Hamersley HMS

Environmental Review Document

Hope Downs 2 Proposal

November 2023

Assessment Number: 2316

Hamersley HMS Pty Ltd
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Disclaimer and Limitation

This document has been prepared by Hamersley HMS Pty Ltd (the Proponent), as manager of the Hope Downs Joint Venture, specifically for the Hope Downs 2 Proposal. Neither the document nor its contents may be referred to without the express approval of the Proponent unless the document has been released for referral and assessment.

Document Status						
Rev	**Author**	**Reviewer/s**	**Date**	**Approved for Issue**		
				To Whom	**GM Signature**	**Date**
1	ELA/RTIO	RTIO	Dec 2022			
2	RTIO	RTIO	May 2023	EPA Services		May 2023
3	RTIO	RTIO	August 2023	EPA Services		August 2023
4	RTIO	RTIO	November 2023	EPA Services		November 2023

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on the environmental review for this Proposal.

Hamersley HMS Pty Ltd (the Proponent) proposes to develop a new iron ore mine, Hope Downs 2 (HD2) (the Proposal), immediately south of its existing Hope Downs 1 and Baby Hope projects, located 80 km northwest of the township of Newman in the Pilbara region of Western Australia. The Proposal centres around the development, operation and closure of two above water table (AWT) iron ore deposits (Hope Downs 2 and Bedded Hilltop). Ore will be transported to Hope Downs 1 for processing and transport, using existing facilities. In addition to the mining development, the Proposal includes the realignment of approximately six kilometres (km) of the Great Northern Highway to allow access to mineral ore associated with the Hope Downs 2 deposit.

The Proposal has been referred for assessment under the (WA) *Environmental Protection Act 1986* (EP Act) through the Environmental Protection Authority (EPA), and the (Cth.) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) through the Department of Climate Change, Energy, the Environment and Water (DCCEEW). This Environmental Review Document (ERD) has been prepared in accordance with EPA guidance for the purposes of reporting on the potential environmental impacts of the Proposal and their proposed mitigation and will be made available for public comment.

This ERD has been prepared in accordance with the EPA's Procedures Manual (Part IV Divisions 1 and 2. The ERD is the report by the Proponent on their environmental review describing this proposal and its likely effects on the environment.

This ERD is available for a public review period of 2 weeks from 4 December 2023, closing on 18 December 2023.

Information on the Proposal from the public may assist the EPA in preparing its assessment report in which it will make recommendations on the Proposal to the Minister for Environment.

Why write a submission?

The EPA seeks information that will inform its consideration of the likely effects of the Proposal, if implemented, on the environment. This may include relevant new information that is not in the ERD, such as alternative courses of action or approaches.

In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the Proponent's responses and other relevant information.

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*.

Why not join a group?

It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people), please indicate the names of all participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, information in the ERD.

When making comments on specific elements of the ERD:

- Clearly state your point of view and give reasons for your conclusions
- Reference the source of your information, where applicable

- Suggest alternatives to improve environmental outcomes.

What to include in your submission

Include the following in your submission to make it easier for the EPA to consider your submission:

- Your name and address
- Date of your submission
- Whether you want your contact details to be confidential
- Summary of your submission, if it is long
- A list of points so that issues raised are clear, preferably by environmental factor
- Refer each point to the page, section and if possible, paragraph of the ERD
- Attach any reference material, if applicable. Make sure your information is accurate.

The closing date for public submissions is: 18 December 2023.

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at https://consultation.epa.wa.gov.au .

Alternatively, submissions can be:

- Posted to: Chairman, Environmental Protection Authority, Locked Bag 10, Joondalup DC WA 6919; or
- Delivered to: Environmental Protection Authority, Prime House, 8 Davidson Terrace, Joondalup WA 6027.

If you have any questions on how to make a submission, please contact EPA Services at the Department of Water and Environmental Regulation on (08) 6364 7000.

SCOPING CHECKLIST

Task No.	Required Work	Section and Page No.
Flora and Vegetation		
1	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model and WA Environmental Offsets Guidelines (2014, or any subsequent revisions). Where significant residual impacts remain, propose an appropriate draft offsets package with due consideration to the WA Environmental Offsets Policy and Guidelines (or any subsequent revisions).	Section 12.3, pg 436
2	Where a contribution to the Pilbara Environmental Offsets Fund is proposed to offset the significant residual impacts, provide an impact reconciliation procedure prepared in accordance with the Instructions on how to prepare *Environmental Protection Act 1986 Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports* and the *Template for Environmental Protection Act 1986 Part IV Reconciliation Procedures* (or any subsequent revisions).	Appendix G2
Terrestrial Fauna		
1	Prepare an Environmental Management Plan, in accordance with the requirements of EPA *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (2020 or any subsequent revisions), that describes any proposed management and/or monitoring plans that will be implemented pre- and post-construction to ensure residual impacts (direct and indirect) are not greater than predicted. Where a buffer zone is proposed, discussion should include an evaluation of the appropriateness of the proposed buffer in terms of the size of the buffer and the relevant characteristics of the buffer area as it relates to significant species.	Appendix A7
2	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model and WA Environmental Offsets Guidelines (2014, or any subsequent revisions). Where significant residual impacts remain, propose an appropriate draft offsets package with due consideration to the WA Environmental Offsets Policy and Guidelines (or any subsequent revisions).	Section 12.3, pg 436
3	Where a contribution to the Pilbara Environmental Offsets Fund is proposed to offset the significant residual impacts, provide an impact reconciliation procedure prepared in accordance with the Instructions on how to prepare *Environmental Protection Act 1986* Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports and the Template for *Environmental Protection Act 1986* Part IV Reconciliation Procedures (or any subsequent revisions).	Appendix G2
4	Where significant residual impacts to MNES remain and contributions to the Pilbara Environmental Offsets Fund are not proposed, include a discussion of the consideration of the *EPBC Environmental Offsets Policy*.	N/A
Subterranean Fauna		
1	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model and WA Environmental Offsets Guidelines (2014, or any subsequent revisions). Where significant residual impacts remain, propose an appropriate draft offsets package with due consideration to the WA Environmental Offsets Policy and Guidelines (or any subsequent revisions).	Section 12.3, pg 436

Task No.	Required Work	Section and Page No.
2	A consolidated report of the surveys undertaken including the integrated results of the surveys (one consolidated report for stygofauna and another for troglofauna). If previous surveys are relied on for context, justification will be provided to demonstrate they are relevant and consistent with EPA guidance.	Appendix D1 and Appendix D2
3	Provide 2D habitat modelling.	Figure 8-3 and Figure 8-4
4	If new/alternative habitat modelling techniques are used, a peer review will be undertaken and provided.	N/A
Inland Waters		
1	Provide a detailed description of the design and location of the Proposal as it relates to potential impacts to surface or groundwater.	Section 9.3, pg 270 and Section 9.4, pg 298
2	Provide an assessment of water supply options (including water sources external to the Proposal) to determine suitability of options.	Section 2.1.3, pg 9 and Section 9.3.6, pg 294
3	Provide a hydrogeological assessment for the Proposal (including groundwater modelling) to assess potential impacts to groundwater dependent ecosystems, including Ben's Oasis.	Section 9.3.5, pg 282
Social Surroundings		
1	Provide evidence and details of consultation with relevant stakeholders, including outcomes of those consultation. Demonstrate how issues raised through consultation have been addressed and specify how the Proponent will minimise impacts to social, cultural and heritage values within and directly adjacent to the Development Envelope.	Appendix F2 and Appendix F3 Section 11.5, pg 373
2	Prepare a draft Social, Cultural and Heritage Management Plan (SCHMP) for each Traditional Owner group, in consultation with each group, where potential significant impacts to cultural social values related to the environment require management. The SCHMP is to describe the social, cultural and heritage values within the relevant country and specifies the measures that will be taken to avoid and minimise impacts to social, cultural and heritage values on that land during the implementation of the Proposal. Apply the mitigation hierarchy and discuss proposed objectives/outcomes, monitoring, management and mitigation measures where necessary to be implemented to appropriately minimise impacts to social surroundings.	Appendix F3
3	Conduct investigations, including ethnographic and archaeological surveys in consultation with the Traditional Owners, to determine the significance of potential impacts to social surroundings as a result of this Proposal.	Appendix F1
Greenhouse Gas Emissions		
1	Prepare a Greenhouse Gas Environmental Management Plan which will demonstrate: • the interim and long-term emissions reductions targets the proposal aims to achieve throughout the project • the best practice design, technology, management and reasonable practicable alternatives and measures appropriate to avoid, reduce or offset scope 1 and 2 emissions from this proposal • the partnerships and arrangements with third parties considered to reduce scope 3 emissions • how the proposal is consistent with achieving corporate emissions reduction targets • the other legal and policy instruments that require GHG emissions reductions from the proposal to meet the EPA's objectives	Appendix A6

Task No.	Required Work	Section and Page No.
Cumulative impact assessment		
1	Flora and vegetation: Describe and assess the extent of any cumulative impacts within local, regional and State contexts, as appropriate. Use the assessment to describe and quantify the potential cumulative residual impacts to identified environmental values that may occur following implementation of the Proposal after considering and applying avoidance and minimisation measures.	Section 15.2.1, pg 553
2	Vertebrate fauna: Describe and assess the cumulative impacts to terrestrial fauna and the following (but not limited to) MNES species: Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* [Pilbara Form]); Ghost Bat (*Macroderma gigas*); Pilbara Olive Python (*Liasis olivaceus barroni*); Oriental Plover (*Charadrius veredus*) and Northern Quoll (*Dasyurus hallucatus*) and the significance of associated fauna habitats.	Section 15.2.2, pg 557
3	Vertebrate fauna: Describe and quantify the extent of cumulative impacts and potential cumulative residual impacts that may occur following implementation of the Proposal after considering and applying avoidance and minimisation measures.	Section 15.2.2, pg 557
4	Subterranean fauna: Describe and quantify the extent of cumulative impacts and potential cumulative residual impacts that may occur following implementation of the Proposal after considering and applying avoidance and minimisation measures. as a result of implementation of the Proposal during both construction and operations to subterranean fauna, taking into consideration the significance of subterranean fauna and fauna habitat.	Section 15.2.3, pg 561
5	Inland waters: describe and assess potential cumulative groundwater and surface water impacts, including changes in groundwater levels, surface water flows within the relevant catchments, and potential impacts to groundwater dependent vegetation within the Weeli Wolli Spring PEC, including Ben's Oasis. Assess the nature, extent and duration of the potential impacts.	Section 15.2.4, pg 561
6	Social surroundings: describe and assess the potential cumulative impacts to social surroundings as a result of changes to the environment from the Proposal giving consideration to Traditional Owners and Pastoral Stations and their activities on the land.	Section 15.2.6, pg 564
7	Greenhouse gas: the Greenhous Gas Environmental Management Plan is to provide context and where relevant, information is provided on the entire Hope Downs 1 (including Baby Hope) and the Proposal operations, including a summary of the estimated peak, annual average and total GHG emissions from Hope Downs 1 (including Baby Hope) and the Proposal.	Appendix A6

EXECUTIVE SUMMARY

Overview

Hamersley HMS Pty Ltd (the Proponent) as manager of the Hope Down Joint Venture between Hope Downs Iron Ore Pty Ltd (a member of the Hancock Prospecting Group) and Hamersley WA Pty Ltd (a member of the Rio Tinto Group) proposes to develop a new iron ore mine, Hope Downs 2 (HD2) (the Proposal), immediately south of its existing Hope Downs 1 and Baby Hope iron ore projects (identified collectively as the 'Hope Downs 1 operations') located approximately 80 km northwest of the township of Newman in the Pilbara region of Western Australia (Figure ES-1).

The Proposal has been referred for assessment under the (WA) *Environmental Protection Act 1986* (EP Act) through the Environmental Protection Authority (EPA), and the (Cth.) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) through the Department of Climate Change, Energy, the Environment and Water (DCCEEW). This Environmental Review Document (ERD) has been prepared in accordance with EPA guidance for the purposes of reporting on the potential environmental impacts of the Proposal and their proposed mitigation and will be made available for public comment.

The Proposal centres around the development, operation and closure of two above water table (AWT) iron ore deposits (Hope Downs 2 (HD2) and Bedded Hilltop (BHT); Figure ES-2). Ore will be transported to the Hope Downs 1 operations for processing and transport, using existing facilities. In addition to the mining development, the Proposal includes the realignment of approximately six kilometres (km) of the Great Northern Highway to allow access to mineral ore associated with the HD2 deposit.

The Proposal is located on the traditional lands of the Nyiyaparli, Ngarlawangga and Banjima people, and extensive and ongoing consultation with the Traditional Owners has resulted in substantial changes to the design of the Proposal and improved social and environmental outcomes.

The Proposal is located on pastoral rangelands, with vegetation that is largely in a good to excellent condition and that contains a number of landforms that are recognised as providing habitat for conservation-significant flora and fauna, including Gorge/Gully and creeklines. The Proposal has respected these and other values to the greatest practicable extent through the application of the mitigation hierarchy (i.e., avoid, minimise, rehabilitate); however, a disturbance footprint of up to 4,900 ha is required for the project, with a significant proportion of this disturbance to be rehabilitated to support native vegetation at the end of the Proposal's 15-year life.

A general proposal description is provided in Table ES-1, and the key proposal elements are provided in Table ES-2.

Table ES- 1: General Description of the Proposal

General Proposal Description	
Proposal Title	Hope Downs 2 Proposal
Proponent name	Hamersley HMS Pty Ltd
Short description	The Hope Downs 2 Proposal (the Proposal) is to develop and operate an above water table (AWT) iron ore mine and associated infrastructure approximately 80 km north-west of Newman in the Pilbara region of Western Australia. The Proposal is on the traditional lands of the Nyiyaparli, Ngarlawangga and Banjima people. The Proposal includes but is not limited to the following: • Development and operation of two AWT iron ore deposits: HD2 and BHT • Mineral waste management infrastructure: including waste rock landforms, landbridges, low grade ore stockpiles, and topsoil and sub-soil stockpiles • New processing infrastructure: including dry processing facilities at HD2 and/or BHT deposits • Support facilities: including workshops, hydrocarbon storage areas, Ammonium Nitrate Fuel Oil (ANFO) facilities, laydown areas, turkey's nests, transfer pads and offices • Linear infrastructure: including heavy and light vehicle access roads, railway crossing, conveyors, pipelines, power distribution network (including sub-stations), communications distribution network and associated communications infrastructure • Renewable energy: including renewable energy generation, energy storage, and associated ancillary infrastructure • Realignment of up to 6 km of the Great Northern Highway • Infrastructure for surface water management: including Pebble Mouse Creek crossings, diversion drains, levees and culverts • Infrastructure for water supply: including abstraction of groundwater and/ or use of surplus water from local sources and adjacent operations • Accommodation: including installation of an upgrade of existing accommodation and/or new construction camp

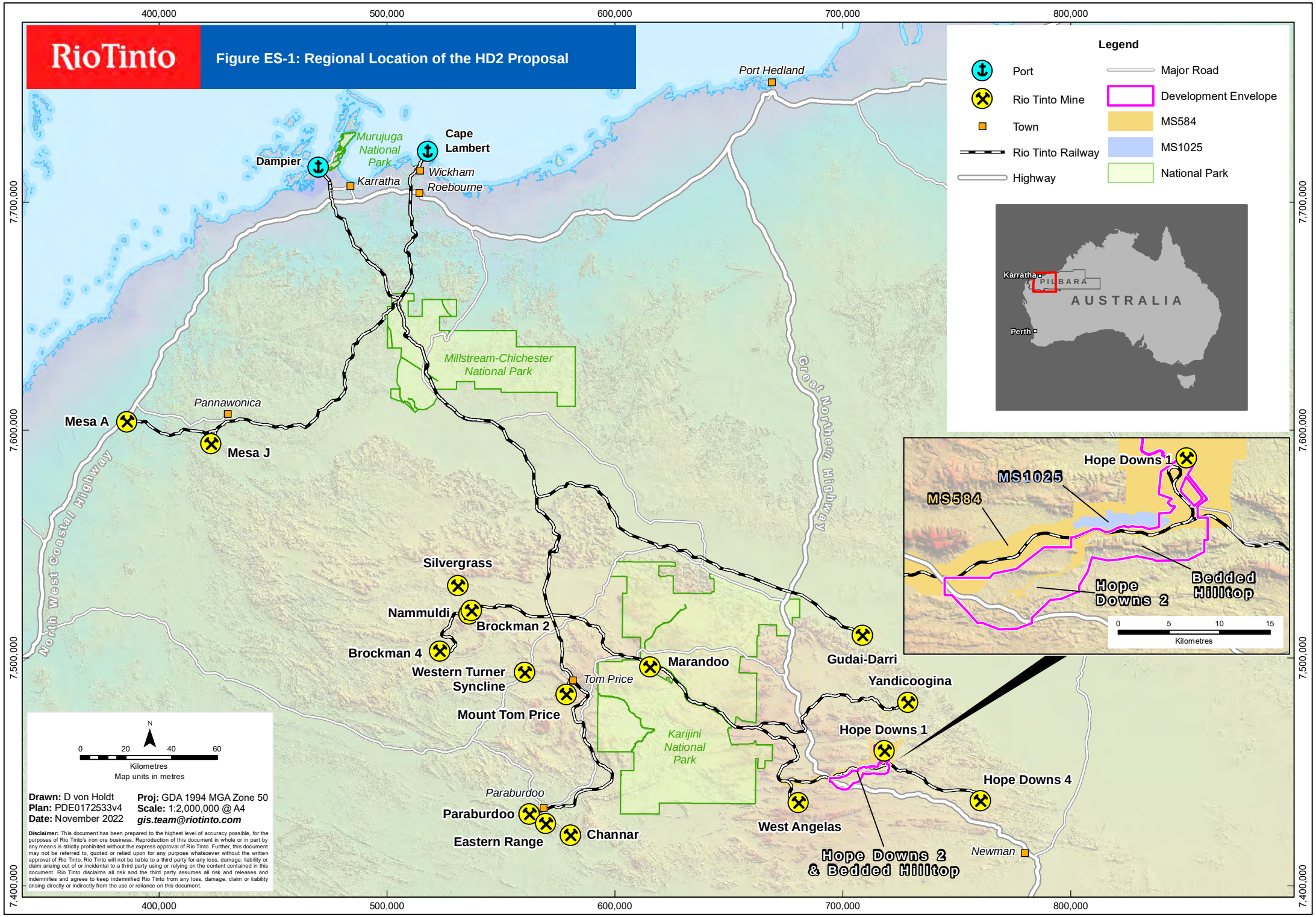
Table ES-2: Proposal Content Elements

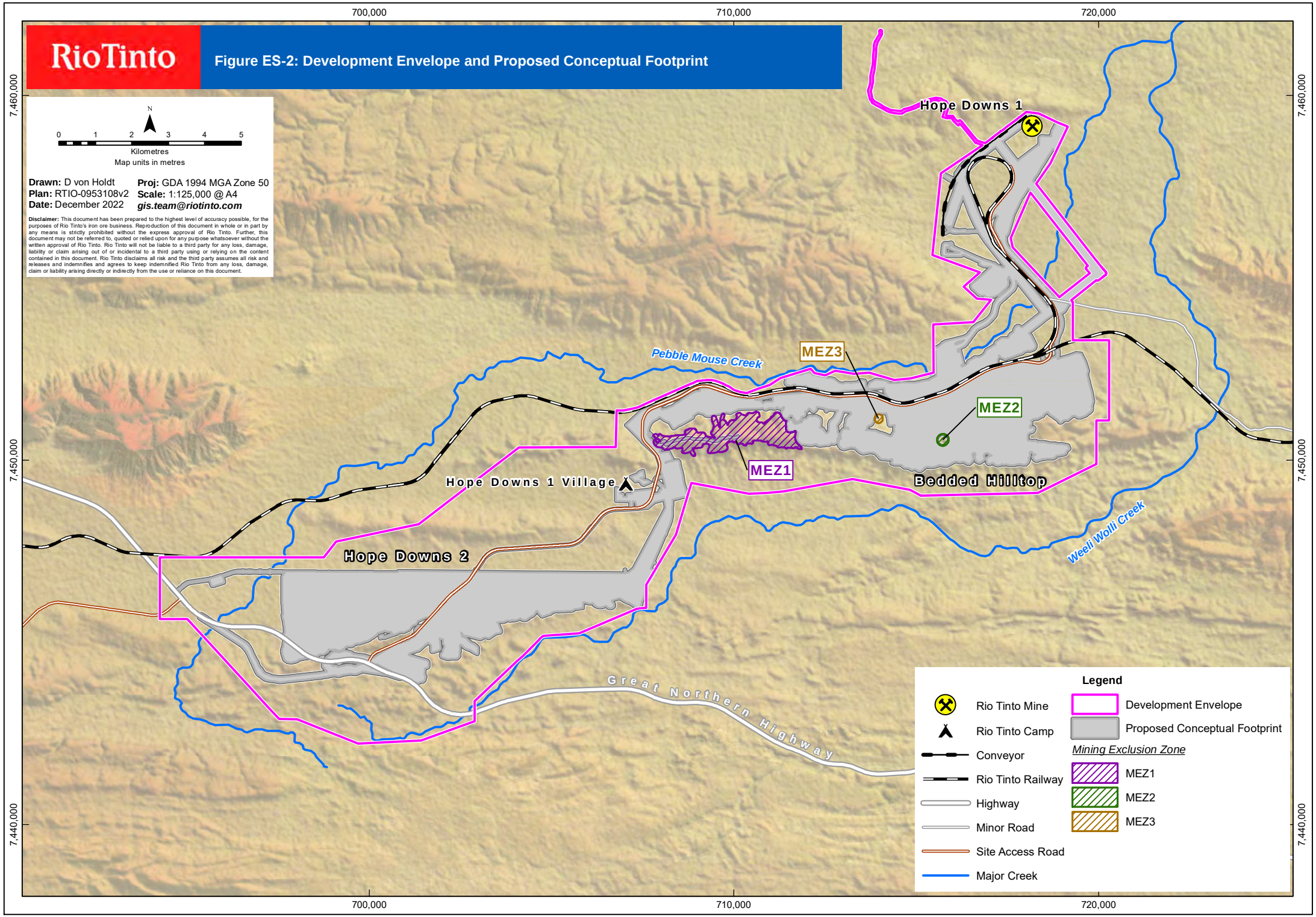
Element	Location	Proposed Extent
Physical Elements		
Mine and associated infrastructure	Figure ES-1 Figure ES-2	Clearing of up to 4,900 ha within a 12,409.5 ha Development Envelope.
Mining Exclusion Zones[1]	Figure ES-2	Mining Exclusion Zones[1] 1, 2 and 3.
Operational Elements		
Water supply	Development Envelope	Abstraction of up to 3 GL/annum or use of surplus water from adjacent operations
Proposal Elements with Greenhouse Gas Emissions		
Scope 1[2]	Diesel and land clearing – no more than 200,518 tonnes of carbon dioxide equivalent (tCO_2-e) per annum	
Scope 2[2]	Electricity generation – no more than 6,330 tCO_2-e per annum	
Scope 3[3]	382 Mt CO_2-e	
Rehabilitation and Closure		
The key closure outcome of this Proposal will be a safe, stable and non-polluting landscape consistent with the post-mining land use and consider environmental and cultural heritage values.		
Other Elements which affect Extent of Effects on the Environment		
Proposal Time	Maximum Project Life	Estimated 15 years

[1] Mining Exclusion Zone (MEZ): Refers to an area within the Development Envelope where no mining excavation will occur, and only low impact activities associated with environmental and cultural heritage monitoring and management may be implemented. MEZ1 contains existing communications infrastructure that is to be maintained. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. There is to be no clearing of critical MNES habitat (Gorge/gully and Breakaway types), no impact to Ghost Bat caves and no clearing of P2 flora within MEZ.

[2] Predicted peak annual emissions include forecast existing operations and new activities associated with the Proposal

[3] Attributable to this Proposal


RioTinto
Figure ES-1: Regional Location of the HD2 Proposal
Legend
Port
Rio Tinto Mine
Town
Rio Tinto Railway
Highway
Major Road
Development Envelope
MS584
MS1025
National Park
Karratha
PILBARA
AUSTRALIA
Perth
Port Hedland
Cape Lambert
Dampier
Murujuga National Park
Wickham
Roebourne
Karratha
Millstream-Chichester National Park
Great Northern Highway
North West Coastal Highway
Pannawonica
Mesa A
Mesa J
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Mount Tom Price
Tom Price
Marandoo
Gudai-Darri
Yandicoogina
Hope Downs 1
Karijini National Park
Hope Downs 4
West Angelas
Paraburdoo
Eastern Range
Channar
Newman
Hope Downs 2 & Bedded Hilltop
MS1025
MS584
Hope Downs 1
Bedded Hilltop
Hope Downs 2
0 5 10 15
Kilometres
N
0 20 40 60
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172533v4
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:2,000,000 @ A4
gis.team@riotinto.com
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400,000
500,000
600,000
700,000
800,000
7,700,000
7,600,000
7,500,000
7,400,000


RioTinto
Figure ES-2: Development Envelope and Proposed Conceptual Footprint
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0953108v2
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Hope Downs 1
Pebble Mouse Creek
MEZ3
MEZ2
MEZ1
Bedded Hilltop
Hope Downs 1 Village
Hope Downs 2
Weeli Wolli Creek
Great Northern Highway
Legend
Rio Tinto Mine
Rio Tinto Camp
Conveyor
Rio Tinto Railway
Highway
Minor Road
Site Access Road
Major Creek
Development Envelope
Proposed Conceptual Footprint
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3

Stakeholder Consultation

The Proponent has undertaken ongoing consultation with the Nyiyaparli, Banjima and Ngarlawangga People and their Registered Native Title Body Corporate representatives, the Karlka Nyiyaparli Aboriginal Corporation, the Banjima Native Title Aboriginal Corporation and Ngarlawangga Aboriginal Corporation relating to the Proposal. This consultation has helped the Proponent to understand the Traditional Owners values, concerns and priorities, relating not only to the Proposal but also the surrounding environment.

Consultation with Traditional Owner emphasised the importance of waterways, particularly Weeli Wolli Creek. Nyiyaparli Traditional Owners were concerned about the proximity of elements of the Hope Downs 2 deposit to Weeli Wolli Creek.

Consultation undertaken with the Nyiyaparli Traditional Owners in the second half of 2021 and through 2022 has resulted in the following changes to the Proposal from the referred Proposal:

- 6 km of Weeli Wolli Creek and a site of significant cultural heritage near the HD2 deposit, has been excluded from the Development Envelope, which was reduced in this area
- Proposed waste rock landform adjacent to Weeli Wolli Creek near HD2 deposit has been removed from the Conceptual Footprint, with the HD2 north-west waste rock landform increasing to allow for this change
- Reduction in the size of the Development Envelope
- Protection of a significant cultural heritage site at BHT by creating Mining Exclusion Zone 3.

Consultation regarding the Proposal commenced in 2019 with key State and Commonwealth departments and agencies, with increased consultation occurring over the past year.

Key Environmental Factors

The EPA identified the following preliminary key environmental factors for this Proposal:

- Flora and Vegetation (Chapter 6)
- Terrestrial Fauna (Chapter 7)
- Subterranean Fauna (Chapter 8)
- Inland Waters (Chapter 9)
- Greenhouse Gas Emissions (Chapter 10)
- Social Surroundings (Chapter 11).

In addition, the EPA is assessing the Proposal under an accredited assessment on behalf of the Commonwealth of Australia under the EPBC Act. The relevant Matters of National Environmental Significance (MNES) are listed as “threatened species and communities” (s18 and s 18A of the EPBC Act). Impacts on MNES are assessed in Chapter 13.

The environmental impact assessment presented in this ERD concluded the following were key environmental factors:

- Flora and Vegetation
- Terrestrial Fauna
- Greenhouse Gas Emissions
- Social Surroundings.

Subterranean Fauna and Inland Waters were concluded to not be key environmental factors. The summary of this assessment is presented in Table ES-4.

Environmental Outcomes, Objective and Management Plans

The mitigation hierarchy has been applied to the Proposal concerning the key environmental values.

The Proponent has undertaken significant design changes since the referral of the Proposal to the EPA, in order to mitigate impacts to environmental and social/cultural values, including the following:

- Reduction in the size of the Development Envelope
- 6 km of Weeli Wolli Creek and a site of significant cultural heritage near the HD2 deposit, has been excluded from the Development Envelope and the Development Envelope reduced in this area
- Proposed waste rock landform adjacent to Weeli Wolli Creek near HD2 deposit has been removed from the Conceptual Footprint, with the HD2 north-west waste rock landform increasing to allow for this change

Three Mining Exclusion Zones (MEZ) have been proposed, to retain critical and supporting habitat of MNES species and protect a significant cultural heritage site. Limits are proposed on the extent of disturbance on critical habitats (Gorge/Gully and Breakaway) for MNES fauna species.

These design changes and mitigations have reduced the impacts of the Proposal on preliminary key environmental factors, as outlined in Table ES-3.

Table ES-3: Environmental effects of design changes to the Proposal on relevant environmental factors

Environmental Factor	Change in Environmental Effects

Flora and Vegetation	• Reduction in impacts to high local significance vegetation units:
	  ○ D4: Area within the Development Envelope reduced by 47 ha, from 95 ha to 48 ha; and
	  ○ H2: Area within the Development Envelope reduced by 34 ha, from 331 ha to 297 ha.
	• Reduction in impacts to P2 priority flora:
	  ○ P2 *Eremophila* sp. West Angelas (121 individuals avoided, approximately 16% of the population is now outside the Development Envelope); and
	  ○ P2 *Aristida lazaridis* (2,639 individuals avoided, approximately 50% of the population is now outside the Development Envelope).

Terrestrial Fauna	• Reduction in impacts to high value conservation significant species / critical MNES habitat: Gorge/Gully and Breakaway habitat types by approximately 32 ha
	• Reduction in impacts to moderate value conservation significant species habitat: Minor Drainage, Rocky Hill, Alluvial Plain, Low Hills and Slopes habitat types by approximately 2,010 ha; however an additional approximately 210 ha of Mulga Woodland habitat is within the Development Envelope
	• Retention of significant value habitat within Mining Exclusion Zones, including:
	  ○ Northern Quoll habitat (55 ha of Critical habitat and 178 ha of Supporting habitat),
	  ○ Ghost Bat habitat (one Category 2 (Cave 10), one Category 3 (Cave 5) and two Category 4 caves (Caves 3 and 6); 55 ha of Critical habitat and 225 ha of Supporting habitat)
	  ○ Pilbara Leaf-nosed Bat habitat (three Category 4 caves)
	• A Category 4 Ghost Bat cave is now outside the Development Envelope
	• Limit the extent of disturbance on critical habitats for MNES fauna species (Gorge/Gully and Breakaway habitat)

Subterranean Fauna	• A decrease in the areas of waste rock landforms by approximately 230 ha will reduce the potential impacts to troglofauna habitat
Inland Waters	• Protection of Weeli Wolli Creek and Pebble Mouse Creek by minimising the extent of these creeks that are within the Development Envelope.

	• Protection of potential impacts on water quality of Weeli Wolli Creek by the removal of the adjacent waste rock landform.
Social Surroundings	The design changes and MEZs to the Proposal will result in: • Protection of the significant cultural heritage site at HD2 (HOPE 4-07 heritage complex) by removing it from the Development Envelope and by removing the WRL adjacent to HOPE 4-07. • Protection of the significant cultural heritage site at BHT deposit by creating MEZ3. • Protection of the cultural heritage values of Weeli Wolli Creek and Pebble Mouse Creek by minimising the extent of these creeks within the Development Envelope, and by removing the waste rock landforms adjacent to Weeli Wolli Creek • Impacts avoided to a heritage site through the change of the powerline alignment to avoid this site. • Protection of a significant cultural heritage site at BHT deposit by creating MEZ3

BHT and HD2 deposits have different habitat characteristics. BHT deposit area has a concentration of the MNES values, both habitats and records of key species, and for this reason a large MEZ (MEZ1), has been proposed to provide for broad habitat protection for all of the MNES species.

MEZ1 is a significant area (233 ha), and includes the following values:

- known locations for Northern Quolls recorded at the southern extent of the range of the species (as identified in the baseline surveys)
- habitat types which are potentially critical for MNES species, comprising 55 ha of Gorge/Gully and Breakaway habitats; and 178 ha of potentially supporting habitat for MNES species, which provide for connected foraging and dispersal habitat
- three Ghost Bat caves (Caves 3, 5 and 6) which are confirmed or potential nocturnal roosts
- known Priority 2 flora records, including 85% (558) of recorded individuals of *Eremophila* sp. West Angelas [S. van Leeuwen 4068] within the Development Envelope.

Based on significant survey work and advice from Pilbara subject matter experts, the avoidance, mitigation, MEZ and offsets are outlined in Table ES-4, which are specific for the Proposal.

The full list of anticipated outcomes and objectives is included in Table ES-4, and further detail is provided in the Environmental Outcomes section.

The Proponent has prepared several draft management plans that set out the principal objectives and methods by which the mitigation measures committed to as part of the Proposal will be implemented and how progress towards, or performance against, those objectives will be measured. The management plans supplement the existing management frameworks that the Proponent already has in place across its diverse operations and have been prepared in accordance with relevant guidelines where they exist. A summary of each of the Proposal's management plans is provided:

- The **Matters of National Environmental Significance (MNES) Fauna Environmental Management Plan** (EMP; Appendix A7) focuses on the ongoing mitigation of potential impacts to MNES fauna species associated with the Proposal, as well as the monitoring and reporting of key performance indicators
- A draft **Social and Cultural Heritage Management Plan** (SCHMP; Appendix F3) has been prepared in consultation with the Nyiyaparli people and sets out in plain English the principles and protocols under which the Proponent will continue to engage and work with this Traditional Owner group, as well as the expected social and heritage outcomes of those processes
- The **Greenhouse Gas Environmental Management Plan** (GHG EMP; Appendix A6) demonstrates the Proponents' contribution towards Western Australia's aspiration of net zero

emissions by 2050, the interim emission reduction targets for the Proposal, and how these will be achieved within the set timeframes

- A **Mine Closure Plan** (MCP; Appendix A4) has been prepared in accordance with current guidance (DMIRS 2020a) and describes the proposed closure outcomes and how they will be refined over the life of operations, as well as high-level plans for achieving those outcomes.

The management plans are expected to be subject to subsequent approval and reporting under instruments issued under the EP and EPBC Acts.

Environmental Offsets

The Proposal will result in significant residual impacts when assessed against current legislation and government policy, even after the thorough application of the mitigation hierarchy. These impacts are principally related to the contribution of the Proposal to the cumulative loss of vegetation in the Pilbara Bioregion and the removal of habitat for several conservation significant fauna species.

In line with government policies, the Proponent will offset these residual impacts by means of contributions to the Pilbara Environmental Offsets Fund (PEOF), which itself has the aim of delivering environmental offsets in the Pilbara Bioregion through a strategic landscape-scale approach, building on regional programs developed in partnership with Traditional Owners, conservation agencies, industry and government.

