following rainfall with some water received from localised surficialalluvial aquifers (Rio Tinto 2019h).Monitoring of surface water within the gullies confirms the ephemeral and dynamic nature of flow withingorges across the Eastern Range. For example, recent intense rainfall events have shown a rate ofrise in excess of approximately 1 m in 15 minutes in the 42E Gully (Rio Tinto 2019a).Monitoring of Eastern Range pools in the vicinity of 32E, 37E and 42E pits commenced in 2011, but islimited as sampling was intermittent (Rio Tinto 2019h). Surface water pools within Eastern Range aretypically very fresh and metal concentrations generally low.8.3.4. HydrogeologyThe Proposal is located in the southern margin of the Hamersley Province, on the south dipping limb ofBellary Anticline, within the Paraburdoo Ranges. It contains bedrock formations from the Fortescue,Hamersley and Wyloo Group (Rio Tinto 2018b, c). The interaction between surface water and theunderlying groundwater hosted within bedrock is important for the water balance. Groundwater flows,levels, recharge and discharge across the Development Envelope are discussed below. The proposed extension at Eastern Range will not result in any mining BWT and most predicted impactsassociated with Paraburdoo mining are not anticipated to extend into the Eastern Range area (otherthan a marginal effect on stygofauna habitat as discussed in Section 7.5.3). Therefore, hydrogeologyof Eastern Range has not been described.ParaburdooThe Seven Mile Creek dissects the Paraburdoo Range, flowing north to south between the existing 4Eand 4W mining areas. Leakage occurs from the creek’s alluvial aquifer to the underlying and adjacentfractured bedrock aquifers.Dewatering of the mineralised Brockman Iron Formation orebody aquifer has occurred in the 4E pit since2001. This, combined with numerous hydrogeological drilling campaigns undertaken in and around the4E deposit since mining began in 1971 has allowed the development of a comprehensivehydrogeological conceptual model for Paraburdoo (Table 8-2; Figure 8-3) (Rio Tinto 2018b).    The 4E deposit lies within a complex hydrogeological setting of high permeability geological unitsseparated by hydraulic barriers (Figure 8-3; Figure 8-4). Low permeability shale bands and weathereddolerite sills and dykes result in aquifer compartmentalisation. This is most evident beneath Seven MileCreek, where the discrete geological units act as leaky “buckets”, which fill and overflow into the nextbucket during creek flooding events, then recede as groundwater seeps into adjacent aquifers (e.g.Wittenoom and Brockman Iron Formation). The depth to groundwater is approximately 5 m belowground level (mbgl) in the Seven Mile Creek alluvial aquifer (Rio Tinto 2018b).  Prior to groundwater abstraction of the 4E mining pit, groundwater levels ranged from approximately345 mRL in the north to 335 mRL in the south, suggesting southerly groundwater flow direction(Figure 8-4; Rio Tinto 2018b). Elevated groundwater levels (360 mRL) were observed in the FortescueGroup to the east of the 18-East fault, which is a hydraulic barrier forcing groundwater flow to the south.Groundwater abstraction associated with mining of 4E has created a cone of depression, with drawdownof up to 60 m observed within the Brockman Iron Formation (Figure 8-4; Rio Tinto 2018b). Minimaldrawdown (approximately 5 m) has been observed within the Wittenoom Formation aquifer, which liesnorth of the Mount McRae Shale and the Mount Sylvia Formation, which form a significant hydraulicbarrier.Groundwater recharge events have been observed in response to large rainfall events. These eventswithin Seven Mile Creek catchment generate surface water flows on average 2-3 times per year, withthe alluvial aquifer becoming fully saturated when groundwater banks up against the Mount McRaeShale and the Mount Sylvia Formation barrier. Groundwater monitoring within the creek has beenundertaken since 2006 and shows a watertable increase by up to 30 m seasonally (Rio Tinto 2018b).Recharge to underlying Wittenoom and Brockman Iron Formations also occurs following rainfall events.Comprehensive groundwater sampling has been undertaken from all dewatering bores in Paraburdoosince 2001. Results of July 2018 sampling of the dewatering bores indicate groundwater quality fromcurrently dewatered aquifers (Rio Tinto 2018b). Groundwater was brackish, with Total Dissolved Solids(TDS) of up to 1520 mg/L. The pH was mildly alkaline, ranging from 7.9-8.3, major ions varied, andmetals results were low.In-depth hydrochemical analysis of surface water in Seven Mile Creek and groundwater from keydewatering bores suggests that groundwater within the Seven Mile Creek aquifer progresses downgradient with losses associated with evapotranspiration from riparian vegetation and infiltration to theunderlying aquifers. This is a key groundwater recharge mechanism for the Brockman Iron Formationand Wittenoom Formation aquifers.Western RangeThe groundwater study area within Western Range extends from Pirraburdu Creek in the east to SixMile Creek in the west. Observations from hydrogeological drilling suggest that groundwater occurswithin numerous geological formations across the Western Range, as shown in Table 8-3  Groundwater to the north of Western Range within the Fortescue Group is relatively deep, and lies ataround 365 mRL (approximately 40 mbgl), apparently disconnected from groundwater in the HamersleyGroup (in the Western Range this group is dominated by the Brockman Iron Formation with groundwaterlevel at approximately 318 mRL) (Figure 8-5; Figure 8-6). Within the Fortescue Group, the hydraulicgradient follows the flow direction of Six Mile Creek south toward the range then flows west through theSix Mile Creek gorge. Within this gorge, depth to groundwater is shallow (approximately 5 mbgl), andwithin an alluvial aquifer. As groundwater flows through the gorge its level reduces to 327 mRL (RioTinto 2018c).Groundwater levels beneath Western Range within the Wittenoom, Brockman Iron and WylooFormations range from 319.5 mRL in the north to 317 mRL in the south (Rio Tinto 2018c, Figure 8-5).The surface level at Western Range ranges from approximately 400 mRL on the foothills to 568 mRL atits highest point. Therefore, depth to groundwater at Western Range is significant (i.e. deep) atapproximately 80 m to 250 mbgl. No groundwater levels have been observed within the Marra MambaIron Formation; however; it is assumed that this acts as a hydraulic barrier, separating the WittenoomFormation from the elevated levels in the Fortescue Group to the north.Groundwater recharge events have been observed in response to large rainfall events. The FortescueGroup aquifer shows low chloride concentrations (approximately 30 mg/L) and a sharp 2-4 m increasein groundwater level after rainfall events suggesting recharge is rapid. A moderate response to rainfallhas been observed in the Wyloo Formation aquifer, with a 2.5 m rise the highest recharge eventrecorded (Rio Tinto 2018c). Wittenoom and Brockman Iron Formation records indicate a muted rainfallresponse, with an increase of less than 1 m observed in water levels.Groundwater sampling data in Western Range is limited, however, no trends in chemical characteristicshave be determined over time based on the available data. Water quality sampling occurred between2012 and 2018 during airlift development and test pumping monitoring and production bores, withsamples analysed for major and minor ions and metal concentrations (Rio Tinto 2018c). Groundwaterquality indicators at Western Range varied according to geology, with higher concentrations of TDScomponents tending to be in the (highest to lowest) Eastern Wyloo, Wittenoom, and Brockmanformations and lower in the (highest to lowest) Western Wyloo and Fortescue formations (Table 8-4). |
| Potential key environmental factor (yes/no – if no the justification is provided)Yes |
| EPA policy and guidance  The Proponent has conducted a number of hydrological and hydrogeological studies relating to theProposal. Table 8-1 summarises the technical studies undertaken. Key studies are provided inAppendix 8. RainfallRainfall in the Pilbara region is low and variable rainfall and occurs predominantly in summer throughlocalised thunderstorms and tropical depressions. Extreme rainfall events associated with tropicalcyclones can result in rainfall of over 200 mm within a 24 hour period, which can lead to large scalesheet flooding. Rainfall is typically greatest around the Hamersley Ranges and decreases with distancefrom the coast.The Paraburdoo Aero Bureau of Meteorology weather station (Station ID 7185) is located 15 km northeast of Paraburdoo mine. 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| Description of environmental impacts  The Proponent has conducted a number of hydrological and hydrogeological studies relating to theProposal. Table 8-1 summarises the technical studies undertaken. Key studies are provided inAppendix 8. RainfallRainfall in the Pilbara region is low and variable rainfall and occurs predominantly in summer throughlocalised thunderstorms and tropical depressions. Extreme rainfall events associated with tropicalcyclones can result in rainfall of over 200 mm within a 24 hour period, which can lead to large scalesheet flooding. Rainfall is typically greatest around the Hamersley Ranges and decreases with distancefrom the coast.The Paraburdoo Aero Bureau of Meteorology weather station (Station ID 7185) is located 15 km northeast of Paraburdoo mine. 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| Environmental Values Impact Assessments:Value : a camaenid land snail (Ninety Seven Mile Creek)* Characterisation

Health of the Seven Mile Creek is the value* Impacts
* Mitigation effect
* Residual impacts quantity, volume or extent

5 * Residual impact

No residual impact is expected.* Significant residual impact (yes/no)

No* Justify significance

No residual impact is expected.* Cumulative impact

%253Cp%253EThe%2520Proposal%2520is%2520not%2520located%2520near%2520any%2520other%2520existing%2520or%2520reasonably%2520foreseeable%2520proposed%2520mines%252C%2520or%2520new%2520or%2520significant%2520water%2520users.%2520Therefore%252C%2520cumulative%2520impacts%2520are%2520not%2520expected%2520to%2520apply%2520with%2520respect%2520to%2520inland%2520waters.%253C%252Fp%253E* Environmental outcome