Table ES-4: Summary of Potential Impacts, Proposed Mitigation and Proposed Environmental Outcomes

Flora and Vegetation	
EPA Objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained (EPA 2021c)
EPA Policy and Guidance	See Section 6.2
Potential Impacts	Direct impacts • Clearing of native vegetation (including riparian vegetation) • Removal of individuals of Priority flora species Indirect impacts • Degradation of vegetation due to increased abundance and diversity of weeds • Degradation of vegetation through dust deposition and altered bushfire regime Cumulative impacts • Cumulative impacts on native vegetation • Cumulative impacts on Priority flora
Mitigation Hierarchy	Avoid • Reduction of the Development Envelope has avoided impacts to the following Priority flora: o *Aristida lazaridis* (P2) - 2,639 individuals avoided, approximately 50% of the population is now outside the Development Envelope o *Eremophila* sp. West Angelas (P2) - 121 individuals avoided, approximately 16% of the population is now outside the Development Envelope o *Lepidium catapycnon* (P4) - 2,345 individuals avoided, approximately 21% of the population is now outside the Development Envelope • Reduction of the Development Envelope has avoided impacts to the following high local significance vegetation units: o D4 area within the Development Envelope reduced by 47 ha, from 95 ha to 48 ha; and o H2 area within the Development Envelope reduced by 34 ha, from 331 ha to 297 ha. • No expected impact to recorded individuals of the priority flora species *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2) • The avoidance of groundwater-related impacts to flora and vegetation, including riparian/ groundwater dependant vegetation by restricting mining to above the water table • The establishment of two MEZs which will contain 241.5 ha of native vegetation and limit the impact to eight species of priority flora from being directly impacted by the Proposal. The MEZs will avoid impacts to: o High local significance vegetation unit H2 (43.5 ha avoided) o Moderate local significance vegetation units H1, H6 and H7 (131.5 ha avoided) o Priority 2 flora species *Eremophila* sp. West Angelas (558 individuals avoided, 85% of the recorded population within the Development Envelope) o Priority 2 flora species *Hibiscus sp. Gurinbiddy* Range (37 individuals avoided, 13% of the recorded population within the Development Envelope)

Flora and Vegetation	
	• Prevent the introduction of new weeds species listed as WoNS entering the Development Envelope through implementing the measures in the Environmental Management Plan (EMP; Appendix A7) • Prevent vegetation degradation through the potential increase in bushfire risk by avoiding clearing activities when severe or high fire risks are present <u>Minimise</u> • Reduction of the Development Envelope reduced impacts to Priority 2 flora species *Aristida lazaridis* • MEZs will minimise impacts to nine vegetation types, including one of high local significance and three of moderate local significance • Limit the spread of existing weeds by implementing the measures in the EMP (Appendix A7) • Manage the potential degradation of vegetation through dust deposition: o Adopt dust suppression techniques, such as water carts o Limit the amount of disturbed land at one time o Implement speed limits on unsealed roads and tracks • Manage the potential degradation of vegetation as a result of increased fire risk: o Manage and monitor hot works, vehicle movement and disposal of fire-starting waste o Ensure firefighting equipment is available in vehicles and around the site o Ensure all personnel on-site have been adequately trained on fire prevention and management <u>Rehabilitate</u> • Undertake progressive rehabilitation in accordance with the approved MCP to achieve the following outcomes: o Final landform is stable and considers hydrological factors o Vegetation on rehabilitated land is self-sustaining and compatible with the final land use • Continue to manage weeds in accordance with the measures in the EMP (Appendix A7)
Residual Impacts, including Assessment of Significance	<u>Non-Significant Residual Impact</u> The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Flora and Vegetation values: • Direct impact to vegetation units of high local significance, of up to 31 ha, consisting of: o 12 ha of the vegetation type D4, which represents 24% of its occurrence within the Development Envelope. Changes to the Proposal Design resulted in 47 ha are no longer within the Development Envelope. The residual impact to the D4 vegetation type is not considered to be significant given the D4 vegetation type is relatively widely distributed in the local area compared to the scale of the proposed clearing, and that *Aristida lazaridis* (P2) is not restricted to the vegetation type. o 19 ha of the vegetation type H2, which represents 6% of its occurrence within the Development Envelope, leaving approximately 278 ha remaining within the Development Envelope. 43.5 ha (15% of extent within the Development Envelope) of H2 vegetation type will be protected within MEZ1 and changes to the Proposal Design resulted in 34 ha no longer being within the Development Envelope. The residual impact to the H2 vegetation type is not considered significant, as the H2 vegetation type has a relatively wide distribution compared to the scale of the proposed clearing (within and outside of the Development

Flora and Vegetation	

	Envelope), a high number of *Eremophila* sp. West Angelas (S. van Leeuwen 4068) will be protected within a MEZ, and all other Priority taxa occur within other vegetation types.
	• Direct disturbance of up to 12 ha of riparian vegetation, represented by vegetation type D4, is not considered a significant residual impact on the riparian zone nor the riparian vegetation it supports.
	• Direct impact to Priority 2 flora species consisting of:
	  ○ No direct disturbance of *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2) individuals recorded within the Development Envelope. With 558 recorded individuals, representing 85% of recorded population within the Development Envelope, are located within MEZ. As such, there is not significant residual impact to the P2 species *Eremophila* sp. West Angelas.
	  ○ Direct disturbance of up to 301 *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) individuals (64%) recorded within the Development Envelope. The removal of these individuals as a result of the Proposal may impact on the local population but is not expected to have a significant residual impact on the regional population as this species occurs widely within the surrounding area.
	  ○ Direct disturbance of up to 395 *Aristida lazaridis* (P2) individuals recorded within the Conceptual Footprint, representing 17% of the 2,304 individuals recorded within the Development Envelope. Changes to the Proposal Design resulted in avoidance of 2,639 individual recorded locations no longer being within the Development Envelope. The removal of these individuals as a result of the Proposal may impact on the local population but is not expected to have a significant residual impact on the local or regional population as this species occurs widely within the surrounding area.
	• Cumulative impacts: implementation of the Proposal will not result in significant residual cumulative impacts to regional vegetation associations, given approximately 93% of pre-European extent for vegetation association Hamersley 82 is remaining within the subregion and approximately 85% of vegetation association Hamersley 18 is remaining.
	<u>Significant Residual Impacts</u>
	• Clearing of up to 4,205 ha of vegetation in good to excellent condition within the Development Envelope. In line with the EPA's section 16e advice on the cumulative environmental impacts of development in the Pilbara region (EPA 2014), any of native vegetation in 'Good' to 'Excellent' condition is considered significant.

Proposed Environmental Outcomes	In consideration of the proposed avoidance and management measures and likely significant residual impacts associated with the Proposal, the anticipated environmental outcome that applies to Flora and Vegetation is: • The clearing of no more than 4,900 ha of native vegetation, of which approximately 4,205 ha is in Good to Excellent condition • No direct disturbance of P2 flora recorded within the Mining Exclusion Zones. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. • There will be no impacts on threatened ecological communities (TECs) or priority ecological communities (PECs) located outside the Development Envelope.

Flora and Vegetation	
	• Environmental offsets are proposed for this clearing of native vegetation. Subject to conditions recommended and implementation of offsets (Chapter 12), the Proponent considers the Proposal can be managed to meet the EPA's objective to protect Flora and Vegetation so that biological diversity and ecological integrity are maintained.
Assessment of Offsets (if relevant)	Following the application of the mitigation hierarchy, the following residual environmental impact is considered a significant impact and therefore requires an offset: • Clearing up to 4,205 ha of native vegetation in good to excellent condition will be offset at a rate of $890/ha The offsets are in line with the State offset guidelines and are expected to counterbalance the significant residual impacts.

Terrestrial Fauna	
EPA Objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained (EPA 2021c)
EPA Policy and Guidance	See Section 7.2
Potential Impacts	<u>Direct Impacts</u> • Clearing of fauna habitat and habitat fragmentation • Loss of fauna individuals • Clearing of SRE habitat and loss of SRE individuals <u>Indirect Impacts</u> • Degradation or alteration of habitat as a result of altered hydrological regimes • Habitat degradation is associated with construction, operational and closure activities, including dust and altered fire regimes • Disturbance from light, noise and/or vibration, resulting in the displacement of fauna associated with construction, operational and closure activities • Disturbance resulting from an increase in abundance and diversity of weeds and feral species <u>Cumulative Impacts</u> • Cumulative regional impacts on fauna habitats • Cumulative regional impacts on terrestrial fauna species present in the Development Envelope
Mitigation Hierarchy	<u>Avoid</u> • Reduction of the Development Envelope has avoided impacts high value conservation significant species / critical MNES habitat: Gorge/Gully and Breakaway habitat types by approximately 32 ha

Terrestrial Fauna	

	• Reduction of the Development Envelope has avoided impacts moderate value conservation significant species habitat: Minor Drainage, Rocky Hill, Alluvial Plain, Low Hills and Slopes habitat types by approximately 2,010 ha; however, an additional approximately 210 ha of Mulga Woodland habitat is within the Development Envelope
	• Ensure all clearing occurs in approved ground disturbance areas by implementing the Proponent's Approval Request system
	• Retention of significant value habitat within Mining Exclusion Zones, including:
	  ○ Northern Quoll habitat (55 ha of Critical habitat and 178 ha of Supporting habitat),
	  ○ Ghost Bat habitat (one Category 2 (Cave 10), one Category 3 (Cave 5) and two Category 4 caves (Caves 3 and 6); 55 ha of Critical habitat and 225 ha of Supporting habitat)
	  ○ Pilbara Leaf-nosed Bat habitat (three Category 4 caves)
	  ○ Establish MEZ2 to protect the only Category 2 roost (Cave 10) within a 150 m buffer from mining activities
	• A Category 4 Ghost Bat cave is now outside the Development Envelope
	• Avoiding the areas of Low Hills and Slopes habitat south of the BHT deposit allow for movement of fauna through the landscape
	<u>Minimise</u>
	• The Development Envelope and Conceptual Footprint have been designed to minimise disturbance to high significance Gorge/Gully and Breakaway fauna habitats as well as to Pebble Mouse Creek and Weeli Wolli Creek, both which may serve as important corridors for fauna
	• Restrict clearing of high significance habitat to authorised extents and ensure compliance by means of continuous implementation of the Proponent's Approvals Request system
	• Minimise physical interaction with, or risk to fauna:
	  ○ Undertake progressive clearing to allow fauna to migrate away from clearing activities or machinery movement
	  ○ Limit light vehicle movements outside of operating mine areas to daylight hours
	  ○ Confine general vehicle traffic to defined roads and tracks
	  ○ Remove roadkill to reduce the risk of an increase in predators
	  ○ Place reflectors on the top strand of any barbed wire fences to minimise entanglement of bat species
	  ○ Provide site induction programs to the workforce on significant fauna, as well as standard operating procedures in the event of fauna interactions
	  ○ Place egress points at artificial water sources, such as turkeys' nests
	• Reduce habitat degradation potentially arising from construction and operation activity, including dust and altered fire regimes:

Terrestrial Fauna	
	○ Restrict vehicles to travel at safe operating speeds on unsealed roads, and from accessing rehabilitated areas except for management purposes ○ Implement measures such as maintaining fire breaks, hot works procedures and fire equipment in buildings and vehicles ○ Provide fire response procedures and training • Reduce potential for displacement of fauna due to disturbances from light, noise and/or vibration: ○ Minimise light overspill by directing lighting in mining areas inwards towards mining activities ○ Ensure equipment is specified to be within Australian standard noise limits ○ Set and monitor noise and vibration targets at the entrance of Cave 10 • Minimise potential for increase in abundance and diversity of pest species: ○ Fence landfills and cover putrescible wastes ○ Design and construct borrow pits in a way to minimise surface water ponding after rehabilitation ○ Undertake feral animal control as required, in co-operation with regional control programs and Traditional Owners <u>Rehabilitate</u> • Undertake progressive rehabilitation in accordance with the approved MCP, to achieve the following outcomes: ○ The final landform is stable and considers hydrological factors ○ Vegetation on rehabilitated land is self-sustaining and compatible with the final land use • Continue to manage introduced fauna
Residual Impacts, including Assessment of Significance	<u>Non-significant residual impacts</u> The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Terrestrial Fauna values: • Direct impact to significant fauna species consisting of: ○ Northern Quoll: Due to the low-density population of Northern Quolls within the Development Envelope, the retention of more than 60% of Critical habitat and 47% of Supporting habitat within the Development Envelope, the protection of Critical and Supporting habitat extent through the implementation of MEZs, and more of both Critical and Supporting habitats present in the wider area (Astron 2020b), the Proposal is not expected to result in significant residual impacts to the local or regional population or conservation status of the species.

Terrestrial Fauna	
	○ Ghost Bat: Due to the low to moderate density population of Ghost Bats in the Development Envelope, the retention of Critical and Supporting habitat and seven Ghost Bats caves within the Development Envelope, of which a portion is protected through the implementation of MEZ1 and MEZ2, the Proposal is not expected to result in significant residual impacts to the regional population or conservation status of the species. ○ Grey Falcon: Due to the highly intermittent presence of the species within the local area, the retention of over 60% of Supporting habitat within the Development Area, and the abundance of suitable habitat in the wider area (Astron 2023f) the Proposal is not expected to result in significant residual impacts to the regional population or conservation status of the species. ○ Pilbara Leaf Nosed Bat: None of the habitat types within the Development Envelope meet the definition of Critical habitat for the Pilbara Leaf-nosed Bat. This is mainly due to the absence of any permanent or semi-permanent roosts within the Development Envelope, distance from a known permanent roost (Category 1-3) and the very low activity level recorded within the Development Envelope. Proposed impact to Supporting habitat comprises two Category 4 Pilbara Leaf-nosed Bat roosts within the Development Envelope. Seven of the nine Pilbara Leaf-nosed Bat roosts (all Category 4) recorded within the Development Envelope will be retained. ○ Pilbara Olive Python: The low density of the Pilbara Olive Python, which is a mobile species that is likely to occur within the Development Envelope and the retention of 182 ha (63%) of Critical habitat within the Development Envelope, means that the Proposal is not expected to result in significant residual impacts to the regional population or conservation status of the species. Additionally, the Proposal has minimised impacts to Weeli Wolli Creek, the location of the majority of the Pilbara Olive Python historical records, with consolidated mapping of habitat showing an additional 634 ha of Gorge/Gully and Breakaway habitats mapped within the consolidated mapping area. • Direct impact to two confirmed SRE taxa: *Aurecocrypta* `HD1` and *Pseudodiploexochus* `C75046`, both are singleton records that were collected from site SRE17, a gorge partially within the proposed Conceptual Footprint of the Proposal. Given the habitat for these taxa is expected to persist following the implementation of the Proposal, there is not expected to be significant residual impacts. • Indirect impacts to significant fauna species during the construction and operation phase of the Proposal are not expected to result in significant residual impacts. • Cumulative impacts: All significant fauna species that occur or are likely to occur within the Development Envelope occur widely in habitat types that remain throughout the Hamersley sub-region and can move throughout the local landscapes, as such the cumulative impact to these species are not expected to be significant. <u>Significant Residual Impacts</u> The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are significant to Terrestrial Fauna values: • Clearing of up to 4,900 ha of terrestrial fauna habitat. This is considered a significant residual impact for the Proposal as per the EPAs cumulative environmental impacts of development in the Pilbara region (EPA 2014). This clearing is proposed to be offset as per Chapter 12

Terrestrial Fauna	

	• Clearing of up to 105 ha of high value habitat (note this occurs within the 4,205 ha of native vegetation in good to excellent condition discussed above), comprising of:
	  ○ 67 ha of Breakaway habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python
	  ○ 38 ha of Gorge/Gully habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python.
	  ○ These fauna habitat types are of high significance, are potentially Critical habitat for several significant fauna and is relatively scarce in the wider area. The Proposal is expected to have a significant environmental impact at a local scale, although this is lessened somewhat by the site's generally low utilisation by significant fauna species, the implementation of MEZs, and the limited scale and nature of the proposed clearing
	• Clearing of up to 2,659 ha of moderate value habitat (note this occurs within the 4,205 ha of native vegetation in good to excellent condition discussed above), comprising of:
	  ○ 369 ha of Rocky Hill habitat – considered to be Supporting for Northern Quoll, Grey Falcon and Ghost Bat
	  ○ 269 ha of Minor Drainage habitat – considered to be Supporting for Northern Quoll, Ghost Bat, and Grey Falcon
	  ○ 70 ha of Alluvial Plain habitat – considered to be Supporting for Ghost Bat
	  ○ 917 ha of Low Hills and Slopes habitat – considered to be Supporting for Ghost Bat
	  ○ 601 ha of Mulga Woodland habitat – considered to be Supporting for Ghost Bat
	  ○ 433 ha of Stoney Plain habitat – considered to be Supporting for Ghost Bat

Proposed Environmental Outcomes	In consideration of the proposed management measures and likely residual impacts, the Proponent will manage the implementation of the Proposal to achieve the following anticipated environmental outcomes for Environmental Factor - Terrestrial Fauna:
	• Direct disturbance to terrestrial fauna habitat limited to 4,900 ha
	• Direct disturbance of 105 ha is of high value habitat, limited to:
	  ○ 67 ha of Breakaway habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python
	  ○ 38 ha of Gorge/Gully habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python.
	• Direct disturbance of 2,659 ha is of moderate value habitat, limited to:
	  ○ 369 ha of Rocky Hill habitat – considered to be Supporting for Northern Quoll, Grey Falcon and Ghost Bat
	  ○ 269 ha of Minor Drainage habitat – considered to be Supporting for Northern Quoll, Ghost Bat, and Grey Falcon .
	  ○ 70 ha of Alluvial Plain habitat – considered to be Supporting for Ghost Bat
	  ○ 917 ha of Low Hills and Slopes habitat – considered to be Supporting for Ghost Bat
	  ○ 601 ha of Mulga Woodland habitat – considered to be Supporting for Ghost Bat

Terrestrial Fauna	
	○ 433 ha of Stoney Plain habitat – considered to be Supporting for Ghost Bat • Direct disturbance to no more than two caves within the Development Envelope, comprised of: one Category 3 (Cave 1) and one Category 4 (Cave 8) Ghost Bat roosts, both caves are also Category 4 Pilbara Leaf-nosed Bat caves (Figure 7-6). • No direct disturbance of high value habitat types and no impact to Ghost Bat caves within the Mining Exclusion Zones. The environmental outcomes of the Proposal are consistent with the EPA objective to protect terrestrial fauna so that biological diversity and ecological integrity are maintained. The proposed implementation conditions and regulation through other DMA processes will ensure these outcomes are achieved.
Assessment of Offsets (if relevant)	Following the application of the mitigation hierarchy, the following residual environmental impact is considered a significant impact and therefore requires an offset: • Clearing up to 105 ha of high significance fauna habitat at a rate of $3,306/ha • Clearing approximately 2,659 ha of moderate significance fauna habitat at a rate of $1,653/ha The offsets are in line with the State offset guidelines and are expected to counterbalance the significant residual impacts.

Subterranean Fauna	
EPA Objective	To protect subterranean fauna so that biological diversity and ecological integrity are maintained (EPA 2021c)
EPA Policy and Guidance	See Section 8.2
Potential Impacts	<u>Direct Impacts</u> • Removal of habitat (excavation) for potentially restricted troglofauna taxa • Temporary reduction in availability of suitable stygofauna habitat as a result of groundwater drawdown <u>Indirect Impacts</u> • Clearing of vegetation and subsequent placement of mineral waste potentially leading to a reduction in organic inputs into the subterranean environment • Vibration and compaction from blasting and heavy traffic may cause voids to collapse • Contamination associated with accidental hydrocarbon spills and siltation of voids from waste rock dumps or stockpiles storage may result in a reduction in the quality of troglofauna habitat <u>Cumulative Impacts</u> • Cumulative regional impacts on troglofauna and stygofauna habitats

Subterranean Fauna	
	• Cumulative regional impacts on troglofauna and stygofauna species present in the Development Envelope
Mitigation Hierarchy	<u>Avoid</u> • No BWT mining to occur, therefore avoiding significant direct impacts to stygofauna as a result of mine dewatering and associated groundwater drawdown and/or discharge. • Establish MEZ1 at BHT to protect 233 ha from direct disturbance. • Reduction in Development Envelope extents resulting in large areas of contiguous troglofauna habitat at both BHT and HD2 deposits are now outside of the Development Envelope. <u>Minimise</u> • Ensure the disturbance of vegetation across the Proposal is minimised at all times and that areas no longer required for use are rehabilitated as soon as possible • Groundwater abstraction will be limited to that which is necessary for construction and operation • Groundwater abstraction will be undertaken in accordance with a licence managed under the RiWI Act • Borefields will be located and operated to ensure drawdown is minimised and not greater than predicted • Limiting clearing around major creeklines and ensuring flow pathways are retained (and associated alluvial / colluvial habitat) • Hydrocarbons, chemicals and waste will be managed in accordance with legal requirements and industry standards <u>Rehabilitate</u> • Pits and other excavations will be stabilised and rehabilitated to stakeholder expectations, as per the MCP • At conclusion of active use, the groundwater production bores will be decommissioned, and groundwater levels will gradually return to pre-mining conditions • Implement the MCP
Residual Impacts, including Assessment of Significance	<u>Non-significant Residual Impact</u> The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant: • The Brockman Iron Formation (BHT only) will be reduced in surface mapped extent within the Development Envelope (approximately 35% will remain, based on mapped surface geology) for troglofauna, however it has been shown that this formation is continuous outside of the Development Envelope and is in contact with other geological formations which provide connected habitat for troglofauna.

Subterranean Fauna	
	• The reduction in surface mapped extent may impact on the distribution of two of the five restricted troglofauna taxa that have only been recorded in the Brockman Iron Formation and within the proposed pit outlines: (*Eukoenenia* `sp. OES2` and *Lagynochthonius* `sp. WAM-PSE096`). However, as outlined in Section 8.4.8.1, the Proposal will not result in significant irreversible impacts to the troglofaunal assemblage and populations of individual taxa. • The Proponent's decision to restrict mining to AWT has greatly reduced the potential for impacts to stygofauna overall. A single taxon has been recorded within Pebble Mouse Creek colluvium within an area that will experience temporary drawdown from nearby production wells but not to the extent that habitat will be significantly impacted. Changes to the Proposal design has reduced potential impact around major creeklines and mitigation measures, such as culvert design, will ensure surface water flow pathways are retained (and retain associated alluvial / colluvial habitat). <u>Significant Residual Impacts</u> The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal demonstrate there are no significant residual impact to subterranean fauna – troglofauna or stygofauna values.
Proposed Environmental Outcomes	After implementation of the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to subterranean fauna values. All species recorded from the Development Envelope are expected to persist following implementation of the Proposal. Accordingly, the Proponent considers the Proposal can be implemented to meet the EPA's objective to protect subterranean fauna so that biological diversity and ecological integrity are maintained. As such the assessment has concluded that subterranean fauna is not a key environmental factor for the Proposal.
Assessment of Offsets (if relevant)	No offsets are proposed.

Inland Waters	
EPA Objective	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (EPA 2021c)
EPA Policy and Guidance	See Section 9.2

Potential Impacts	<u>Direct Impacts</u>
	• Alteration of hydrological regimes of surface water systems resulting from the construction and operation of open mine pits and associated infrastructure, including:
	  o Reduction in catchment area of Weeli Wolli Creek and Pebble Mouse Creek
	  o Reduction in surface water flows to significant environmental values of Weeli Wolli Spring and Ben's Oasis
	  o Alteration to surface water flow levels and volume within Pebble Mouse Creek due to linear infrastructure crossings
	• Alteration to groundwater levels through:

Inland Waters	
	○ Operation of a HD2 borefield to provide water supply requirements. Indirect Impacts • Increases in sediment load of Pebble Mouse Creek as a result of clearing and soil disturbance, including the construction of crossings and the placement and management of stockpiles • Reduction in surface water and groundwater quality due to accidental spills of hydrocarbons, hazardous materials and waste Cumulative Impacts • Cumulative reduction to the size of catchments, including sub catchments associated with key values • Cumulative drawdown
Mitigation Hierarchy	Avoid • The following avoidance measures have been implemented during the mine planning process: ○ Reduction in Development Envelope to remove approximately 6 km of Weeli Wolli Creek from the Development Envelope ○ The area of Weeli Wolli Creek that is within the Development Envelope, is not adjacent to any area of the conceptual footprint, therefore is not expected to be impacted by direct or indirect impacts ○ Relocation of the waste rock landform from the Weeli Wolli Creek catchment area ○ No below water table mining of the HD2 or BHT deposits avoids potential impacts to local aquifers from dewatering ○ All production bores will be located within a hydrogeologically-isolated aquifer system (that does not support any ground-water dependent ecosystems) ○ Impacts to downstream water quality will be avoided by constructing the crossings during the dry (no-flow) season Minimise • The Proponent will implement a Water Management Strategy that will: ○ Ensure appropriate surface water diversion infrastructure will be in place to maintain surface water flow to Ben's Oasis and Weeli Wolli Creek ○ Maximise use of excess water from the adjacent operations, thereby minimising abstraction requirements at HD2 ○ Proposed groundwater abstraction volumes to be limited to no more than 3 GL/annum within the sustainable yield of the HD2 groundwater resources • All diversions, levees and culverts will be constructed in accordance with best industry practice and will include the use of rock armour to minimise erosion risk and impacts to water quality during significant flow events

Inland Waters	
	• Sediment in stormwater drainage from at-risk areas will be minimised by the inclusion of appropriate erosion and sediment controls, such as armouring and settling ponds • Bulk hydrocarbons and solid and liquid wastes will be managed in accordance with legal obligations and industry best practice • No fluorinated fire-fighting foam will be used or stored as part of the Proposal. <u>Rehabilitate</u> • Prepare, implement and regularly update an MCP, which includes closure objectives relevant to the restoration and/or maintenance of values associated with Inland Waters, including: o All disturbed areas that are no longer required will be stabilised and, if appropriate, rehabilitated o Groundwater bores will be decommissioned in accordance with relevant guidelines once no longer required o All disturbed areas that are no longer required will be stabilised and, if appropriate, rehabilitated o All surface water diversions remaining after closure are designed and engineered to minimise impacts on local hydrological regimes, ensure long term stability across the realistic range of expected flow events, and do not significantly cause or contribute to water quality impacts o The crossings will be completely removed during the closure, in accordance with the MCP. Removal will be completed during the dry (no-flow) season and the creek bed and banks will be appropriately stabilised to reduce erosion and ensure natural values are re-established o Modelling will be used to ensure the integrity of legacy structures, such as waste rock landforms, is retained over the long term o All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure
Residual Impacts, including Assessment of Significance	<u>Non-Significant Residual Impacts</u> The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Inland Waters – surface water values: • Weeli Wolli Creek catchment: the Weeli Wolli Creek catchment area has the potential to be reduced by approximately 46 km^2, representing a reduction in total catchment area by 1%, which is considered negligible and not a significant residual impact. • Ben's Oasis: Is located outside the Development Envelope and the environmental value of Ben's Oasis is not expected to be impacted by the Proposal given that it is sustained by the groundwater aquifer. The implementation of mitigation measures, including diversion structures, will reduce the relative catchment area loss from 6 km^2 to 1 km^2, equivalent to 0.2% of pre-mining conditions, which will not result in significant residual impacts.

Inland Waters	
	• Weeli Wolli Spring: Is located outside the Development Envelope, to the north of existing HD1 operations. Weeli Wolli Spring is impacted by HD1 operations, which are BWT, and the water levels (and therefore volumes) at Weeli Wolli Spring are supplemented by a series of spur lines running off the main discharge pipe to Weeli Wolli Creek. While the Proposal is expected to result in a reduction in the total catchment supporting Weeli Wolli Spring by approximately 45 km^2, representing a 3.5% reduction in catchment area, this is considered relatively negligible and there not a significant residual impact. In addition, the existing management measures in place for the HD1 operations, it is unlikely that the modelled reduction will actually be observed. The implementation of the Proposal will not result in a significant residual impact. • Pebble Mouse Creek: The Proposal will reduce the total Pebble Mouse Creek catchment area approximately 26 km^2, which represents less than 8% of the total catchment. Modelling show water depths in Pebble Mouse Creek directly downstream of the HD2 pits could be reduced by approximately 0.1 m. However, given the sporadic flow of the creek and the management measures to be implemented, this reduction is not considered significant and will not result in downstream residual impacts on the Weeli Wolli Spring. No significant residual impacts from the loss of catchment area attributable to the Proposal are expected. • No significant indirect residual impacts to surface water flow or water quality to Ben's Oasis, Weeli Wolli Creek or Weeli Wolli Spring are predicted to as a result of the Proposal. • The BHT waterhole (GHD19-17-WS) is ephemeral and therefore impacts to this feature are not considered significant. The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Inland Waters – groundwater values: • Mining: There is no groundwater drawdown associated within the mining, as the Proposal deposits are AWT only and will not require dewatering of the HD2 or BHT aquifers to access ore deposits • Groundwater drawdown abstraction of groundwater is for production needs only and is limited to the relatively small volume of 3GL/a from production bores located at HD2; drawdown is restricted to the HD2 groundwater system by geological barriers and will not affect the sensitive receptors of Ben's Oasis or Weeli Wolli Spring. • Cumulatively, drawdown from HD2 production bores is not expected to extend into or interact with the HD1 aquifer due to location of geological barriers. As a result, there will be negligible additional effects, as a result of the Proposal, on either HD1 or BHP's Mining Area C existing drawdown. Considering the above points, the implementation of the Proposal will not result in any significant residual impacts on environmental values from abstraction and subsequent groundwater drawdown. <u>Significant Residual Impacts</u> The assessment of residual impacts, after application of mitigation measures, concluded following residual impacts are considered to be significant to Inland Waters values: • Impact to pool HD2-(HD214_04): The pool is conceptually expected to the semi-permanent or ephemeral, therefore impacts to this waterhole are considered significant.

Inland Waters	
Proposed Environmental Outcomes	The referred design of the Proposal included potential impacts to Weeli Wolli Creek water quality. Following feedback from Nyiyaparli Traditional Owners and their representatives, the design was altered and a s43A subsequently approved by the EPA. The current design of the HD2 deposit mine pit includes potential impacts to the location where the HD2 pool was identified. Identification of the pool occurred during social surroundings survey work, during 2022. During subsequent ongoing consultation with Nyiyaparli Traditional Owners and their representatives, the importance of the HD2 pool and associated creekline was raised (Stevens, 2022, Appendix F5). In response to this feedback, the Proponent has committed to design changes to avoiding impacts to this pool and is continuing to work with the Nyiyaparli Traditional Owners and their representatives, as outlined in the SCHMP. Implementation of the SCHMP is a recommended condition. The Proponent has undertaken a full assessment of surface and groundwater values and potential impacts associated with the implementation the Proposal. The assessment that is summarised above has concluded that after implementation of the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to inland waters values. This is also due to the scale and nature of the activities included in the Proposal, including AWT mining. Noting that the cultural values associated with Inland Waters values are addressed in the Social Surroundings factor. Accordingly, the environmental outcomes of the Proposal are consistent with the EPA objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. As such it is concluded that Inland Waters is not a key environmental factor.
Assessment of offsets (if relevant)	N/a

Greenhouse Gas Emissions	
EPA Objective	To minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as far as practicable (EPA 2023)
EPA Policy and Guidance	See Section 10.2
Potential Impacts	<u>Direct Impacts</u> • Direct emissions from the burning of fossil fuels for mobile and stationary energy demands and changes in land use (clearing of vegetation) (Scope 1 emissions) • Indirect Impacts • Indirect emissions from the consumption of electricity. The Proponent draws its power from the integrated Rio Tinto power network (Pilbara Power Generation Network) (Scope 2 emissions)

Greenhouse Gas Emissions	
	• Scope 3 indirect emissions (other than Scope 2 emissions) as a consequence of the activities of the Proponent's customers, from sources not owned or controlled by the Proponent's business. In this case, largely in the manufacturing of steel [1]
Mitigation Hierarchy	<u>Avoid</u> • Minimise land clearing • Road trains will be used to transport ore from pit to processing facilities instead of haul trucks to improve fuel efficiency • Utilise existing HD1 north and south crushing plants to avoid building new plants and therefore generating associated emissions; maximise use of the closer HD1 south crushing plant, particularly for HD2 ores • Design and construct non-process infrastructure buildings with 5-star Greenstar rating in accordance with the National Construction Code • Install high efficiency LED lighting across the majority of plant infrastructure • Design haulage roads to optimise haulage distances and inclines and minimise stop/starts • Install rooftop solar and remote solar panels to power borefield pumps <u>Minimise</u> • Minimise diesel use by optimising mine design and reducing double-handling of materials • Use high-efficiency electrical motors and variable speed drives where practicable • Use variable speed generators in de-watering bores for improved efficiency • Use pressure accumulators in potable water and fire water systems to maintain system pressure during periods of low-flow or no-flow <u>Offset</u> • Offsets will be delivered by retiring credible offsets units in 2025, 2030, 2035 and 2040, as follows: ○ Integrate principles of the International Carbon Reduction and Offset Alliance (ICROA) in relation to the sourcing and use of credible offsets units for carbon offsetting

[1] Scope 3 emissions sit outside of the geographic scope for assessment and are included for context purposes only.

Greenhouse Gas Emissions	
	○ Credible offset units sourced will be based on the principles outlined in ICROA's Technical Specification: real, measurable, permanent, and additional. Independently verified and unique • Only credible offset units sourced from projects that are or will be validated, verified and registered
Residual Impacts, including Assessment of Significance	<u>Non-Significant Residual Impact</u> The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to GHG values: • Cumulative impacts, when considered in combination with the adjacent Hope Downs 1 operations, will, overall result in a cumulative reduction in net emissions. • The Proposal peak emissions represent 0.26% of WA emissions (using the 2020-21 WA GHG inventory from the Australia's National Greenhouse Accounts, which is the latest available data) <u>Significant Residual Impact</u> After the application of the mitigation hierarchy, including avoidance and reduction measures, the Proposal is predicted to result in the following significant residual impacts to Greenhouse Gas Emissions: • is expected to contribute net GHG emissions (Scope 1 emissions) of approximately 720,162 t CO_2-e through the life of the project. The GHG EMP outlines how the overall net emissions from the Proposal will be abated from the implementation of emissions reduction measures or offset.
Proposed Environmental Outcomes	In consideration of the proposed management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to GHG include: • Five yearly interim reduction of emissions from 2025 to 2050 based on targets outlined in Table 10-6 and in Section 4.1.2 of the GHG EMP, including but not limited to: ○ Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 and 2 emissions ○ Commitment to offset if the targets are not met ○ Five yearly progress reporting ○ Five yearly formal re-submission or if a significant change is triggered • Abatement of Scope 1 emissions in accordance with targets as set out in the GHG EMP (currently estimated at 1,210,672 t CO_2-e). The proponent has prepared a GHG EMP (Appendix A6) that outlines how emissions from the Proposal are monitored and managed to minimise the contribution to global emissions. The environmental outcomes of the Proposal are consistent with the EPA objective to minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as far as practicable so that environmental values are protected. The proposed implementation conditions will ensure these outcomes are achieved.

Greenhouse Gas Emissions	
Assessment of offsets (if relevant)	The retirement of Credible Offset Units in relation to the Proposal for 2025, 2030, 2035, 2040, 2045 and 2050 will occur where the measures to avoid or reduce emissions are insufficient to meet Scope 1 interim and long-term emissions reduction targets.

Social Surroundings	
EPA Objective	To protect social surroundings from significant harm (EPA 2021c)
EPA Policy and Guidance	See Section 11.2

Potential Impacts	Impacts to:
	• Water
	• Interfering with Warlu or other spiritual entities through impacts from noise and/or disruption to surface water flows, creeks, or significant waterholes
	  ○ Pebble Mouse Creek crossings: potentially impacting the flow of Pebble Mouse Creek
	  ○ The potential effect on Traditional Owner water-related cultural obligations and to other groups upstream and downstream of the diversion along the two main creek systems
	  ○ most of the catchment from the minor tributary feeding into Pebble Mouse Creek which is associated with the HD2 waterhole (HD214_04) will be lost to the HD2 pit
	  ○ Waterhole (GHD19-07-WS) at BHT will be lost to waste rock landform development
	• Sense of place and Amenity (Dust, Noise and Vibrations)
	  ○ The impacts of dust accumulating in water features and along drainage lines – including ecological and water quality effects and with respect to the enjoyment of place
	  ○ The effect of dust emissions on country, including amenity and aesthetics, special places, animals, plants, and people
	  ○ The volume (and source) of water required to suppress dust under standard practice
	  ○ Noise and vibration impacts to sense of place, enjoyment, and use of country (including at camping spots and other areas used for cultural purposes etc.)
	  ○ Noise and vibration impacts to animals, including making existing habitats undesirable
	  ○ Potential vibration impacts to heritage sites and special places
	  ○ Increased dust leads to reduced visibility and safety for drivers using GNH in areas near the Development Envelope

Social Surroundings	

	• Sense of Place and Amenity (Altered Visual Landscape)
	  ○ Pit development and construction of waste rock landforms and land bridges at BHT and HD2 has potential to affect the visual character of the landscape
	  ○ Changes to or alteration of cultural landmarks used by Traditional Owners to navigate and pass down: stories of connection between places; and connection between people and place
	  ○ Potential disruption to vistas from three prominent high points (within 3.5- 32 km from the Development Envelope)
	  ○ Disruption to visual amenity along the southern ridgeline and areas visible from Weeli Wolli Creek
	• Access to Country
	  ○ Reduced extent of freely and safely accessible areas on their country – particularly Weeli Wolli Creek and associated places, as well as reduced access to exercise native title rights and enjoy country generally (including special places, waterholes, places to hunt or collect resources, camping spots and any place of social significance)
	  ○ Limitations and difficulties Traditional Owners face to visit country due to Proponent controls on access, activities associated with mining and exploration and the presence of physical barriers
	  ○ As Weeli Wolli Creek and Weeli Wolli Springs are publicly accessible, maintaining access to these areas for the public is also an important consideration
	  ○ Direct disturbance of country, special places and other sites of social, cultural and heritage significance (for example, waterholes, creeklines, camping sites, hunting grounds, plant and animal habitat and heritage sites)
	• Special Places
	  ○ Increased visibility of Traditional Owner culture on site and support for sharing of culture, including recording of knowledge and Country, including cultural mapping and Traditional Ecological Knowledge consultation/projects
	  ○ The potential impact on culturally significant waterholes in the region and associated effects on indigenous animals of cultural importance to Traditional Owners that rely on these waterholes
	  ○ Avoidance of heritage sites and restricted access to significant sites along the Great Northern Highway
	  ○ Concerns regarding the keeping of artefacts salvaged from disturbed areas and the desire to engage with the Proponent around joint planning an appropriate facility
	• Plants and Animals
	  ○ A reduction in the presence, health and abundance of culturally significant plant and animal species

Social Surroundings	
	○ A reduction in the presence, health and abundance of other plant and animal populations ○ A reduction in biodiversity within the Development Envelope during operations and, depending on rehabilitation outcomes, potentially permanently post-closure ○ Interference in Traditional Owners' cultural role as land managers and caretakers which may impact their ability to care for country as its cultural custodians (e.g., fire management practices) ○ Traditional Owner involvement in Proposal management and monitoring • Mine Closure and Rehabilitation ○ Improved mine planning to reduce ongoing and cumulative impacts ○ Post-closure rehabilitation, including backfill of pits ○ Ongoing (residual) physical and biological impacts to country and potential chemical impacts through the permanent existence of waste rock landforms, pit voids and land bridges (final landforms) ○ Ongoing (residual) amenity and visual impacts to country including those with respect to position, scale, shape and visual nature of final landforms, pit voids, permanent drainage features and rehabilitation outcomes - noting Nyiyaparli Traditional Owners' desire for landforms and rehabilitated country to be as natural looking as possible ○ Recognition of Native Title rights in post-mining land use - Nyiyaparli People expect to resume/continue the activities associated with Native Title rights with unfettered access to country that supports cultural activities and all species with particular attention to culturally important plant and animal species ○ Closure and rehabilitation design that includes culturally important aspects such as useful or important plant species, fauna habitat creation for key animals and features that reflect traditional stories and understanding of the land ○ Ongoing amenity impacts associated with rehabilitation which may not enable return of valuable species to Traditional Owner culture and well-being ○ Amenity impacts associated with the potential permanent loss of temporary water holes and special places • Cumulative Impacts ○ On water from mining activities in the wider area by multiple proponents ○ Traditional Owner water-related cultural obligations, and to other groups upstream and downstream of the diversion along the two main creek systems (Pebble Mouse Creek and Weeli Wolli Creek)

Social Surroundings	
	○ Dust accumulation in water features and along drainage lines – including ecological and water quality effects and with respect to the enjoyment of place ○ Noise, visual amenity, and visual landscapes in the region, which already has a number of mining operations in close proximity ○ Plants and animals in the region, particularly the loss of individuals or populations of plants or animal species, loss of biodiversity and impacts to animals as a result of loss and fragmentation of habitat and migration pathways and social and cultural impacts of loss of culturally significant plants and animals
Mitigation Hierarchy	<u>Avoid</u> • Changes to reduce the area of the Development Envelope, avoiding most of Weeli Wolli Creek including the HOPE4-07 site-complex and avoid some sections of Pebble Mouse Creek, and exclude some areas of vegetation • Infrastructure areas (i.e., outside pits and waste rock landforms) redesigned on basis of a sensitive sites analysis, avoiding direct impact to all but two listed heritage sites • Establish MEZ3 to protect the BDH16-03 rock shelter, with a 100m buffer • Removal of a proposed waste rock landform at the HD2 deposit near Weeli Wolli Creek to avoid the creekline and HOPE4-07 site-complex and avoid impacts to visual and general amenity associated with the creek area, and potential impact of run-off from the landform on the waterbody • Removal of a proposed waste rock landform south of BHT and retention of the southern façade of the BHT ridgeline to avoid impacts to visual and general amenity and important Gorge/Gully habitat for Ghost Bats, Northern Quolls and other fauna, and avoid the potential impact of run-off from the landform to, Weeli Wolli Creek including Ben's Oasis. from the mine design • An additional landbridge at BHT has been avoided through redesign • Commitments to maintain access (i.e. avoid loss of access) to Weeli Wolli Creek gabion and Weeli Wolli Springs and avoid as far as practicable restricting access to areas on which cultural activities are conducted and within which resources are collected • Conduct heritage clearance surveys to ensure all heritage sites are identified, with Proposal activities designed to avoid the sites if possible • Ensure workforce undertake site inductions which include details of required access permissions <u>Minimise</u> • Traditional Owner concerns about dust creation and water use have been included in the ore transport option assessment, resulting in road trains (equally with crush-convey) being the preferred option to transport ore from HD2. Road train transport option is a sealed road from HD2 deposit to the Hope Downs 1 operations plant, to minimise dust emissions and water use associated with dust suppression

Social Surroundings	
	• Designs for the Pebble Mouse Creek haul and road train road crossings and Great Northern Highway bridge over Pebble Mouse Creek to minimize area of direct disturbance and ensure minimal impacts to streamflow • Implement noise management measures, such as plant and equipment modifications and installation of baffles to minimise impacts to special places, people and native fauna • Undertake waste management and site housekeeping actions to minimise the visual impact of litter and waste • Continue to work on options to minimise disruption to access to Weeli Wolli Creek during construction, in consultation with Traditional Owners • Use MEZs. dust, noise and vibration modelling, and blast management plans for rockshelters and caves to inform additional potential mitigation measures • Heritage surveys to inform decisions to relocate activities if possible, and inform potential salvage of artefacts, to minimise potential impacts • Conduct workforce training on importance of avoiding areas outside approved disturbance • Direct lighting inwards to minimise potential impacts to native fauna <u>Rehabilitate</u> • Prepare, implement and regularly update an MCP, including consultation and collaboration with Traditional Owners as guided by the SCHMPs, which includes closure objectives relevant to the restoration and/or maintenance of values associated with Social Surroundings, including: o All disturbed areas that are no longer required will be stabilised and, if appropriate, rehabilitated o Progressive rehabilitation will be undertaken where possible to facilitate continued access to sites and places of cultural significance o Targets and measure with respect to visual impacts of final landforms o All contamination risks are appropriately managed o All remaining mineral waste landforms and other structures remaining within floodplains have additional erosion protection as appropriate to their risk potential o All infrastructure within creeklines, such as crossings and culverts, that are no longer required will be removed o Revegetation and rehabilitation to minimise ongoing erosion and creation of dust following operations. Self-sustaining ecosystems are intended to be re-established o Assess rehabilitation seed mixes and seek to incorporate identified culturally significant species (bush tucker/medicine) where practical

Social Surroundings	
	○ Post-closure continued access to sites and places of cultural significance will be maintained in accordance with relevant health and safety requirements ○ Targets and measure with respect to the inclusion of culturally important plants in revegetation • Repatriate salvaged heritage material in accordance with Traditional Owner preferences and AH Act/ACH Act approvals • Store repatriated salvaged heritage material in keeping place(s)
Residual Impacts, including Assessment of Significance	<u>Non-Significant Residual Impacts</u> The assessment of residual impacts, following the application of proposed avoidance and management measures associated with the Proposal that demonstrate non-significant residual impacts to Social Surroundings include: • Direct and indirect impacts to cultural values and the traditional usage of the land for the Banjima People. Impacts are considered non-significant given they relate to infrastructure only (no mining activities on Banjima country) and impacts are not different than those already experienced through implementation of the Hope Downs 1 Ministerial Statements (MS 584, 893 and 1025) • There will be no direct impacts to Weeli Wolli Creek and the only direct disturbance to Pebble Mouse Creek is for essential linear (creek crossing) infrastructure, including potentially a bridge for the Great Northern Highway re-alignment • No direct impact will occur to two identified sites of significant cultural heritage interest - BDH16-03 and HOPE4-07 • No European heritage sites have been documented within the Development Envelope • Re-alignment of the Great Northern Highway, in accordance with a Traffic Management Plan, to be developed in consultation with Main Roads WA, Traditional Owners and other key stakeholders. The plan will be developed following further design work and stakeholder consultation. <u>Significant Residual Impacts</u> After application of mitigation measures, the following significant residual impacts are predicted to Social Surroundings: • Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Nyiyaparli People. These impacts will be managed through a co-developed SCHMP, where impacts require management • Direct impact to two identified pools – HD2 waterholes (HD214_04) and BHT waterhole (GHD19-07-WS). The current design of the HD2 deposit mine pit includes potential impacts to the location where the HD2 pool was identified. Identification of the pool occurred during social surroundings survey work, during 2022. During subsequent ongoing consultation with Nyiyaparli Traditional Owners and their representatives, the importance of the HD2 pool and associated creekline was raised (Stevens, 2022, Appendix F5). In response to this feedback, the Proponent has committed to design changes to avoiding impacts to this pool and is continuing to work with the Nyiyaparli Traditional Owners and their representatives, as outlined in the SCHMP. • Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Ngarlawangga People, if the Great Northern Highway re-alignment is located on Ngarlawangga country. These impacts will be managed through a co-developed SCHMP.

Social Surroundings	
	• Direct and indirect impacts resulting from the re-alignment of the Great Northern Highway as a result of implementation of the Proposal. These impacts will be managed through a Traffic Management Plan, which is to be approved by Main Roads WA. Potential direct impacts to heritage values will be appropriately managed via Aboriginal heritage legislation and the IHMP. Any disturbance will be in accordance with approvals under s.16 and/or s.18 of the AH Act or ACH Permit and/or ACHMP under the ACH Act, and as agreed with Traditional Owners through consultation, based on the principle of free, prior and informed consent. Ongoing engagement with Traditional Owners will be managed through engagement frameworks established through existing agreements and SCHMPs (where relevant and required).
Proposed Environmental Outcomes	In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Social Surroundings are set out below: • Avoid, where practicable, and otherwise minimise direct and indirect impacts to the environment which impact to Nyiyaparli social and cultural values as a result of implementation of the Proposal, in accordance with the draft Nyiyaparli SCHMP • Avoid, where practicable, and otherwise minimise direct and indirect impacts to the environment which impact to Ngarlawangga social and cultural values as a result of implementation of the Proposal, in accordance with the SCHMP • Avoid, where practicable, and otherwise minimise direct and indirect impacts resulting from the re-alignment of the Great Northern Highway as a result of implementation of the Proposal, in accordance with the Traffic Management Plan. Based on consultation and engagement with Traditional Owners, the Proposal was assessed as having a significant residual impact on social surroundings-related environmental values in relation to the Nyiyaparli People and Ngarlawangga Peoples Traditional Lands, specifically those related to the preservation of cultural amenity of the area within and nearby to the Proposal. Waterholes are generally of high cultural significance to Traditional Owners, two culturally significant waterholes have been identified by Nyiyaparli Traditional Owners within the Development Envelope on Nyiyaparli Country (HD214_04 at HD2 and GHD19-07-WS at BHT) that will be directly impacted by the Proposal. Given the importance of water in arid landscapes and its social surroundings importance to Traditional Owners, the Proponent is working to avoid and/or mitigate impacts to BHT and HD2 pools, in consultation with the Nyiyaparli Traditional Owners and their representatives, as outlined in the SCHMP. Implementation of the SCHMP is a recommended condition. The Proponent considers that there is a process of consultation and engagement in place with Traditional Owners and key stakeholders to inform the application of the EPAs mitigation hierarchy to ensure the Proponent can meet the EPAs objective for Social Surroundings.
Assessment of offsets (if relevant)	Required measures and management approaches will be agreed in the Nyiyaparli SCHMP. The Nyiyaparli SCHMP has been co-developed with Nyiyaparli Traditional Owners. A SCHMP will be co-developed with the Ngarlawangga Traditional Owners, should significant impacts be associated with the re-alignment of Great Northern Highway. The co-developed SCHMP/s will ensure the Proponent continues to apply the EPA's mitigation hierarchy (avoid, minimise, mitigate) to all activities undertaken in relation to this Proposal, through consultation and partnership with Traditional Owners and their representatives. A condition requiring the implementation of these SCHMP's is expected for this Proposal.

Summary of Holistic Impact Assessment

In addition to providing a detailed assessment of the potential environmental impacts and mitigation measures for individual environmental factors, the Proponent has also sought to understand the environment as a whole. A detailed understanding informs the environmental values and processes and the holistic views and concerns raised through consultation relevant stakeholders, including the Nyiyaparli, Banjima and Ngarlawangga Peoples. The inputs and perspectives of the Traditional Owners continues to be vital in growing this understanding of the whole environment and the balance between its many interconnected elements. A conceptual model of these fundamental elements and their many interconnections is represented in Figure ES-3.

Many of the key environmental values within the Development Envelope were identified across multiple environmental factors, with the most significant values being:

- High significance vegetation, flora and fauna habitats (including for SRE) associated with the rocky gullies and breakaways of the HD2 and BHT ridgelines, particularly south-facing examples, which are also of significance to the Traditional Owner groups
- Moderate significance vegetation and fauna habitats associated with Pebble Mouse Creek and other smaller tributaries within the Development Envelope, including their function as corridors for the movement of water, fauna, people and nutrients through the landscape.

Accordingly, the Proponent has placed a very high priority on the avoidance, minimisation and rehabilitation of impacts to these key values, including the establishment of a 233 ha Mining Exclusion Zone (MEZ1) over the western end of the BHT ridgeline, and the removal of a proposed waste rock landform from the southern flank of the HD2 ridgeline it was adjacent to Weeli Wolli Creek and a site of significant cultural heritage. With these measures in place, as well as the many others specified in Table ES-4, and taking into account proposed offsets, the Proponent believes that, even in a holistic sense, no additional or different mitigation measures would be of benefit to the outcomes of the Proposal in this regard.

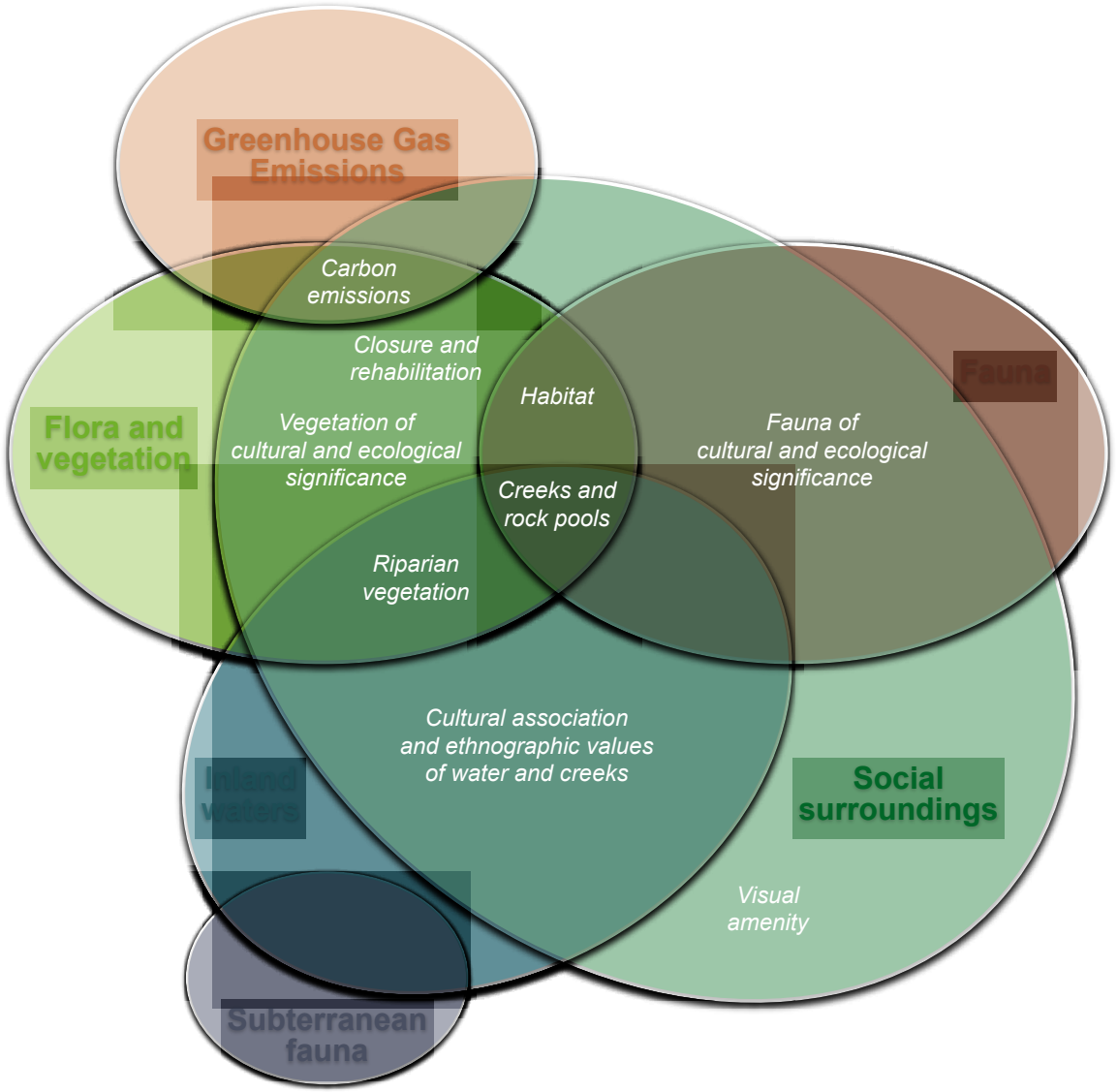
Summary of Cumulative impact assessment

The Proposal is located within the Pilbara bioregion and the Hamersley (PIL01) subregion, both of which are subject to pressures from multiple developments, including other iron ore mining projects (EPA 2014). The cumulative loss of vegetation and associated environmental values in the Hamersley subregion has been identified as a concern by the EPA (2014). Therefore, the proposed clearing is considered significant and is proposed to be offset.

There are at least ten other existing and reasonably foreseeable developments within 50 km of the Proposal, including the Proponent's Hope Downs 1 operations. For that reason, the Proponent has considered the Proposal's potential further to impact environmental values under pressure from these developments. The review of key flora and vegetation, fauna and hydrological values did not find any instances where the current threat level of an ecological community or species would be increased as a result of the Proposal or where impacts to surface and groundwater regimes might exacerbate existing pressures. The review of social and cultural values has confirmed that a widespread concern exists amongst Traditional Owner groups about cumulative impacts to values including surface water, groundwater, increased dust, removal of special places, habitat for plants and animals, access to country. Social surroundings surveys undertaken to support this Proposal have identified areas of significant cultural value to Traditional Owners, and these are discussed in considerable detail within the ERD.

Further, as discussed throughout this document, it is considered that the existing obligations and commitments prescribed under a range of regulatory instruments and decision-making processes, are appropriate to manage potential cumulative impacts associated with the Proposal in addition to new conditions proposed for consideration by the EPA.

RioTinto



HOPE DOWNS 2 PROPOSAL

FIGURE 14-1

Holistic View of Links between Environmental Factors and Values

Prepared by: ELA/TtCOF_RH | Doc: \\tt.local\coh\S772\S\GRAPHICS\20278_ELA_RioTinto_HopeDowns\20278_ELA-RT_GRA001_VENN.ai_1 | Date: 06.12.2022

TABLE OF CONTENTS

1.	**INTRODUCTION**	**1**
1.1.	Purpose and Scope	1
1.2.	Proponent	1
1.3.	Proposal Terminology	2
2.	**PROPOSAL**	**3**
2.1.	Proposal Content	3
2.2.	Proposal Alternatives	18
2.3.	Local and Regional Context	24
3.	**LEGISLATIVE CONTEXT**	**35**
3.1.	Environmental Impact Assessment Process	35
3.2.	Other Approvals and Regulations	37
4.	**STAKEHOLDER ENGAGEMENT**	**44**
4.1.	Key Stakeholders	44
4.2.	Stakeholder Engagement Process	47
4.3.	Stakeholder Consultation	47
4.4.	Stakeholder Consultation	48
5.	**ENVIRONMENTAL PRINCIPLES**	**50**
6.	**FLORA AND VEGETATION**	**54**
6.1.	EPA Environmental Factor and Objective	54
6.2.	Relevant Policy and Guidance	54
6.3.	Receiving Environment	55
6.4.	Potential Environmental Impacts	97
6.5.	Mitigation	106
6.6.	Assessment and Significance of Residual Impact	122
6.7.	Environmental Outcomes	139
7.	**TERRESTRIAL FAUNA**	**141**
7.1.	EPA Environmental Factor and Objective	141
7.2.	Relevant Policy and Guidance	141
7.3.	Receiving Environment	142
7.4.	Potential Environmental Impacts	191
7.5.	Mitigation	201
7.6.	Assessment and Significance of Residual Impacts	219
7.7.	Environmental Outcome	231
8.	**SUBTERRANEAN FAUNA**	**234**
8.1.	EPA Environmental Factor and Objective	234
8.2.	Relevant Policy and Guidance	234

8.3. Receiving Environment 235
8.4. Troglofauna 241
8.5. Stygofauna 256
8.6. Environmental Outcome 267

9. INLAND WATERS 269
9.1. EPA Environmental Factor and Objective 269
9.2. Policy and Guidance 269
9.3. Receiving Environment 270
9.4. Potential Environmental Impacts 298
9.5. Mitigation 321
9.6. Assessment and Significance of Residual Impacts 328
9.7. Environmental Outcomes 332

10. GREENHOUSE GAS EMISSIONS 335
10.1. EPA Environmental Factor and Objective 335
10.2. Relevant Policy and Guidance 335
10.3. Receiving Environment 338
10.4. Potential Environmental Impacts 338
10.5. Mitigation 341
10.6. Assessment of Significance of Residual Impacts 348
10.7. Environmental Outcomes 349

11. SOCIAL SURROUNDINGS 351
11.1. EPA Environmental Factor and Objective 351
11.2. Relevant Legislation, Policy and Guidance 351
11.3. Consultation and Social Surroundings Study Effort 353
11.4. Receiving Environment 361
11.5. Potential Impacts to Social Surroundings 373
11.6. Mitigation 394
11.7. Assessment of Significance of Residual Impacts to Social Surroundings 427
11.8. Environmental Outcomes 430

12. OFFSETS 433
12.1. Objective 433
12.2. Policy and Guidance 433
12.3. Assessment and Significance of Residual Impact – EP Act 436
12.4. Assessment of Significant Residual Impact – EPBC Act 448
12.5. Proposed Offsets 452
12.6. Consistency with Offset Policies 455
12.7. Stakeholder Consultation Regarding Offsets 457

13. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE 458
13.1. Controlled Action Provisions (EPBC 2021/9035) 458
13.2. Relevant Policy and Guidance 458

13.3. Existing Environmental Values Relevant to MNES 464
13.4. Summary of Potential Impacts to MNES and Mitigation Hierarchy 484
13.5. Summary of Proposed Mitigation Relevant to MNES 494
13.6. Northern Quoll (*Dasyurus hallucatus*) 500
13.7. Ghost Bat (*Macroderma gigas*) 511
13.8. Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) 524
13.9. Pilbara Olive Python (*Liasis olivaceus barroni*) 531
13.10. Summary of Significant Residual Impacts of Offset Requirements for MNES 539

14. HOLISTIC IMPACT ASSESSMENT 541
14.1. Connections and Interactions Between Environmental Factors 541
14.2. Consideration of Holistic Effects 543
14.3. Conclusion 545

15. CUMULATIVE IMPACT ASSESSMENT 551
15.1. Reasonably Foreseeable Projects 551
15.2. Summary of Cumulative Assessment for Key Environmental Factors 553
15.3. Predicted Cumulative Outcomes 564

16. REFERENCES 565

List of Tables

Table 1-1: Proponent Details 2
Table 2-1: General Proposal Description 8
Table 2-2: Proposal Elements with the Potential to have a Significant Effect on the Environment 9
Table 2-3: Changes to the Proposal to Avoid or Reduce Environmental, Cultural and Social Impacts 20
Table 2-4: Description of Land Systems Associated with the Development Envelope 28
Table 2-5: Current and Forecast Mining Proposals within 50 km of the Proposal and in the Hamersley Subregion 33
Table 3-1: Other Decision-Making Authority Approvals 40
Table 4-1: Key Stakeholders for the Proposal 44
Table 4-2: Principles of Stakeholder Engagement 47
Table 5-1: EP Act Principles 51
Table 6-1: Relevant Policy and Guidance for Flora and Vegetation 54
Table 6-2: Summary of Technical Studies for the Flora and Vegetation Factor 55
Table 6-3: Pre-European Vegetation Associations within the Development Envelope 60
Table 6-4: Vegetation Types within Development Envelopes 63
Table 6-5: Criteria used to Assign Significance to Flora and Vegetation 71
Table 6-6: Vegetation Types of Moderate Local Significance and Justification for Rating 73

Table 6-7: Characteristics of Riparian Vegetation Types within the Development Envelope 78

Table 6-8: Likelihood of GDV in the Development Envelope 80

Table 6-9: Vegetation Condition of Remnant Vegetation in the Development Envelope in the Development Envelope (Astron 2019a) 83

Table 6-10: Fire History of the Development Envelope 83

Table 6-11: Consolidated Vegetation Mapping Extents 88

Table 6-12: Significant Flora Species Recorded in Development Envelope 92

Table 6-13: Indicative Disturbance – High and Moderate Local Significance Vegetation Types 98

Table 6-14: Impacts to Significant Flora Species within the Development Envelope 100

Table 6-15: Extent of Other Current and Forecast Mining Proposal within 50 km of the Proposal and in the Hamersley Subregion 102

Table 6-16: Cumulative Impacts on Beard (Beard 1975) Vegetation Associations within the Hamersley Subregion 104

Table 6-17: Cumulative Impacts on Significant Flora Species within the Hamersley IBRA Subregion 105

Table 6-18: Changes in Impacts to Priority Flora from Changes in Proposal Design 107

Table 6-19: Changes in Impacts to Vegetation Units from Changes in Proposal Design 107

Table 6-20: Vegetation Units within Mining Exclusion Zones 1 and 2 112

Table 6-21: Application of the Mitigation Hierarchy for Flora and Vegetation 116

Table 6-22: Assessment of Impacts to Significant Vegetation 123

Table 6-23: Assessment of Impacts on Significant Flora Species 130

Table 6-24: Assessment of Impacts on Priority Annual or Short Lived Perennial Flora Species 134

Table 6-25: Summary of assessment for Flora and Vegetation 139

Table 7-1: Relevant Policy and Guidance for Terrestrial Fauna 141

Table 7-2: Summary of Technical Studies for Terrestrial Fauna Environmental Factor 143

Table 7-3: Fauna Habitat Significance Assessment Criteria for Significant Species 150

Table 7-4: Fauna Habitat Types within the Development Envelope (Astron 2020d) 151

Table 7-5: Consolidated Mapping Habitat Extents 155

Table 7-6: Characteristics and Utilisation of Ghost Bat caves identified within the Development Envelope 157

Table 7-7: Categories of Caves identified within the Development Envelope for Ghost Bat and Pilbara Leaf-nosed Bats 157

Table 7-8: Significant Fauna Recorded at or Likely to Occur within the Development Envelope 160

Table 7-9: Priority Fauna Recorded within the Development Envelope 177

Table 7-10: Priority Fauna with a High Likelihood to Occur within the Development Envelope but Not Recorded 177

Table 7-11: Critical and Supporting Fauna Habitat within the Survey Area and Surroundings 182

Table 7-12: Suitability of SRE Habitat within the Development Envelope 183

Table 7-13: SRE Species Recorded within the Development Envelope 184

Table 7-14: Caves potentially impacted within the Development Envelope for Ghost Bat and Pilbara Leaf-nosed Bats 191
Table 7-15: Indicative Disturbance – Fauna Habitat Types 193
Table 7-16: Definition of Level of Risk for SRE Invertebrate Fauna and Habitats (Biologic 2022) 194
Table 7-17: Assessment of Risk to SRE Fauna recorded within the Conceptual Footprint 195
Table 7-18: Occurrence of Significant Fauna Species within Approved and Reasonably Foreseeable Projects within 50 km of the Proposal 199
Table 7-19: Cumulative Impacts on Land Systems within the Pilbara Region 200
Table 7-20: Changes in Impacts to Critical Habitat Resulting from Changes in Proposal Design 201
Table 7-21: Habitat Protected by MEZs within the Development Envelope 206
Table 7-22: Upper Limit of Clearing for High Significance Habitat Types and Features 209
Table 7-23: Mitigation Measures for the Terrestrial Fauna Environmental Factor 212
Table 7-24: Assessment of Impacts to Fauna Habitat 219
Table 7-25: Assessment and Significance of Residual Impacts to Priority Fauna in the Development Envelope 224
Table 7-26: Assessment Findings and Proposed Conditions for Terrestrial Fauna 231
Table 8-1: Relevant Policy and Guidance for Subterranean Fauna 234
Table 8-2: Summary of Technical Studies for Subterranean Fauna Environmental Factor 236
Table 8-3: SRE Categorisation Used by WAM 241
Table 8-4: Troglofauna Taxa Recorded from the Surveys (Stantec 2022) 244
Table 8-5: Application of Mitigation Hierarchy for Troglofauna 253
Table 8-6: Summary of Stygofauna Taxa Recorded from the Development Envelope 259
Table 8-7: Mitigation Measures for Stygofauna Values 265
Table 9-1: Relevant Policy and Guidance for Inland Waters 269
Table 9-2: Summary of Studies 270
Table 9-3: Rainfall – Hope Downs 1 Weather Station and Newman Averages (mm) 271
Table 9-4: Significant Surface Water Features 275
Table 9-5: Pools of Cultural Significance 277
Table 9-6: Peak Flow and Critical Duration Estimates for Pebble Mouse Creek 279
Table 9-7: Modelled Peak Flows at Sensitive Receptors 279
Table 9-8: Total Modelled Volumes at Sensitive Receptors 280
Table 9-9: HD2 Deposit Groundwater Summary 285
Table 9-10: BHT Deposit Groundwater Summary 290
Table 9-11: Current Small Volume 5C Licences 295
Table 9-12: Catchment Area Loss – Weeli Wolli Creek 299
Table 9-13: Catchment Area Loss – Weeli Wolli Springs 299
Table 9-14: Catchment Area Loss – Pebble Mouse Creek 299

Table 9-15: Modelled Peak Flows at Sensitive Receptors Following Proposal Implementation 299
Table 9-16: Total Modelled Volumes at Sensitive Receptors Following Proposal Implementation 300
Table 9-17: Cumulative Impacts – Catchment Area (Weeli Wolli Creek) 319
Table 9-18: Application of the Mitigation Hierarchy for the Inland Waters 324
Table 9-19: Assessment Findings and Proposed Conditions for Inland Waters 332
Table 10-1: Relevant Policy and Guidance for Greenhouse Gas Emissions 336
Table 10-2: Estimated GHG Emissions from the Proposal (Rio Tinto 2022b) 339
Table 10-3: Proposal GHG Emissions Intensity 340
Table 10-4: Benchmarking Against Comparable Open Cut Iron Ore Mines in the Pilbara 341
Table 10-5: Mitigation Measures for the Greenhouse Gas Emissions Environmental Factor 343
Table 10-6: Interim and Long-term Emissions Reduction Targets (Rio Tinto 2022b) 347
Table 10-7: Assessment Findings and Proposed Regulatory Mechanisms for Greenhouse Gas Emissions 349
Table 11-1: Relevant Policy and Guidance for Social Surroundings 351
Table 11-2: Relevant Legislation for Social Surroundings 352
Table 11-3: Summary of Technical Studies for the Social Surroundings Factor 355
Table 11-4: Summary of In-field Archaeological and Ethnographic Heritage Surveys within the Development Envelope 358
Table 11-5: Social Surroundings Consultation (non-Traditional Owners) 360
Table 11-6: Potential Impacts for each Traditional Owner groups from the Proposal 366
Table 11-7: Potential Impacts to Social Surroundings from the Proposal 374
Table 11-8: Summary of Existing Design Changes to Avoid and Reduce Impacts from the Proposal 396
Table 11-9: Application of the Mitigation Hierarchy for Impacts to Social Surroundings - Water 403
Table 11-10: Application of the Mitigation Hierarchy for Social Surroundings - Sense of Place and Amenity (Dust, Noise and Vibrations) 406
Table 11-11: Application of the Mitigation Hierarchy for Social Surrounds - Sense of Place and Amenity (Visual Landscape, Land Use and Amenity) 410
Table 11-12: Application of the Mitigation Hierarchy for Social Surroundings - Access to Country 413
Table 11-13: Application of the Mitigation Hierarchy for Social Surroundings - Special Places (including Aboriginal Heritage Sites and Places) 418
Table 11-14: Application of the Mitigation Hierarchy for Social Surrounds - Plants and Animals of Cultural Significance 423
Table 11-15: Assessment Findings and Proposed Conditions for Social Surroundings 430
Table 12-1: Quantification of Residual Impact to be Offset 437
Table 12-2: Residual Impact Significance Model (RISM) 447
Table 12-3: Summary of Significant Residual Impacts to MNES Species Habitat Requiring Offsets 451
Table 12-4: Environmental Values from the Proposal that Require Offset 452
Table 12-5: Considerations of Principles of WA Offset Policy 455

Table 12-6: Consideration of Commonwealth Offset Principles 457

Table 13-1: Approved Conservation Advice, Listing Advice and Recovery Plans 459

Table 13-2: Relevant Threat Abatement Plans for the Proposed Action 461

Table 13-3: Summary of Technical Studies for MNES Fauna 466

Table 13-4: Habitat Significance Assessment Criteria for MNES Fauna Species under the EPBC Act 469

Table 13-5: MNES Fauna Habitat within the Development Envelope 471

Table 13-6: Characteristics and Utilisation of Ghost Bat Caves identified within the Development Envelope 477

Table 13-7: EPBC Act Listed Fauna Species and Likelihood of Occurrence in the Development Envelope 479

Table 13-8: Upper Disturbance Limits for Regional and High Significance MNES Habitat Types 485

Table 13-9: Caves potentially impacted within the Conceptual Footprint for Ghost Bat and Pilbara Leaf-nosed Bats 485

Table 13-10: Summary of Residual Impacts to MNES Fauna Species Following Implementation of Management and Mitigation Measures 495

Table 13-11: Critical and Supporting Habitat for Northern Quoll in the Development Envelope 503

Table 13-12: Assessment of the Significance of Impacts to Northern Quoll 507

Table 13-13: National Recovery Plan for the Northern Quoll 509

Table 13-14: Critical and Supporting Habitat for Ghost Bats within the Development Envelope 514

Table 13-15: Location of Ghost Bat Caves, Impacts and Mitigation Measures 516

Table 13-16: Assessment of the Significance of Impacts to Ghost Bat 519

Table 13-17: Pilbara Leaf-nosed Bat Habitat Types and Rating Scale (Bat Call WA 2021b) 525

Table 13-18: Assessment of the Significant Impact to Pilbara Leaf-nosed Bat 529

Table 13-19: Assessment of the Significance of Impacts on Pilbara Olive Python 536

Table 13-20: Significant Residual Impact Resulting from the Clearing of Critical and Supporting MNES Habitats within the Development Envelope 539

Table 14-1: Holistic Impact Assessment Summary 547

Table 15-1: Current and Forecast Mining Proposals within 50 km of the Proposal and in the Hamersley Subregion 551

Table 15-2: Pre-European Vegetation Associations within the Development Envelope (based on Beard 1975) 554

Table 15-3: Cumulative Impacts on Beard (Beard 1975) Vegetation Associations within the Hamersley Subregion 555

Table 15-4: Cumulative Impacts on Significant Flora Species within the Hamersley IBRA Subregion 556

Table 15-5: Occurrence of Significant Fauna Species within Approved and Reasonably Foreseeable Projects within 50 km of the Proposal 559

Table 15-6: Cumulative Impacts on Land Systems within the Pilbara Region 560

List of Figures

Figure 2-1: Regional Location of the Proposal 5
Figure 2-2: Development Envelope and Proposed Conceptual Footprint 6
Figure 2-3: Hope Downs Hub and Existing Approvals 7
Figure 2-4: Proposal Description - Development Envelope and Mining Exclusion Zones 10
Figure 2-5: Proposed Surface Water Management Infrastructure 15
Figure 2-6: Optimisation of the Conceptual Footprint 23
Figure 2-7: Monthly Mean Maximum Temperature (°C) and Mean Rainfall (mm) for Newman Aero Station (Station No. 007176) (BoM 2022) 25
Figure 2-8: IBRA Hamersley (PIL03) Subregion 26
Figure 2-9: Land Systems of the Development Envelope 29
Figure 2-10: Key Topographical Features, Rivers and Conservation Reserves 32
Figure 2-11: Existing and Reasonably Foreseeable Projects within the Hamersley Subregion 34
Figure 3-1: Native Title Determination Areas 38
Figure 3-2: Mining and Land Act Tenure 39
Figure 6-1: Flora and Vegetation Surveys and Studies within and Surrounding the Development Envelope 57
Figure 6-1a: Historical Flora and Vegetation Surveys and Studies within and Surrounding the Development Envelope 578
Figure 6-2: Vegetation Survey Effort within the Development Envelope 59
Figure 6-3: Pre-European Vegetation Associations 61
Figure 6-5: Distribution of Vegetation Types within the Development Envelope – Overview 67
Figure 6-5: Significant Vegetation within and around the Development Envelope – Overview 74
Figure 6-6: Riparian Vegetation within and around the Development Envelope 79
Figure 6-7: Likelihood Mapping of Groundwater Dependent Vegetation within and around the Development Envelope 82
Figure 6-8: Vegetation Condition within the Development Envelope – Overview 84
Figure 6-9: Recent Fire History of the Development Envelope and Surrounds 87
Figure 6-10: Consolidated Vegetation Map 90
Figure 6-11: Significant Flora Records within the Development Envelope – Overview 93
Figure 6-12: Avoidance of Impacts to Significant Flora and Vegetation - Overview 109
Figure 6-13: Vegetation Types and Priority Flora Species within the Mine Exclusion Zones 113
Figure 6-14: *Aristida lazaridis* Occurrences in Vegetation Units 136
Figure 7-1: Terrestrial Fauna Surveys 148
Figure 7-1a: Historical Terrestrial Fauna Surveys 148
Figure 7-2: Fauna Habitat Types within the Development Envelope 154
Figure 7-3: Consolidated Fauna Habitat Map 156
Figure 7-4: Recorded Northern Quoll Occurrences and Suitable Habitat within the Development Envelope - Overview 163
Figure 7-5: Recorded Ghost Bat Occurrences and Suitable Habitat in the Development Envelope – Overview 167
Figure 7-6: Suitable Habitat and Records of Pilbara Leaf-nosed Bat in the Development Envelope 171

Figure 7-7: Suitable Habitat for the Pilbara Olive Python within the Development Envelope and Surroundings 174
Figure 7-8: Priority Fauna Records within the Development Envelope – Overview 179
Figure 7-9: SRE Habitat and Records within the Development Envelope and Surroundings - Overview 186
Figure 7-10: Avoidance of Impacts to Significant Fauna – Overview 203
Figure 7-11: Habitat Types and Caves within the Mine Exclusion Zones (MEZs) 207
Figure 7-12: Cave 10 within Mine Exclusion Zone 2 208
Figure 8-1: Troglofauna Survey Effort 239
Figure 8-2: Stygofauna Survey Effort 240
Figure 8-3: Troglofauna Records in the Development Envelope and Adjacent Areas in relation to Mapped Geology 247
Figure 8-4: Stygofauna Records in the Development Envelope and Adjacent Areas in relation to Surface Geology and Groundwater Drawdown Extent 262
Figure 9-1: Surface Water Catchments and Water Features 274
Figure 9-2: Hydraulic Model Extent and Boundary Conditions 281
Figure 9-3: Groundwater Aquifers of the Development Envelope 283
Figure 9-4: Hydrogeological Cross Section of the HD2 Deposit 287
Figure 9-5: HD2 Pre-mining Water Levels (mAHD) 288
Figure 9-6: Hydrogeological Cross Section of the BHT Deposit 291
Figure 9-7: BHT Pre-mining Water Levels (mAHD) 292
Figure 9-8: 1:100 AEP Difference Map (Depth) 302
Figure 9-9: 1:5 AEP Difference Map (Depth) 303
Figure 9-10: 1:100 AEP Maximum Flood Depth in Pebble Mouse Creek following Haul Road Construction 305
Figure 9-11: 1:100 AEP Maximum Flow Velocities in Pebble Mouse Creek following Haul Road Construction 306
Figure 9-12: 1:5 AEP Maximum Flood Depth in Pebble Mouse Creek following Haul Road Construction 307
Figure 9-13: 1:5 AEP Maximum Flood Velocities in Pebble Mouse Creek following Haul Road Construction 308
Figure 9-14: 1:100 AEP Maximum Flood Depth in Pebble Mouse Creek following Long Term Road Train (LTRT) Construction 309
Figure 9-15: 1:100 AEP Maximum Flood Velocities in Pebble Mouse Creek following Long Term Road Train (LTRT) Construction 310
Figure 9-16: Proposed HD2 Surface Water Management Infrastructure 311
Figure 9-17: Proposed Pebble Mouse Creek Surface Water Management Infrastructure 312
Figure 9-18: Predicted Maximum Drawdown from HD2 Borefield Operations 314
Figure 9-19: Predicted Water Levels at the end of Abstraction from HD2 Borefield Operations 315
Figure 10-1: Proposed Scope 1 Emissions and Reduction Targets at Five Year Intervals (Rio Tinto 2023) 348
Figure 11-1: Social Setting and Land Use within and Around the Development Envelope 363
Figure 11-2: Native Title Determination Associated with the Development Envelope 367
Figure 11-3: Major Natural Landforms and Surface Water Infrastructure 372