%253Cp%253EThrough%2520the%2520implementation%2520of%2520the%2520EPA%25E2%2580%2599s%2520mitigation%2520hierarchy%252C%2520the%2520residual%2520impacts%2520of%2520the%2520proposal%2520to%2520inland%2520waters%2520are%2520as%2520low%2520as%2520reasonably%2520practicable%2520and%2520the%2520Proponent%2520considers%2520that%2520the%2520Proposal%2520can%2520be%2520managed%2520to%2520meet%2520the%2520EPA%25E2%2580%2599s%2520objective%2520for%2520inland%2520waters.%253C%252Fp%253E* Justification

%253Cp%253Enot%2520sure%253C%252Fp%253E |
| Offset explanation  |
| Application of the mitigation hierarchy

|  |  |  |  |
| --- | --- | --- | --- |
| potential impact | avoidance | minimisation | rehab |
| Alteration togroundwateraquifers due toabstraction ofgroundwater. | Avoidance of mine dewateringor abstraction for water supplyis not possible for thisProposal; however,groundwater aquifersconnected with Ratty Springswill not be impacted bydewatering. | Cumulative water balance modelling andhydrogeological modelling has been, andwill continue to be, undertaken to facilitateunderstanding and effective management ofcurrent and future operational waterdemands and dewatering requirements,with a view to minimising groundwaterabstraction for water supply.Abstraction from the 4EE dewateringborefield is expected to reduce demandfrom the Turee Creek and Channarborefields. | Groundwater levels areexpected to recoverfollowing cessation ofdewatering. No specificrehabilitation isproposed. |
| Alteration tohydrologicalregimes ofsurface watersystems fromdischarge ofsurplusdewateringwater. | Avoidance of surface waterdischarge of all surplusdewatering water is notpossible for this Proposal | Only water that is surplus to operationalrequirements will be discharged.Discharge to surface water systems will beminimised where practicable via alternativedischarge methods including in-pit disposaland aquifer recharge (if viable).Surface water discharge will occurintermittently during the life of mineSurface water discharge will be managedsuch that the wetting front does not extendbeyond the Development Envelope. | Not applicable |
| Alteration togroundwateraquifers fromdischarge ofsurplusdewatering waterto disused minepits. | Avoidance of surplus waterdischarge is not possible forthis Proposal. | Only surplus dewatering water exceedingoperational requirements will be dischargedto disused mine pits. | Not applicable |

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| Assessment and significance of residual impacts The Proposal will result in groundwaterdrawdown as a result of dewatering BWTresources and supply of water for operationalrequirements.Dewatering at 4EE deposit at Paraburdoo willresult in a further reduction of groundwaterlevels in Seven Mile Creek alluvial aquifer.This aquifer will be periodically rechargedduring high rainfall events.Dewatering at Western Range does not occurin the vicinity of any shallow groundwateraquifers and is therefore not likely to affectany riparian vegetation and GDEs.The Proponent considers that the potentialimpacts can be managed, and the residualimpact will not be significant, and thisProposal can be managed to meet the EPA’sobjective for this factor. |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Landforms |
| Environmental objective  |
| Description of receiving environment No impact to landforms is expected. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Marine environmental quality |
| Environmental objective  |
| Description of receiving environment The proposal is not located near the coast and no impact is expected. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Marine fauna |
| Environmental objective  |
| Description of receiving environment This proposal is no located near a marine environment. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Social surroundings |
| Environmental objective  |
| Description of receiving environment The Proponent has undertaken extensive Aboriginal archaeological and ethnographic surveys withinthe Development Envelope since 1984, with approximately 65 reports prepared since this time. Table9-1 summarises the technical studies undertaken, and Figure 9-1 shows locations of heritage surveyswithin and in the vicinity of the Development Envelope. A summary report of the heritage worksundertaken to support the Greater Paraburdoo Iron Ore Hub Proposal is present in Appendix 9 (RioTinto 2020c).Many of the reports contain information which is of a sensitive nature to the Yinhawangka People. Theinformation and assessment in this section is of general nature only and excludes specific culturalinformation that may be contained within the Development Envelope. Surveys and investigations havebeen undertaken in consultation with and regularly accessed by the Yinhawangka People.A Visual Impact Assessment was undertaken by Rio Tinto (2019i; Appendix 9) to evaluate the predictedvisual impact of the Proposal for sites with the greatest potential for visual impact as well as sites ofcultural significance. A table of technical studies is present in attachment 1.  |
| Potential key environmental factor (yes/no – if no the justification is provided)Yes |
| EPA policy and guidance The Proponent has undertaken extensive Aboriginal archaeological and ethnographic surveys withinthe Development Envelope since 1984, with approximately 65 reports prepared since this time. Table9-1 summarises the technical studies undertaken, and Figure 9-1 shows locations of heritage surveyswithin and in the vicinity of the Development Envelope. A summary report of the heritage worksundertaken to support the Greater Paraburdoo Iron Ore Hub Proposal is present in Appendix 9 (RioTinto 2020c).Many of the reports contain information which is of a sensitive nature to the Yinhawangka People. Theinformation and assessment in this section is of general nature only and excludes specific culturalinformation that may be contained within the Development Envelope. Surveys and investigations havebeen undertaken in consultation with and regularly accessed by the Yinhawangka People.A Visual Impact Assessment was undertaken by Rio Tinto (2019i; Appendix 9) to evaluate the predictedvisual impact of the Proposal for sites with the greatest potential for visual impact as well as sites ofcultural significance. A table of technical studies is present in attachment 1.  |
| Description of environmental impacts The Proponent has undertaken extensive Aboriginal archaeological and ethnographic surveys withinthe Development Envelope since 1984, with approximately 65 reports prepared since this time. Table9-1 summarises the technical studies undertaken, and Figure 9-1 shows locations of heritage surveyswithin and in the vicinity of the Development Envelope. A summary report of the heritage worksundertaken to support the Greater Paraburdoo Iron Ore Hub Proposal is present in Appendix 9 (RioTinto 2020c).Many of the reports contain information which is of a sensitive nature to the Yinhawangka People. Theinformation and assessment in this section is of general nature only and excludes specific culturalinformation that may be contained within the Development Envelope. Surveys and investigations havebeen undertaken in consultation with and regularly accessed by the Yinhawangka People.A Visual Impact Assessment was undertaken by Rio Tinto (2019i; Appendix 9) to evaluate the predictedvisual impact of the Proposal for sites with the greatest potential for visual impact as well as sites ofcultural significance. A table of technical studies is present in attachment 1.  |
| Environmental Values Impact Assessments:Value : Aboriginal Heritage Site or Place:RATTY SPRINGS/GARDAGARLI.* Characterisation

Gardagarli (Johnny’s Gorge, Ratty Springs) is located in Pirraburdu Creek to the north of the proposed14-16W and 20W deposits and will not be directly impacted by the Proposal (Section 8).Garrabagarrangu (Red Ochre Quarry) is located to the south of the proposed 36W deposit. An exclusionzone will be established around Garrabagarrangu in consultation and agreement with the YinhawangkaPeople and will be maintained in order to preserve the cultural value of the site and will be documentedin the CHMP. During mining, a 200 m wide corridor will be maintained between the adjacent wastedumps to allow for continued access by the Yinhawangka People to Garrabagarrangu. Access rightsto this location will be incorporated into the Yinhawangka and Rio Tinto Paraburdoo Land AccessProtocol currently held and utilised by Greater Paraburdoo Operations and YAC. The Proponent (in consultation with the Yinhawangka People) will also ensure the CHMP:• manages potential impacts to Garrabagarrangu; and• includes a requirement for site inductions for all site employees and contractors to outline thelocations of heritage sites in the Development Envelope, s.18 requirements, and the consequencesif sites are knowingly disturbed.Where it is deemed that impacts to heritage sites cannot be avoided, the Proponent will implement stepsto minimise or mitigate impacts and ensure required statutory approvals are obtained. The Proponentwill request approvals under s.16 and/or s.18 of the AH Act where applicable. This process will beundertaken in consultation with the Yinhawangka People (Rio Tinto 2019e).* Impacts
* Mitigation effect
* Residual impacts quantity, volume or extent

0 * Residual impact

No direct residual impacts. Possible aethetic impacts for Aboriginal people using the sites.* Significant residual impact (yes/no)

No* Justify significance

No residual impact due to ongoing consultaiton* Cumulative impact

%3Cp%3ENo%20cumulative%20impact%E2%80%A6.%3C%2Fp%3E* Environmental outcome

%3Cp%3EAfter%20the%20application%20of%20the%20mitigation%20hierarchy%20(Table%209-2)%20and%20with%20ongoing%20consultation%20with%20the%20Yinhawangka%20People%20regarding%20the%20Proposal%20through%20both%20formal%20and%20informal%20forums%2C%20and%20obligations%20under%20the%20AH%20Act%2C%20the%20Proponent%20considers%20that%20the%20Proposal%20can%20be%20managed%20to%20meet%20the%20EPA%E2%80%99s%20objective%20for%20Social%20Surroundings.%3C%2Fp%3E* Justification