Figure 11-4: Design Changes made to Avoid and Minimise Potential Impacts to Social Surroundings 400
Figure 12-1: Significant Species Home Range Utilised to Determine Total Offset Area for Critical and Supporting Habitat 449
Figure 12-2: Environmental Values Requiring Offsets 454
Figure 13-1: MNES Survey Effort within and Surrounding the Development Envelope 468
Figure 13-2: Fauna Habitat Types within the Development Envelope - Overview 474
Figure 13-3: Avoidance of Impacts to MNES Fauna - Overview 487
Figure 13-4: Recorded Northern Quoll Occurrences and Suitable Habitat within the Development Envelope – Overview 505
Figure 13-5: Recorded Ghost Bat Occurrences and Suitable Habitat within the Development Envelope 515
Figure 13-6: Cave 10 within Mining Exclusion Zone 2 518
Figure 13-7: Recorded Pilbara Leaf-nosed Bat Occurrences and Suitable Habitat within the Development Envelope 527
Figure 13-8: Suitable Habitat for the Pilbara Olive Python within the Development Envelope 534
Figure 14-1: Holistic View of Links Between Environmental Factors and Values 542
Figure 15-1: Existing and Reasonably Foreseeable Projects within the Hamersley Subregion 552

List of Plates

Plate 6-1: D4 ‘High’ Locally Significant Vegetation Type 72
Plate 6-2: H2 'High' Locally Significant Vegetation Type 72
Plate 7-1: Northern Quoll 161
Plate 7-2: Ghost Bat 165
Plate 7-3: Pilbara Leaf-nosed Bat 169
Plate 7-4: Pilbara Olive Python 172
Plate 11-1: Rocky Landscape with Rockshelters 369
Plate 11-2 Weeli Wolli Spring 370
Plate 11-3 Bedded Hilltop Range from the West 371

Appendices

Appendix A Chapters 1 to 5

A.1: Environmental Scoping Document

A.2: EPBC Checklist

A.3: Proposal Content Document

A.4: Hope Downs 2 Draft Mine Closure Plan

A.5: Hope Downs 2 Proposal Consultation Register

A.6: Draft Hope Downs 2 Greenhouse Gas Management Plan

A.7: Draft Hope Downs 2 Environmental Management Plan

Appendix B Flora and Vegetation

B.1: Hope Downs 2 Proposal Flora and Vegetation Survey Report

B.2: Hope Downs Development Envelope Consolidated Vegetation Mapping Report

B.3: Targeted Riparian Values Assessment of the Greater Hope Downs 1 Area

Appendix C Terrestrial Fauna

C.1: Hope Downs 2 Proposal Fauna Survey Report

C.2: Hope Downs Development Envelope Consolidated Fauna Habitat Mapping Report

C.3: Hope Downs 2 Proposal – Ghost Bat Cave Characteristics Report

C.4: Hope Downs 2 Proposal – Ghost Bat Memo

C.5: Hope Downs 2 Proposal Grey Falcon Assessment Report

C.6: Hope Downs 2 Proposal Matters of National Environmental Significance Fauna Assessment Report

C.7: Hope Downs 2 Proposal Matters of National Environmental Significance Northern Quoll Monitoring – Phase 3 of 3 Results (July – October 2022) and Phases 1 to 3 Summary Report

C.8: Hope Downs 2 Short-Range Endemic Invertebrate Fauna Preliminary Risk Assessment

C.9: Hope Downs 2 Proposal – Long Term Motion Cameras

Appendix D Subterranean Fauna

D.1: Hope Downs 2 Proposal Level 2 Troglofauna Survey

D.2: Hope Downs 2 Proposal Level 2 Stygofauna Survey

Appendix E Inland Waters

E.1: Assessment of Surface Water Impacts on Sensitive Receptors in the Weeli Wolli Creek Catchment

E.2: Hydrogeological Assessment of the Hope Downs 2 and Bedded Hilltop Deposits

E.3: Baby Hope Hydrology & Hydraulic Assessment

Appendix F CONFIDENTIAL

F.1: Heritage Values – Confidential

F.2: Hope Downs 2 Traditional Owner Consultation Summary – Confidential

F.3: Draft Nyiyaparli Social and Cultural Heritage Management Plan – Confidential

F.4: Banjima Social Surrounds HD2 Report – Confidential

F.5: Nyiyaparli HD2 Social Surrounds Report – Confidential

F.6: Ngarlawangga HD2 Social Surrounds Reports – Confidential

F.7: HD2 Air Quality Modelling Report – Confidential

F.8: HD2 Noise and Vibration Report – Confidential

Appendix G Offsets

G.1: Progressive Rehabilitation Summary

G.2: Draft Hope Downs 2 Impact Reconciliation Procedure

Abbreviations

Abbreviation	Description
ACCU	Australian Carbon Credit Unit
ACH Act	Aboriginal Cultural Heritage Act 2021
ACHMP	Aboriginal Cultural Heritage Management Plan
AEP	Annual Exceedance Probability
AH Act	Aboriginal Heritage Act (WA) 1972
AHD	Australian Height Datum
ALARP	As low as reasonably practicable
AMD	Acid and Metalliferous Drainage
ANFO	Ammonium Nitrate Fuel Oil
ARU	Autonomous recording Units
AWT	Above Water Table
BAM Act	Biosecurity and Agricultural Management Act 2007
BC Act	Biodiversity Conservation Act (WA) 2016
BESS	Battery Energy Storage System
BHP	BHP Billiton
BHT	Bedded Hilltop
BIF	Banded Iron Formation
BNTAC	Banjima Native Title Aboriginal Corporation
BWT	Below Water Table
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DG Safety Act	Dangerous Goods Safety Act 2004
DMA	Decision-making Authorities
DMIRS	Department of Mines, Industry Regulation and Safety
DPIRD	Department of Primary industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EAR	Ecosystem at Risk
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EP Act	Environmental Protection Act 1986
EPA	Environmental Protection Authority
EPA Services	Environmental Protection Authority Services
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERD	Environmental Review Document
ESA	Environmentally Sensitive Area

Abbreviation	Description
ESD	Environmental Scoping Document
ESG	Environmental, Social and Governance
GDE	Groundwater Dependent Ecosystem
GDV	Groundwater Dependent Vegetation
GHG	Greenhouse Gas
GHG EMP	Greenhouse Gas Environmental Management Plan
GIS	Geographic Information System
GL	Gigalitres
GL/a	Gigalitres per annum
GNH	Great Northern Highway
GWL	Groundwater Licence
HD2	Hope Downs 2
HSEC	Health, Safety and Environment and Communities
M	Migratory
IBRA	Interim Biogeographic Regionalisation for Australia
IBSA	Index of Biodiversity Surveys for Assessments
ICOMOS	International Council on Monuments and Sites
ICROA	International Carbon Reduction and Offset Alliance
IHMP	Integrated Heritage Management Program
ILUA	Indigenous Land Use Agreement
IRP	Impact Reconciliation Procedure
JTSI	Department of Jobs, Tourism, Science and Innovation
KNAC	Karlka Nyiyaparli Aboriginal Corporation
KNP	Karijini National Park
LAA	Lands Acquisition Act 1989
LAP	Land Access Protocol/s
LIC	Local Implementation Committee
LOM	Life of Mine
LTRT	Long-Term Road Train
mbgl	metres below ground level
MCP	Mine Closure Plan
MEZ	Mining Exclusion Zone
mg/L	Milligrams per Litre
MI	Migratory
Mining Act	Mining Act 1978
ML/d	Mega Litres per Day
MNES	Matters of National Environmental Significance
MRZ	Mine Restriction Zone
MRWA	Main Roads Western Australia
MS	Ministerial Statement

Abbreviation	Description
Mt	Million tonnes
NA	Not Applicable
NAC	Ngarlawangga Aboriginal Corporation
NAF	Non-Acid Forming
NDC	Nationally Determined Contributions
Air NEPM	National Environment Protection Measures for Ambient Air Quality
NGER Act	National Greenhouse and Energy Reporting Act
NMD	Neutral Metalliferous Drainage
NPI	National Pollutant Inventory
NT	Native Title
NT	Northern Territory
OTU	Operational Taxonomic Unit
p/a	Per annum
P	Priority
PAF	Potentially acid forming
PCD	Proposal Content Document
PEC	Priority Ecological Communities
PEOF	Pilbara Environmental Offsets Fund
PLNB	Pilbara Leaf-nosed Bat
PMP	Project Management Plan
PMST	Protected Matters Search Tool
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
Rio Tinto	Rio Tinto Iron Ore Group
RISM	Residual Impact Significant Model
RIWI Act	Rights in Water and Irrigation Act 1914
RNTBC	Registered Native Title Body Corporate
ROM	Run of Mine
RRJV	Roads Ridge Joint Venture
RR	Roads Ridge
RVA	Riparian Values Assessment
SCHMP	Social and Cultural Heritage Management Plan
SOP	Saleable Ore Product
SRE	Short Range Endemic
SS	Social Surroundings
TAP	Threat Abatement Plan
TEC	Threatened Ecological Communities
TO	Traditional Owner
TSI	Torres Strait Islander
TSP	Total Suspended Particles

Abbreviation	Description
UCL	Unallocated Crown Land
VHF	Very High Frequency
VU	Vunerable
WA	Western Australia
WAM	Western Australian Museum
WAOL	Western Australian Organism List
WoNS	Weeds of National Significance
WQPN	Water Quality Protection Notes
ZOI	Zone of Instability

1. INTRODUCTION

The Hope Downs 2 Proposal (the Proposal) involves the development of two new above water table (AWT) iron ore deposits, named Bedded Hilltop (BHT) and Hope Downs 2 (HD2). The Proposal is adjacent to the existing Hope Downs 1 mining operation and 80 km northwest of the township of Newman in the Pilbara Region of Western Australia. The Proposal is on the traditional lands of the Nyiyaparli, Ngarlawangga and Banjima people.

1.1. Purpose and Scope

The purpose of this Environmental Review Document (ERD) is to provide sufficient information on the Proposal and the effects of the Proposal on the environment to allow assessment of the Proposal under Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The ERD has been prepared in accordance with an Environmental Scoping Document (ESD) (Appendix A1) approved by the Western Australian Environmental Protection Authority (EPA) on 26 October 2022. The ERD content, format and environmental assessment are consistent with relevant EPA guidance.

A Section 43A application was submitted to the EPA, and this ERD has been prepared to reflect the scope of the Proposal as amended by that application.

This ERD presents detailed information on the environmental factors nominated by the EPA as potential 'key' environmental factors that implementation of the Proposal could potentially significantly impact.

The objectives of the ERD are to:

- Describe all operational components of the Proposal that have the potential to have a significant effect on the environment
- Describe the local and regional context within which the Proposal would be implemented
- Identify and assess the potential impacts of the Proposal implementation
- Describe the mitigation strategies the Proponent would use to avoid, minimise, manage, rectify and offset residual impacts
- Identify whether there are any residual impacts after the application of the avoidance and minimisation elements of the mitigation hierarchy and assess whether these residual impacts are significant
- Determine whether the Proposal can deliver environmentally acceptable outcomes considering applicable legal requirements and WA EPA policy objectives.

This ERD also satisfies the requirements for an accredited assessment under the EPBC Act and includes an assessment of potential significant impacts of the Proposal on Matters of National Environmental Significance (MNES) (Chapter 13) and a checklist of requirements outlined in Schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations) against the ERD (Appendix A2).

The ERD considers all phases of Proposal implementation, including construction, commissioning, operation and closure. Cumulative impacts with other existing and potential future projects are also assessed. The potential impacts to key environmental factors are described in detail and assessed using relevant studies specific to the Proposal, which are also described. Copies of the studies and reports used in preparing the ERD are provided as appendices.

1.2. Proponent

Hamersley HMS Pty Ltd (the Proponent) as manager of the Hope Downs Joint Venture (HDJV) between Hope Downs Iron Ore Pty Ltd (a member of the Hancock Prospecting Group) and Hamersley WA Pty Ltd (a member of the Rio Tinto Group). The Proponent details are provided in Table 1-1.

Table 1-1: Proponent Details

Item	Detail
Company	Hamersley HMS Pty Ltd
ACN	115 004 129
Address	152–158 St Georges Terrace, Perth WA 6000

The key contact for the Proposal is:

Sally Pickard

Senior Advisor, Environmental Approvals

152-158 St Georges Terrace, Perth WA 6000

+61 8 9327 2000

Sally.Pickard@riotinto.com

1.3. Proposal Terminology

The following terminology is used throughout this document:

Proposal: The Proposal is the development of two new above water table iron ore deposits and associated activities. The Proposal is the subject of this assessment and does not include the Existing Operations. See Section 2.1.1.

Approved Proposals: Refers to the proposals for Hope Downs 1 and Baby Hope as approved under MS 584, 893 and 1025. See Section 2.1.1.

Existing Operations: Refers to the existing iron ore operations that form the Approved Proposals (Hope Downs 1 and Baby Hope), collectively referred to as the 'Hope Downs 1 operations' and includes components of the Approved Proposals that have and those that are yet to be implemented. See Section 2.1.1.

Development Envelope: Refers to the area in which the new mine areas and associated facilities of the Proposal are located. All direct impacts associated with the Proposal will be contained within the Development Envelope.

Conceptual Footprint: Refers to the current indicative layout of the direct disturbance footprint of the Proposal, which includes key elements such as mine pits, waste rock landforms and infrastructure, to a maximum extent of 4,900 ha (Figure 2-2). This footprint is indicative only; therefore, the final location of key elements and infrastructure may occur outside the Conceptual Footprint within the Development Envelope and within any approval limits. This flexibility within the Development Envelope is part of this assessment, as the Proponent has allocated and undertaken survey work throughout the entire Development Envelope to support this assessment.

Mining Exclusion Zone (MEZ): Refers to an area within the Development Envelope where no mining excavation will occur, and only low impact activities associated with environmental and cultural heritage monitoring and management may be implemented. MEZ1 contains existing communications infrastructure that is to be maintained. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. There is to be no clearing of critical MNES habitat (Gorge/gully and Breakaway types), no impact to Ghost Bat caves and no clearing of P2 flora within MEZ.

2. PROPOSAL

2.1. Proposal Content

The Proposal includes the development of two new iron ore deposits, Bedded Hilltop (BHT) and Hope Downs 2 (HD2), and supporting infrastructure, located approximately 80 km north-west of the township of Newman in the Pilbara Region of Western Australia (Figure 2-1).

The Proposal includes a Conceptual Footprint of approximately 4,900 hectares (ha) to support the development, operation and closure of two new Above Water Table (AWT) iron ore deposits within a proposed Development Envelope of approximately 12,409.5 ha (Figure 2-2).

The Proposal Content Document is attached as Appendix A3.

2.1.1. Existing Operations

This Proposal is adjacent to the Proponent's existing Hope Downs 1 and Baby Hope Ministerial Statements (MS 584, 893 and 1025), collectively referred to as the 'Hope Downs 1 operations' (Figure 2-3).

The Hope Downs 1 operations include the following activities that do not form part of the Proposal:

- Below water table mining
- Management of surplus water including discharge to the environment
- Maintenance of Weeli Wolli Spring flow during operations by direct discharge
- Closure; as it relates to the backfill of below water table pits to above water table
- Re-establishment of Weeli Wolli Spring to a self-sustaining system by replenishment of the dewatered HD1 aquifer following closure.

These activities and associated impacts will continue to be managed under the above Ministerial Statements. The Proposal does not affect the Hope Downs 1 operations' ability to comply with its approval conditions.

The Proposal is not considered to be an expansion of the Hope Downs 1 operations as the Proposal does not seek to expand the processing capacity of the Hope Downs 1 mine or associated ore processing and transportation infrastructure, including the Hope Downs 1 operations railway facilities. The existing Hope Downs 1 operations ore processing and rail infrastructure will be used to process and transport iron ore for the Proposal into the Rio Tinto rail network. These facilities were approved under Ministerial Statement 584, therefore no impact assessment associated with the Proposal has been undertaken on the continued use of these facilities, with the exception of GHG emissions (addressed in Chapter 10).

Accordingly, the EPA determined to assess the Proposal on a stand-alone basis for conditioning separate from the Hope Downs 1 operations.

2.1.1.1. Shared Infrastructure

The ore from the Proposal will be processed and transported through the existing Hope Downs 1 operations infrastructure as Hope Downs 1 mine pits reach the end of their operational life. There is no proposed increase in ore tonnage through the Hope Downs 1 operations ore processing infrastructure. Therefore, this infrastructure is not expanding to accommodate the dry crushing and screening processing of iron ore for the Proposal. The Proposal includes tie-in to existing Hope Downs 1 operations ancillary infrastructure, including water pipelines, heavy and light vehicle access roads, communications and power, as outlined in Table 2-1.

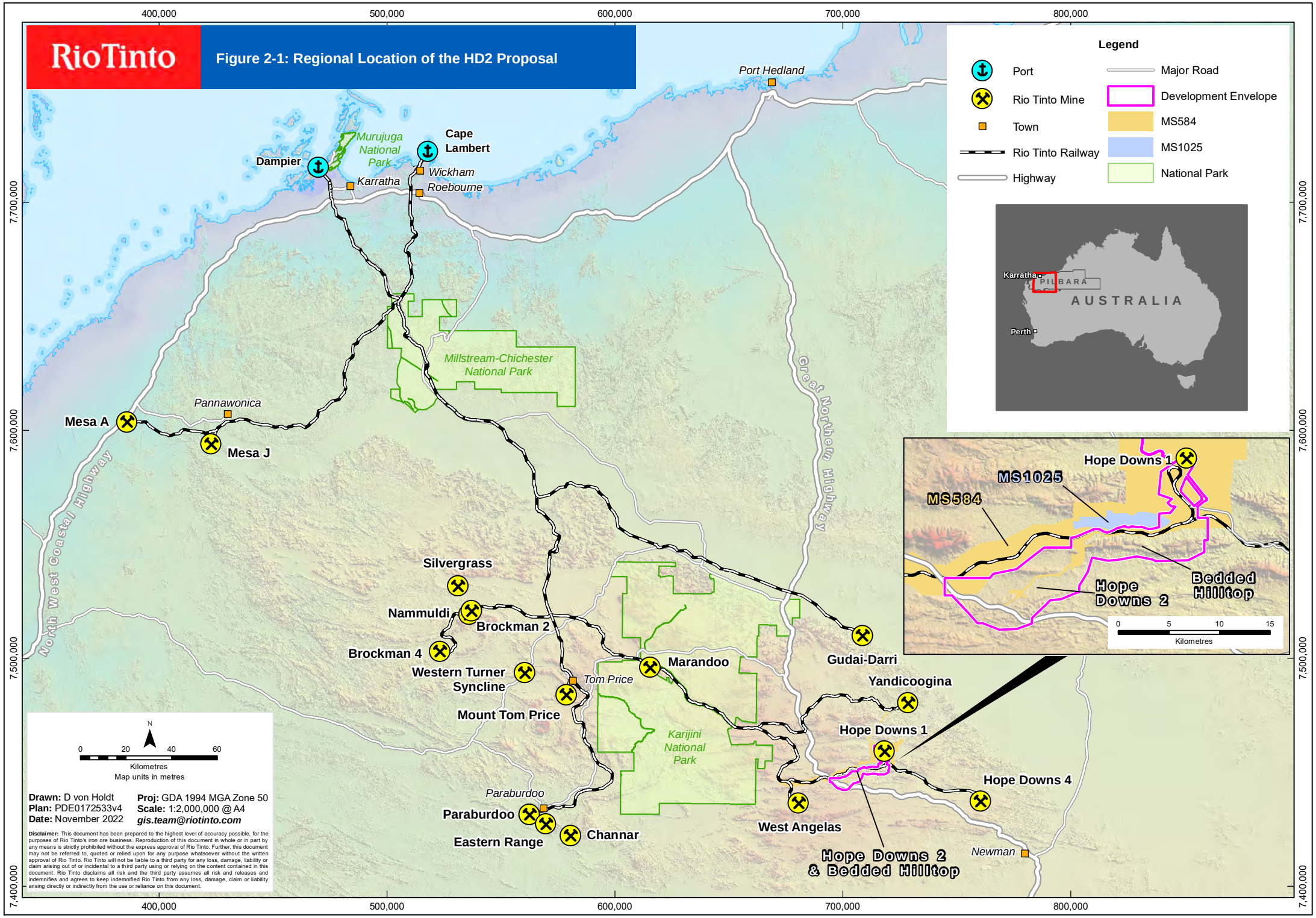
The Proposal also includes the development of the following secondary elements that will be located within areas of the Proposal Development Envelope that overlap with the existing Hope Downs 1 operations Development Envelope:

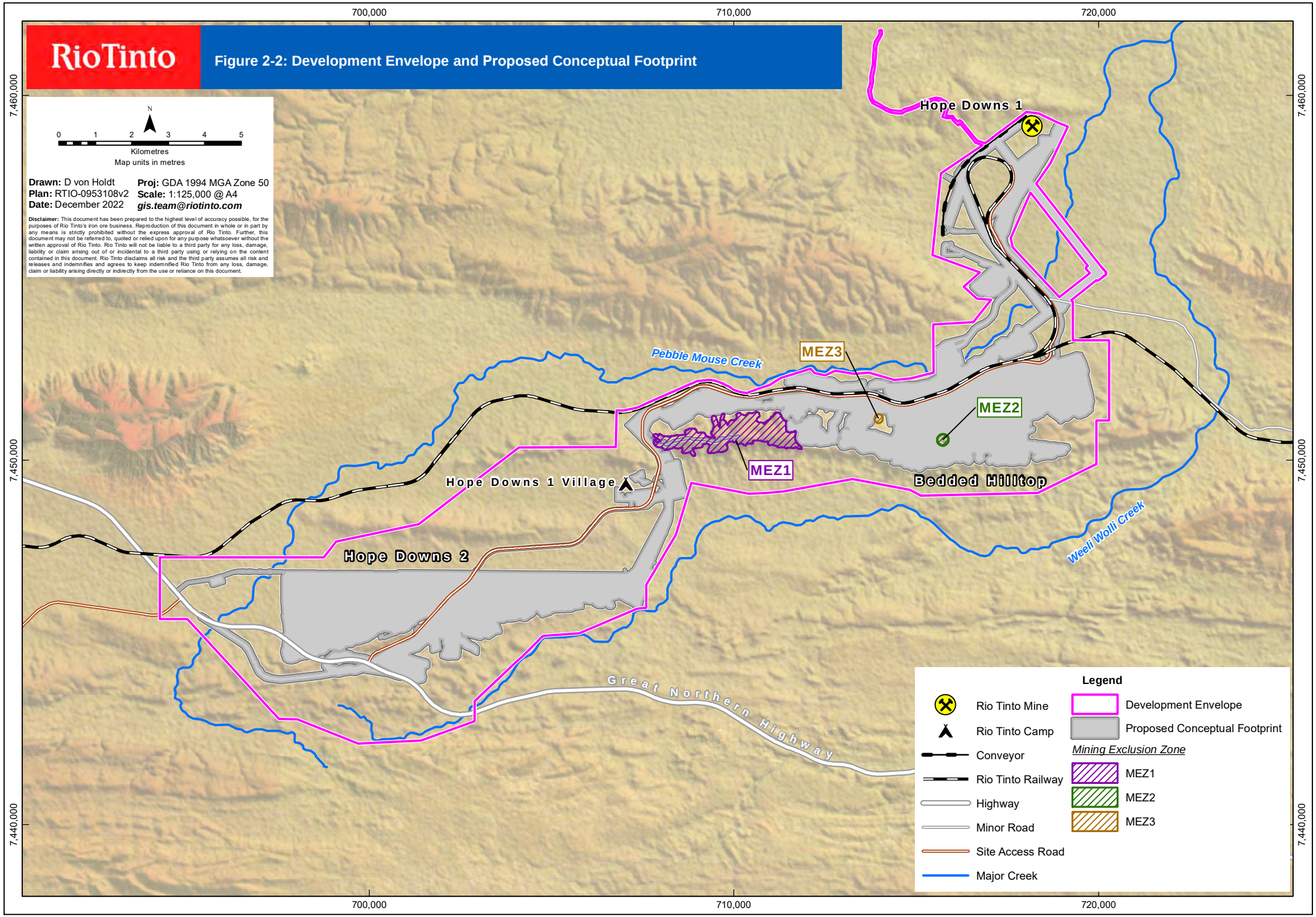
- Infrastructure for transportation of ore (via haul road, road train and/or conveyors) to Hope Downs 1 operations
- Water supply includes, water pipelines to transport surplus water from adjacent operations, such as Hope Downs 1 operations, to provide the Proposal's operational water supply
- Linear infrastructure will connect into existing Hope Downs 1 operations networks: including heavy and light vehicle access roads, railway crossing, conveyors, pipelines, power distribution network (including sub-stations), communications distribution network and associated communications infrastructure
- Accommodation includes an expansion of the existing village and potentially a new construction camp

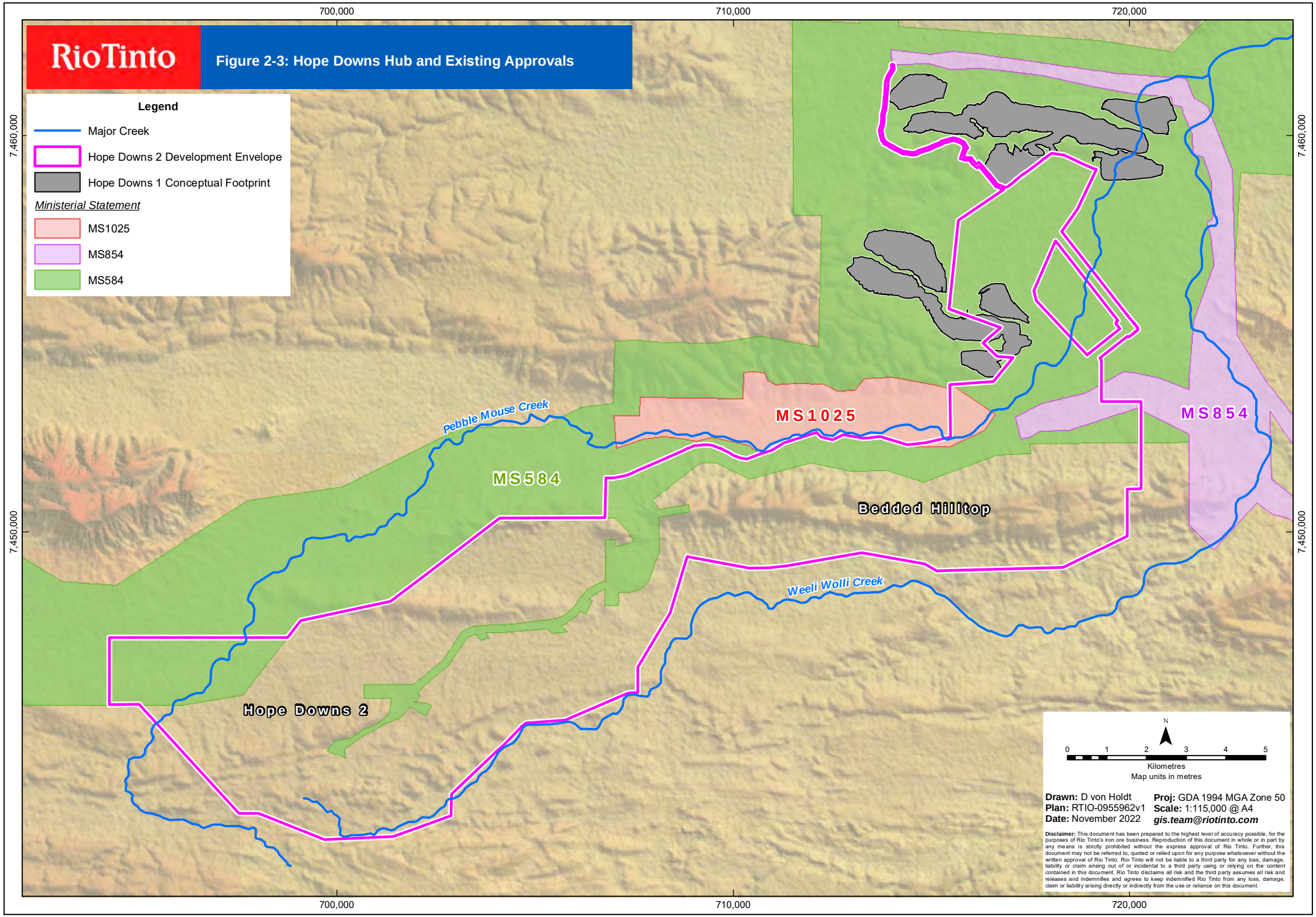
While these elements are proximate to the Hope Downs 1 operations, they are ancillary in nature to those operations and the additional infrastructure is solely required to support the implementation of Proposal.

2.1.1.2. Hope Downs 4 (MS 854 and 932)

The Hope Downs 4 mine (MS 854 and 932) is located approximately 40 km south-east of the Proposal. MS 854 includes infrastructure corridors, including an infrastructure corridor for a rail link into the Rio Tinto rail main line. This infrastructure corridor overlaps with a small area of the Proposal's Development Envelope. See Figure 2-3.


RioTinto
Figure 2-1: Regional Location of the HD2 Proposal
Legend
Port
Rio Tinto Mine
Town
Rio Tinto Railway
Highway
Major Road
Development Envelope
MS584
MS1025
National Park
Karratha
PILBARA
AUSTRALIA
Perth
Port Hedland
Cape Lambert
Dampier
Murujuga National Park
Wickham
Karratha
Roebourne
Millstream-Chichester National Park
Great Northern Highway
North West Coastal Highway
Pannawonica
Mesa A
Mesa J
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Tom Price
Mount Tom Price
Marandoo
Gudai-Darri
Yandicoogina
Karijini National Park
Hope Downs 1
Hope Downs 4
West Angelas
Hope Downs 2 & Bedded Hilltop
Newman
Paraburdoo
Eastern Range
Channar
MS1025
MS584
Hope Downs 1
Hope Downs 2
Bedded Hilltop
0 5 10 15
Kilometres
N
0 20 40 60
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172533v4
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:2,000,000 @ A4
gis.team@riotinto.com
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400,000
500,000
600,000
700,000
800,000
7,700,000
7,600,000
7,500,000
7,400,000


RioTinto
Figure 2-2: Development Envelope and Proposed Conceptual Footprint
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0953108v2
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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700,000
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Hope Downs 1
Pebble Mouse Creek
MEZ3
MEZ2
MEZ1
Hope Downs 1 Village
Bedded Hilltop
Hope Downs 2
Weeli Wolli Creek
Great Northern Highway
Legend
Rio Tinto Mine
Rio Tinto Camp
Conveyor
Rio Tinto Railway
Highway
Minor Road
Site Access Road
Major Creek
Development Envelope
Proposed Conceptual Footprint
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3


RioTinto
Figure 2-3: Hope Downs Hub and Existing Approvals
Legend
Major Creek
Hope Downs 2 Development Envelope
Hope Downs 1 Conceptual Footprint
Ministerial Statement
MS1025
MS854
MS584
700,000
710,000
720,000
7,460,000
7,450,000
Pebble Mouse Creek
MS1025
MS854
MS584
Bedded Hilltop
Weeli Wolli Creek
Hope Downs 2
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0955962v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
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2.1.2. General Proposal Description

The Proposal is located in the Pilbara Region of Western Australia, approximately 80 km northwest of Newman in the Shire of East Pilbara (Figure 2-1). The Proposal centres around the development of a new iron ore mining area comprising two AWT deposits: the HD2 deposit in the south-west of the Development Envelope and the BHT deposit in the north-east of the Development Envelope (Figure 2-2). Iron ore mined from the deposits will be transported by haul truck, road train or conveyor to the adjacent Hope Downs 1 operations for processing and then transported by rail to Rio Tinto's port facilities.

At the completion of mining, the proposed mining area will be decommissioned and rehabilitated to ensure the area is returned to a safe and non-polluting condition and that post-closure landforms are stable and revegetated with native species as appropriate.

Development of the HD2 deposit will require the realignment of up to 6 km-length of the Great Northern Highway, which will be carried out in accordance with the outcome of consultation with Main Roads WA. It will comply with all standards and specifications set out by Main Roads WA.

The general description of the Proposal is presented in Table 2-1, with a detailed discussion on the construction and operation of the key Proposal elements being presented in Section 2.1.3.

Table 2-1: General Proposal Description

General Proposal Description	
Proposal title	Hope Downs 2 Proposal
Proponent name	Hamersley HMS Pty Ltd
Short description	The Proposal is to develop and operate an AWT iron ore mine and associated infrastructure approximately 80 km north-west of Newman in the Pilbara region of Western Australia. The Proposal is on the traditional lands of the Nyiyaparli, Ngarlawangga and Banjima people. The Proposal includes but is not limited to the following: • Development and operation of two AWT iron ore deposits: HD2 and BHT • Mineral waste management infrastructure: including waste rock landforms, landbridges, low grade ore stockpiles, and topsoil and sub-soil stockpiles • New processing infrastructure: including dry processing facilities at HD2 and/or BHT deposits • Support facilities: including workshops, hydrocarbon storage areas, Ammonium Nitrate Fuel Oil (ANFO) facilities, laydown areas, turkey's nests, transfer pads and offices • Linear infrastructure: including heavy and light vehicle access roads, railway crossing, conveyors, pipelines, power distribution network (including sub-stations), communications distribution network and associated communications infrastructure • Renewable energy: including renewable energy generation (excluding wind turbines), energy storage, and associated ancillary infrastructure • Realignment of up to 6 km of the Great Northern Highway • Infrastructure for surface water management: including Pebble Mouse Creek crossings, diversion drains, levees and culverts • Infrastructure for water supply: including abstraction of groundwater and/ or use of surplus water from local sources and adjacent operations • Accommodation: including installation of an upgrade of existing accommodation and/or new construction camp

2.1.3. Detailed Proposal Description

The Proposal will require a disturbance footprint of up 4,900 ha within a proposed Development Envelope of approximately 12,409.5 ha (Figure 2-2 and Table 2-2).

The Development Envelope shown in Figure 2-2 incorporates all the Proposal elements and provides the boundary within which the Proposal will be implemented. The figure also shows the indicative location of Proposal elements within the Development Envelope, noting that the exact location and layout is still subject to ongoing heritage surveys and consultation with Traditional Owners as well as periodic design changes in response to changing market and operational conditions.

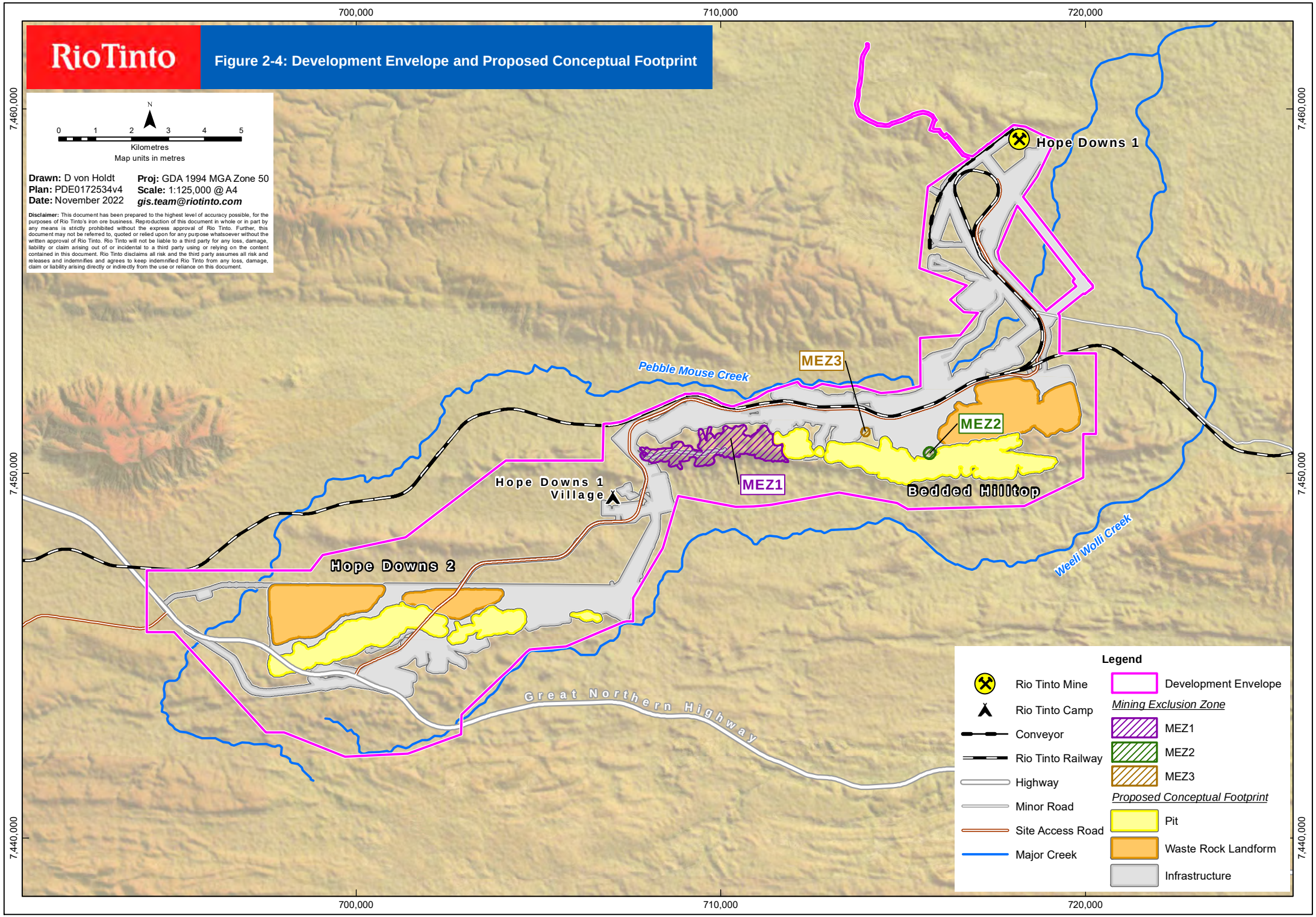
Table 2-2: Proposal Elements with the Potential to have a Significant Effect on the Environment

Proposal Elements	Location	Maximum Extent or Range
Physical Elements		
Mine and associated infrastructure	Figure 2-4	Clearing of up to 4,900 ha within a 12,409.5 ha Development Envelope.
Mining Exclusion Zones[1]	Figure 2-4	Mining Exclusion Zones[1] 1, 2 and 3.
Operational Elements		
Water supply		Abstraction of up to 3 GL per annum or use of surplus water from adjacent operations
Proposal elements with greenhouse gas emissions		
Scope 1[2]	Diesel and land clearing – no more than 200,518 tonnes of carbon dioxide equivalent (tCO_2-e) per annum	
Scope 2[2]	Electricity generation – no more than 6,330 tCO_2-e per annum	
Scope 3[3]	382 Mt CO_2-e	
Rehabilitation and Closure		
The key closure outcome of this Proposal will be a safe, stable and non-polluting landscape consistent with the post-mining land use and consider environmental and cultural heritage values.		
Other Elements that affect extent of effects on environment		
Proposal time	Maximum operational project life	Estimated 15 years

[1] Mining Exclusion Zone (MEZ): Refers to an area within the Development Envelope where no mining excavation will occur, and only low impact activities associated with environmental and cultural heritage monitoring and management may be implemented. MEZ1 contains existing communications infrastructure that is to be maintained. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. There is to be no clearing of critical MNES habitat (Gorge/gully and Breakaway types), no impact to Ghost Bat caves and no clearing of P2 flora within MEZ.

[2] Predicted peak annual emissions include forecast existing operations and new activities associated with the Proposal

[3] Attributable to this Proposal


RioTinto
Figure 2-4: Development Envelope and Proposed Conceptual Footprint
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172534v4
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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700,000
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Hope Downs 1
Pebble Mouse Creek
MEZ3
MEZ2
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Bedded Hilltop
Hope Downs 1 Village
Hope Downs 2
Weeli Wolli Creek
Great Northern Highway
Legend
Rio Tinto Mine
Rio Tinto Camp
Conveyor
Rio Tinto Railway
Highway
Minor Road
Site Access Road
Major Creek
Development Envelope
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Infrastructure

2.1.3.1. Native Vegetation Clearing and Topsoil Removal

Clearing up to 4,900 ha of additional native vegetation is proposed within the 12,409.5 ha Development Envelope. Clearing will occur during the implementation, operation and closure of the Proposal. Disturbance of native vegetation will be restricted to the minimum extent necessary.

Topsoil and subsoil will be recovered as part of clearing activities. Topsoil is essential in successful rehabilitation relative to subsoil or overburden material. It contains a natural seed bank and typically contains organic material and nutrients. Topsoil layers in the Pilbara, including in the Development Envelope, are highly variable in thickness, ranging from minimal soils on rocky areas to approximately 300 mm in valley areas. Stripped topsoil and subsoil will be stored in out-of-pit stockpiles for later use in rehabilitation.

2.1.3.2. Development of Mine Pits

The Proposal includes the development of AWT open cut pits at the HD2 deposit and BHT deposit (Figure 2-2). Mining is anticipated to involve conventional drill, blast, load and haul techniques whereby the blasted material will be excavated and loaded into haul trucks (i.e., bulk mining methods) for dry crushing and processing at existing operations and/or crushed/screened and hauled/conveyed to existing operations for processing. Mining equipment would include but not be limited to excavators, haul trucks, drill rigs, bulldozers, water trucks, service trucks and graders. In line with relevant Australian standards, explosives magazines would store explosives for open pit blasting activities.

2.1.3.3. Mineral Waste Management

Mineral waste generated by the Proposal will be stored in designated waste rock landforms, to be located out-of-pit, as shown on Figure 2-2. Mineral waste will also be used to construct land bridges. Additionally, opportunities for progressive backfilling of pits will be investigated as mine planning becomes further advanced. Other mineral waste management infrastructure includes low grade ore stockpiles, topsoil and subsoil stockpiles.

Deposits are expected to pose a low risk of acid metalliferous drainage (AMD) and will not require active management during operations or closure.

2.1.3.4. Linear Infrastructure

BHT Ore Transport Infrastructure

Ore will be transported from BHT deposit to the Hope Downs 1 operations primary ore crushing facilities via autonomous haul trucks, given this is a relatively short distance (up to 12 km). The BHT haul road network will consist of two landbridges to access the mining area, haul roads to access stockpiling areas, and a heavy vehicle road connecting BHT to the Hope Downs 1 operations infrastructure via the existing haul road network.

HD2 Ore Transport Infrastructure

The HD2 deposit is located approximately 28 km from the Hope Downs 1 operations ore processing facilities; as such, a more extensive study into ore transport options has been undertaken. Three potential options for the transport of ore from the HD2 deposit to the Hope Downs 1 operations ore processing facilities were considered:

- Haul trucks
- Crush/Conveyor
- Road Trains.

Further engineering work has resulted in haul trucks being discounted as an option for ore transport from HD2 deposit to the Hope Downs 1 operations processing plant. This is given they have a maximum haul distance of approximately 10 km, so it would not be suitable for the longer haul distance required.

The Proposal will build either a crush and conveyor option or a road train ore transport option to transport ore from the HD2 deposit to the Hope Downs 1 operations processing facilities. Only one option will be required and constructed, however, this impact assessment covers the potential impact of both options.

Road Trains

Road train transport is the preferred option, given the distance and the 15-year mine life. The road train transport option involves transport of ore along a 27 km long, sealed, dedicated heavy haulage road, which will be built to enable road trains to transfer ore from HD2 to laydown facilities adjacent to Hope Downs 1 operations. The road design will ensure full segregation between different types of vehicle traffic.

There are two transfer pad options, one near the HD1 North primary crusher and one near the HD1 South primary crusher. Transfer pads are a rehandling point where the ore from HD2 loaded road trains is dumped on a stockpile and loaded into haul trucks using front end loaders. Haul trucks will then transfer the ore to the HD1 crusher. The transfer pads are strategically located near the Hope Downs 1 operations processing hub located on relatively flat terrain, close to the existing Hope Downs 1 operations primary crushing facilities. The location of both transfer pads is also outside the 1% Annual Exceedance Probability (AEP) flood extent of Pebble Mouse Creek and does not impact any known conservation significant environmental values or heritage sites.

Conveyor Transport

If the conveyor ore transport option is developed, an overland conveyor will be used to transport the crushed ore from the HD2 deposit to the Hope Downs 1 operations transfer pads, adjacent to the existing HD1 run of mine (ROM) infrastructure. A primary ore crushing facility will be established at HD2 and ore from within the HD2 deposit will hauled to the proposed HD2 crusher with trucks.

General Linear Infrastructure

The Proposal will utilise existing ore processing and transport infrastructure associated with the Hope Downs 1 operations, including the rail line, as well as new infrastructure, includes but is not limited to:

- Heavy and light vehicle access roads
- Railway crossing
- Conveyors
- Pipelines, power distribution network (including sub-stations)
- Communications distribution network and associated communications infrastructure.

2.1.3.5. Renewable energy

To achieve net zero by 2050, emission abatement projects will be implemented both locally at the Proposal and throughout the Pilbara, focussed on displacement of gas in electricity generation and diesel in fleet with renewable energy sources and energy storage. The Proposal description includes renewable energy generation (excluding wind turbines), energy storage, and associated ancillary infrastructure in order to allow for the implementation of these opportunities. Opportunities will be undertaken within the Development Envelope and proposed Conceptual Footprint. Future improvements in technology will be monitored and assessed for feasibility over the life of the Proposal. The impacts associated with renewable energy generation and storage infrastructure are not considered different than those proposed for other supporting infrastructure. Specific renewables projects are not considered in the GHG chapter (Chapter 10) or GHG Environmental Management Plan (GHG EMP).

Wind generation activities are not included in this definition of renewable energy generation.

2.1.3.6. Operational Water Supply Strategy

Water will be required during construction and operations at a volume of about 3 GL per year (peak). A potable supply of 400 L per day per person will be required: with a peak of 800 personnel, equating to approximately 0.12 GL per year. This small volume of water can be sourced within the groundwater abstraction licence limits of the existing HD1 Village borefield and is therefore excluded from the water forecasting in this assessment.

Water demands for the Proposal will be met via the following:

- Use of surplus water from adjacent operations, such as water abstracted at Hope Downs 1 operations for mine dewatering, which will minimise water volumes released to the environment and minimise use of additional groundwater resources
- A borefield local to the Proposal to meet any potential shortfalls in the supply of water from the Hope Downs 1 operations.

Use of surplus water from the Hope Downs 1 operations will result in a reduction in discharge from HD1 to Weeli Wolli Creek. However, water supply for the maintenance of Weeli Wolli Spring will continue as required under Approved Proposals.

HD1 Water Supply

The HD1 Borefield comprises three borefields; the HD1N, HD1S and Baby Hope borefields. Annual abstraction volumes exceed 35 GL/year and are expected to reduce as the HD1 aquifer depletes and dewatering lessens. The abstracted water is currently used primarily to meet local operational demands (i.e., dust suppression and ore processing), with an important component used to maintain permanent pools at the Weeli Wolli Spring via a series of irrigation pipelines. Water not used on site or via the Weeli Wolli Creek irrigation spurs is discharged to Weeli Wolli Spring or down-stream of the Spring at 'the gabion', the licensed discharge point. It is a portion of the water that is currently discharged at the gabion that would be utilised as the Proposal water supply. The water supply strategy and associated environmental impacts are discussed further in Chapter 9.

2.1.3.7. Surface Water Management

The Proposal surface water management objective is to minimise impacts on the natural function and environmental value of water courses, including key environmental values described in Section 9.3, water quality and overland flow downstream from the mine area. The strategy also aims to minimise the impact of uncontrolled surface water movement on mine safety and mine production.

The Proposal includes infrastructure for surface water management, including crossings of Pebble Mouse Creek, diversion drains, floodways, levees and culverts.

Pebble Mouse Creek is a significant watercourse separating the existing mining facilities at HD1 South and the deposits of BHT and HD2. It is proposed that the haul road connecting HD1 to the BHT deposit will cross Pebble Mouse Creek and that an engineered crossing be constructed to manage flood risk.

The Proposal will build either a crush and conveyor option or a road train ore transport option to transport ore from HD2 deposit to the Hope Downs 1 operations processing facilities. The crossings associated with each option are:

- Road trains: one potential crossing of Pebble Mouse Creek for the long-term road train (LTRT) plus another crossing to access a potential transfer pad location (TP4)
- Conveyor: one crossing of Pebble Mouse Creek would be required for this transport option. There are currently two locations where this crossing may be located (Figure 2-5).

Only one option will be required and constructed, however, this impact assessment covers the potential impact of both options.

A crossing of Pebble Mouse Creek is required to construct the new Mine Access Road (Figure 2-5). The re-alignment of Great Northern Highway may require a new crossing of Pebble Mouse Creek in the form of a bridge, however, the requirement for this crossing is still to be determined, as the final engineering design for the Proposal is still being completed.

It is also proposed that a water transfer pipeline from HD1 be buried approximately 1.5 m beneath the creek bed adjacent to the Pebble Mouse Creek haul road crossing.

Drainage diversion infrastructure has been proposed at the HD2 deposit to manage drainage line ephemeral surface water flow around the pit. The diversion drain configuration aims to divert flow from a tributary of Pebble Mouse Creek that originally travelled north towards Weeli Wolli Creek in the southeast. The levee and drains have been designed to convey a 1:100 AEP event. Proposed alignments of these structures are shown in Figure 2-5.

At closure, operational diversion drains will either be removed or replaced with permanent surface water diversions. This will be determined in consultation with the Traditional Owners.

Surface water management infrastructure will be designed to minimise erosion and downstream sedimentation risks.

2.1.3.8. Processing Facilities

The Proposal utilises existing ore handling and processing infrastructure at the Hope Downs 1 operations, supported by the construction and utilisation of the following:

- Dry crushing and screen processing facilities at HD2 deposit
- Run of mine (ROM) pads
- Ore stockpile.

No wet processing of ore is proposed, as deposits are AWT.

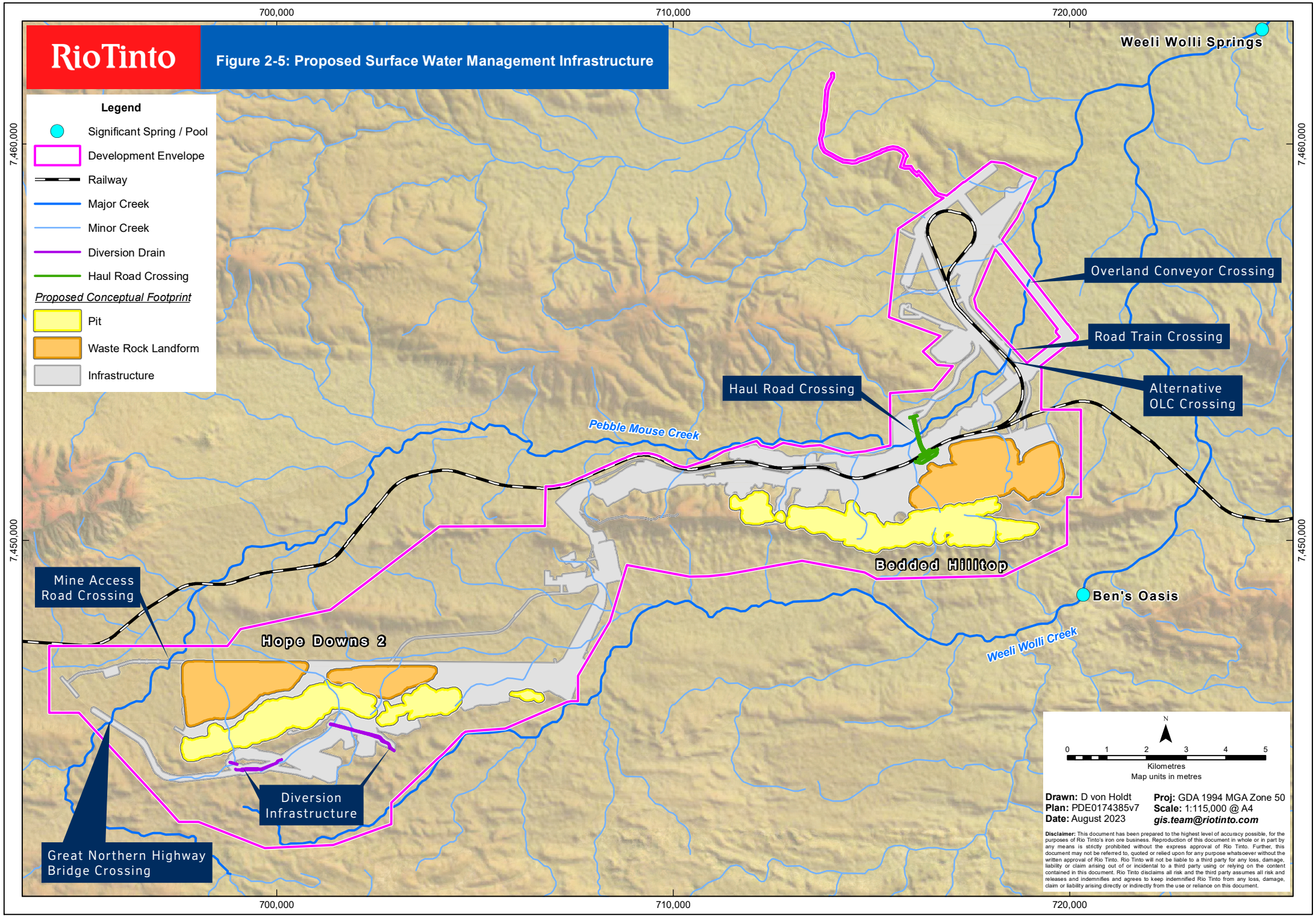
2.1.3.9. Support Facilities

The Proposal will utilise existing support facilities at the Hope Downs 1 operations, where possible, but new facilities will be required, including but not limited to:

- Heavy and light vehicle workshops and fixed plant workshops
- Hydrocarbon storage areas
- ANFO facilities
- Laydown areas
- Turkeys' nests
- Transfer pads
- Offices.

2.1.3.10. Accommodation

The accommodation for the operational workforce will result in the upgrade and/or expansion of the existing Hope Downs 1 operations accommodation and/or the installation of an additional camp within the proposed Conceptual Footprint of the Proposal. These camps may also be developed to support the construction crew.


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Figure 2-5: Proposed Surface Water Management Infrastructure
Legend
Significant Spring / Pool
Development Envelope
Railway
Major Creek
Minor Creek
Diversion Drain
Haul Road Crossing
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Infrastructure
700,000
710,000
720,000
7,460,000
7,450,000
Weeli Wolli Springs
Overland Conveyor Crossing
Road Train Crossing
Alternative OLC Crossing
Haul Road Crossing
Pebble Mouse Creek
Bedded Hilltop
Ben's Oasis
Weeli Wolli Creek
Mine Access Road Crossing
Hope Downs 2
Diversion Infrastructure
Great Northern Highway Bridge Crossing
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0174385v7
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:115,000 @ A4
gis.team@riotinto.com
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2.1.3.11. Waste Management

The Proponent has existing systems and procedures to collect and recycle waste streams such as hydrocarbon wastes (oil, drums, rags, filters, etc.), tyres, batteries, scrap metal and conveyor belting. These existing systems will be used for the Proposal. Hazardous wastes will be collected and removed for treatment by licensed contractors. The Proponent will utlise existing licenced landfills at adjacent Hope Downs 1 operations, to minimise the number of new landfills required for the implementation of the Proposal. Approval for new licenced landfills will be sought under Part V of the EP Act.

2.1.3.12. Great Northern Highway Realignment

The Great Northern Highway is the main highway connecting Perth to Port Hedland and Wyndham. The highway passes through Newman and is the main access to the Pilbara and Kimberley.

A portion of the current alignment of the Great Northern Highway sits over the proposed HD2 deposit. Therefore, to mine this portion of the HD2 deposit, up to 6 km of the highway may need to be re-aligned to the west (Figure 2-2).

The realignment may also include the construction of an alternative bridge crossing further upstream of Pebble Mouse Creek.

Consultation with Traditional Owners and adjacent tenure holders has commenced and may impact the final alignment route, including the option for not moving Great Northern Highway. As options are developed and consultations with third parties progress, the Proponent will continue to consult with Main Roads to finalise the alignment, land assembly and construction model for the Great Northern Highway re-alignment. The alignment will also comply with Main Roads requirements, including the required 1 km buffer from mining/blasting activities.

Tenure for the re-alignment of the Great Northern Highway will be sought by the Proponent once the final alignment is determined, in consultation with Main Roads WA. Current underlying mining tenure, L47/52, will not be used to construct this infrastructure.

2.1.4. Proposal Exclusions

The scope of the Proposal subject to assessment excludes:

- Low impact activities required to inform proposal planning and investigation during the Part IV of the EP Act assessment, including, but not limited to, drilling and associated activities for resource evaluation, geotechnical assessment, and hydrogeology investigations. These activities will be subject to the relevant provisions under Part V of the EP Act and the *Rights in Water and Irrigation Act 1911* (RIWI Act)
- Activities that are part of or required for continuation of the Approved Proposals or other Rio Tinto sites.

Current Rio Tinto operational activities are authorised via statutory environmental approvals under Part IV and V of the EP Act and the RIWI Act. The Proponent notes that whilst the Proposal is under assessment, additional approvals or amendments to the Approved Proposals may be required to support the continuation of existing operations that do not relate to the implementation of this Proposal. Therefore, the above exclusions are not limited to only those activities already approved but also to activities authorised by existing approvals as they may be amended (including under Section 45C of the EP Act).

The EPA's consent may be sought for minor or preliminary works associated with the Proposal under Section 41A (3) of the EP Act.

2.1.5. Approach to Impact Assessment

The Proponent has defined the Development Envelope, which contains the Proposal's construction and operational activities. The Proposal's final footprint will be located within the Development Envelope.

An indicative conceptual layout and associated disturbance area referred to as the proposed Conceptual Footprint, has been provided to represent the Proposal's maximum amount of disturbance for construction and operational activities.

Iron ore mines can operate over many years, and pit and waste rock landforms and infrastructure requirements can change over time as they are subject to environmental and heritage considerations, market influences, business requirements, legal agreements and customer demand. Also, over time new technology and advances unfold that enable the implementation of improved mining and infrastructure practices.

In order to allow for a full environmental impact assessment (EIA) of the Proposal but also enable the flexibility to implement the Proposal, the entire Development Envelope has been assessed for mining activities and surveys undertaken in accordance with EPA guidance. Where areas of significant environmental or cultural heritage are within the Development Envelope, Mining Exclusion Zones (MEZs) have been applied or other methods to achieve the EPA's objectives, including outcome or management-based conditions or management plans.

The Conceptual Footprint and the activities of this Proposal can occur across the Development Envelope up to the authorised extent, subject to the proposed MEZs and other limits as proposed in conditions or management plans.

2.1.5.1. Mining Exclusion Zones

MEZs are defined as an area within the Development Envelope where no mining excavation will occur. Only low-impact environmental, heritage and cultural monitoring and management activities may be implemented. MEZ1 contains existing communications infrastructure that is to be maintained. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. There is to be no clearing of critical MNES habitat (Gorge/gully and Breakaway types), no impact to Ghost Bat caves and no clearing of P2 flora within the MEZs. MEZs form part of the Proposal Content Document (Appendix A3) and are shown on Figure 2-3.

Two MEZs (MEZ1 and MEZ2) are proposed to protect habitat that is important for conservation significant species, particularly Northern Quoll and Ghost Bat habitats, specifically:

- MEZ1 (233 ha) – established to protect:
    - Known locations for Northern Quolls recorded at the southern extent of the range of the species (as identified in the baseline surveys)
    - Northern Quoll habitat (55 ha of high value Gorge/Gully and Breakaway habitats; and 178 ha of connected foraging and dispersal habitat)
    - Three Ghost Bat caves (Caves 3, 5 and 6) which are confirmed or potential nocturnal roosts
    - Pilbara Leaf-nosed Bat supporting habitat is three Category 4 caves (Cave 3, 5 and 6)
    - Known Priority 2 flora (*Eremophila* sp. West Angelas [S. van Leeuwen 4068]) records.
- MEZ2 (8 ha) – established to ensure that the integrity and surrounding habitat of the potential maternity Ghost Bat cave (a Category 2 cave, Cave 10) is maintained for use by Ghost Bats. A 150 m buffer has been applied to Cave 10 to protect it from mining/blasting. The cave is also a Pilbara Leaf-nosed Bat Category 4 cave and considered supporting habitat for the species.

An additional MEZ, MEZ3, is proposed to protect heritage site BDH 16-03 at BHT. MEZ3 has been added at the request of the Nyiyaparli Traditional Owners. Note this occurred late in the preparation of

the ERD and has not been considered in the assessment of impacts in Chapters 6, 7 or 13. Values protected by MEZ3 are discussed further in Chapter 11.

MEZ2 – Cave 10

Cave 10 is a Category 2 Ghost Bat cave and a Category 4 Pilbara Leaf-nosed Bat cave.

MEZ2 was established with the entrance to Cave 10 as the centre-point, with a 150 m buffer forming the boundary of the MEZ. The 150 m buffer was established based on expert advice on suitability of buffers to be designated around Hamersley Range Ghost Bat Category 2 and 3 roosts. The intention of MEZ2 and PPV controls proposed in the EMP (Appendix A7) is to provide adequate protection to maintain the structural integrity and ecological function of the roost, providing a buffer predominantly from direct impacts. Further management and monitoring measures are outlined in the EMP (Appendix A7).

2.2. Proposal Alternatives

2.2.1. Justification of the Proposal

The Proponent is the manager of the Hope Downs Joint Venture (HDJV) which operates the Hope Downs Hub on behalf of the participants in the HDJV. Ore from the Hope Downs Hub supplies the global market with iron ore. This Proposal is required as part of the plan to sustain iron ore production from the Hope Downs Hub mining operations.

Subject to future development decisions being made by the HDJV participants, the Proposal is capable of supplying ore for approximately 15 years and is critical to sustain the Hope Downs Hub mining operations. The Proposal will supplement iron ore production from the region and will provide ore required for the Pilbara Blend whilst optimising the use of existing Rio Tinto infrastructure, processing facilities and accommodation, as far as practicable, thereby reducing the disturbance footprint that would otherwise be required.

The Proposal will result in economic benefits for Australia and Western Australia regions through:

- Contribution to the value of mineral exports
- Royalties and taxation payments
- Capital investment
- Sustained direct and indirect employment opportunities in the region
- Sustained 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 support social and economic development projects, including:

- Continued education, training, employment and business opportunities for local people, including local Aboriginal people and Traditional Owners
- Continued funding for various regional organisations, including sporting and cultural groups.

The Proposal will continue to use 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 greenfield project of this scale.

2.2.2. Consideration of Alternatives

The Proposal's Development Envelope, Conceptual Footprint and operational design have been through numerous iterations during the planning process to ensure options to balance production goals against the requirement to avoid or minimise any direct and indirect impacts to environmental and

cultural values. The options that have been identified and implemented are summarised in Table 2-3 and shown on Figure 2-3.

Consultation undertaken with the Nyiyaparli Traditional Owners in the second half of 2021 has resulted in the following changes to the Proposal:

- Reduction in the size of the Development Envelope
- Weeli Wolli Creek near the HD2 deposit has been excluded from the Development Envelope to the north
- Proposed waste rock landform adjacent to Weeli Wolli Creek near the HD2 deposit has been eliminated from the Conceptual Footprint

The details of the changes are outlined in Table 2-3 and shown on Figure 2-3.

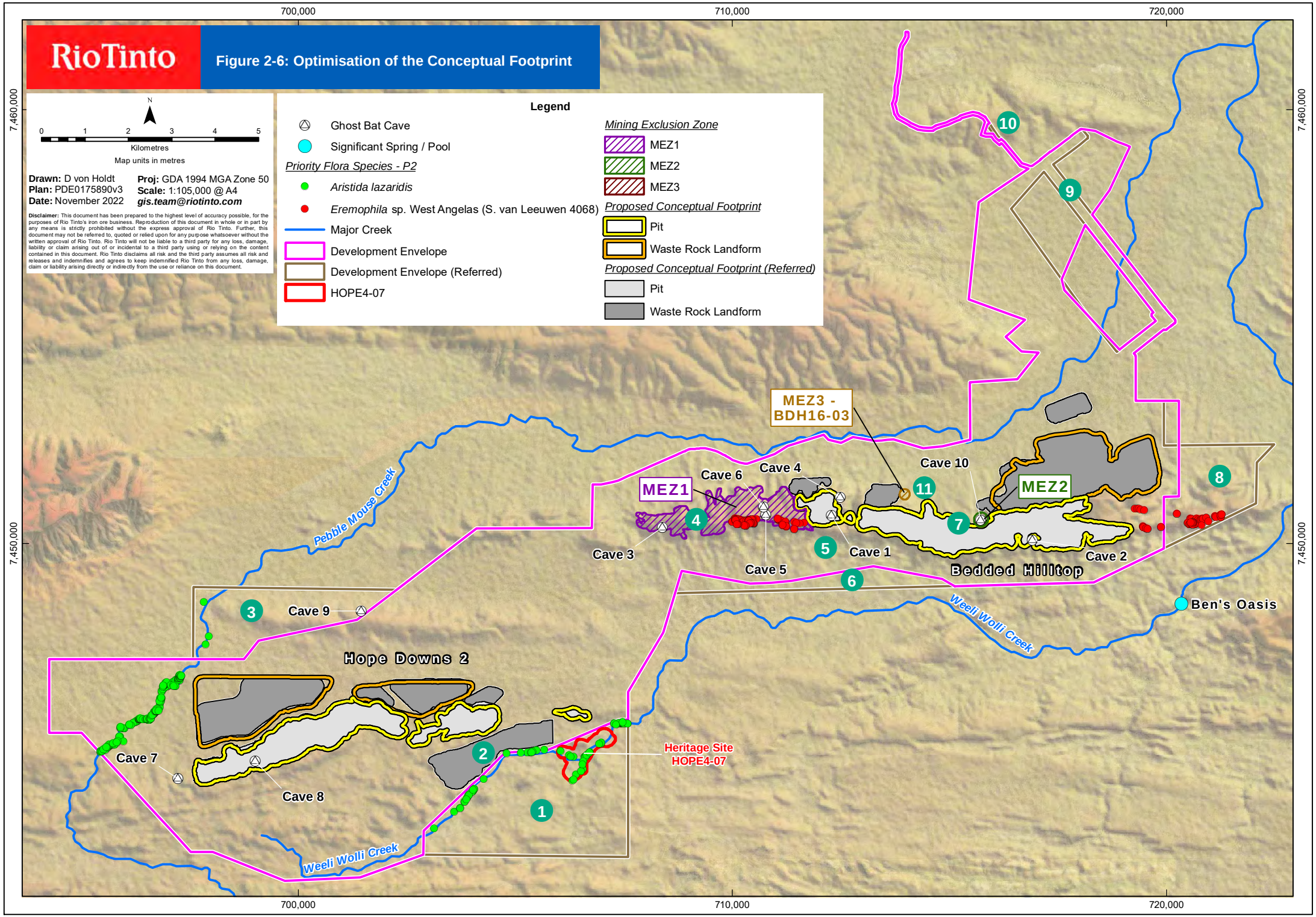
A Section 43A application was approved by the EPA on 17 January 2023 and this ERD has been prepared in line with the scope of that application.

Table 2-3: Changes to the Proposal to Avoid or Reduce Environmental, Cultural and Social Impacts

Changes Made (Reference Number in Figure 2-6)	Outcome Achieved
1. The Development Envelope was reduced and moved to the north of Weeli Wolli Creek, near HD2 deposit A Section 43A application has changed the Development Envelope from the s38 referral.	Excluded the culturally significant site HOPE 4-07 from the Development Envelope at the request of the Nyiyaparli Traditional Owners. Minimised area of Weeli Wolli Creek that is in the Development Envelope, at the request of the Nyiyaparli Traditional Owners. Reduced the area of the Development Envelope, at the request of the Nyiyaparli Traditional Owners. Changes in the Development Envelope has reduced the impact to critical MNES (Gorge/gully and Breakaway) habitat by approximately 50% and impacts to Priority flora have reduced by: • Priority 2 flora species *Aristida lazaridis* (2,639 individuals avoided, approximately 50% of the population is now outside the Development Envelope) • Priority 2 flora species *Eremophila* sp. West Angelas (121 individuals avoided, approximately 16% of the population is now outside the Development Envelope) • Priority 4 flora species *Lepidium catapycnon* (2,345 individuals avoided, approximately 21% of the population is now outside the Development Envelope)
2. Plans at the HD2 deposit for a waste rock landform to be developed adjacent to Weeli Wolli Creek and HOPE 4-.07 site were revised	Waste rock landform no longer adjacent to Weeli Wolli Creek, at the request of the Nyiyaparli Traditional Owners who were concerned about the impact to the visual amenity and potential impacts to water quality of Weeli Wolli Creek.
3. Development Envelope reduced and the area of Pebble Mouse Creek was excluded from Development Envelope	Minimised area of Pebble Mouse Creek that is in the Development Envelope, at the request of the Nyiyaparli Traditional Owners. Reduced the area of the Development Envelope, at the request of the Nyiyaparli Traditional Owners. The change in Development Envelope has resulted in one Category 4 Ghost Bat cave now located outside of Development Envelope.

Changes Made (Reference Number in Figure 2-6)	Outcome Achieved
4. MEZ1 established over 233 ha	MEZ1 was established to avoid impacts to: • Northern Quolls recorded at the southern extent of the range of the species (as identified in the baseline surveys) • Northern Quoll habitat (55 ha of high value Gorge/Gully and Breakaway habitats; and 178 ha of connected foraging and dispersal habitat), • Three Ghost Bat caves, one Category 3 (Caves 5) and two (Caves 3 and 6) • Three Pilbara Leaf-nosed bat caves, all Category 4 (Caves 3, 5 and 6) • Priority 2 flora: 85% of known *Eremophila* sp. West Angelas (S. van Leeuwen 4068) and 13% *Hibiscus* sp. Gurinbiddy Range records within the Development Envelope
5. Plans for a waste rock landform on the southern façade of BHT has been revised and is no longer included in the Proposal	Important fauna movement corridor is retained Visual impacts to the southern façade of BHT are eliminated
6. Development Envelope reduced to the south of BHT deposit	Reduced the area of the Development Envelope, at the request of the Nyiyaparli Traditional Owners.
7. MEZ2 (8 ha) established, with minimum 150 m buffer from mining/blasting	MEZ2 established to ensure that the integrity and surrounding habitat of the potential maternity Ghost Bat cave (a Category 2 cave, named Cave 10) is maintained for use by Ghost Bats.
8. Development Envelope reduced to the east of BHT deposit.	Reduction in the Development Envelope excludes Priority 2 flora species *Eremophila* sp. West Angelas (S. van Leeuwen 4068) records and critical MNES habitat from the Development Envelope.
9. Maximise use of existing facilities at the Hope Downs 1 operations	Reduction in overall disturbance footprint.
10. Development Envelope changed to avoid impact to a heritage site	Development Envelope and power infrastructure alignment changed to avoid impact to a registered heritage site.
11. MEZ3 established, incorporating 150 m buffer from mining/blasting	Protection of culturally significant site BDH16-03.
The number of creek crossings has been kept to a minimum and is designed to ensure natural flows are not significantly impeded, particularly during low-flow periods, and that fauna can move through the culverts	Reduction in impacts to Pebble Mouse Creek.

Changes Made (Reference Number in Figure 2-6)	Outcome Achieved
All proposed mine pits will be AWT	Avoidance of impacts associated with mine dewatering, including discharge of excess mine dewater.
The primary water supply for the Proposal is intended to be from adjacent operations, i.e. the Hope Downs 1 operations dewatering program	Waste groundwater stewardship through reducing unnecessary discharge to Weeli Wolli Creek and minimising impacts to the local aquifers.
Road train transport option would use a sealed road for road trains carrying ore between the HD2 deposit and Hope Downs 1 operations	Reduction in dust emissions and turbid runoff to Pebble Mouse Creek.


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Figure 2-6: Optimisation of the Conceptual Footprint
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0175890v3
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:105,000 @ A4
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Legend
Ghost Bat Cave
Significant Spring / Pool
Priority Flora Species - P2
Aristida lazaridis
Eremophila sp. West Angelas (S. van Leeuwen 4068)
Major Creek
Development Envelope
Development Envelope (Referred)
HOPE4-07
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Proposed Conceptual Footprint (Referred)
Pit
Waste Rock Landform
700,000
710,000
720,000
7,460,000
7,450,000
MEZ3 - BDH16-03
MEZ1
MEZ2
Cave 1
Cave 2
Cave 3
Cave 4
Cave 5
Cave 6
Cave 7
Cave 8
Cave 9
Cave 10
Bedded Hilltop
Hope Downs 2
Ben's Oasis
Heritage Site HOPE4-07
Pebble Mouse Creek
Weeli Wolli Creek
Weeli Wolli Creek
1
2
3
4
5
6
7
8
9
10
11

2.3. Local and Regional Context

2.3.1. Environmental Setting

2.3.1.1. Climate

The Hope Downs Hub area is a semi-arid to arid environment, characterised by hot summers and warm winters. The region experiences climate extremes, where severe droughts and major floods can follow in close succession.

The climate of the Pilbara region is classified as arid tropical with two distinct seasons: a hot, wet summer (October – April) and a mild, dry winter (May – September) (BoM 2022).

Based on long-term climatic data from the nearest Bureau of Meteorology weather station at Newman Aero (Station 007176), approximately 90 km south-east of the Proposal, the mean annual rainfall since 1971 is 324 mm, with a range of 37 mm to 620 mm. The mean maximum monthly temperatures since 1996 range between 23.1°C and 39.3°C, and are above 30°C for much of the year (BoM 2022) (Figure 2-7). The mean annual pan evaporation is 3,385 mm, greatly exceeding the mean annual rainfall and highlighting the water-limited environment and the significance of permanent water bodies in the region.