%3Cp%3ENot%20sure%20here%3C%2Fp%3E |
| Offset explanation  |
| Application of the mitigation hierarchy

|  |  |  |
| --- | --- | --- |
| 1 | 1 | 1 |
| 1 | 1 | 1 |
| 1 | 1 | 1 |

  |
| Assessment and significance of residual impacts The key Social Surroundings values identified in the Development Envelope that are considered relevantto the Proposal include:• Two SoSS’s (Gardagarli and Garrabagarrangu (Red ochre quarry) located within the DevelopmentEnvelope.• Water sources identified as being highly significant to the Yinhawangka People.• Various locations within the vicinity of the Proposal that are publicly accessible and potentially haveviews of the Paraburdoo mine site (e.g. Paraburdoo town).There will be no direct impact to Gardagarli or Garrabagarrangu. Waste dump designs at WesternRange have been modified to allow for the establishment of an exclusion zone around Garrabagarranguin consultation and agreement with the Yinhawangka People and will be maintained in order to preservethe cultural value of the site. Additionally, the Proponent has modified the pit design at 14-16W tominimise the visual and physical impacts to Pirraburdu Creek as per consultation with the YinhawangkaPeople.Implementation of the Proposal will result in impacts to some heritage sites including a limited sectionof Wanu Wanu (Seven Mile Creek) and surface water pools at Eastern Range and Western Range(Section 8). The Proponent acknowledges the high cultural significance of water systems to theYinhawangka People and further consultations will continue to be undertaken to improve sustainablewater management outcomes through inclusive and ongoing engagement with Yinhawangka aligned toRio Tinto Iron Ore’s Water Strategy. The issue of water management will remain an ongoing dialoguebetween Rio Tinto and the Yinhawangka People that will adapt to requirements as the mine lifeprogresses. |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Subterranean fauna |
| Environmental objective  |
| Description of receiving environment \"\n**Regional context**\nThe Development Envelope is located within the Pilbara bioregion which is recognised as a global\nhotspot for subterranean biodiversity, especially stygofauna, and is the best studied region for\nsubterranean fauna in WA. Estimates for the Pilbara are that the region contains 500 to 550 stygofauna\nspecies of (Eberhard et al. 2005, 2009; Halse et al. 2014).\nAll sites in the Pilbara should be assumed to support significant stygofauna and troglofauna\nassemblages, unless there is strong evidence that subterranean habitats lack pore spaces, have a\ngeology that renders conditions completely anoxic, or contain groundwater of salinity >60,000 mgL-1\n(EPA 2016j). These conditions do not occur within the Development Envelope and; therefore,\nsubterranean fauna investigations were a key part of the environmental investigations for this Proposal.\n**Local context**\nThe Development Envelope is located within the Hamersley subregion. The Development Envelope’s\niron-bearing formations within the Pilbara region are known to contain habitat for subterranean fauna\nand troglofauna and stygofauna are known to occur in the Development Envelope (Biologic 2019b).\nDetails of the geology and habitat suitability for subterranean fauna within the Development Envelope\nare presented in Appendix 7. As the habitats, species assemblages and potential impacts are distinct\nfor troglofauna and stygofauna, this information is presented separately Sections 7.4 and 7.5.\n\n \n\nFigures are provided in Attachment 1.\n\" |
| Potential key environmental factor (yes/no – if no the justification is provided)Yes |
| EPA policy and guidance \"\n**Regional context**\nThe Development Envelope is located within the Pilbara bioregion which is recognised as a global\nhotspot for subterranean biodiversity, especially stygofauna, and is the best studied region for\nsubterranean fauna in WA. Estimates for the Pilbara are that the region contains 500 to 550 stygofauna\nspecies of (Eberhard et al. 2005, 2009; Halse et al. 2014).\nAll sites in the Pilbara should be assumed to support significant stygofauna and troglofauna\nassemblages, unless there is strong evidence that subterranean habitats lack pore spaces, have a\ngeology that renders conditions completely anoxic, or contain groundwater of salinity >60,000 mgL-1\n(EPA 2016j). These conditions do not occur within the Development Envelope and; therefore,\nsubterranean fauna investigations were a key part of the environmental investigations for this Proposal.\n**Local context**\nThe Development Envelope is located within the Hamersley subregion. The Development Envelope’s\niron-bearing formations within the Pilbara region are known to contain habitat for subterranean fauna\nand troglofauna and stygofauna are known to occur in the Development Envelope (Biologic 2019b).\nDetails of the geology and habitat suitability for subterranean fauna within the Development Envelope\nare presented in Appendix 7. As the habitats, species assemblages and potential impacts are distinct\nfor troglofauna and stygofauna, this information is presented separately Sections 7.4 and 7.5.\n\n \n\nFigures are provided in Attachment 1.\n\" |
| Description of environmental impacts \"\n**Regional context**\nThe Development Envelope is located within the Pilbara bioregion which is recognised as a global\nhotspot for subterranean biodiversity, especially stygofauna, and is the best studied region for\nsubterranean fauna in WA. Estimates for the Pilbara are that the region contains 500 to 550 stygofauna\nspecies of (Eberhard et al. 2005, 2009; Halse et al. 2014).\nAll sites in the Pilbara should be assumed to support significant stygofauna and troglofauna\nassemblages, unless there is strong evidence that subterranean habitats lack pore spaces, have a\ngeology that renders conditions completely anoxic, or contain groundwater of salinity >60,000 mgL-1\n(EPA 2016j). These conditions do not occur within the Development Envelope and; therefore,\nsubterranean fauna investigations were a key part of the environmental investigations for this Proposal.\n**Local context**\nThe Development Envelope is located within the Hamersley subregion. The Development Envelope’s\niron-bearing formations within the Pilbara region are known to contain habitat for subterranean fauna\nand troglofauna and stygofauna are known to occur in the Development Envelope (Biologic 2019b).\nDetails of the geology and habitat suitability for subterranean fauna within the Development Envelope\nare presented in Appendix 7. As the habitats, species assemblages and potential impacts are distinct\nfor troglofauna and stygofauna, this information is presented separately Sections 7.4 and 7.5.\n\n \n\nFigures are provided in Attachment 1.\n\" |
| Environmental Values Impact Assessments:Value : Pannikin Plain Cave isopod* Characterisation

text text text* Impacts
* Mitigation effect
* Residual impacts quantity, volume or extent

0 * Residual impact

After the mitigation hierarchy has been applied, no significant residual impact to troglofauna areexpected and the Proponent considers that the Proposal can be managed to meet the EPA’sobjectives for Subterranean Fauna in relation to troglofauna.* Significant residual impact (yes/no)

No* Justify significance

After the mitigation hierarchy has been applied, no significant residual impact to troglofauna areexpected and the Proponent considers that the Proposal can be managed to meet the EPA’sobjectives for Subterranean Fauna in relation to troglofauna.* Cumulative impact

%2525253Cp%2525253ECurrent%25252520predictions%25252520of%25252520the%25252520cumulative%25252520impact%25252520of%25252520the%25252520Proposal%25252520show%25252520that%25252520more%25252520than%2525252050%25252525%25252520by%25252520volume%25252520of%25252520pre-mining%25252520troglofauna%25252520habitat%25252520will%25252520continue%25252520to%25252520be%25252520present%25252520in%25252520each%25252520area%25252520(i.e.%25252520Western%25252520Range%2525252C%25252520Paraburdoo%2525252C%25252520Eastern%25252520Range).%25252520Given%25252520the%25252520presence%25252520of%25252520a%25252520significant%25252520volume%25252520of%25252520connected%25252520habitat%25252520outside%25252520the%25252520predicted%25252520impact%25252520areas%2525252C%25252520the%25252520Proposal%25252520is%25252520unlikely%25252520to%25252520affect%25252520the%25252520ecological%25252520integrity%25252520of%25252520the%25252520troglofauna%25252520community.%25252520Three%25252520taxa%25252520are%25252520at%25252520%252525E2%25252580%25252598low%252525E2%25252580%25252599%25252520risk%25252520of%25252520impact%25252520and%25252520five%25252520taxa%25252520area%25252520at%25252520%252525E2%25252580%25252598moderate%252525E2%25252580%25252599%25252520risk%25252520of%25252520impact%25252520from%25252520the%25252520Proposal.%25252520Most%25252520of%25252520these%25252520taxa%25252520were%25252520also%25252520detected%25252520from%25252520single%25252520sites.%25252520It%25252520would%25252520be%25252520reasonable%25252520to%25252520assume%25252520that%25252520their%25252520actual%25252520distribution%25252520is%25252520wider%25252520than%25252520recorded%25252520throughout%25252520the%25252520local%25252520extent%25252520of%25252520suitable%25252520habitat%25252520and%25252520habitat%25252520connectivity%25252520throughout%25252520the%25252520ranges%25252520will%25252520be%25252520maintained.%25252520As%25252520discussed%25252520in%25252520Section%252525207.4.4%2525252C%25252520taxa%25252520with%25252520small%25252520or%25252520single%25252520site%25252520distributions%25252520are%25252520often%25252520an%25252520inherent%25252520artefact%25252520of%25252520sampling%25252520and%25252520the%25252520Proponent%25252520expects%25252520the%25252520five%25252520%252525E2%25252580%25252598moderate%252525E2%25252580%25252599%25252520risk%25252520category%25252520taxa%25252520will%25252520continue%25252520to%25252520occur%25252520in%25252520the%25252520adjacent%25252520areas%25252520of%25252520remaining%25252520habitat%25252520during%25252520and%25252520after%25252520the%25252520Proposal%25252520is%25252520implemented%25252520and%25252520cumulative%25252520impacts%25252520to%25252520troglofauna%25252520habitat%25252520or%25252520species%25252520are%25252520not%25252520expected%25252520to%25252520be%25252520significant.%2525253C%2525252Fp%2525253E* Environmental outcome