Climate Change

For the period 1970 - 2016, the following climate trends have been identified for the central Pilbara area in which the Proposal is located (BoM 2022):

- Annual mean temperature has increased 0.2°C per decade, largely during winter and spring months, and annual maximum temperature has increased by 0.4°C per decade
- Annual rainfall has increased 10 – 20 mm per decade, and rainfall patterns have shifted to become more summer-dominated
- Annual pan evaporation has decreased 2.5 – 5 mm per decade.

Climate projections show very high confidence for substantial temperature increases to continue in the Pilbara, with the north-west of Western Australia warming more than elsewhere in Australia (DPIRD 2021).

Annual average temperature in the Pilbara is projected to increase:

- By 2030: a rise of 0.6–1.5°C for all emission scenarios
- By 2090: a rise of 1.5–3.1°C for medium and 3.1–5.6°C for high emission trajectories.

Annual rainfall is projected to remain largely unchanged to 2090 and there is high confidence that natural rainfall variability will remain the primary driver of rainfall changes to 2030. There is medium confidence that tropical cyclones will become less frequent in future but will increase in intensity. There is high confidence that potential evaporation will increase, but only medium confidence in the magnitude of the change (DPIRD 2021).

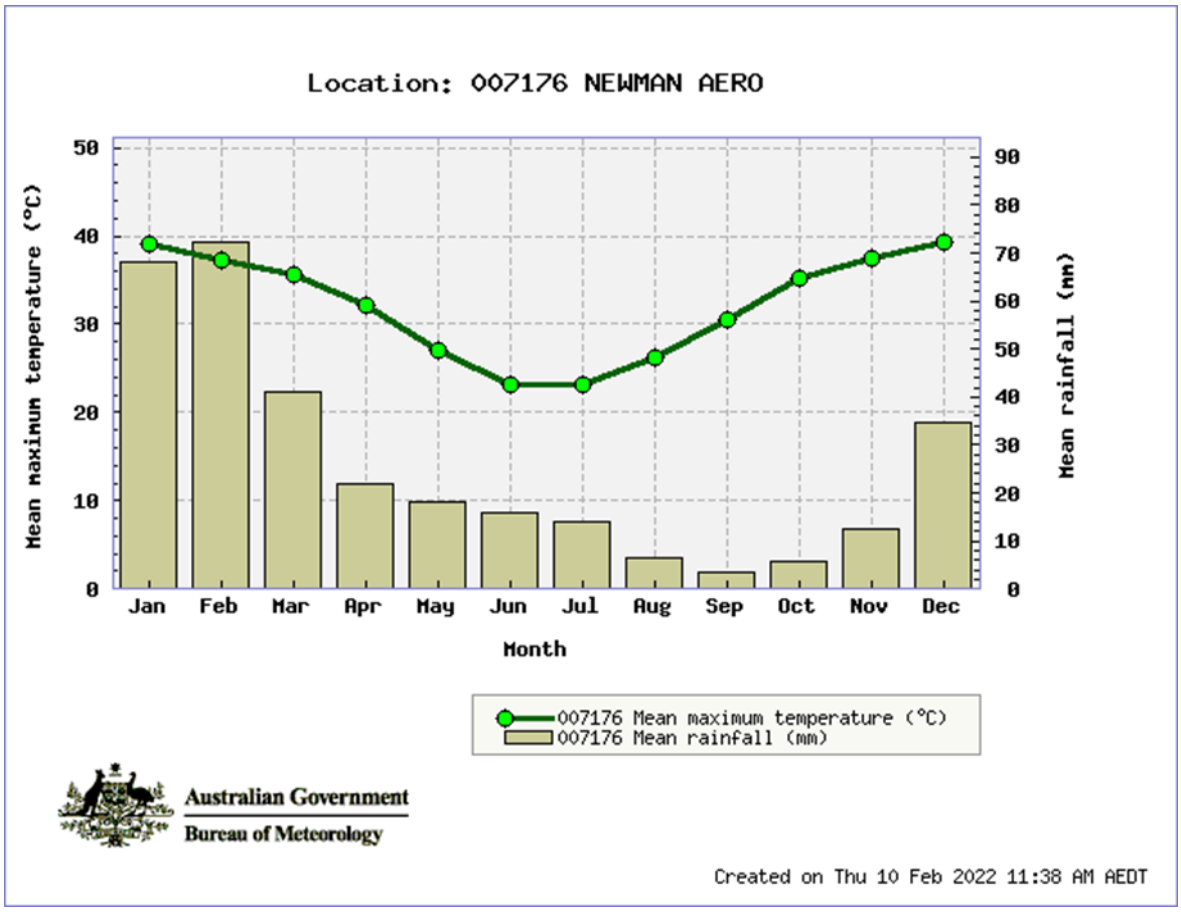


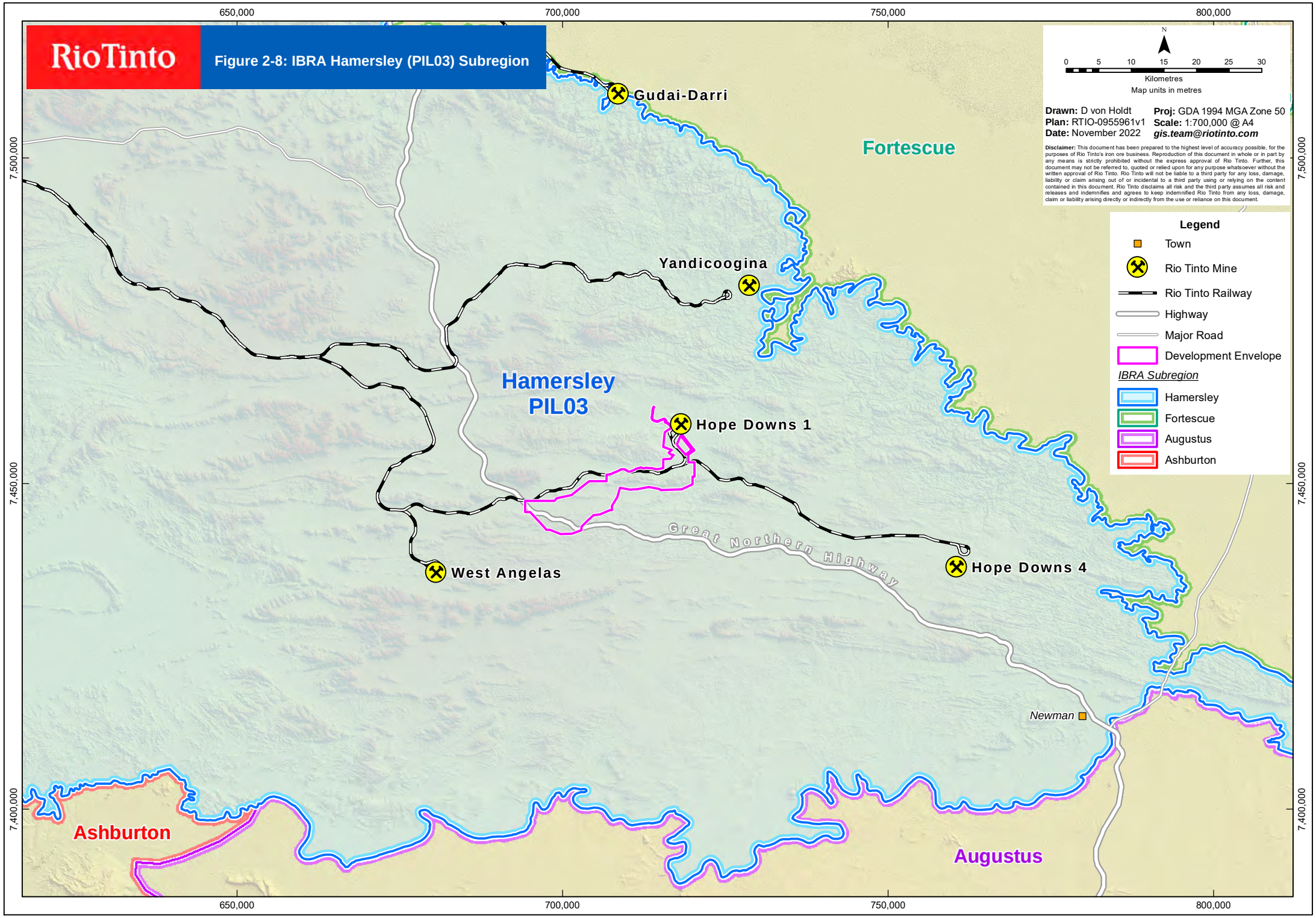
Figure 2-7: Monthly Mean Maximum Temperature (°C) and Mean Rainfall (mm) for Newman Aero Station (Station No. 007176) (BoM 2022)

2.3.1.2. Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) divides the Australian continent into 89 geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information (Thackway and Cresswell 2015). The 89 bioregions are further defined into 419 sub-regions, which are more localised and homogenous geomorphological units within each bioregion.

The Proposal is located within the Pilbara IBRA bioregion and the Hamersley (PIL03) subregion (Figure 2-8), which is shown in and described as:

“Mountainous area of Proterozoic sedimentary ranges and plateaus, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine-textured soils in valley floors, and Eucalyptus leucophloia over Triodia brizoides on skeletal soils of the ranges. The climate is semi-desert tropical, average 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue River (to the north), the Ashburton River to the south, or the Robe River to the west” (Kendrick 2001).


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Figure 2-8: IBRA Hamersley (PIL03) Subregion
650,000
700,000
750,000
800,000
7,500,000
7,450,000
7,400,000
N
0 5 10 15 20 25 30
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0955961v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:700,000 @ A4
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Legend
Town
Rio Tinto Mine
Rio Tinto Railway
Highway
Major Road
Development Envelope
IBRA Subregion
Hamersley
Fortescue
Augustus
Ashburton
Gudai-Darri
Yandicoogina
Hope Downs 1
Hope Downs 4
West Angelas
Great Northern Highway
Newman
Fortescue
Hamersley
PIL03
Ashburton
Augustus

2.3.1.3. Geology and Lithology

The Proposal is situated at the south-eastern corner of the Pilbara Craton. The cratonic basement comprises Archean granite-greenstone and is overlain by the Archean-Proterozoic rocks of the Hamersley Basin. These rocks can be divided into three stratigraphic groups: the Fortescue, Hamersley and Turee Creek groups; the Hamersley Group is the most relevant to the Proposal (HDMS 2000). It is approximately 2.5 km thick and comprises five major and several minor Banded Iron Formations (BIFs), separated by shales and dolomites, with minor felsic volcanic and extensive dolerite dykes and sills. The two BIF units of economic importance within the Hamersley Group are the Brockman Iron Formation (~620 m thick) and the Marra Mamba Iron Formation (~230 m thick).

The HD2 deposit is a Marra Mamba type ore deposit. It consists of east to west trending Marra Mamba Iron Formation (MMIF), which is mineralised in two places, separated by approximately 2 km (Rio Tinto 2020a). Mineralisation is predominantly contained in the Newman member but also includes detrital and West Angela shale units.

The BHT deposit is a Brockman Iron deposit in contrast to the other Marra Mamba deposits in the area. The deposit forms an east to west striking ridge with a relatively flat top and some gentle folding. The Brockman mineralisation extends to >200 m deep in places, overlain by a detrital sequence containing some mineralised material.

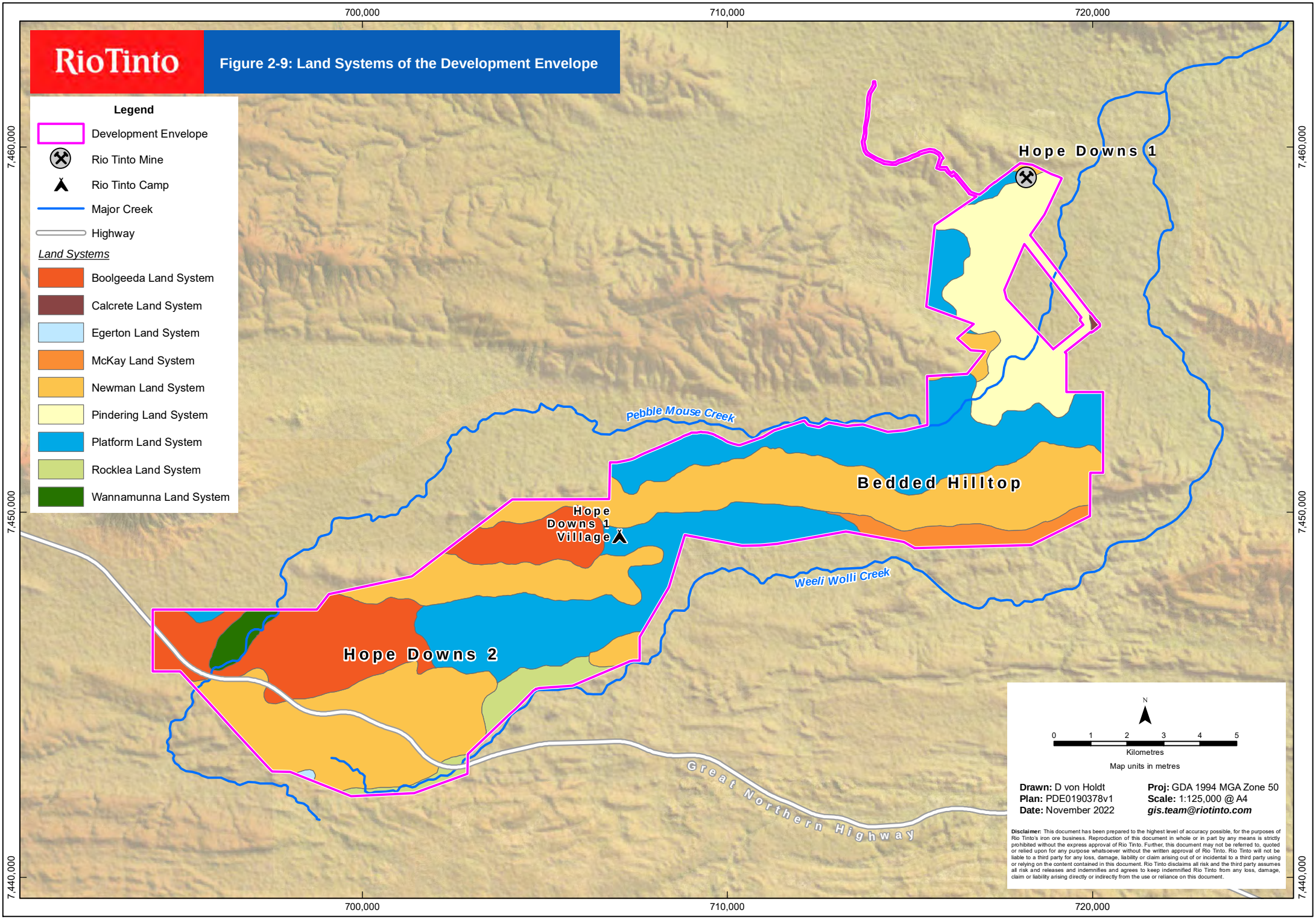
The Proposal Mine Closure Plan (MCP) (Appendix A4) provides further description of the geology and lithology of the HD2 and BHT orebodies.

2.3.1.4. Land Systems

The Proposal intersects nine land systems, of which the Newman, Platform and Boolgeeda cover 70% of the Development Envelope (Table 2-4 and Figure 2-9). These three land systems are defined by plateaux, ridges and mountains progressing to stony lower slopes and plains.

Table 2-4: Description of Land Systems Associated with the Development Envelope

Land System	Total Area within Bioregion (ha)	Total Area (ha) and Proportion of Development Envelope (%)
Boolgeeda - Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands	961,847	1,486.0 (13.7)
Calcrete - Low calcrete platforms and plains supporting shrubby hard spinifex grasslands	134,834	4.9 (<0.1)
Egerton - Highly dissected plains and slopes with sparse mulga shrublands or shrubby hard spinifex grasslands	66,849	1.4 (<0.1)
McKay - Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts	426,124	326.7 (3.0)
Newman - Rugged jaspilite plateaux, ridges and mountains with hard spinifex	1,994,339	4,647.2 (43.0)
Pindering - Gravelly hardpan plains supporting groved mulga shrublands with hard and soft spinifex	38,738	410.5 (3.8)
Platform - Dissected slopes and raised plains supporting shrubby hard spinifex grasslands	236,390	2,522.2 (23.3)
Rocklea - Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs	2,880,288	1,314.1 (12.1)
Wannamunna - Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands and occasionally eucalypt woodlands	63,004	104.5 (1.0)


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Figure 2-9: Land Systems of the Development Envelope
Legend
Development Envelope
Rio Tinto Mine
Rio Tinto Camp
Major Creek
Highway
Land Systems
Boolgeeda Land System
Calcrete Land System
Egerton Land System
McKay Land System
Newman Land System
Pindering Land System
Platform Land System
Rocklea Land System
Wannamunna Land System
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Hope Downs 1
Pebble Mouse Creek
Bedded Hilltop
Hope Downs 1 Village
Weeli Wolli Creek
Hope Downs 2
Great Northern Highway
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
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2.3.1.5. Topography and Major Watercourses

Topography

The main physiographic units in the Newman area where the Proposal is located are the Hamersley Plateau, the Fortescue Valley and the Kumerina Hills (Beard 1975). Prominent topographical features in the region are Pamelia Hill (874 m), Mount Robinson (1,142 m), The Governor (1,051 m) and Mount Meharry (1,250 m). For comparison, the surface elevation of the Proposal mine areas is approximately 750 m above sea level (Figure 2-10). A discussion of how the local topography relates to social and cultural values is provided in Chapter 11.

Hydrology

Regionally, the Proposal is located within the Weeli Wolli Creek catchment's upper reaches, forming part of the Fortescue River Region (BoM 2012).

Two main watercourses of significance which occur within the Development Envelope and its immediate surrounds are Weeli Wolli Creek and Pebble Mouse Creek (Figure 2-5). A small length of Weeli Wolli Creek and parts of Pebble Mouse Creek are within the Development Envelope.

These watercourses support two pools which are of ecological and cultural significance, both located outside the Development Envelope:

- Ben's Oasis – Significant feature of Weeli Wolli Creek
- Weeli Wolli Spring – located downstream of the confluence of Weeli Wolli Creek and Pebble Mouse Creek.

Both Weeli Wolli Spring and Ben's Oasis are permanent water features supported by groundwater. Weeli Wolli Spring, Ben's Oasis and the riparian vegetation supported by the spring is categorised as a Priority 1 Ecological Community.

Hydrological features are discussed further in Chapter 9.

2.3.1.6. High Level Values of Weeli Wolli Springs & Creek

Weeli Wolli Spring and Creek are important features in the east Pilbara, this section provides an overview of the values of these environments.

Weeli Wolli Spring is located to the north of the Development Envelope. It is to the north of the Hope Downs 1 mining operations and within MS584 Development Envelope. It is a condition of MS584 to restore self-sustaining spring flow at Weeli Wolli Spring following mine closure of Hope Downs 1.

Hydrogeology

Weeli Wolli Spring is supported by a combination of shallow and deep groundwater flows and surface run off. Where the gorge narrows and groundwater intercepts the surface, seepage 'springs' occur with resultant surface flow of ground water.

Ecological

Weeli Wolli Spring supports a large diversity of vegetation and high floristic richness due to the varied geology and landscape of the area in association with the shallow water table, pools and permanent spring flow that are defining features of Weeli Wolli Spring. It is the shallow nature of the groundwater, and its permanent surface expression in the area that sustain the ecosystem in, around and downstream of the springs. The flora, microbat assemblage and stygofauna community are the main groups of biota that are considered to distinguish the Weeli Wolli Creek ecosystem.

Flora

Weeli Wolli Spring and Creek support an unusual vegetation assemblage of high floristic richness with a few specific species of high conservation significance. Four main vegetation communities exist within the springs area. One community is more restricted regionally, and at Weeli Wolli is associated with the localised pools in the springs. This community is 'an Open Woodland of *Eucalyptus victrix, Eucalyptus camaldulensis* var. *obtusa, Melaleuca argentea* over *Acacia citrinoviridis, Acacia coriacea supsp. Pendens, Acacia sericophylla* and *Melaleuca lasiandra* over *Cyperus vaginatus* on major creeklines with pools with alluvial soils of variable composition' (Pers. comm. L. Mattiske, 04/09/2009). An important aspect of this community is the composition of the understorey, in particular the sedge and herb assemblages.

Species of high conservation significance include *Stylidium weeli wolli* and a hybrid zone between two native cotton species (*Gossypium sturtianum* and *G. robinsonii*). Other flora of conservation or biological significance that occur in the spring include: *Fimbristylis sieberiana*, *Fimbristylis oxystachya*, *Fimbristylis rara, Elytrophorus spicatus*, *Mollugo cerviana*, *Rotala diandra* and *Rotala mexicana*.

Fauna

Weeli Wolli Spring and Creek and the underground water body provide habitat for a wide range of fauna, including terrestrial, avian, aquatic and subterranean. Assemblages include aquatic fauna (micro and macro invertebrates and fish), stygofauna, microbats and animals of the hyporheic zone.

Specific bat species of conservation significance at Weeli Wolli include the Ghost bat (*Macroderma gigas*) - identified by the DEC as a Priority fauna species (P4) and the most northerly distribution of the Chocolate Wattle Bat (*Chalinobolus morio*).

Heritage and Social

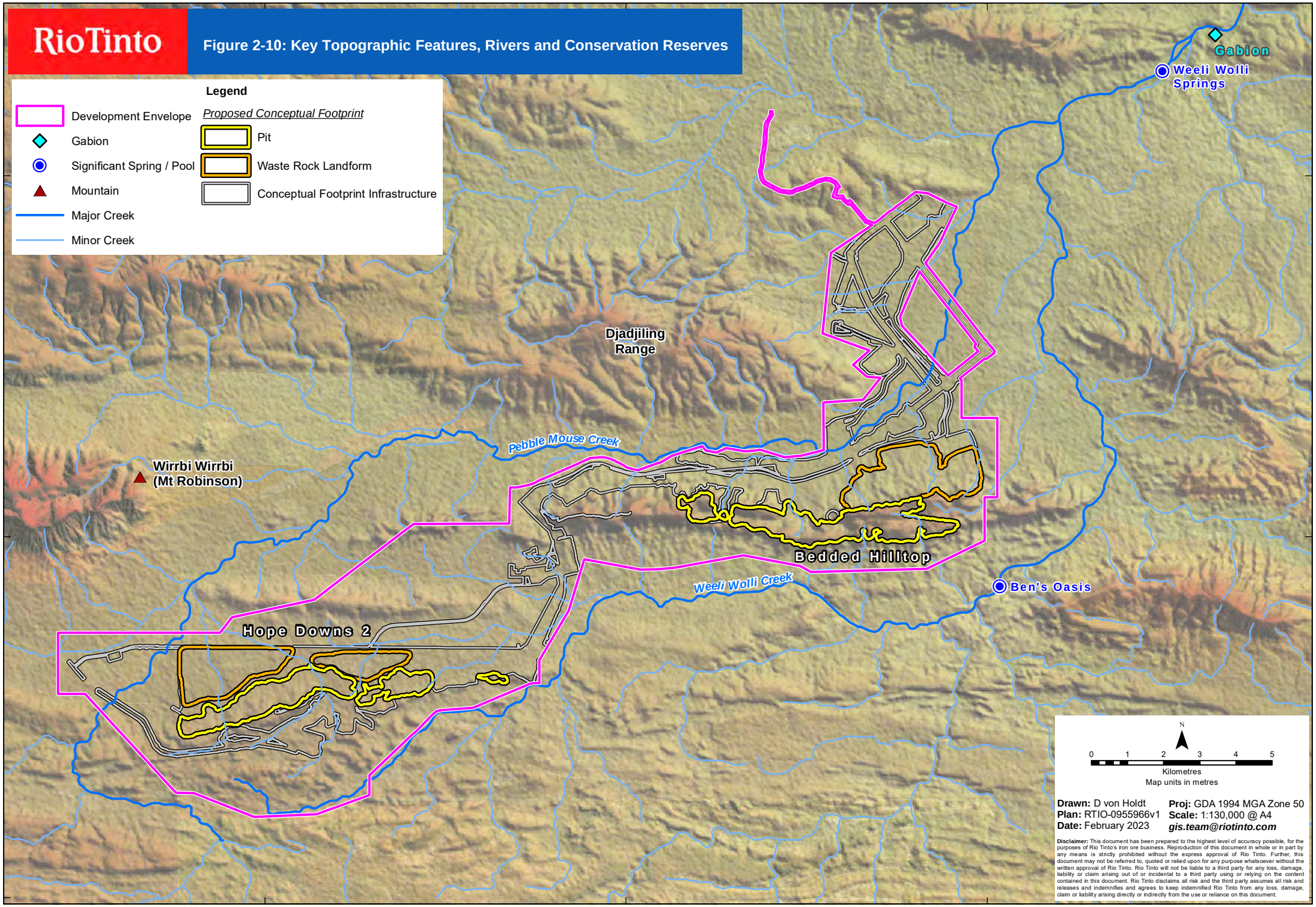
Aboriginal culture is spiritually and physically connected to the landscape through *Jukurppa*

(Dreaming) stories, ceremony, and physical places such as ethnographic and archaeological heritage sites. Weeli Wolli Creek is an important permanent water source, food source, camping and meeting place and has been visited by the Traditional Owners of the area for many thousands of years. Significant ethnographic and archaeological heritage sites are also associated with the Weeli Wolli water course. The Weeli Wolli Spring holds special significance for the Traditional Owner groups of the region as a place where the snake spirit or rainbow serpent (*Warlu*) resides.

Weeli Wolli Spring and Creek are significant for tourism in the region.

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Figure 2-10: Key Topographic Features, Rivers and Conservation Reserves



Drawn: D von Holdt
Plan: RTIO-0955966v1
Date: February 2023

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2.3.2. Social Setting

2.3.2.1. Conservation Reserves and Environmentally Sensitive Areas

The closest conservation reserve to the Proposal is the 627,400 ha Karijini National Park (also considered an environmentally sensitive area (ESA)), located approximately 32 km to the west of the Development Envelope (Figure 2-10).

No conservation reserves or ESAs will be directly or indirectly impacted by the Proposal.

2.3.2.2. Land Use and Existing Development

Current land use is dominated by iron ore mining, given the Proposal is adjacent to the existing Hope Downs 1 operations. Other iron ore mines are located nearby (Section 2.3.2).

Traditional Owners continue to use the land in and around the Proposal, particularly Weeli Wolli Spring. Traditional Owner use of the land is discussed further in Chapter 11.

Additional land use in the region includes pastoral grazing, although the proposed Development Envelope is located on Vacant Crown Land and is not covered by a pastoral lease.

Other land uses include:

- Public and private infrastructure (including roads and railways)
- Unallocated Crown Land (UCL).

2.3.2.3. Existing and Reasonably Foreseeable Projects within the Hamersley Subregion

There are several existing and reasonably foreseeable iron ore mining projects within the Proposal region and, more broadly, within the Hamersley subregion of the Pilbara bioregion. Those projects in the Hamersley sub-region within 50 km of the Proposal are listed and described in Table 2-5 and shown in Figure 2-11. The projects within the Hamersley subregion occupy similar positions in the landscape and, therefore, encompass areas with fauna and flora assemblages that are comparable to the Proposal.

Table 2-5: Current and Forecast Mining Proposals within 50 km of the Proposal and in the Hamersley Subregion

Project	Status	Location
Rio Tinto Managed Operations		
Hope Downs 1 (including Baby Hope)	Existing	Adjacent
Hope Downs 4	Existing	42 km
West Angelas Iron Ore Mine (including deposits C, D and G)	Existing	28 km
West Angelas Iron Ore Mine (Revised Proposal)	Proposed	28 km
Yandicoogina Iron Ore Project	Existing	29 km
Koodaideri Iron Ore Mine and Infrastructure Project (now referred to as Gudai-Darri Project)	Existing	36 km
Third-party Operations		
Mining Area C (including Southern Flank) – BHP Billiton Iron Ore Pty Ltd (BHP)	Existing	15 km
Marillana Creek – Yandi – BHP	Existing	37 km
Central Marra Mamba – Wonmunna Iron	Existing	10 km
Iron Valley – Mineral Resources Limited	Existing	49 km

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Figure 2-11: Existing and Reasonably Foreseeable Projects within the Hamersley Subregion

Legend

- Development Envelope
- Airport
- Rio Tinto Mine
- Third Party Mine
- Rio Tinto Camp
- Third Party Camp
- Highway
- Major Road
- Minor Road
- Site Access Road
- Rio Tinto Railway
- Major Creek

Ministerial Statement

- 1020
- 1025
- 1038
- 1113
- 584
- 854
- 999

Land Administration Act Tenure

- General Lease
- Rio Tinto - Pastoral Lease
- Third Party - Pastoral Lease
- National Park
- Reserve

N

0 5 10 15

Kilometres

Map units in metres

Drawn: D von Holdt **Proj:** GDA 1994 MGA Zone 50
Plan: RTIO-0955969v1 **Scale:** 1:380,000 @ A3
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650,000 700,000 750,000

7,500,000 7,450,000

Karijini National Park

Gudai-Darri

Gudai-Darri Exploration Camp

Gudai-Darri

Gudai-Darri Village

MARILLANA CREEK

N050471 Juna Downs Station

Spinifex Camp

Yandicoogina Barimunya

Yandi Camp (BHPBIO)

Iron Valley

Nyidinghu Camp

Yandi

Yandi Village

Yandicoogina

N050471 Juna Downs Station

N050368 Marillana Station

Karijini National Park

Packsaddle Camp

Mining Area C

Mulla Mulla Camp

Coondawanna

South Flank

Hope Downs 1

COONDINER CREEK

Hope Downs 1 Village

Great Northern Highway

Wonmunna

West Angelas Village

West Angelas

Wintamarra Village

West Angelas

Hope Downs 4

Hope Downs 4 Village

N050676 Turee Creek Station

Angelo River Camp

3. LEGISLATIVE CONTEXT

3.1. Environmental Impact Assessment Process

The Proposal is subject to assessment under the Commonwealth EPBC Act and the Western Australian EP Act. The Proposal will undergo an accredited assessment in which the Commonwealth will rely on the outcomes of the assessment conducted by the Western Australian EPA to inform its consideration for approval under the EPBC Act.

This ERD content, format and environmental assessment have considered the following EPA guidance:

- Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures (EPA 2021a) (Administrative Procedures)
- Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2021b) (Procedures Manual)
- Statement of Environmental Principles, Factors and Objectives and Aims of EIA (EPA 2021c)
- Instructions – How to identify the content of a Proposal (EPA 2021d)
- Instructions – How to prepare an Environmental Review Document (EPA 2021e)
- Interim Guidance – Environmental outcomes and outcomes-based conditions (EPA 2021f)
- Instructions for preparing data packages for the Index of Biodiversity Surveys for Assessments (IBSA) (EPA 2021g)
- Instructions on how to prepare EP Act Part IV Environmental Management Plans (EMPs) (EPA 2021h)
- Interim Guidance- Taking Decision Making Processes into Account in EIA (EPA 2021i).

3.1.1. Environmental Protection Act 1986

The EP Act is WA's primary environmental legislation governing environmental protection and impact assessment. Part IV, Division 1 of the EP Act, provides for the referral and assessment of proposals that may significantly impact the environment. The EPA Services division within the Department of Water and Environmental Regulation (DWER) administers the impact assessment process.

The Proposal was referred to the EPA on 24 August 2021, with additional information subsequently provided at the request of DWER. On 29 October 2021, the EPA determined that the Proposal would be assessed under Part IV of the EP Act. The level of assessment was set at Public Environmental Review – with a two-week public review period.

The EPA identified the key environmental factors as:

- Flora and Vegetation
- Terrestrial Fauna
- Subterranean Fauna
- Inland Waters
- Greenhouse Gas Emissions
- Social Surroundings, including Aboriginal Heritage and Culture.

In addition, the EPA required that the Environmental Review include an analysis of the cumulative impacts of this Proposal with the existing and proposed activities in the proximity of the Proposal. A Section 43A application was approved by the EPA on 17 January 2023, and this ERD has been prepared in line with the scope of that application. No new environmental issues have emerged during the assessment, so no additional key environmental factors have been identified. The Proponent prepared

an ESD to define the ERD's form, content, timing and procedure. The ESD (Appendix A1) was approved on 26 October 2022. Since the approval of the ESD, the Proponent has submitted and had approved a request to change the relevant key characteristics of the Proposal under Section 43A of the EP Act.

The ERD has been prepared in accordance with the ESD (Appendix A1), Administrative Procedures (EPA 2021a) and the Procedures Manual (EPA 2021b) to meet the requirements of Section 40(2)(b) of the EP Act. This ERD is now published for two weeks, during which time the public is invited to comment on the ERD. Refer to the **Invitation to make a submission** section at the beginning of this document for guidance on how to make a submission and the closing date for submissions.

After the public review period, the EPA will assess the Proposal, considering the ERD, any submissions received, and the Proponent's responses to any submissions received. The EPA also considers relevant policies and guidelines and may seek advice from relevant government agencies. The EPA will prepare an assessment report recommending whether the Proposal should be approved and, if recommending approval, any implementation conditions that should apply. The EPA Report and Recommendations (EPA Report) will be made public and is subject to appeal. After the appeal period has concluded, the EPA Report will be provided to the Minister for the Environment, who will determine any appeals and decide whether the Proposal may be implemented and, if so, any implementation conditions and procedures which will apply.

3.1.2. Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the primary Commonwealth environmental legislation protecting Matters of National Environmental Significance (MNES) and is administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). The Proposal was referred to DCCEEW under the EPBC Act on 30 August 2021.

The Minister for the Environment determined that the Proposal is a Controlled Action under Section 75 of the EPBC Act on 21 December 2021; therefore, it will require further assessment and approval under the EPBC Act before proceeding. The relevant Matter (the controlling provision) is 'Listed threatened species and communities' (sections 18 and 18A of the EPBC Act). The relevant MNES as per the Commonwealth's Controlled Action determination are the following listed species:

- Northern Quoll (*Dasyurus hallucatus*)
- Night Parrot (*Pezoporus occidentalis*)
- Ghost Bat (*Macroderma gigas*)
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* [Pilbara Form])
- Pilbara Olive Python (*Liasis olivaceus barroni*)
- Grey Falcon (*Falco hypoleucos*).

The significance of potential impacts from the Proposal on MNES concerning relevant EPBC Act guidance is addressed in this ERD in Chapter 13.

3.1.3. Accredited Assessment

The EPA will assess the Proposal as an accredited assessment on behalf of the Commonwealth under Section 87 of the EPBC Act. This agreed approach provides for a single environmental assessment and will be undertaken in consultation with DCCEEW. After its assessment, the EPA will provide its assessment report to DCCEEW to allow that agency to consider the Proposal's potential impacts on MNES.

The Commonwealth Minister for the Environment will then approve based on final advice from DCCEEW. An EPBC Decision Notice will be issued on approval, including implementation conditions to be applied to the various stages of the Proposal.

3.1.4. State Agreement

The Proposal is located within an area covered by the *Iron Ore (Hope Downs) Agreement Act 1992* (WA). A State Agreement is a legal contract between the WA Government and a proponent of a major project within State boundaries. A State Agreement details the rights, obligations, term and conditions for development a specific project. Elements of the Proposal located outside of the State Agreement tenure are supported by various tenures granted under the *Mining Act 1978* (Mining Act) and the *Land Administration Act 1997 (LAA)*.

3.2. Other Approvals and Regulations

3.2.1. Native Title

The Proposal is located within the boundaries of the recognised Native Title determination areas of three Traditional Owner groups of the Pilbara region: Nyiyaparli, Banjima and Ngarlawangga. Most of the Proposal, including all areas of active mining, occurs within the Native Title area of the Nyiyaparli people. The land subject to the Native Title of the Banjima and Ngarlawangga peoples is restricted to small sections in the north and west of the Development Envelope respectively. The Native Title areas which intersect the Proposal are presented in Figure 3-2.

Rio Tinto and the Proponent have negotiated and executed claim-wide land use agreements with all three Traditional Owner groups.

3.2.2. Land Tenure

The Proposal is located on State Agreement Mining Lease 282 (M282SA) granted under the *Iron Ore (Hope Downs) Agreement Act 1992.*

The HD2 deposit is located on Section 2 of M282SA, and the BHT deposit is located on Section 1 of M282SA. Section 2 is not contiguous with Section 1 of M282SA.

Currently, a LAA lease, J717064 (Hope Downs Village Access Road) is located between Sections 1 and 2 of M282SA for a private access road from the Great Northern Highway to service the Hope Downs 1 operations area and accommodation village.

The Proposal's Development Envelope overlaps with third party tenure (primarily BHP) and tenure held by the Rhodes Ridge Joint Venture (RRJV).