%2525253Cp%2525253EOutcome%25252520will%25252520be%25252520an%25252520impact%25252520to%25252520%252525E2%25252580%252525A6.%2525253C%2525252Fp%2525253E* Justification

%2525253Cp%2525253EThis%25252520factor%25252520is%25252520justified%252525E2%25252580%252525A6.%2525253C%2525252Fp%2525253E |
| Offset explanation  |
| Application of the mitigation hierarchy emoval of potentialstygofauna habitat.Avoidance of removal ofstygofauna habitat is not possiblefor this Proposal; however, anestimated more than 90% of habitatwill remain intact within theDevelopment Envelope.Impacts to stygofauna taxa andassemblages will be minimisedthrough the continued availabilityof significant connected premining habitat.Not applicable. Removal of 1% of stygofauna habitat atWestern Range and 10% at Paraburdoo. Nostygofauna habitat removed at EasternRange.The Proponent considers that the potentialimpacts can be managed, and the residualimpact will not be significant, and thisProposal can be managed to meet the EPA’sobjective for this factor.Reduction instygofauna habitatthrough minedewatering.Avoidance of a reduction instygofauna habitat through minedewatering is not possible underthis Proposal; however,approximately 98%, 75% and 99%of current modelled stygofaunahabitat will not be affected bydewatering at Western Range,Paraburdoo and Eastern Range,respectively.Dewatering and abstraction forwater supply will be minimised tothat required to implement theProposal.Water from mine dewatering willbe used on site in the firstinstance to minimise therequirement for additionalgroundwater abstraction foroperational water supply.The Proponent will abstractgroundwater within licence limitsand monitor groundwater levelsto ensure impact remains withinthe predicted range ofdrawdown.Cessation ofgroundwater abstractionat BWT pits will enablerecovery of groundwaterlevels and re-saturationof stygofauna habitat.Increase in abstraction from the currentlicence limit of 9 GL/a to 14 GL/a under thisProposal. This includes abstraction of 5.5 to7.5 GL/a within the Brockman andWittenoom Formations to dewater the 4EEdeposit, plus minor abstraction required forthe 36W and 66W deposits.Temporary reduction of stygofauna habitatof 25% at Paraburdoo, 2% at WesternRange and 1% at Eastern Range.The Proponent considers that the potentialimpacts can be managed, and the residualimpact will not be significant, and thisProposal can be managed to meet the EPA’sobjective for this factor.Loss of stygofaunaindividuals.Avoidance of loss of stygofaunaindividuals is not possible for thisProposal.Impacts to most (>96%)stygofauna taxa andassemblages will be minimisedthrough the continued availabilityof significant connected premining habitat.Not applicable. The Proponent expects Bathynellidae ‘sp.WAM-BATH001’ and Bathynellidae ‘sp.GP2’ to persist in the DevelopmentEnvelope based on:• Demonstrated resilience by bothspecies to historical disturbance,• Occurrence of Bathynellidae ‘sp. WAMBATH001’ in alluvials nort |
| Assessment and significance of residual impacts After the mitigation hierarchy has been applied, no significant residual impact to troglofauna areexpected and the Proponent considers that the Proposal can be managed to meet the EPA’sobjectives for Subterranean Fauna in relation to troglofauna. |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Terrestrial environmental quality |
| Environmental objective  |
| Description of receiving environment No impact to TEQ is expected. |
| Potential key environmental factor (yes/no – if no the justification is provided)No |
| EPA policy and guidance  |
| Description of environmental impacts  |
| Environmental Values Impact Assessments: |
| Offset explanation  |
| Application of the mitigation hierarchy  |
| Assessment and significance of residual impacts  |
| Likely environmental outcomes |
| Potential environmental impacts (Needed for each environmental factor except Greenhouse Gas Emissions) |
| Factor Terrestrial fauna |
| Environmental objective  |
| Description of receiving environment A number of terrestrial fauna surveys have been undertaken within the Development Envelope andsurrounding area. Table 6-1 summarises the terrestrial fauna investigations undertaken for theProposal. These investigations collate and summarise all relevant historical terrestrial fauna surveysundertaken and used to inform this ERD.All fauna surveys have been conducted in accordance with the following guidance, where relevant:• Environmental Factor Guideline - Terrestrial Fauna (EPA 2016d);• Position Statement No. 3 (EPA 2002);• Technical Guidance - Terrestrial Fauna Surveys (EPA 2016e);• Technical Guidance – Sampling of Short Range Endemic Invertebrate Fauna (EPA 2016g);• Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016f); Fauna habitat is summarised in Table 6.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fauna Type Habitat | Description | Value | Related vegetation types | Microhabitat | Habitat condition |
| Gorge/gully | The most restrictedhabitats in theDevelopment Envelopeand is described as deepoften rocky gorges,sometimes withephemeral pools. | Primary high value habitat forconservation significantspecies.Provides significantrefugia/shelter sites andsupports a diversity of faunaspecies.High value for SRE fauna | Corymbia ferriticola trees overAcacia citrinoviridis, A. aneurasens. lat.Shrubland over Triodiaepactia hummock grassland. | Overhangs,crevices, caves,tree hollows,ephemeral, semipermanent water | high |
| Breakaway | Common habitat in thePilbara. Breakaway orridge line, falling away tosteep scree slope ordrainage line. This habitatcontains exposed rockfaces with accumulationsof rock boulders andscree. | High value to the conservationsignificant species.High value for SRE fauna. | Acacia aneura sens. lat., A.pruinocarpa shrubland over A.tetragonophylla, Dodonaeapachyneura, Eremophilacryptothrix shrubs over Triodiaepactia hummock grassland | Caves(roost/feedcaves).Cracks andcrevices.Sheltered leaflitter. | high |

     |
| Potential key environmental factor (yes/no – if no the justification is provided)Yes |
| EPA policy and guidance A number of terrestrial fauna surveys have been undertaken within the Development Envelope andsurrounding area. Table 6-1 summarises the terrestrial fauna investigations undertaken for theProposal. These investigations collate and summarise all relevant historical terrestrial fauna surveysundertaken and used to inform this ERD.All fauna surveys have been conducted in accordance with the following guidance, where relevant:• Environmental Factor Guideline - Terrestrial Fauna (EPA 2016d);• Position Statement No. 3 (EPA 2002);• Technical Guidance - Terrestrial Fauna Surveys (EPA 2016e);• Technical Guidance – Sampling of Short Range Endemic Invertebrate Fauna (EPA 2016g);• Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016f); Fauna habitat is summarised in Table 6.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fauna Type Habitat | Description | Value | Related vegetation types | Microhabitat | Habitat condition |
| Gorge/gully | The most restrictedhabitats in theDevelopment Envelopeand is described as deepoften rocky gorges,sometimes withephemeral pools. | Primary high value habitat forconservation significantspecies.Provides significantrefugia/shelter sites andsupports a diversity of faunaspecies.High value for SRE fauna | Corymbia ferriticola trees overAcacia citrinoviridis, A. aneurasens. lat.Shrubland over Triodiaepactia hummock grassland. | Overhangs,crevices, caves,tree hollows,ephemeral, semipermanent water | high |
| Breakaway | Common habitat in thePilbara. Breakaway orridge line, falling away tosteep scree slope ordrainage line. This habitatcontains exposed rockfaces with accumulationsof rock boulders andscree. | High value to the conservationsignificant species.High value for SRE fauna. | Acacia aneura sens. lat., A.pruinocarpa shrubland over A.tetragonophylla, Dodonaeapachyneura, Eremophilacryptothrix shrubs over Triodiaepactia hummock grassland | Caves(roost/feedcaves).Cracks andcrevices.Sheltered leaflitter. | high |

     |
| Description of environmental impacts A number of terrestrial fauna surveys have been undertaken within the Development Envelope andsurrounding area. Table 6-1 summarises the terrestrial fauna investigations undertaken for theProposal. These investigations collate and summarise all relevant historical terrestrial fauna surveysundertaken and used to inform this ERD.All fauna surveys have been conducted in accordance with the following guidance, where relevant:• Environmental Factor Guideline - Terrestrial Fauna (EPA 2016d);• Position Statement No. 3 (EPA 2002);• Technical Guidance - Terrestrial Fauna Surveys (EPA 2016e);• Technical Guidance – Sampling of Short Range Endemic Invertebrate Fauna (EPA 2016g);• Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016f); Fauna habitat is summarised in Table 6.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fauna Type Habitat | Description | Value | Related vegetation types | Microhabitat | Habitat condition |
| Gorge/gully | The most restrictedhabitats in theDevelopment Envelopeand is described as deepoften rocky gorges,sometimes withephemeral pools. | Primary high value habitat forconservation significantspecies.Provides significantrefugia/shelter sites andsupports a diversity of faunaspecies.High value for SRE fauna | Corymbia ferriticola trees overAcacia citrinoviridis, A. aneurasens. lat.Shrubland over Triodiaepactia hummock grassland. | Overhangs,crevices, caves,tree hollows,ephemeral, semipermanent water | high |
| Breakaway | Common habitat in thePilbara. Breakaway orridge line, falling away tosteep scree slope ordrainage line. This habitatcontains exposed rockfaces with accumulationsof rock boulders andscree. | High value to the conservationsignificant species.High value for SRE fauna. | Acacia aneura sens. lat., A.pruinocarpa shrubland over A.tetragonophylla, Dodonaeapachyneura, Eremophilacryptothrix shrubs over Triodiaepactia hummock grassland | Caves(roost/feedcaves).Cracks andcrevices.Sheltered leaflitter. | high |