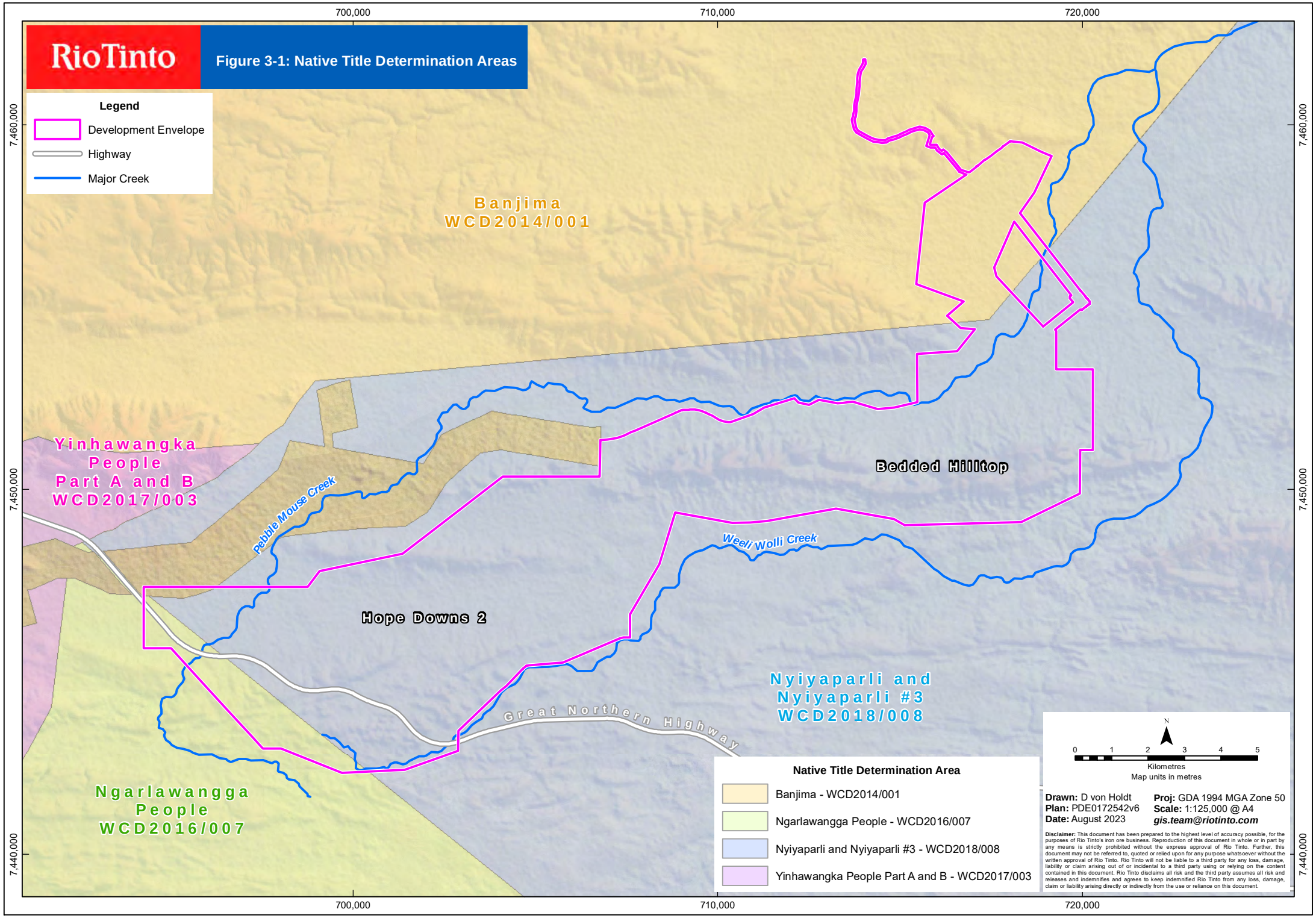
Areas of the Proposal located on third party tenure within the Development Envelope will be subject to the grant of additional tenure or subject to access agreements prior to ground disturbing activities in these areas.

No pastoral leases intercept the Development Envelope. Marillana Station is the closest pastoral lease, with the boundary located approximately 1 km east of the northern section of the Development Envelope.

Land tenure is presented in Figure 3-2.

3.2.3. State Decision-making Authorities and Other Approvals

In addition to the EPA, consideration of the Proposal under Part IV of the EP Act and any subsequent assessment, various other environmental assessments and authorisations would be required before the Proposal could be implemented, as summarised in Table 3-1.


RioTinto
Figure 3-1: Native Title Determination Areas
Legend
Development Envelope
Highway
Major Creek
Banjima
WCD2014/001
Yinhawangka
People
Part A and B
WCD2017/003
Bedded Hilltop
Pebble Mouse Creek
Weeli Wolli Creek
Hope Downs 2
Great Northern Highway
Nyiyaparli and
Nyiyaparli #3
WCD2018/008
Ngarlawangga
People
WCD2016/007
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Native Title Determination Area
Banjima - WCD2014/001
Ngarlawangga People - WCD2016/007
Nyiyaparli and Nyiyaparli #3 - WCD2018/008
Yinhawangka People Part A and B - WCD2017/003
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172542v6
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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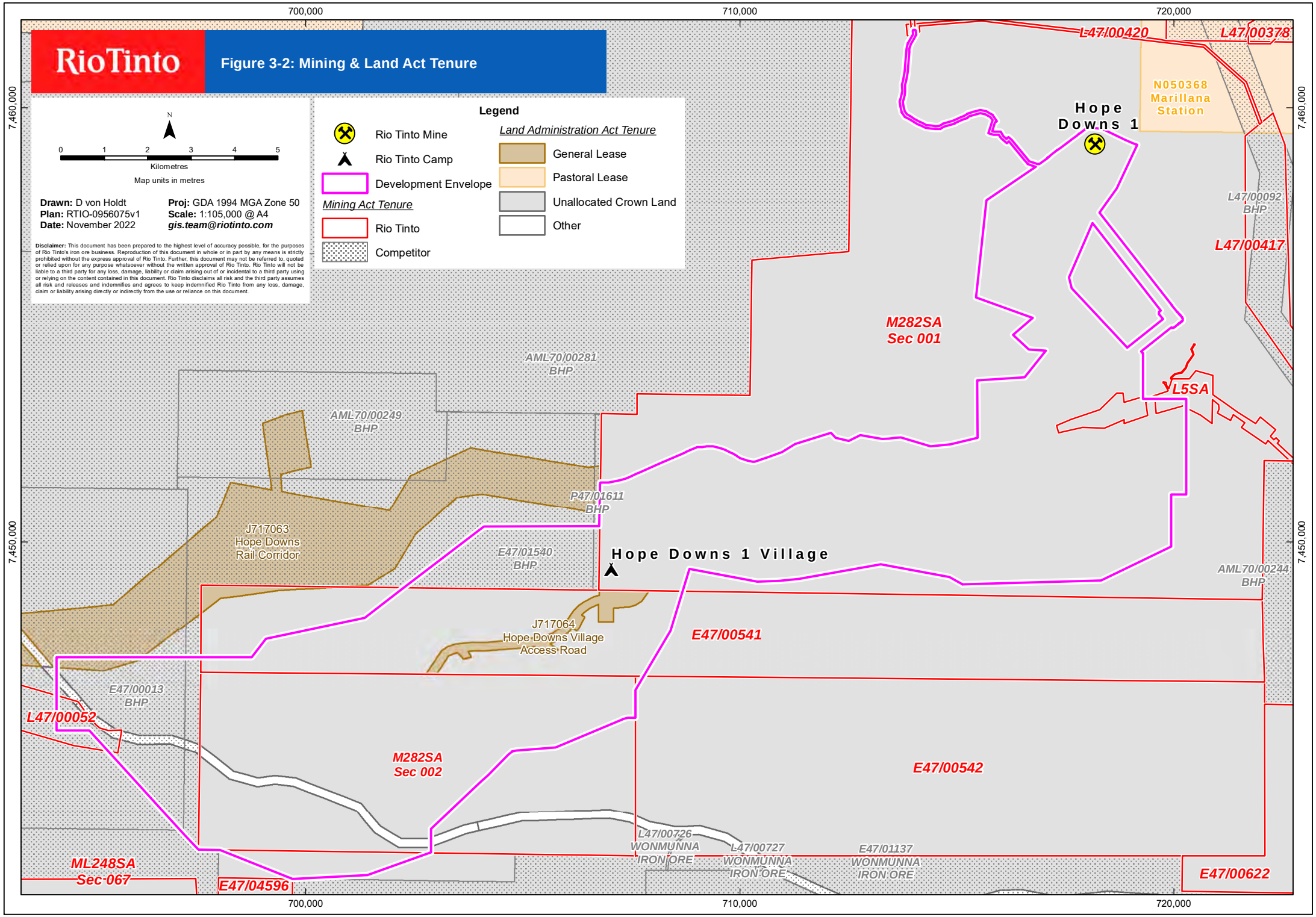

RioTinto
Figure 3-2: Mining & Land Act Tenure
Legend
Rio Tinto Mine
Rio Tinto Camp
Development Envelope
Mining Act Tenure
Rio Tinto
Competitor
Land Administration Act Tenure
General Lease
Pastoral Lease
Unallocated Crown Land
Other
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956075v1
Date: November 2022
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700,000
710,000
720,000
7,460,000
7,450,000
L47/00420
L47/00378
N050368
Marillana
Station
Hope
Downs 1
L47/00092
BHP
L47/00417
M282SA
Sec 001
AML70/00281
BHP
L5SA
AML70/00249
BHP
P47/01611
BHP
J717063
Hope Downs
Rail Corridor
E47/01540
BHP
Hope Downs 1 Village
AML70/00244
BHP
J717064
Hope Downs Village
Access Road
E47/00541
E47/00013
BHP
L47/00052
M282SA
Sec 002
E47/00542
L47/00726
WONMUNNA
IRON ORE
L47/00727
WONMUNNA
IRON ORE
E47/01137
WONMUNNA
IRON ORE
ML248SA
Sec 067
E47/04596
E47/00622

Table 3-1: Other Decision-Making Authority Approvals

State Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
Minister for Water, DWER	*Rights in Water and Irrigation Act 1914* (RiWI Act)	Section 5c licence to take water: • Operation of dewatering and water supply borefields Section 26D licence to construct or alter a well • Construction of dewatering and water supply bore	Yes EPA Inland Waters factor and objective considered in decision-making. RiWI Act processes regulate the extraction, but not disposal, of water associated with mine dewatering. The licence application is advertised for public comment when a significant impact on the water resource is expected, or the request is to take more than 1 GL/a. No appeal rights exist to the public on licence decisions. Assessments of licence applications to take groundwater include consideration of environmental and social impacts including effects on: • Groundwater resource - availability, allocation and quality • Groundwater Dependent Ecosystems (GDEs) • Other groundwater users Hydrogeological studies are required to inform the assessment, including the potential impacts of taking water. Licence conditions will usually include requirements to undertake and report groundwater volume and quality monitoring to ensure detrimental impacts on the environment, other users and the groundwater resource are no more than predicted. This typically requires a Groundwater Operating Strategy to be prepared and implemented. Surface water impacts may be considered in the assessment but are not essential. Although the licences address impacts on other users, stakeholder consultation - including engagement with Traditional Owners - is not a requirement of licence application, assessment and operation. Impacts on stygofauna are not assessed (although related results may be included in groundwater monitoring reporting required by the licence).
Chief Executive Officer, DWER	Part V of the EP Act	Works Approval and Operating Licence*	Yes EPA factors and objectives considered in decision-making.

State Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
		Activities and prescribed premise categories applicable to the Proposal include: • 5 – Processing of ore • 12 – Screening, etc of materials • 64 – Class II Putrescible landfill • 73 – Bulk storage of chemicals etc	• Inland Waters – To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected • Flora and Vegetation / Terrestrial Fauna – To protect flora and vegetation / terrestrial fauna so that biological diversity and ecological integrity are maintained • Terrestrial environmental quality – To maintain the quality of land and soils so that environmental values are protected • Air Quality – To maintain air quality and minimise emissions so that environmental values are protected • Social surroundings – To protect social surroundings from significant harm • Human Health – To protect human health from harm Works approvals and licences regulate industrial emissions and discharges to air, land or water and apply to 'prescribed premises' categories defined in Schedule 1 of the Environmental Protection Regulations. Applications are open for public comment and the public and licence holder have the right to appeal decisions. DWER will seek comment and advice from people and public authorities deemed may have an interest during the assessment. Assessments take into consideration risk to the environment, public health and amenity and the controls proposed to mitigate these risks. Compliance monitoring and reporting are included in standard conditions of approval.
Chief Dangerous Goods Officer, Department of Mines, Industry Regulation and Safety (DMIRS)	*Dangerous Goods Safety Act 2004* (DG Safety Act)	Dangerous goods licence: • Storage and handling of hazardous materials during construction and operations	Yes Dangerous goods licence applications require risk assessments demonstrating the dangerous goods site can be operated with minimal risk to people, property and the environment.

State Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
			DMIRS will notify DWER of all new licence applications or amendments to existing licences, resulting in additional environmental assessment and approval (i.e., under the EP Act).
Department of Planning, Lands and Heritage (DPLH) Minister for Aboriginal Affairs	*Aboriginal Heritage Act 1972* (AH Act) *Aboriginal Cultural Heritage Act 2021* (WA) (ACH Act) Replacing the AH Act, in mid-2023	ACH Permit and/or ACHMP To be determined	Yes Potential direct impacts to heritage values will be appropriately managed via Aboriginal heritage legislation and the IHMP. Any disturbance will be in accordance with approvals under s.16 and/or s.18 of the AH Act (or ACH Permit and/or ACHMP under the ACH Act, and as agreed with Traditional Owners through consultation, based on the principle of free, prior and informed consent.
Minister for Environment, Chief Executive Officer and Department of Biodiversity, Conservation and Attractions (DBCA)	*Biodiversity Conservation Act 2016* (BC Act)	Impacts to threatened flora and fauna species are managed through DBCA: • Authorisation to take threatened flora species • Authorisation to take or disturb threatened flora species	Yes EPA factors and objectives considered in decision-making: • Flora and vegetation – refer above • Terrestrial fauna – refer above Authorisation to take threatened species is always required irrespective of any approval granted or exemption under the EP Act. The BC Act provides the ability to impose conditions on authorisations to take threatened species that mitigate or offset the impact of such actions. There is no provision for public comment or appeal with respect to the issue of an authorisation to take threatened species.
DMIRS Minister for Mines and Petroleum	*Mines Safety and Inspection Act 1994* *Mines Safety and Inspection Regulations 1995*	Approves the Project Management Plan (PMP). Imposes general duty of care provisions to maintain safe and healthy workplaces at mining operations and protect people at work from hazards	No A PMP is required to address occupational health and safety matters.
Minister for Mines and Petroleum	*Mining Act 1978* (WA)	Mine Closure Plan	No

State Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
			DMIRS publishes the Guidelines for Preparing a Mine Closure Plan (DMIRS 2020), which the draft MCP has been prepared in accordance with (Appendix A4).
Local Government	*Building Act 2011* Part V of the EP Act *Health Act 1911*	Building and Health approvals	No
WA Minister for Transport; Planning; Ports – Department of Transport; Main Roads WA	Main Roads Act 1930		Yes Authorisation required for the re-alignment of Great Northern Highway and associated works.
Minister for State Department of Jobs, Tourism, Science and Innovation (JTSI)	State Agreement Act *Iron Ore (Hope Downs) Agreement Act 1992*	State Agreement is required to be administered by JTSI on behalf of the Western Australian Government	Yes The State Agreement details the rights, obligations, terms, and conditions for the project's development.

** The term 'works approval' will be replaced by 'controlled work' under Stage 3 of EP Act amendments introduced under the Environmental Protection Amendment Act 2020, with a proclamation estimated to occur in late 2022.*

4. STAKEHOLDER ENGAGEMENT

The Proponent has approached the development of the Proposal with a clear understanding of the potential environmental, social and safety risks that may eventuate from the Proposal. The Proponent has also tailored the management measures and design implications to effectively manage these risks. The Proponent has undertaken a thorough stakeholder engagement process as part of defining these risks. Activities undertaken to date include (but are not limited to):

- Identify key stakeholders for relevant phases of the Proposal
- Identify risks/ issues and, if possible, avoidance of risks and resolution of issues that affect stakeholders
- Issuing communication to stakeholders
- Establishing and maintaining relationships with stakeholders
- Managing the Proponent's database of stakeholders.

- The Proponent has actively consulted with identified stakeholders since the early exploration stages of the Proposal. This consultation has evolved throughout the Proposal's design and will continue throughout the Proposal's assessment, construction, operation, decommissioning, and closure phases.

4.1. Key Stakeholders

Relevant stakeholders identified and consulted with for the Proposal, including Decision-making Authorities (DMAs), other relevant state government agencies and local government authorities, local communities, and environmental non-government organisations, are listed in Table 4-1.

Table 4-1: Key Stakeholders for the Proposal

Stakeholder Sector	Organisation	Key Interest/s
Government of Western Australia	Environmental Protection Authority (EPA)	Administers EP Act Part IV (EP Act) EIAs
	Department of Planning, Lands and Heritage (DPLH)	Native Title requirements Heritage, cultural, ethnographic and archaeological sites
	Department of the Premier and Cabinet	Aboriginal policy
	Department of Mines, Industry Regulation and Safety (DMIRS)	Administers Mining Act and regulations Tenement conditions Mining proposals and programs of work Mine closure Rehabilitation standards Safety in resource sector
	Department of Water and Environmental Regulation (DWER)	Administers RIWI Act Provision of licences to abstract water Groundwater quality and quantity Administers Part V (EP Act), Industry regulation and licensing, and *Contaminated Sites Act 2003*

Stakeholder Sector	Organisation	Key Interest/s
		Supports administration of the Environmental Protection Authority and Part IV of the EP Act and *Environmental Protection Amendments Act 2020*.
	Department of Jobs, Tourism, Science and Innovation (JTSI)	Administers State Agreement Acts Major Projects Future Battery Mineral Strategy Jobs Renewable energy initiatives
	Department of Primary Industries and Regional Development (DPIRD) Department of Communities	Regional and community development
	Department of Biodiversity, Conservation and Attractions (DBCA)	Administers BC Act Flora, fauna and habitat conservation Interest in projects that are located on DBCA managed land Baseline surveys and licenses to take flora and fauna
	Department of Fire and Emergency Services (DFES)	Fire breaks Provision of emergency services
	Department of Health	Environmental health, building and planning compliance
Australian Government	Department of Climate Change, Energy, the Environment and Water (DCCEEW) Department of the Prime Minister and Cabinet National Indigenous Australians Agency	Matters of National Environmental Significance Native Title and Aboriginal heritage Community Development Program
Local Government Authorities and community	Shire of East Pilbara	Rates Local economy Benefits to local economy and community Safety of locals and passers-by Use of public roads and infrastructure Compliance with building, health, sewage and other Local government regulation
Traditional Owner Groups	Nyiyaparli people Ngarlawangga people Banjima people	Access to and use of Traditional Owner land Social and cultural heritage values Native Title rights Potential socio-economic opportunities resulting from the Proposal

Stakeholder Sector	Organisation	Key Interest/s
		Impacts to sites and social and cultural heritage values of significance / heritage protection Change of rights to land access Land access agreement Operational interactions (e.g. traffic, road condition, noise, and other amenity issues)
Pastoralists	Marillana Pastoral Station	Access to and use of pastoral land Business and other economic opportunities associated with the Proposal Change of rights to land access Land access agreement Operational interactions (e.g. traffic, road condition, noise and other amenity issues) Firebreaks Provision of emergency service
Tenure holders	Rhodes Ridge Joint Venture (RRJV) BHP	Access to and use of tenure Change of rights to land access Land access agreement Operational interactions (e.g. traffic, road condition, noise and other amenity issues) Firebreaks
Interested Stakeholders		
Non-government organisations and interested groups	Wildflower Society of WA Conservation Council of WA Chamber of Commerce and Industry WA The Outback Way	Potential interest in baseline surveys and significance of data Local content and service provision
Shareholders	Shareholders	Project value
Suppliers	Consultants and contracting	Business opportunities associated with the Proposal

4.2. Stakeholder Engagement Process

A stakeholder consultation program was developed specifically for the Proposal to undertake effective consultation, which focused on the principles as outlined in Table 4-2.

Table 4-2: Principles of Stakeholder Engagement

Principles	Requirements
Communication	Communication must be open, accessible, clearly defined, two-way and appropriate
Transparency	The process and outcomes of community and stakeholder engagement should, wherever possible, be made open and transparent, agreed upon and documented
Collaboration	The process and outcomes of community and stakeholder engagement should, wherever possible, be made open and transparent, agreed upon and documented
Inclusiveness	The process and outcomes of community and stakeholder engagement should, wherever possible, be made open and transparent, agreed upon and documented
Integrity	Community and stakeholder engagement should establish and foster mutual trust and respect

The overarching objectives of the consultation program included the following:

- Ensure stakeholders understand the nature of the Proposal, including likely impacts and benefits that may be derived from the Proposal
- Communicate the Proposal's vision by ensuring open and transparent communication of the Proposal development process, impacts and risk management
- Enable individuals, groups and agencies with interest in the Proposal to have access to up-to-date relevant information
- Establish opportunities for two-way feedback to engage stakeholders and maximise the Proposal outcomes through obtaining local knowledge and expertise
- Provide a means through which stakeholders can raise concerns and issues and Rio Tinto with the means to respond to these
- Assess stakeholder issues and concerns so that proposed impacts can be minimised to as low as reasonably practicable and in-line with stakeholder expectations

4.3. Stakeholder Consultation

The Proponent established a database to collate and record stakeholder engagement to ensure effective consultations and engagements. This will help address the issues raised and track external interest in the Proposal (Table 4-2). Consultations undertaken to support the Social Surroundings' understanding of the Proposal are listed in the Social Surroundings chapter and not included in Table 4-2.

4.3.1. Traditional Owner Groups

The Proponent has undertaken ongoing consultation with the Nyiyaparli, Banjima and Ngarlawangga People and their Registered Native Title Body Corporate representatives, the Karlka Nyiyaparli Aboriginal Corporation (KNAC), the Banjima Native Title Aboriginal Corporation (BNTAC) and Ngarlawangga Aboriginal Corporation (NAC) relating to the Proposal. This consultation has helped the Proponent to understand the Traditional Owner concerns and priorities, relating not only to the Proposal but also current operations.

Consultation undertaken to date has been considered in current study programs and impact assessments and is summarised in Appendix A5 and Appendix F2. Importantly, the body of consultation has gone some way to assist Traditional Owners in having a deeper understanding of the Proposal and providing the Proponent a deeper appreciation of the Traditional Owners connection to Country. The Proponent recognises that ongoing consultation with Traditional Owners is imperative throughout the Proposal Life of Mine (LOM).

As the Proposal progresses, the Proponent looks forward to continued collaboration with the Nyiyaparli, Banjima and Ngarlawangga People.

4.3.2. Pastoral Stations

The Proponent has undertaken regular and ongoing consultation with Marilliana Pastoral Station since 2019. Marillana Station is owned by BHP and was sub-leased to KNAC in April 2022. In more recent updates, no questions or issues have been raised (Appendix F2).

4.3.3. Government and Special Interest Groups

Consultation with several State and Commonwealth Departments and Agencies commenced in 2019, with increased consultation occurring over the past three years.

To date there have been several opportunities for public involvement in the impact assessment process. Opportunities for formal involvement to date have included:

- Comment on the level of assessment appropriate for the project under Part IV of the EP Act (1 – 7 September 2021). The EPA received two separate submissions which raised concerns about the Proposal's impact on the environment and the key environmental factors, including Greenhouse Gas Emissions
- Comment on Controlled Action Status of the Proposal under the EPBC Act (commencing 29 September 2021). No information on submissions was received from DCCEEW.

4.4. Stakeholder Consultation

To ensure effective consultation and engagement, an engagement and consultation database has been established to collate and record stakeholder engagement, ensure issues raised are addressed and track interest in the Proposal. The database contains the following information:

- Stakeholder group
- Organisation/person
- Key interest areas
- Discussion objectives and outputs
- Date
- Form of consultation (group/individual meeting, phone call, email, formal written correspondence)
- Determination of whether there is any requirement to 'close the loop' on any matters addressed.

Consultation activities undertaken to date and feedback received from stakeholders are provided in Appendix F2. Consultation relevant to closure planning for the Proposal is reflected within the MCP (Appendix A4).

4.4.1. Ongoing Stakeholder Consultation

Stakeholder consultation is ongoing and will continue throughout the project's approvals process, construction, operation, and closure stages. This will include the following levels of engagement:

- Information: The Proponent will continue to publish and distribute information to stakeholders
- Consultation: The opportunity for two-way exchange of information
- Participation: Active, multi-directional interaction and more intensive forms of consultation
- Negotiation: Face-to-face discussion with the intent of reaching agreement on a specific issue.

This ERD provides stakeholders with a formal opportunity to provide feedback and comment on the Proposal, which will be responded to in the Response to Submissions in the final ERD. If approved, the Proponent will continue to implement a Community and Stakeholder Consultation Program during the construction and operations phase of the Proposal. This program would ensure that stakeholders are well informed of Proposal development and to identify, monitor, and manage relevant issues raised by stakeholders and the community due to the Proposal.

5. ENVIRONMENTAL PRINCIPLES

Section 4A of the EP Act identifies the object and principles of the Act, which is to protect the Environment of the State, having regard to a list of specific principles. These principles are the highest order which the EPA must have regarded as a condition of the valid exercise of its powers when assessing and reporting on proposals under the EP Act.

The Proponent has considered these principles concerning the development and implementation of the Proposal. Table 5-1 outlines how the principles relate to the Proposal.

Table 5-1: EP Act Principles

Principle	Consideration
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation In application of this precautionary principle, decisions should be guided by: • Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment • An assessment of the risk-weighted consequences of various options	The Proponent has conducted numerous environmental studies within the Development Envelope to understand the environmental values and the potential impacts as a result of the Proposal. Scientific certainty around environmental values is relatively high due to the number and nature of studies undertaken in the Pilbara, for the broader Rio Tinto Group at surrounding operations and from publicly available information from other proponents. The Development Envelope supports a number of conservation significant values, including records of and high value habitat for Northern Quoll, Ghost Bat and Pilbara Leaf-nosed Bat. A total of 9 Ghost Bat caves have been recorded, including one Category 2 cave. The Proposal will directly impact only one Category 3 and one Category 4 cave. High value habitat is also present for the Pilbara Olive Python; however, no direct or indirect evidence of the species has been recorded in the Development Envelope. These Proposal specific studies have informed the design of the Proposal, and modifications to the Development Envelope and mine plan have been made to avoid and minimise environmental impacts, where practicable. These modifications, their environmental benefits and operational impacts are listed in Table 2-3 and Figure 2-3. These design changes have reduced the potential impact of the Proposal on significant environmental values and the establishment of Mining Exclusion Zones.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations	The Proposal has been designed to address the EPA's objectives for the identified environmental factors, with mitigation measures to reduce residual environmental impacts and offsets proposed to compensate for any significant residual impacts. The Proposal responds to the growing demand for mineral resources and provides environmentally sensitive and economically sustainable means of meeting those demands through operations in the Pilbara. Aboriginal heritage surveys have identified several archaeological and ethnographic sites within the Development Envelope. Two sites of significant cultural heritage were identified (HOPE7-04 and BDH16-03). The Proposal has been amended to reduce and change the Development Envelope so that HOPE7-04 is no longer within the Proposal and to include MEZ3 to protect site BDH16-03. A Nyiyaparli Social and Cultural Heritage Management Plan (SCHMP, Appendix F3) will manage cultural values into the future. The Proponent has and will continue to work collaboratively with the Traditional Owners of the area. This work aims to ensure that all indigenous social and cultural heritage values are maintained and that future generations can enjoy the land, while seeking to mininmise the permanent impacts that result from mining activities. The Proponent recognises the risk that greenhouse gas emissions pose to the global environment and its impact on future generations. As such, a Greenhouse Gas Environmental Management Plan (GHG EMP, Appendix A8) has been prepared, following the current best practises to minimise emissions, to outline the processes and targets the Proponent will undertake to meet the net-zero by 2050 commitment by the Australian Government. Given the Proposal will have reached the end of its life by 2050, no contingency for not meeting the 2050 net-zero target is proposed as the Proponent commits to providing offsets as a contingency for any net emissions generated.

Principle	Consideration
	The Proponent will implement offsets for significant residual impacts to vegetation in Good to Excellent condition, and high value habitat (Gorge/Gully and Breakaway habitats) for Northern Quoll, Ghost Bats and Pilbara Leaf-nosed Bat. This assessment demonstrates that the Proposal can be implemented to avoid significant impacts on the health, diversity or productivity of the environment for the benefit of future generations.
Principles relating to improved valuation, pricing and incentive mechanisms • Environmental Factors should be included in the valuation of assets and services • The polluter pays principles — those who generate pollution and waste should bear the cost of containment, avoidance or abatement • The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes • Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems	The Proponent acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when practicable. For example: • Detailed flora and vegetation and terrestrial fauna field surveys have been undertaken to identify and confirm the relative environmental values within the Development Envelope. From this, environmental factors have been considered in determining the mine design and location of the infrastructure • Procedures will be in place to ensure that emissions and discharges are minimised as far as practicable • Potential impacts on the identified ecological attributes within the Development Envelope has been a fundamental design consideration as the mine layout has been modified to reduce impacts to conservation significant environmental values • The Proponent has proposed management actions to mitigate and manage the Proposal related impacts to flora and vegetation, terrestrial fauna, subterranean fauna, inland waters, social surroundings and greenhouse gas emissions • Offsets have been proposed for significant residual impacts to vegetation in Good to Excellent condition, critical habitat (Gorge/Gully and Breakaway habitats) for Northern Quoll, Ghost Bats and Pilbara Olive Python and supporting habitat for MNES species, as outlined in Chapter 12.
The principle of the conservation of biological diversity and ecological integrity	The Proponent has considered the relevant environmental factors and has iteratively modified the mine and infrastructure design to avoid/minimise impacts to significant environmental values where practicable. This includes: • The Development Envelope was revised to exclude the majority of Weeli Wolli Creek from the Development Envelope and the proposed Conceptual Footprint was revised to increase the separation distance of mining operations (pits and waste rock landforms) to Weeli Wolli Creek. This has avoided indirect and direct impacts to the creek

Principle	Consideration
	• A Mining Exclusion Zone (MEZ1) will be established that excludes mine excavation and blast activities and thereby avoids direct impacts to an area of potential critical Northern Quoll habitat. MEZ1 will also have the additional benefits of avoiding direct impacts to a population of Priority 2 flora (*Eremophila* sp. West Angelas (S. van Leeuwen 4068)), three Ghost Bat caves (Caves 3, 5 and 6) which are confirmed or potential nocturnal roosts and some medium to high certainty above water table troglofaunal habitat • A Mining Exclusion Zone (MEZ2) will also be established around the one potential maternity Ghost Bat roost (Category 2, Cave 10) at BHT, to exclude mine excavation and blast activities to ensure the protection and retention of this roost for the local population • A Mining Exclusion Zone (MEZ3) will also be established around a site of significant cultural heritage at BHT, to exclude mine excavation and blast activities, to ensure the protection and retention of this site The Proponent will also implement an EMP (Appendix A7) to manage potential impacts to environmental values within the Development Envelope and an MCP (Appendix A4). The Proponent will implement offsets for significant residual impacts to vegetation in Good to Excellent condition, critical habitat (Gorge/Gully and Breakaway habitats) for Northern Quoll, Ghost Bats and Pilbara Leaf-nosed Bat and supporting habitat for MNES species, as outlined in Chapter 12.
The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment	The Proponent has been considerate of the principle of waste minimisation including the destination and use of removed materials. Waste will be minimised during construction, operation and closure by adopting the hierarchy of waste controls: avoid, minimise, reuse, recycle and safe disposal.

6. FLORA AND VEGETATION

6.1. EPA Environmental Factor and Objective

The EPA objective for flora and vegetation is to protect flora and vegetation so that biological diversity and ecological integrity are maintained (EPA 2021c)

This section describes the flora and vegetation that occurs within the Development Envelope and the surrounding region. It assesses the Proposal's potential impacts on significant flora and vegetation, proposed mitigation measures, and the predicted outcome for this key environmental factor.

For this EIA, flora is defined as native vascular plants and vegetation is defined as groupings of different flora patterned across the landscape that occur in response to environmental conditions (EPA 2016a). Significant flora and vegetation are defined as any flora species or vegetation community protected under legalisation, listed as Priority under DBCA or important locally.

6.2. Relevant Policy and Guidance

6.2.1. EPA Policy and Guidance

The relevant policy and guidance for Flora and Vegetation are identified in Table 6-1.

Table 6-1: Relevant Policy and Guidance for Flora and Vegetation

Policy and Guidance	Explain How the Policy and Guidance has Been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors, Objectives and Aims (EPA 2021c).	Considered during the development of this document.
Environmental Factor Guideline: Flora and Vegetation (EPA 2016a).	Considered in the design (methods and approach) of the flora and vegetation surveys or previous guidance (if survey undertaken before current guidelines). Survey adequacy outlined in Section 7.3.2.
EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b).	
Instruction on how to prepare an Environmental Review Document (EPA 2021e).	Considered during the development of this document.
Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans (EPA 2021h)	
Instructions on how to prepare *Environmental Protection Act 1986* Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports (EPA 2021j).	Considered in the impact assessment and offset strategy for flora and vegetation.
Template for *Environmental Protection Act 1986* Part IV Reconciliation Procedures (EPA 2021k).	
Cumulative environmental impacts of development in the Pilbara region: Advice of the Environmental Protection Authority to the Minister for Environment under Section 16(e) of the *Environmental Protection Act 1986* (EPA 2014).	Considered in understanding cumulative impacts and supports conclusions on significance, and therefore offsets required for clearing, of vegetation based on its condition.
Other State and Commonwealth	

Policy and Guidance	Explain How the Policy and Guidance has Been Considered
WA Environmental Offsets Policy (GoWA 2011)	Considered in the impact assessment and offset strategy for flora and vegetation
WA Environmental Offsets Guidelines (GoWA 2014).	

6.3. Receiving Environment

6.3.1. Studies and Survey Effort

Table 6-2 provides the location, types and timing for each of the surveys/studies as well as summarises their limitations and to which guidelines/policies they are considered to be in accordance. Figure 6-1 and Figure 6-2 show the survey coverage and sampling effort, respectively.

Table 6-2: Summary of Technical Studies for the Flora and Vegetation Factor

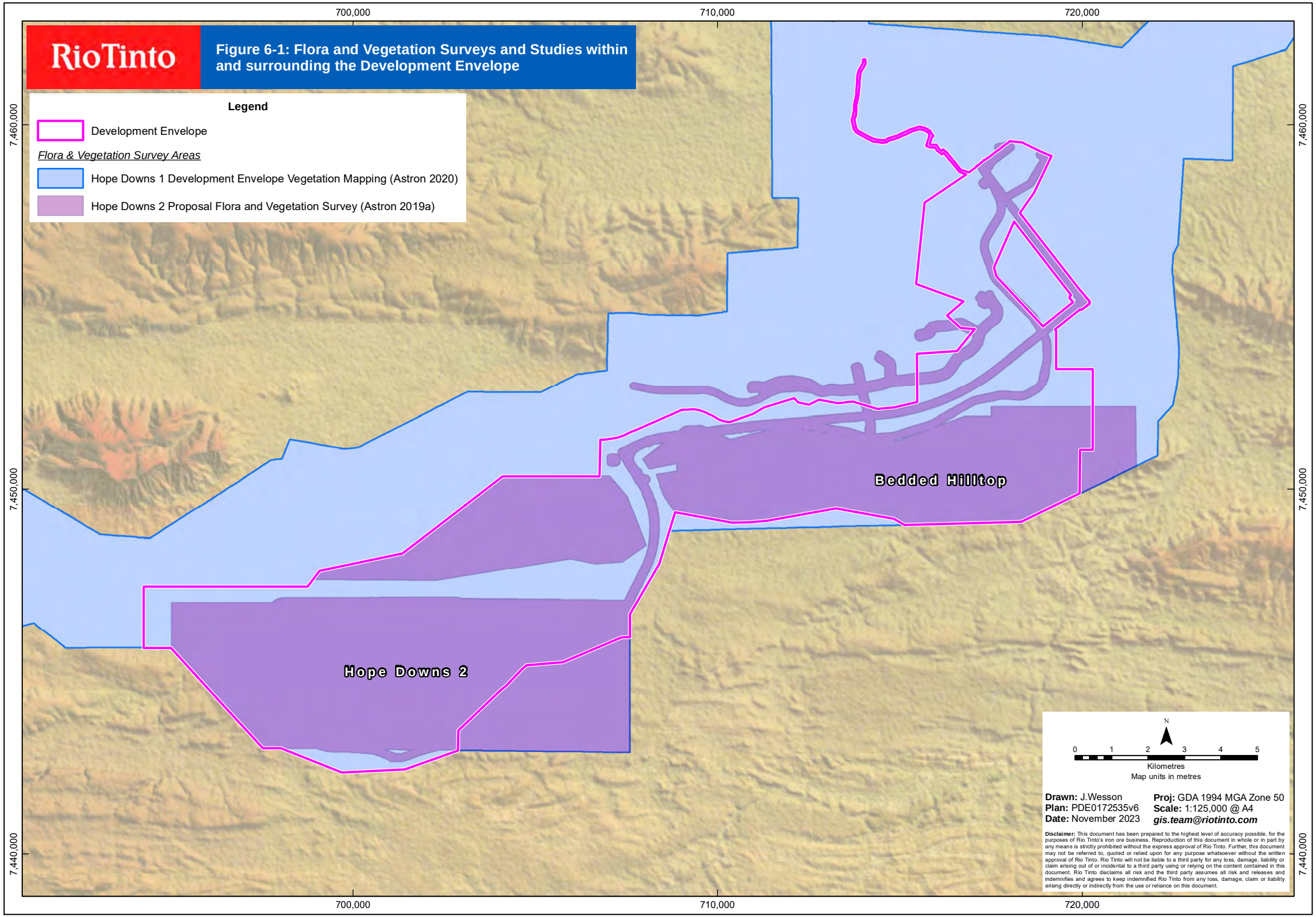
Studies/Survey	Study Area, Type & Timing	Consistency with Guidance
Key Studies and Surveys		
Hope Downs 2 Proposal Flora and Vegetation Survey (Astron 2019a) Appendix B1	**Survey Area:** Hope Downs 2 and Bedded Hilltop survey area (Figure 6-1 and Figure 6-2) **Type:** Three-phase detailed flora survey **Timing:** 1st -12th November 2017 (Phase 1); 18th - 30th May 2018 (Phase 2); 20th – 31st May 2019 (Phase 3).	The survey meets relevant EPA Act policy and guidance for the survey area. Survey approach and method undertaken with consideration of the following: • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact (EPA 2016b) • Position Statement No. 3 (EPA 2002) • Environmental Factor Guideline - Flora and Vegetation (EPA 2016a). The following limitations and constraints associated with this report are detailed below: • Below average rainfall for the entire survey period and the 6 months preceding it • Significant areas within the survey area had been burnt between 2015 and 2019 • The rugged south-facing slopes of BHT were difficult to safely traverse due to the challenging terrain and therefore could not be thoroughly searched for conservation significant flora in their entirety
Hope Downs Development Envelope-Vegetation Mapping (Astron 2020a) Appendix B2	**Survey Area:** Hope Downs 1 Development Envelope (including the Development Envelope of Hope Downs 2 **Type:** Reconnaissance level survey and desktop assessment for vegetation mapping to consolidate all previous mapping within HD1 and HD2 Development Envelopes. **Timing:** May 2020	There is no specific guidance for desktop flora and vegetation mapping consolidation. Prepared to provide contextual information regarding the size and distribution of local vegetation types across the greater project area.