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| Environmental Values Impact Assessments:Value : grey falcon* Characterisation

The Grey Falcon has been previously recorded within the Development Envelope, with a potentialbreeding pair that may occupy the Development Envelope (Astron 2018c, d). The most suitable habitatis the Drainage Line habitat, particularly in times of inundation when surface water is present(Astron 2018d). This species is highly mobile and is expected to forage across a wide range of habitatswithin and outside of the Development Envelope.Clearing will directly impact up to approximately 9.5% of Drainage Line habitat in the DevelopmentEnvelope available for potential foraging habitat for the species. Given the relatively minor disturbanceto Drainage Line habitat and that foraging is not expected to be restricted to the Development Envelopeand given the widespread availability of suitable habitat in the region, the proposed disturbance is notexpected to significantly impact a local population or the conservation status of the species.* Impacts
* Mitigation effect
* Residual impacts quantity, volume or extent

70 Hectares* Residual impact

Loss of habitat fauna: Residual impacts from the Proposal include the removal of up to 70 ha Drainage Line. An offset is proposed for the locally significant residual impacts, even though the residual impact is unlikely to be significant at a regional scale.Vehicle movements and fencing mayresult in mortality for fauna. Theseimpacts affect individuals and are notlikely to cause a significant impact onspecies.* Significant residual impact (yes/no)

No* Justify significance

Through the implementation of the EPA’s mitigation hierarchy (Section 6.7), the residual impacts of theProposal to grey falcon are as low as reasonably practicable. As the fauna habitat is not high value habitat, no offsets are proposed.* Cumulative impact

%3Cp%3EInfo%20needed%20here%3C%2Fp%3E* Environmental outcome

%3Cp%3EAs%20such%2C%20the%20EPA%E2%80%99s%20objective%20for%20terrestrial%20fauna%20will%20be%20met%20and%20biological%20diversity%20and%20ecological%20integrity%20will%20be%20maintained.%3C%2Fp%3E* Justification

%3Cp%3EGiven%20management%20commitments%2C%20known%20wide%20distribution%20of%20fauna%20habitats%20in%20the%20Pilbara%2C%20proposed%20offsets%20and%20the%20Proponent%E2%80%99s%20past%20performance%20in%20implementing%20appropriate%20mitigations%20as%20part%20of%20the%20construction%20and%20operation%20of%20mining%20projects%20in%20the%20Pilbara%2C%20the%20Proponent%20considers%20that%20the%20Proposal%20can%20be%20managed%20to%20meet%20the%20EPA%E2%80%99s%20objective%20for%20terrestrial%20fauna.%3C%2Fp%3E |
| Offset explanation  |
| Application of the mitigation hierarchy Avoidance• The conceptual footprint has been modified where practicable to avoid impacts to high valuefauna habitat and cave systems, including:• modification of the 36W pit crest to provide an adequate stand-off for the protection ofCave 6 (potential Ghost Bat maternity roost); and• modification of Waste Dump 1B to allow for the retention of Cave 18 (potential Ghost Batmaternity roost).• The Proposal avoids direct and indirect impacts to Ratty Springs.• The mine design incorporates 100 m mining restriction zones from Ghost Bat caves 6, 16, 17and 18 to avoid direct disturbance, minimise the impact of blasting and associated vibrationon the structure and quality of roosts and protect the integrity of the habitat values of thesecaves.Minimise• Clearing of high value vertebrate fauna habitat will be restricted to these areas:• up to 290 ha Gorge/Gully;• up to 45 ha Breakaway; and• up to 7 ha Riverine.• Mining restriction zones retain high and moderate value habitat within the DevelopmentEnvelope.• Intact high, moderate and low value habitat will remain within and around the DevelopmentEnvelope.• Mining restriction zones with a 100 m radius will be established around Ghost Bat caves inproximity to the conceptual footprint (being Caves 6, 16, 17 and 18) to avoid direct impacts tothe species. No blasting will occur in these zones.• Proponent will implement a Blast Management Plan for Ghost Bat Caves 6, 16, 17 and 18 toensure to ensure the structural integrity of the caves is maintained.• Surplus groundwater will be utilised on-site for mine operations and processing, wherepracticable. Use of dewatering for operational water supply will minimise the need foradditional groundwater abstraction from water supply borefields.• Discharge of surplus dewatering water to surface water systems will be minimised (to reducerisk of alterations in Riverine/ Drainage Line habitat) as discharge to dis-used pits will beutilised where practicable.• The Proponent will undertake feral animal control within the Development Envelope.• The Proponent will avoid the use of barbed wire fencing within the Development Envelope asfar as practicable, noting the requirement for pastoralists, whose leases intersect theDevelopment Envelope, to use barbed wire in stock fences. Where the use of barbed wirefencing is legislated, the top strand will be replaced with single strand wire and reflectors willbe installed to deter bat interaction.• The Proponent will implement the following management measures:• speed limits will reduce risk to fauna;• undertake progressive clearing to allow fauna to migrate away from clearing activities ormachinery movements;• weeds will be managed during operations in accordance with the Iron Ore (WA) PilbaraWeed Management Strategy including key actions such as periodic spraying andequipment hygiene;• dust suppression to minimise disturbance to fauna habitats;• locate and construct water sources, domestic waste facilities, administration facilities andcamps to minimise fauna (and feral animal) access;• lighting in mining areas will be directed inwards towards mining activities to minimise lightoverspill; and• awareness training to identify conservation significant fauna and habitat, relevantmanagement measures, personnel/contractor responsibilities, and incident reportingrequirements (i.e. reporting of fauna observations and/or incidents).Rehabilitation• The Closure Plans includes objectives to ensure that vegetation on rehabilitated land is selfsustaining and compatible with the post closure land use, and final landforms are stable andconsider ecological and hydrological factors. Rehabilitation will be undertaken progressivelyto minimise the presence of disturbed areas.• Habitat elements considered part of the rehabilitation design include, amongst others:• vegetation known to provide food or shelter;• retaining and replacing woody debris;• retention of leaf litter using small-scale topography; and• introducing in-situ rock features.• Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore RehabilitationHandbook and will involve fauna and habitat monitoring.• Weeds will be managed during closure as part of the rehabilitation process.  |
| Assessment and significance of residual impacts Significant residual impactThe Proponent considers the following residual impacts are significant for significant terrestrialfauna, particularly MNES (Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara OlivePython), and may require offsets:• Clearing of 342 ha of high value habitat including 290 ha of Gorge/Gully, 45 ha of Breakawayand 7 ha of Riverine habitats.• Removal of two confirmed diurnal roosts, two potential diurnal roosts and one nocturnalforaging cave for Ghost Bat.Any removal of roost caves is considered significant under the Conservation Advice, however thesecaves were not identified as priorities for protection by Bat Call (2020a) and therefore, their removalis not expected to result in a decline in the local population.The Proponent proposes an environmental offset for the clearing of high value fauna habitat |
| Likely environmental outcomes |
|  |
| Offsets |
| Offset’s objective |
| Residual Environmental Impacts Significance:Value : grey falcon* Extent:70
* Offset levelRequires offset
* Explanation

Value : Aboriginal Heritage Site or Place:RATTY SPRINGS/GARDAGARLI.* Extent:0
* Offset levelRequires offset
* Explanation

Value : a camaenid land snail (Ninety Seven Mile Creek)* Extent:5
* Offset levelRequires offset
* Explanation

Value : Aluta quadrata* Extent:15
* Offset levelRequires offset
* Explanation

Significant residual impact on threatened speicesValue : Pannikin Plain Cave isopod* Extent:0
* Offset levelRequires offset
* Explanation
 |
| Offsets policy and guidance  |
| Consideration of the Environmental Offsets Principles:1. Environmental offsets will only be considered after avoidance and mitigation options have been pursued.
2. Environmental offsets are not appropriate for all projects.
3. Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted.
4. Environmental offsets will be based on sound environmental information and knowledge.
5. Environmental offsets will be applied within a framework of adaptive management.
6. Environmental offsets will be focused on longer term strategic outcomes.
 |
| Use of the Pilbara Environmental Offsets Fund (yes/no)  |
| Offsets Summary  |
| Matters of National Environmental Significance |
| MNES value : * Conservation status

 True* Receiving and existing environment

Several fauna investigations, including a targeted survey to assess the presence of MNES have beenundertaken within the Development Envelope. A summary of existing environmental values relating toMNES identified within the Development Envelope is provided in Section 10.6. A targeted survey has been undertaken by Astron (2018e) for species at Eastern Range using motionsensing cameras in suitable microhabitats in Gorge habitats within the Development Envelope.Subsequent investigations for potential suitable habitat for Northern Quoll have been undertaken byAstron (2018c, d) to ascertain its presence in the remaining areas of the Development Envelope. Thesurvey at Eastern Range was undertaken during the time of year that Northern Quolls in the Pilbara aremost active (Astron 2018e). The survey effort for Northern Quoll covers the entire DevelopmentEnvelope and results from baseline investigations are accurate in terms of the size and temporalpresence and abundance of the local Northern Quoll population.* Range and habitat preference

The Northern Quoll (Dasyurus hallucatus) is listed as Endangered under Schedule 2 of the BC Act andEndangered under the EPBC Act.The species was originally found across northern Australia from the North-West Cape of WA to southeast Queensland; however, its abundance has significantly declined in recent years. The Northern Quollis now restricted to five regional populations across Queensland, the Northern Territory and WesternAustralia on both the mainland and offshore islands (Rio Tinto 2018a). This species occurs in a varietyof habitats but is commonly found in open lowland savannah forest and rocky escarpments. Rockyareas are particularly important for Northern Quolls in the Pilbara as these areas retain water andprovide a diversity of microhabitats (Astron 2018c). These areas also tend to have greater floristicdiversity and productivity resulting in greater prey density compared to non-rocky areas. These rockyareas also provide refuge from feral cats, fire and livestock and provide breeding potential(Astron 2018c)* Likelihood of occurrence

936500000* Reason for likelihood of occurrence

Present.Recorded at eight locations in the DevelopmentEnvelope; six locations at Western Range (four scatsand two motion sensitive camera records) and twoscats at Paraburdoo (Astron 2018c, d). All eightrecords were in the Breakaway and Gorge/Gullyhabitats within the Development Envelope.A Northern Quoll footprint was previously recordedat Eastern Range in 2010, with a track identified in acave within Gorge habitat close to the EasternRange mining operations (Astron 2018c).* Habitat suitability for MNES

The EPBC Act Referral Guideline for the Endangered Northern Quoll (DoE 2016) (Northern QuollReferral Guideline) defines critical habitat for Northern Quoll as habitat within the modelled distributionfor the species which provides shelter for breeding, refuge from fire and/or predation by cane toad. Thisincludes:• offshore islands where Northern Quoll is known to exist;• rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields and majordrainage lines or treed creeks; and• structurally diverse woodland or forest areas containing large diameter trees, termite mounds orhollow logs.Habitat that is critical to the survival of this species also includes dispersal and foraging habitatassociated with or connecting populations that are important to the long-term survival of the species(DoE 2016). As the population of Northern Quoll in the Development Envelope is low density and doesnot meet the definition of an important population, the foraging habitat in the Development Envelope isnot defined as critical habitat. Critical habitat in the Development Envelope for Northern Quoll is limitedto rocky habitats which include Breakaways and Gorge/Gully habitat where records and potentialdenning habitat for Northern Quoll exist. The Northern Quoll Rocky habitats adjoining drainage lineshave a heightened level of importance given the proximity of denning habitat to foraging areas (RioTinto 2018a).A large area of habitat for this species is protected within Karijini National Park, approximately 32 kmeast northeast of the Development Envelope.Up to 921 ha of the Development Envelope provides high value (critical) denning and foraging habitatfor the Northern Quoll (Astron (2018c, d), including:• Gorge/Gully – 629 ha of shelter (denning) and foraging habitat (critical habitat); and• Breakaway – 291 ha of shelter (denning) and foraging habitat (critical habitat)A further 131 ha of Riverine, 4,516 ha of Rocky Hill and 740 ha of Drainage Line moderate valueforaging and dispersal habitats are present within the Development Envelope. This does not representcritical habitat for the species. * Relevant impacts

High value potential shelter and foraging habitat(Gorge/Gully, Breakaway)921 335 37Moderate value foraging and dispersal habitat (Riverine,Drainage Line, Rocky Hill)5,387 1,077 20  Injury and mortality of MNES may result from both direct and indirect impacts from the Proposed Action.Fauna may be directly impacted from construction, operation and closure activities which have thepotential to decrease local fauna abundance, particularly species which are attracted to roads forbasking or foraging activities. This includes:• fauna being injured/killed by collisions with earthmoving equipment and/or vehicles duringconstruction works or operation; and• injury or mortality as a result of entanglement in fencing, especially to Ghost Bat and Pilbara Leafnosed Bat.Interaction with vehicles and fencing has the potential to reduce the local abundance of fauna,particularly if habitats are in proximity to activity or infrastructure. Groundwater drawdown resulting from increased dewatering in the 4EE pit at Paraburdoo has thepotential to impact riparian vegetation within Riverine habitat areas of Seven Mile Creek; specifically,the area to the north of the low permeability Mount McRae Shale/Mount Sylvia Formation, where thecreek intersects the Paraburdoo Range. This stretch of riparian vegetation is degraded but provideshigh value habitat for Pilbara Olive Python and may be used by a number of species for both foragingand dispersal. Groundwater abstraction has the potential to affect GDE’s over an area of up toapproximately 27 ha area and reduce canopy cover of phreatophytic species and potentially reduce theabundance of understorey vegetation along Seven Mile Creek. This may in turn impact foraging anddispersal habitat for MNES in the Development Envelope.There will be minor dewatering required at Western Range, however there are no shallow watertablesthat support GDE's in this area. Mining at Eastern Range is AWT. Therefore, there is no potentialchange to habitat values associated with groundwater abstraction outside of the Paraburdoo miningarea.Surplus water discharge to Riverine and Drainage Line fauna habitat may be required at Six Mile Creek,Pirraburdu Creek and the existing Joe’s Crossing discharge location at Seven Mile Creek (refer toSection 8). Surface water discharge may result in increased vegetative cover within the creekline thatmay experience flow during natural no flow conditions. The area of flow will be managed to be limitedto the extent of the Development Envelope. Increased vegetation cover may provide increased shelterand foraging habitat for fauna.Habitat fragmentation and barriers to fauna movementFragmentation, the process by which contiguous areas of habitat are interrupted and/or separated intotwo or more smaller areas, can result in the following impacts to MNES:• altered movement patterns and/or reduced ability to disperse;• genetic isolation; and• increased competition for resources.The Proposed Action extends along the east-west Paraburdoo Range, with the greatest potential forhabitat fragmentation occurring in the Western Range area where disturbance of the range will result infragmentation of habitat in a north-south direction. Habitat connectivity will be largely maintained in aneast-west direction to the north of Western Range. Additionally, north-south habitat connectivity will bemaintained along the major creeklines in the Development Envelope which will not be directly impactedbeyond the construction of essential infrastructure and crossings at Seven Mile Creek and PirraburduCreek connecting Paraburdoo and Western Range. These linkages facilitate the connection of foraginghabitats for MNES and enable dispersal and connection between individuals and populations of MNES.Habitat degradation associated with construction activity and/or increased human activity,including transmission of weeds, dust and increased abundance of introduced fauna speciesConstruction activity and vehicle movements have the potential to increase dust and spread weeds.However, these risks will be effectively managed by the Proponent and are not expected to affect habitatvalues.Vegetation clearing can increase access of feral predators to fauna habitats, resulting in increasedpredation causing injury or mortality, impacting local populations of fauna. Feral cat control is notcurrently undertaken within the Development Envelope. However, the Proponent will undertake feralanimal control within the Development Envelope.Greater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 310Disturbance from light, noise and/or vibration, and possible displacement of fauna associatedwith construction activity and mining operations.Light, noise and vibration emissions during mine construction and operations have the potential toimpact MNES in proximity to these activities.The Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat and Ghost Bat utilise caves andshelters in Breakaways and Gully/Gorge habitats for denning and shelter or roosting. The Proposal willinvolve open cut mining by conventional drill and blast techniques. This has the potential to result invibration disturbance to major Gorge/Gully habitat adjacent to mining operations which providespotential denning and roosting habitat for MNES recorded in the Development Envelope. Blastvibrations may also result in damage to the structural integrity of bat roosts.Noise and vibration from clearing, construction and blasting may disturb MNES and cause individualsto temporarily or permanently vacate shelters and diurnal/maternal roosts. If these disturbances occurduring the breeding season or while pups remain in the roost, the breeding cycle of the local batpopulation may be impacted.Research and anecdotal evidence indicate the potential for artificial lighting to influence the behaviourof both nocturnal and diurnal species (Gaston & Bennie 2014). Increased night time light emissionswithin the Development Envelope may attract invertebrate species and in turn, alter nocturnal foragingbehaviour of MNES.* Assessment of impacts against criteria

Direct impactsLoss of fauna habitatThe Development Envelope includes denning habitats which satisfy the definition of critical habitat inaccordance with the Northern Quoll Referral Guideline (DoE 2016), including rocky habitats such asBreakaways and Gorges/Gullies. This habitat within the Development Envelope does not support ahigh-density important population of the species, as demonstrated by limited recorded captures; despiteappropriate survey effort in areas of suitable, good quality habitat within the Development Envelope. Asevidenced by the location of records, the local Northern Quoll population appears to have a strongassociation with the Breakaway and Gorge/Gully habitat. This is consistent with records across thePilbara.The Northern Quoll has been recorded at eight locations in the Development Envelope, six records fromthe Western Range and two in the balance of the Development Envelope (Astron 2018c, d). No NorthernQuoll dens were recorded in the Development Envelope (Astron 2018c, d). Northern Quoll are commonin the Robe Valley, approximately 192 km northwest from the Development Envelope, with 906 recordsin that location. Northern Quoll have also been recorded in historical mining areas in this region,particularly where mesa escarpments are largely intact (Rio Tinto 2018a). In contrast to the RobeValley, the population of Northern Quoll in the Development Envelope is expected to be relatively smalland be classified as a ‘low density’ population in accordance with Northern Quoll Referral Guideline(DoE 2016), based on the low number of observations and historical records in the DevelopmentEnvelope.Breakaway and Gorge/Gully habitats are rated as being of high importance, or critical habitat, forNorthern Quoll locally and the Proposed Action has been designed to largely avoid these habitats.Vegetation clearing in the Development Envelope will result in the direct loss of up to 335 ha ofBreakaway and Gorge/Gully habitat, which represents 36.4% of the available critical habitat for NorthernGreater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 311Quoll within the Development Envelope. A further 1,077 ha of moderate value foraging and dispersalhabitat will be removed; however, these habitats are common and widespread in the Pilbara region anddo not represent critical habitat for the species and their removal is not expected to be characterised asa significant residual impact. The balance of clearing will occur in Stony Plain and Low Hill habitats,widespread and of low value to Northern Quoll, as such there will be no significant residual impact onthis species in these areas.The direct loss of up to 335 ha of Breakaway and Gorge/Gully critical habitat for Northern Quoll withinthe Development Envelope represents a locally significant impact and is proposed to be offset (refer toSection 12).Loss of fauna individualsNorthern Quoll may be vulnerable to injury or mortality from vehicle and machinery movements,particularly when foraging nocturnally. Given the local population is expected to be low, the potentialfor injury or mortality is also expected to be very low. To avoid and minimise the potential for interactionwith vehicle and machinery movements, most construction activities for the Proposed Action will occurduring daylight hours, reducing the risk of encounters with Northern Quoll during the construction phase.While vehicle movements will increase temporarily during the construction period and roads will expandinto the proposed new mining areas, overall vehicle movements during the operational phase will notincrease from the existing number and/or frequency of vehicle movements associated with the existingoperation.The Proponent will implement the following measures to mitigate potential indirect impacts to NorthernQuoll:• progressive clearing to allow fauna to migrate away from clearing activities or machinerymovements;• all relevant personnel to undergo training to identify Northern Quolls and their habitat, relevantmanagement measures, personnel/contractor responsibilities, and incident reporting requirements(i.e. reporting of fauna observations and/or incidents); and• progressive rehabilitation of cleared areas no longer required for operational purposes.On this basis, vehicle and machinery movements for the Proposed Action are not expected to result insignificant impacts to Northern Quoll and will not result in a change to the conservation status of thisspecies.Indirect impactsDegradation/alteration of habitat as a result of altered hydrological regimesGroundwater drawdown and surface water discharge have the potential to affect Riverine and DrainageLine habitat. As Riverine and Drainage Line habitat is not considered high value for the Northern Quoll,any change in habitat value as a result of altered hydrological regimes is not expected to have asignificant impact on the species. In addition, there is no potential for impacts to riparian/GDE vegetationat Western Range where the majority of the Northern Quolls have been recorded.Habitat fragmentation and barriers to fauna movementExtensive tracts of intact Northern Quoll habitat will remain around the Proposed Action in theDevelopment Envelope. A total of approximately 4,896 ha (77.6%) of high and moderate value habitatfor shelter/denning, foraging and dispersal will remain available in the Development Envelope.Significant corridors in different landforms such as ridges, hillsides and drainage lines will remain inplace to allow movement around the mining area and through the landscape. Northern Quolls have alsobeen recorded within operational areas at Pilbara mine sites and so can disperse through these areas.Habitat fragmentation will also be mitigated through the staging of the Proposed Action to ensure areasproposed to be cleared will not all be disturbed at once. Progressive rehabilitation of areas no longerGreater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 312required for mine operation will also occur to minimise the presence of disturbed areas. As such, habitatfragmentation caused by the Proposed Action is not expected to result in significant overall effects onNorthern Quoll habitat or movement.Habitat degradation associated with construction activity and/or increased human activity, includingtransmission of weeds, dust, and increased abundance of introduced fauna speciesThe invasion of introduced grasses such as Gamba Grass (Andropogon gayanus) and other weeds arerecognised threats to Northern Quoll as they out-compete native grasses. Gamba Grass has not beenrecorded in the Development Envelope. The Proponent will undertake weed control in areas of retainednative vegetation close to disturbance such as roads, tracks and infrastructure. In addition, vehicle andmachinery movements will be restricted to roads and access pathways within the conceptual footprintto avoid spread or introduction of weeds. Weed management is outlined in Section 5.5.2.The Pilbara region is naturally dusty, and the Proposed Action is located in and near an existingoperational mine. A study examining the impacts of dust on plant health in semi-arid environmentsfound no evidence dust deposition up to 77 g/m2/month results in detrimental effects (Matsuki etal. 2016). Any decline in vegetation health, and hence Northern Quoll foraging habitat, due to dustdeposition is expected to be limited to areas immediately adjacent to the active mining operations.Potential impacts to vegetation from dust emissions may occur in only a small proportion of the availableNorthern Quoll foraging habitat adjacent to mine operations, and naturally occurring high dust eventsare possible at exposed locations at dry and windy times of the year. Continued implementation ofexisting dust suppression strategies to avoid prolonged dust emissions and dust cover on adjacentvegetation is expected to result in a low likelihood of Northern Quoll being adversely affected by dust.The cane toad is the invasive species which poses the greatest threat to Northern Quoll but is notcurrently established in the Pilbara. The Proposed Action will not increase the potential for cane toadsto become established in the Development Envelope and the Proponent will undertake feral animalcontrol within the Development Envelope.After the application of mitigation measures, no significant impacts on Northern Quolls are expectedfrom the habitat degradation from dust emissions and/or the introduction or spread of weeds into faunahabitat.Disturbance from light, noise and/or vibration, and possible displacement of fauna associated withconstruction activity and mining operations.The indirect impacts of noise and vibration emissions are not expected to impact Northern Quoll. A lowdensity population of Northern Quoll exists in the Development Envelope despite noise and vibrationfrom current mining operations within Paraburdoo. No dens have been identified in the DevelopmentEnvelope and therefore, vibrations from mining operations will not significantly alter the number orquality of available shelters. The sporadic and brief nature of blasting also means that blasting relatedvibrations are not expected to interfere with the Northern Quoll’s foraging or breeding behaviour. Assuch, it is not expected that noise and vibrations from the Proposed Action will result in a significantimpact to the species.Light emissions from the Proposed Action are not expected to significantly alter nocturnal foragingactivities as light emissions are already present in the current operational mining area at Paraburdoo.Additional light emissions from the Proposed Action is not expected to significantly impact NorthernQuoll denning or foraging behaviour as:• lighting in the mining area will be directed into the pit, away from Northern Quoll potential denningformations in Breakaway and Gorge/Gully habitat; and• lighting will be installed only where required, that is, mainly in-pit and operational areas.No significant impacts on Northern Quolls are expected from light, noise and/or vibration.Greater Paraburdoo Iron Ore Hub Proposal Assessment No: 2189 EPBC 2018/8341Environmental Review Document 313Significance of direct and indirect impacts to Northern QuollAn assessment of the Proposed Action on Northern Quoll is detailed in Table 10-8, with reference to theSignificant Impact Guidelines (DoE 2013).* Safeguards and mitigations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| potential impact | avoidance | minimisation | rehab | residual impact |
| removal of habitat | The conceptual footprint has been modified wherepracticable to avoid impacts to high value faunahabitat and cave systems. Including:• Modification of the 36W pit crest to provide anadequate stand-off for the protection of Cave 6(potential Ghost Bat maternity roost); and• Modification of Waste Dump 1B to allow for theretention of Cave 18 (potential Ghost Batmaternity roost).The Proposal avoids direct and indirect impacts toRatty Springs as well as high value Riverine andDrainage Line Pilbara Leaf-nosed Bat foraginghabitat at Ratty Springs and in Pirraburdu Creek.The Proposed Action has avoided direct impacts to13 recorded confirmed and potentialdiurnal/maternity roosts for the Ghost Bat andavoided the only known Pilbara Leaf-nosed Batroost at Ratty Springs.The mine design incorporates 100 m miningrestriction zones from Ghost Bat caves 6, 16, 17and 18 to avoid direct disturbance, minimise theimpact of blasting and associated vibration on thestructure and quality of roosts and protect | Clearing of high value habitat will be restricted to the areas identifiedin the residual impact column.Mining restriction zones retain high and moderate value habitatwithin the Development Envelope.Mining restriction zones have been delineated to minimise indirectdisturbance (dust and noise) to significant caves for Ghost Bat andPilbara Leaf-nosed Bat.A Blast Management Plan will be implemented to manage vibrationfrom blasting to ensure the structural integrity of significant caves ismaintained throughout the life of the mining operation.The Proponent proposes that the Proposed Action approvalDecision Notice will include the requirement to prepare andimplement an EMP (in accordance with the State approval) tomitigate impacts to listed threatened species. | The Closure Plans includes, amongstothers, objectives to ensure thatvegetation on rehabilitated land is selfsustaining and compatible with thepost-closure land use, and finallandforms are stable and considerecological and hydrological factors.Habitat elements considered part ofthe rehabilitation design include,amongst others:• vegetation known to provide foodor shelter;• retaining and replacing woodydebris;• retention of leaf litter using smallscale topography; and• introducing in-situ rock features.Rehabilitation will be conducted inaccordance with the Rio Tinto Iron OreRehabilitation Handbook and willinclude fauna and habitat monitoring. | Residual impacts from the Proposed Action include:• clearing up to 342 ha of high value and 1,070 ha of moderatevalue MNES habitat;• clearing of low value MNES Stony Plain and Low Hill habitatscomprising 2,895 ha.Significant impacts that require offsets comprise of the following:• removal of up to 342 ha of high value Pilbara Olive Pythonhabitat;• removal of up to 335 ha of high value habitat for Northern Quoll,Ghost Bat and Pilbara Leaf-nose Bat;• removal of two confirmed diurnal roosts (Caves 1 and 4), twopotential diurnal caves (Caves 3 and 13) and one nocturnal cave(Cave 5).Low and moderate value habitat types in the Development Envelopeare common and widespread; the local loss of these habitats isconsidered of low importance with regard to MNES ongoing viabilityin the Pilbara region.The proposed offset for the significant residual impact is discussedin Section 12. |
| Loss of, or injury to,individuals as a result ofvehicle and machinerymovement or interactionswith infrastructure. | Mining restriction zones with a 100 m radius will beestablished around Ghost Bat caves in proximity tothe conceptual footprint (being Caves 6, 16, 17 and18) to avoid direct impacts to the species. | The Proponent will avoid the use of barbed wire fencing, as far aspracticable, noting the requirement for pastoralists, whose leasesintersect the Development Envelope, to use barbed wire in stockfences. Where barbed wire fencing is required for legislativecompliance, reflectors will be attached to make fencing more visibleand to reduce the risk of fauna injury or mortality due toentanglement with fencing.The Proponent will implement the following managementmeasures:• progressive clearing and progressive rehabilitation of disturbedareas to allow fauna to migrate away from clearing activities ormachinery movements;• implement vehicle speed limits on all access roads;• roadkill will be removed from trafficable areas; and• awareness training to identify conservation significant faunaand habitat, relevant management measures,personnel/contractor responsibilities, and incident reportingrequirements (i.e. reporting of fauna observations and/orincidents).The Proponent proposes that the Proposed Action approvalDecision Notice will include the requirement to prepare andimplement an EMP (in accordance with the State approval) tomitigate impacts to listed threatened species. | The Proponent will implement ClosurePlans which include a closureobjective to ensure that the finallandform is stable and considersecological and hydrological factors. | Given high value habitat has been avoided as much as is practicable(most impact is in low or moderate value habitat), the potential forloss of individuals has been minimised and; therefore, the Proponentexpects no significant residual impact. |

     The relevant plans and guidance documents for Northern Quoll are:• EPBC Act Referral Guideline for the Endangered Northern Quoll Dasyurus hallucatus (DoE 2016);• Commonwealth Listing Advice on Northern Quoll (Dasyurus hallucatus) (TSSC 2005);• National Recovery Plan for the Northern Quoll Dasyurus hallucatus (Hill & Ward 2010);• Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by canetoads (DSEWPaC 2011c);• Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listedgrasses (DSEWPaC 2012a); and• Threat abatement plan for predation by feral cats (DoE 2015a).There is no approved Conservation Advice for Northern Quoll. However, the Listed AdviceCommonwealth Listing Advice on Northern Quoll (Dasyurus hallucatus) (TSSC 2005) lists priorityrecovery and threat abatement actions required for the Northern Quoll:• minimise the impact of colonising cane toads on the species by:• investigating the use of physical barriers or other means, where feasible, to prevent thecolonisation of key habitat areas;• undertaking translocation and management of Northern Quoll populations in safe havenswhere necessary;• identify areas of critical habitat (e.g. island populations);• investigate the need to establish a captive breeding program for the species; and• investigate the status of the species in Queensland, including the reasons for its survivalfollowing cane toad invasion.The EPBC Act Referral Guideline for the Endangered Northern Quoll (DoE 2016) provides an outline ofthe requirements for Proponents on habitat quality, habitats critical to the survival of the species,populations important for the species long-term survival, survey expectations, standards for mitigatingimpacts and significant impacts. These referral guidelines were used to guide the assessment of thepotential impacts from the Proposed Action to the Northern Quoll and development of appropriatemitigations. Consistent with the EPBC Act Referral Guideline for the Endangered Northern Quoll(DoE 2016), the Proponent has:• assessed the Northern Quoll habitat values and potential for populations within the DevelopmentEnvelope using survey’s consistent with the use of the recommended detection technique (remoteactivated cameras and scat searches) in this guideline;used the information provided in the baseline and targeted investigations to identify and avoidclearing habitat critical to the Northern Quoll within the Development Envelope;• maintained dispersal opportunities within the Development Envelope for populations important forthe long-term survival of the Northern Quoll;• developed measures to avoid and or minimise both direct and indirect mortality to the NorthernQuoll population; and• developed adaptive management measures to control impacts from fire, pastoralism, and invasivespecies, particularly feral cats and weeds.The National Recovery Plan for the Northern Quoll (Dasyurus hallucatus) (Hill & Ward 2010). Thisrecovery plan aims to minimise the rate of decline of the Northern Quoll in Australia and ensure thatviable populations remain in each of the major regions of distribution into the future. The ProposedAction aligns with the objective of this Recovery Plan (refer to Table 10-13).

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| --- | --- | --- |
| objective | actions | proposed action assessment |
| Protect NorthernQuoll populationson offshore islandsfrom invasion andestablishment ofcane toads, cats andother potentialinvasive species | 1.1 Maintain biosecurity of important offshore islandsthrough quarantine measures on the mainland. | The Proposed Action does notinvolve transfers to offshoreislands. As such, theseactions do not apply to theGreater Paraburdoo Hub. |
| 1.2 Monitor offshore islands supporting quollpopulations to detect the presence of cane toads, catsand any other potential invasive predator. |  |  |
| 1.3 Develop and where required implement a strategyfor rapid-response control of cane toad or catoutbreaks on offshore islands occupied by NorthernQuolls. |  |  |
| Foster the recoveryof Northern Quollsubpopulations inareas where thespecies hassurvived alongsidecane toads | 2.1 Determine which factors affect survival andrecovery of Northern Quolls in areas with cane toad. | The Proponent has completedbaseline investigations,including a targeted survey forthe Northern Quoll to identifypotential refuge habitats withinthe Development Envelope. |

  * Summary

A number of factors are considered to be threatening the survival of the species:• inappropriate fire regimes;• predation following fire; and• lethal toxic ingestion of cane toad toxin.The Cane toad (Bufo marinus) is yet to establish in the Pilbara and is not expected to be introduced bythe Proposed Action; as such the actions documented in the Threat abatement plan for the biologicaleffects, including lethal toxic ingestion, caused by cane toads (DSEWPaC 2011c) are not relevant to theProposed Action as they relate to research and identification of cane toad impacts.The five listed grasses in the Threat abatement plan to reduce the impacts on northern Australia'sbiodiversity by the five listed grasses (DSEWPaC 2012a) are:• gamba grass (Andropogon gayanus);• para grass (Urochloa mutica);• olive hymenachne (Hymenachne amplexicaulis);• mission grass (Pennisetum polystachion); and• annual mission grass (Pennisetum pedicellatum).None of these introduced taxa were identified to occur within or in the vicinity of the DevelopmentEnvelope during database searches or recorded during the flora and vegetation assessments(Astron 2018a, b). As such the actions documented within this threat abatement plan are not relevantto the Proposed Action, with the exception that the Proponent is committed to minimising/preventing thespread/introduction of weed species to the Development Envelope. The Proponent will implementground disturbance, flora management, and weed hygiene procedures as part of the EMP duringconstruction and operation of the Greater Paraburdoo Hub to ensure weeds are controlled as far aspracticable. The flora management procedure will also include regular and targeted weed control (e.g.by spraying, physical removal) as appropriate.Cats have been recorded within the Development Envelope. Mine sites have the potential toattract/increase the abundance of introduced fauna due to the provision of additional resources (foodscraps, water, shelter), and as such, the Proponent will record all introduced fauna sightings and willundertake feral animal control within the Development Envelope. As such, the Proposed Action willalign with the Threat abatement plan for predation by feral cats (DoE 2015a).The proposed action is not expected to interfere with the recovery of the Northern Quoll given:• the on-ground management within the Development Envelope; and• the extensive areas of potential foraging and breeding habitat close to the Proposed Action area asillustrated in Figure 10-1.The Proposed Action is expected to be consistent with the recovery plan, in particular the protection andmanagement of suitable habitat within the Development Envelope. |
| Policy and Guidance :  |
| Objects and Principles of the EP Act  |
| EP Act Object |
| Consideration of the Principles of the EP Act:1. The precautionary principle
2. The principle of intergenerational equity
3. Principles relating to improved valuation, pricing, and incentive mechanisms
4. The principle of the conservation of biological diversity and ecological integrity
5. The principle of waste minimisation
 |
| Environmental Conclusion |
| Holistic impact assessment  |
| Cumulative environmental impact assessment  |
| Conclusion |
| Supporting documents |
| Attachments* Alternative Footprint
* Alternative Envelope
* Boundary
* A5\_3 Western Range Closure Plan (Rio Tinto 2019e).pdf
* A5\_2 Paraburdoo Closure Plan (Rio Tinto 2019d).pdf
* A5\_1 Eastern Range Closure Plan (Rio Tinto 2019c) Part 2.pdf
* A5\_1 Eastern Range Closure Plan (Rio Tinto 2019c) Part 1.pdf
* Greater Paraburdoo Hub Environmental Review Document Part 1.pdf
* A5\_4 GP Progressive Rehabilitation Summary (Rio Tinto 2019k).pdf
* Appendix 5-5 Mine closure plan.pdf
* UAT Shapefiles DE.zip
* UAT Shapefile DF.zip
* map (1).pdf
* map.pdf
* Managing and responding to Enquiries. (2).docx
 |
| Relevant maps |