Targeted Riparian Values Assessment of the Greater Hope Downs 1 Area (Rio Tinto 2022d) Appendix B3	**Survey Area:** A 35 km section of Pebble Mouse Creek and a 40 km section of Weeli Wolli Creek within and around the Hope Downs 2 Development Envelope **Type:** Desktop assessment and targeted flora and Vegetation survey **Timing:** 12th -17th July 2021	The survey meets relevant EP Act policy and guidance for the survey area. Survey approach and method were undertaken in with consideration of the following: • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact (EPA 2016b) • Environmental Factor Guideline – Flora and Vegetation (EPA 2016a) The following limitations and constraints associated with this report are detailed below: Assessment is broadly restricted to Moderate and Major sized drainage (i.e. Weeli Wolli Creek and Pebble Mouse Creek and its tributaries), and so doesn't cover minor drainage which extends into the upland regions of the Development Envelope.

A number of historical flora and vegetation surveys have previously been carried out within the Development Envelope and the Hope Downs Hub area; these were also reviewed to provide vegetation unit and vegetation condition information. Vegetation unit boundaries from the following surveys were used to inform interpretation of vegetation units and condition in the Hope Downs Hub area:

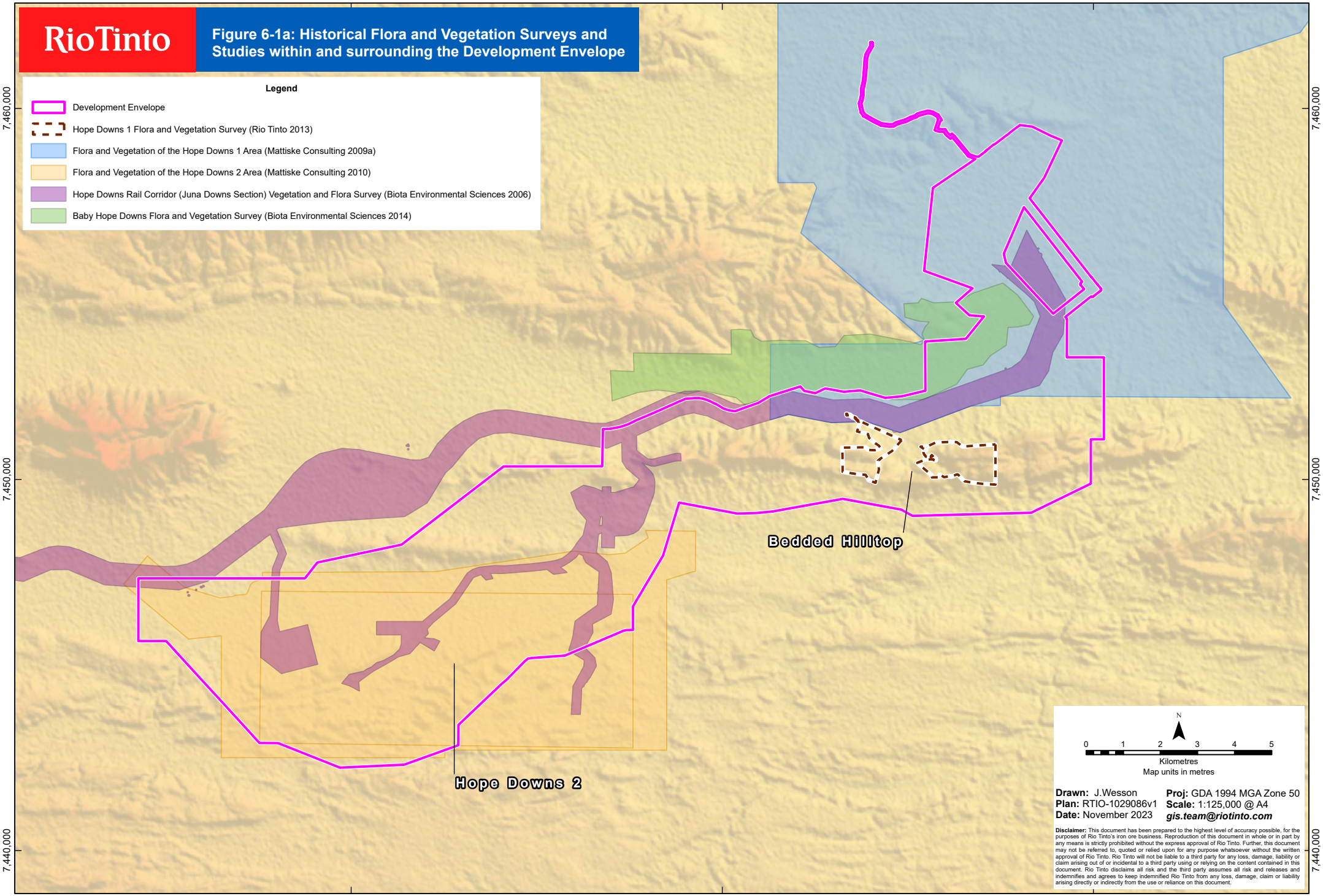
- Hope Downs 1 Flora and Vegetation Survey (Rio Tinto 2013)
- Hope Downs Rail Corridor (Juna Downs Section) Vegetation and Flora Survey (Biota Environmental Sciences 2006)
- Baby Hope Downs Flora and Vegetation Survey (Biota Environmental Sciences 2014)
- Flora and Vegetation of the Hope Downs 1 Area (Mattiske Consulting 2009a)
- Flora and Vegetation of the Hope Downs 2 Area (Mattiske Consulting 2010)

The survey extents are shown in Figure 6-1a.


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Figure 6-1: Flora and Vegetation Surveys and Studies within and surrounding the Development Envelope
Legend
Development Envelope
Flora & Vegetation Survey Areas
Hope Downs 1 Development Envelope Vegetation Mapping (Astron 2020)
Hope Downs 2 Proposal Flora and Vegetation Survey (Astron 2019a)
Bedded Hilltop
Hope Downs 2
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: J.Wesson
Plan: PDE0172535v6
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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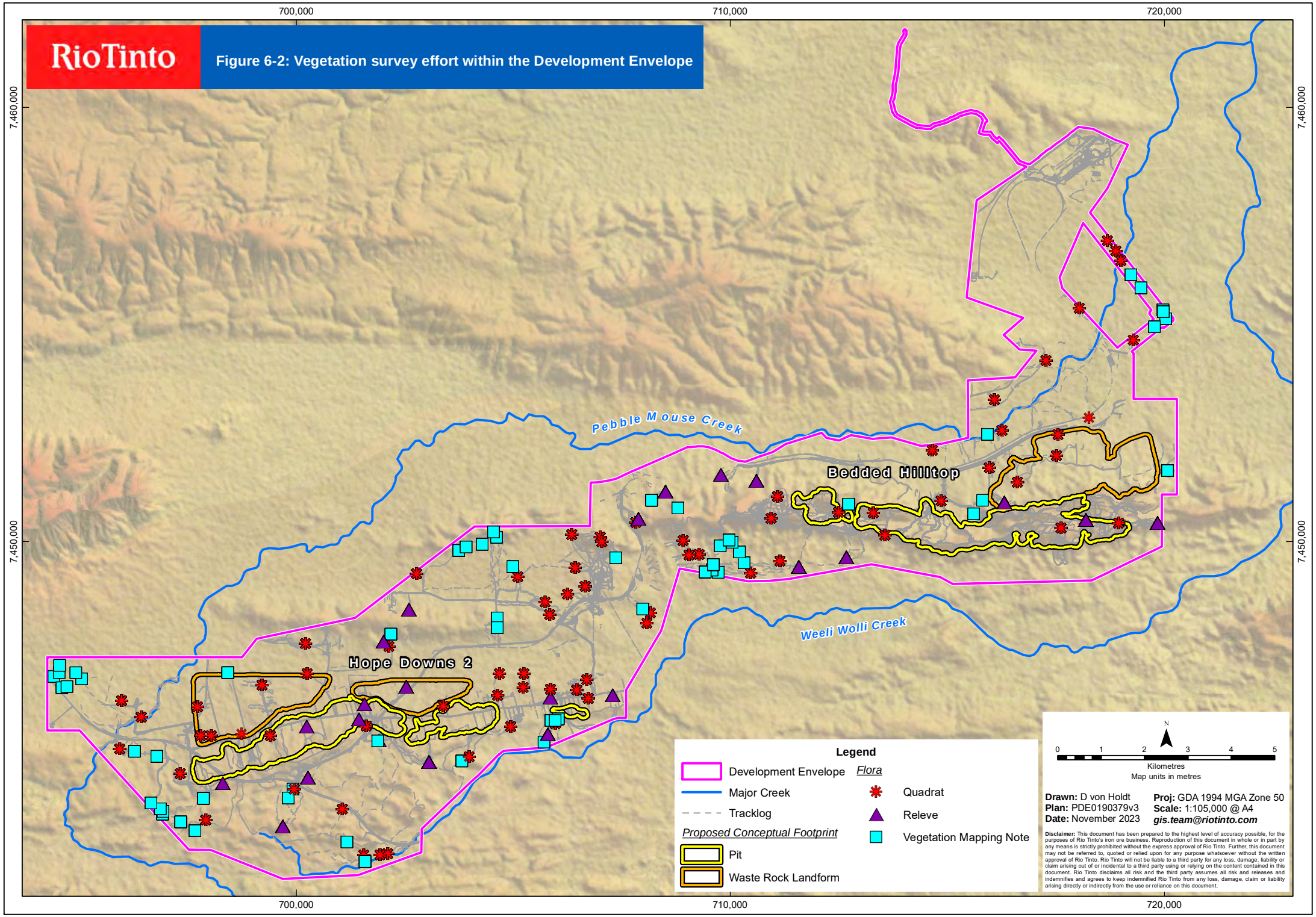
Figure 6-1a: Historical Flora and Vegetation Surveys and Studies within and surrounding the Development Envelope



Drawn: J.Wesson
Plan: RTIO-1029086v1
Date: November 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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Figure 6-2: Vegetation survey effort within the Development Envelope
700,000
710,000
720,000
7,460,000
7,450,000
Pebble Mouse Creek
Bedded Hilltop
Hope Downs 2
Weeli Wolli Creek
Legend
Development Envelope
Major Creek
Tracklog
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Flora
Quadrat
Releve
Vegetation Mapping Note
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0190379v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:105,000 @ A4
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6.3.2. Vegetation

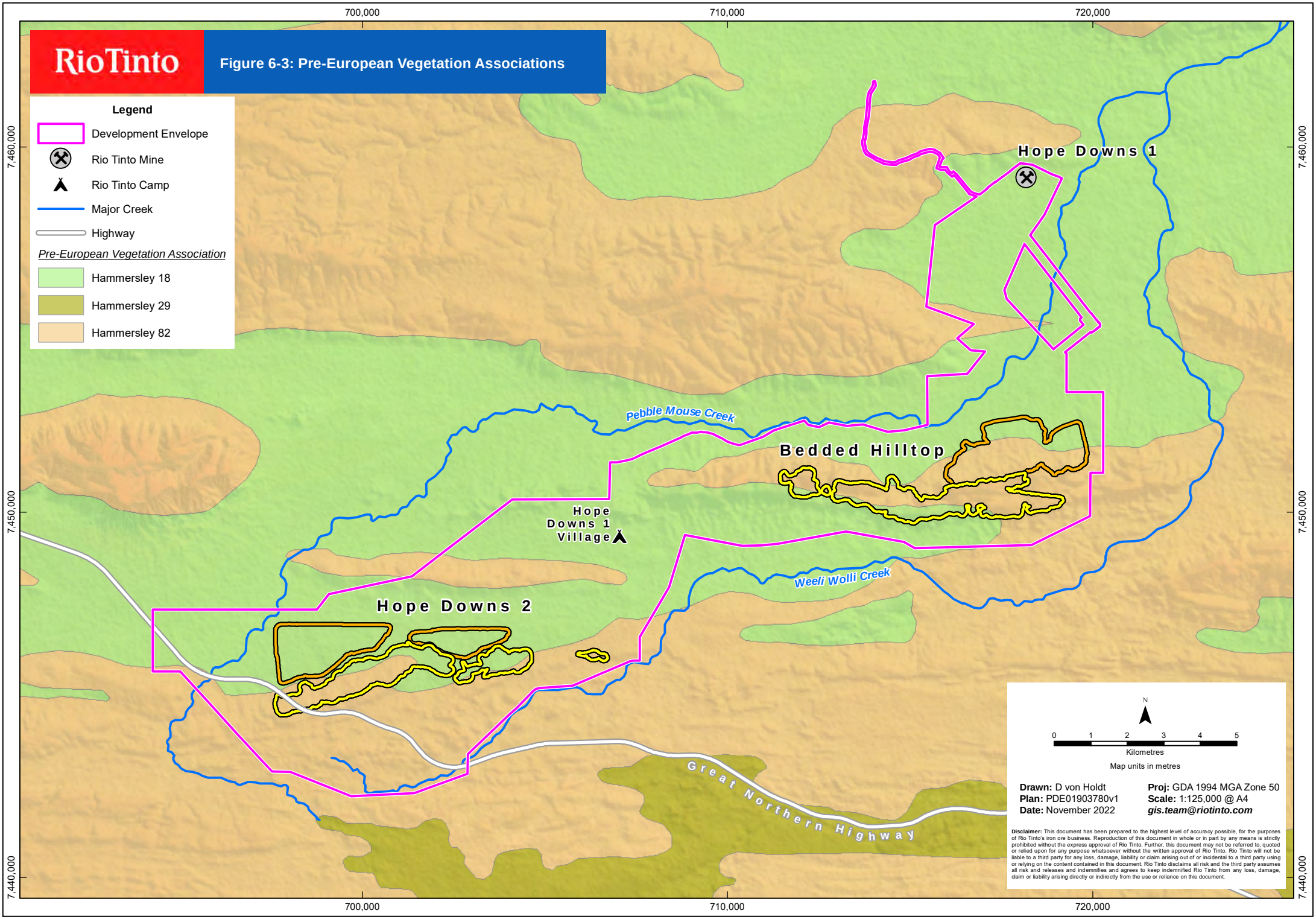
6.3.2.1. Pre-European Vegetation

Vegetation mapping of Western Australia was completed on a broadscale (1:1,000,000 and 1:250,000) by Beard (1975), defining broad vegetation associations. These vegetation associations were reassessed by Shepherd et al. (2002) to account for clearing in the intensive land use zone of WA and to divide some of the larger vegetation types.

The Development Envelope intersects two vegetation associations (Table 6-3, Figure 6-3). Both vegetation association units currently have more than 99% of their respective pre-European extents remaining.

Table 6-3: Pre-European Vegetation Associations within the Development Envelope

Vegetation Association and Description	Extent within the Hamersley Subregion			Formal Protection	Extent within the Development Envelope	
	Pre-European (ha)	Current (ha)	Percent Remaining	Percentage in Reserves	Hectares (ha)	Percentage of Current Extent
Hamersley_18 – low woodland, open low woodland or sparse woodland; mulga (*Acacia aneura*).	580,512	576,389	99.3%	29.6%	7,874	1.4%
Hamersley_82 – hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	2,168,702	2,156,558	99.4%	13.7%	4,535	0.2%


RioTinto
Figure 6-3: Pre-European Vegetation Associations
Legend
Development Envelope
Rio Tinto Mine
Rio Tinto Camp
Major Creek
Highway
Pre-European Vegetation Association
Hammersley 18
Hammersley 29
Hammersley 82
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Hope Downs 1
Pebble Mouse Creek
Bedded Hilltop
Hope Downs 1 Village
Weeli Wolli Creek
Hope Downs 2
Great Northern Highway
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE01903780v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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6.3.2.2. Local Vegetation Types

Twenty-three vegetation types have been identified and mapped within the Development Envelope (Astron 2019a). The vegetation types fall within three main groups that largely reflect local topography and landforms: hills and slopes (52% of Development Envelope), plains (22% of Development Envelope) and drainage lines (14% of Development Envelope). Approximately 12% of the Development Envelope has been previously disturbed.

The vegetation types with the highest coverage within the Development Envelope are:

- **P3 (Plains)** (occupying 2,066 ha or 16.6% of the Development Envelope): *Acacia aptaneura, A. catenulata* subsp. *occidentalis, A. pruinocarpa* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii* scattered shrubs to open shrubland over *Triodia pungens* open hummock grassland to hummock grassland
- **H7 (Hills and slopes)** (occupying 1,798 ha or 14.5% of the Development Envelope): *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Senna glutinosa* subsp*. glutinosa, Acacia maitlandii* scattered shrubs over *Triodia wiseana* and/or *T. vanleeuwenii* and/or *T. pungens* open hummock grassland to hummock grassland
- **H8 (Hills and slopes)** (occupying 1,186 ha or 9.6% of the Development Envelope): *Eucalyptus leucophloia* subsp*. leucophloia* scattered low trees to low open woodland over *Acacia pruinocarpa, Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Triodia vanleeuwenii, (T. pungens)* open hummock grassland to hummock grassland with *Amphipogon sericeus* scattered tussock grasses***.**

Descriptions and extents of each of the vegetation types within the Development Envelope are provided in Table 6-4 and presented in Figure 6-4. Riparian vegetation survey results are provided in Section 6.3.2.4

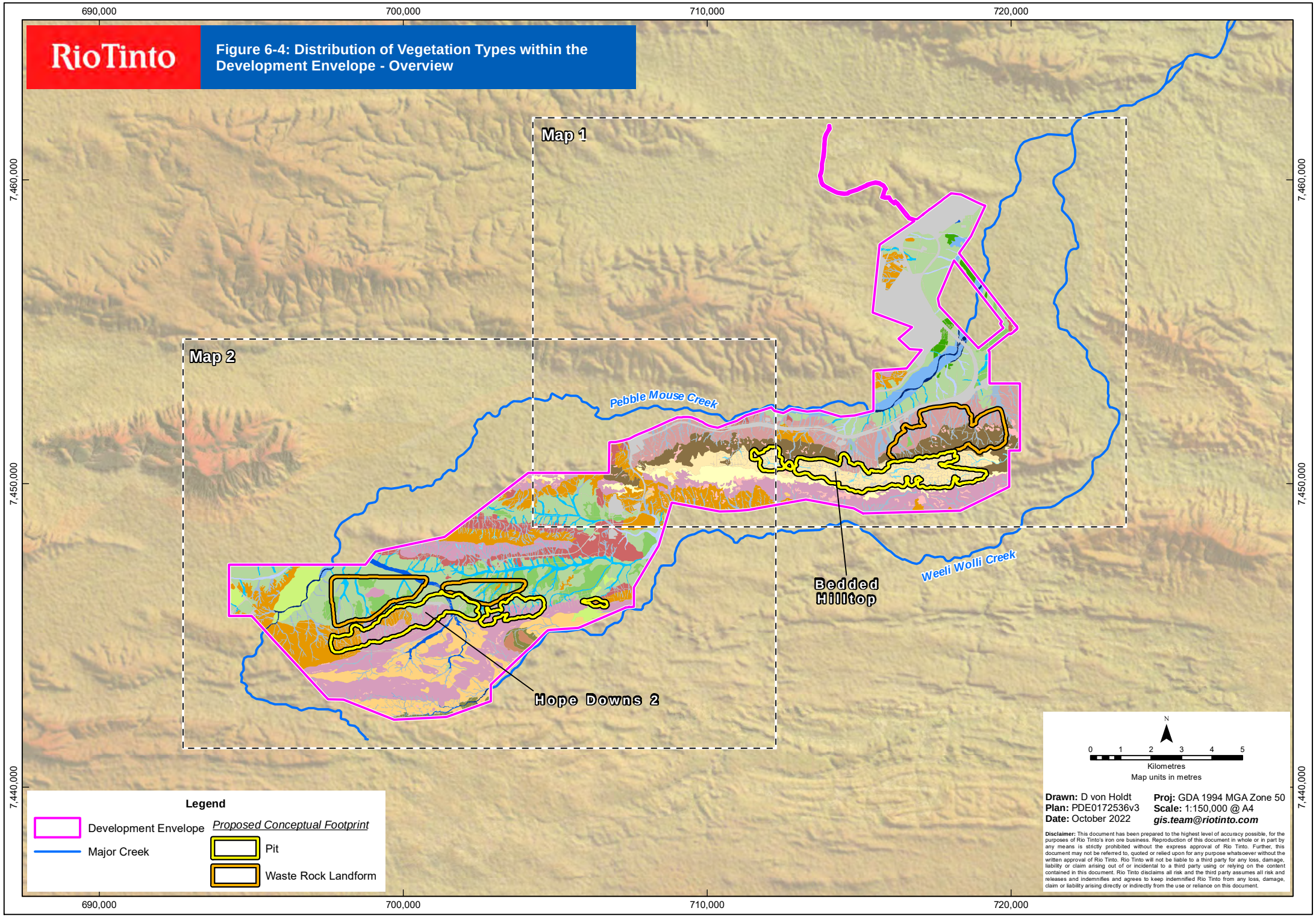
Table 6-4: Vegetation Types within Development Envelopes

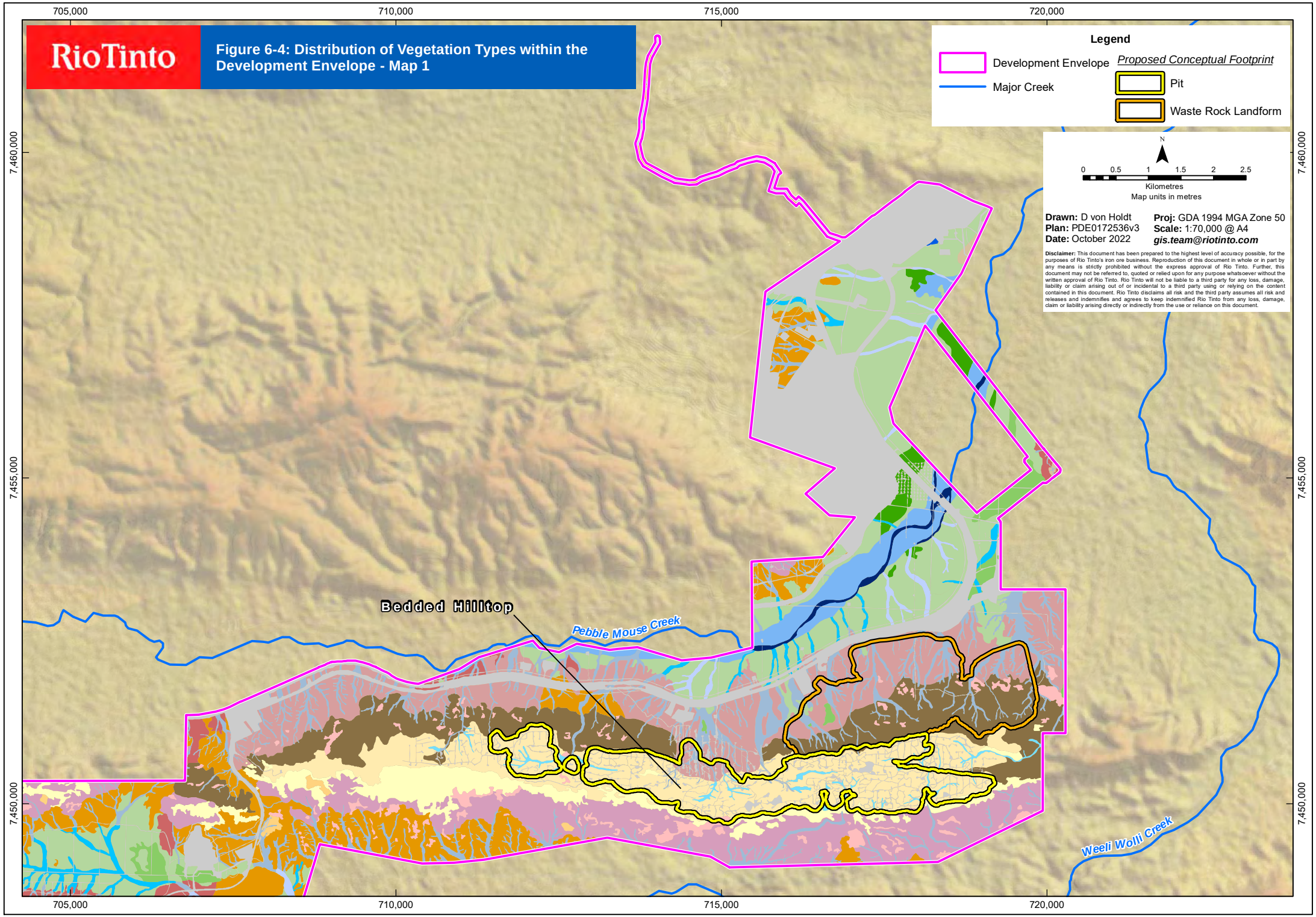
Vegetation Type	Description	Mapped Vegetation Extent (ha; Astron 2020a)	Vegetation Extent in the Development Envelope (ha and %)	Vegetation Extent in the Conceptual Footprint (ha)
Vegetation of Drainage Lines				
D1	*Corymbia hamersleyana* sens. lat., *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Petalostylis labicheoides, Acacia monticola, A. maitlandii* scattered tall shrubs to tall shrubland over *Dodonaea lanceolata* var. *lanceolata, Androcalva luteiflora* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland to open hummock grassland with *Themeda triandra, Eriachne mucronata* very open tussock grassland to open tussock grassland.	2,547	883 (7.1)	370
D2	*Acacia aptaneura, A. catenulata* subsp*. occidentalis, A. pruinocarpa* tall shrubland to tall open scrub over *Petalostylis labicheoides* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland with *Chrysopogon fallax* scattered tussock grasses*.*	807	350 (2.8)	133
D3	*Corymbia ferriticola, Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Petalostylis labicheoides, Acacia hamersleyensis, Dodonaea viscosa* subsp. *spatulata* tall open shrubland over *Triodia pungens* very open hummock grassland with *Eriachne mucronata, Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Cymbopogon ambiguus* very open tussock grassland to tussock grassland.	420	49 (0.4)	29
D4	*Eucalyptus victrix*, (*E. camaldulensis* subsp. *obtusa*) low open woodland to open woodland over *Acacia citrinoviridis, Petalostylis labicheoides* scattered tall shrubs to tall shrubland over *Androcalva luteiflora, Gossypium sturtianum* var. *sturtianum* scattered shrubs to open shrubland over *Triodia longiceps* scattered hummock grasses to very open hummock grassland with *Themeda triandra*, *Eulalia aurea*, (*Cenchrus ciliaris*) very open tussock grassland to tussock grassland and *Bidens bipinnata* scattered herbs.	440	48 (0.4)	12
D5	*Eucalyptus xerothermica* scattered low trees to low open woodland over *Petalostylis labicheoides, Acacia maitlandii, A. pyrifolia* tall open shrubland to tall shrubland over *Androcalva luteiflora* scattered shrubs over *Triodia longiceps* very open hummock grassland to open hummock grassland with *Themeda triandra, Eulalia aurea* open tussock grassland to tussock grassland and *Bidens bipinnata* scattered herbs*.*	165	76 (0.6)	42
D7	*Acacia citrinoviridis, A. aptaneura, A. pruinocarpa* scattered tall shrubs to tall shrubland over *Senna artemisioides* subsp*. oligophylla* scattered low shrubs over *Triodia longiceps* open hummock grassland to hummock grassland*.*	1,293	191 (1.5)	54

Vegetation Type	Description	Mapped Vegetation Extent (ha; Astron 2020a)	Vegetation Extent in the Development Envelope (ha and %)	Vegetation Extent in the Conceptual Footprint (ha)
D8	*Eucalyptus xerothermica* scattered low trees to low open woodland over *Acacia aptaneura, A. catenulata* subsp*. occidentalis* tall open shrubland to tall open scrub over *Triodia pungens* scattered hummock grasses to very open hummock grassland with *Themeda triandra* very open tussock grassland to open tussock grassland.	162	108 (0.9)	41
Vegetation of Plains				
P1	*Acacia aptaneura, A. catenulata* subsp. *occidentalis*, (*A. pruinocarpa*) tall shrubland to tall open scrub over *Eremophila forrestii* subsp. *forrestii* open shrubland to shrubland over *Triodia pungens,* (*T. vanleeuwenii*) scattered hummock grasses to very open hummock grassland.	1,077	449 (3.6)	300
P2	*Acacia aptaneura, A. pruinocarpa, A. tetragonophylla* scattered tall shrubs to tall open shrubland over *Eremophila forrestii* subsp*. forrestii, A. synchronicia* scattered shrubs over *Ptilotus obovatus, Sida fibulifera* scattered low shrubs over *Aristida latifolia, Astrebla elymoides, Eragrostis xerophila* open tussock grassland to tussock grassland.	453	215 (1.7)	19
P3	*Acacia aptaneura, A. catenulata* subsp. *occidentalis, A. pruinocarpa* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii* scattered shrubs to open shrubland over *Triodia pungens* open hummock grassland to hummock grassland.	5,520	2,066 (16.7)	1,016
P4	*Acacia pruinocarpa, A. aptaneura, A. catenulata* subsp. *occidentalis* tall open shrubland to tall shrubland over *Rhagodia eremaea* scattered shrubs.	296	60 (0.5)	35
Vegetation of Hills and Slopes				
H1	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* sens. lat. scattered low trees to low open woodland over *Petalostylis labicheoides, Senna glutinosa* subsp. *glutinosa* scattered tall shrubs over *Gompholobium oreophilum, Acacia hilliana, A. spondylophylla* low open shrubland to low shrubland over *Triodia vanleeuwenii, T. wiseana, T. pungens* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses.	1,628	597 (4.8)	376
H2	Eucalyptus repullulans scattered low mallees over Acacia catenulata subsp. occidentalis, A. aptaneura, (Grevillea saxicola) tall shrubland to tall open scrub over Scaevola acacioides, Dodonaea pachyneura, Eremophila latrobei subsp. filiformis scattered shrubs to open shrubland over Triodia pungens scattered hummock grasses to very open hummock grassland with Eriachne mucronata scattered tussock grasses to very open tussock grassland	439	297 (2.4)	19

Vegetation Type	Description	Mapped Vegetation Extent (ha; Astron 2020a)	Vegetation Extent in the Development Envelope (ha and %)	Vegetation Extent in the Conceptual Footprint (ha)
H3	*Corymbia deserticola* subsp. *deserticola* scattered low trees over *Acacia inaequilatera, Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp. *pruinosa* scattered shrubs over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses to very open tussock grassland.	917	641 (5.2)	521
H4	Eucalyptus leucophloia subsp. leucophloia scattered low trees over Senna glutinosa subsp. glutinosa, S. glutinosa subsp. pruinosa scattered shrubs over Triodia vanleeuwenii and/or T. wiseana open hummock grassland to hummock grassland.	1,221	623 (5.0)	319
H5	*Eucalyptus socialis* subsp*. eucentrica* scattered low mallees to low open mallee woodland over *Acacia bivenosa* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp*. xluerssenii* scattered shrubs over *Ptilotus obovatus* scattered low shrubs over *Triodia wiseana* very open hummock grassland to open hummock grassland	1,118	7 (0.1)	4
H6	Acacia aptaneura, A. catenulata subsp. occidentalis tall open shrubland to tall shrubland over Eremophila forrestii subsp. forrestii, Senna stricta scattered shrubs to open shrubland over Triodia pungens and/or T. vanleeuwenii and/or T. wiseana scattered hummock grasses to very open hummock grassland with Eriachne mucronata scattered tussock grasses.	171	146 (1.2)	25
H7	Eucalyptus leucophloia subsp. leucophloia scattered low trees to low open woodland over Senna glutinosa subsp. glutinosa, Acacia maitlandii scattered shrubs over Triodia wiseana and/or T. vanleeuwenii and/or T. pungens open hummock grassland to hummock grassland.	4,169	1,798 (14.5)	382
H8	*Eucalyptus leucophloia* subsp*. leucophloia* scattered low trees to low open woodland over *Acacia pruinocarpa, Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Triodia vanleeuwenii, (T. pungens)* open hummock grassland to hummock grassland with *Amphipogon sericeus* scattered tussock grasses*.*	3,749	1,186 (9.6)	314
H9	*Acacia arida, Grevillea wickhamii* subsp*. hispidula* open shrubland over *Triodia wiseana* open hummock grassland with *Themeda* sp*.* Mt Barricade (M.E. Trudgen 2471*)* very open tussock grassland.	32	31 (0.3)	0
H10	Eucalyptus leucophloia subsp. leucophloia scattered low trees with E. repullulans and/or E. socialis subsp. eucentrica and/or E. pilbarensis scattered low mallees to low open mallee woodland over Acacia bivenosa scattered shrubs over Triodia wiseana, (T. angusta) open hummock grassland to hummock grassland.	1,681	668 (5.4)	153

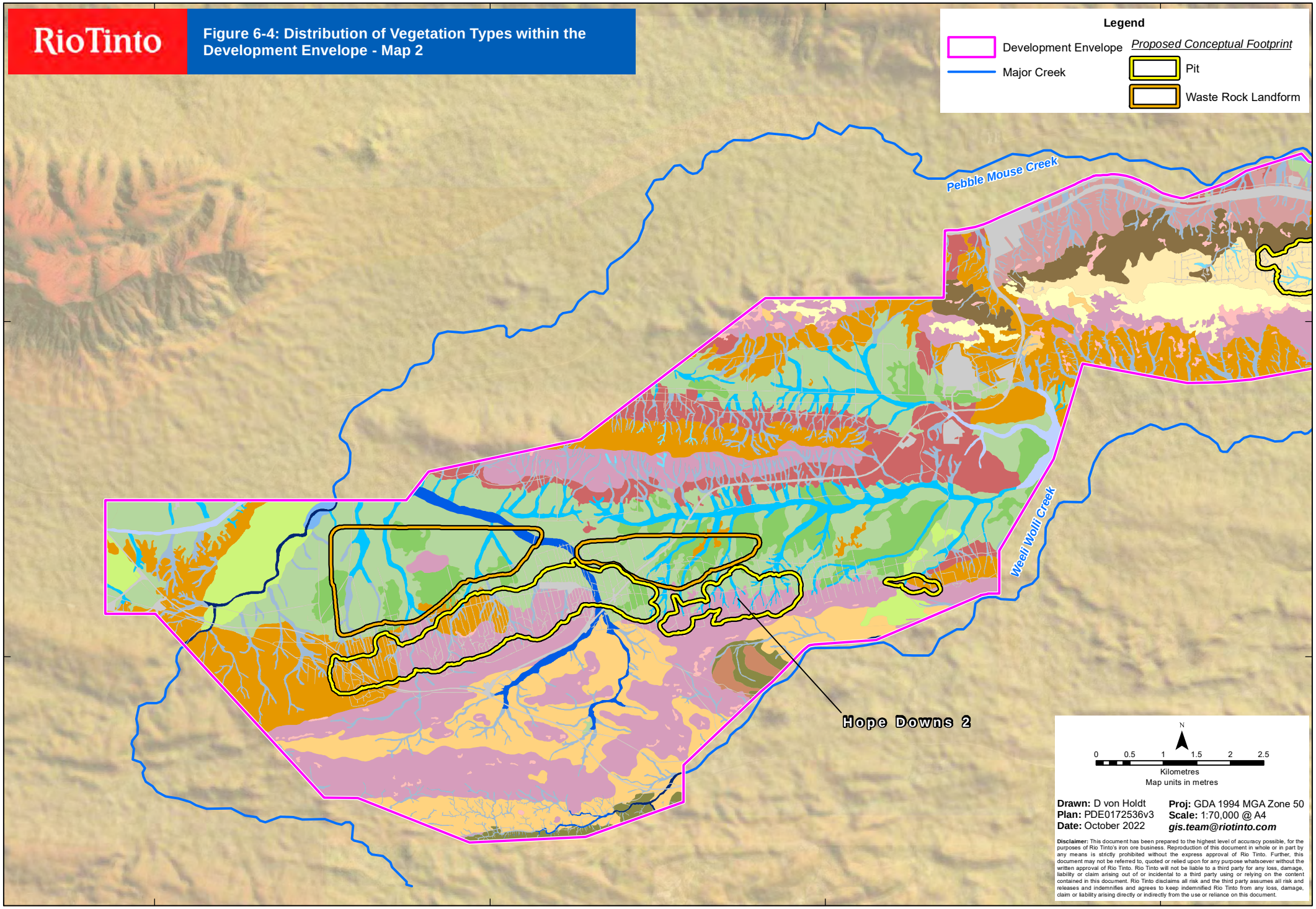
Vegetation Type	Description	Mapped Vegetation Extent (ha; Astron 2020a)	Vegetation Extent in the Development Envelope (ha and %)	Vegetation Extent in the Conceptual Footprint (ha)
H11	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. gamophylla* low open mallee woodland over *Acacia ancistrocarpa* scattered tall shrubs to tall open shrubland over *A. hilliana* scattered low shrubs to low open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) open hummock grassland to hummock grassland.	1,681	414 (3.3)	42
H12	*Corymbia hamersleyana sens*. lat. scattered low trees over *Acacia inaequilatera, Hakea chordophylla, A. bivenosa* scattered tall shrubs to tall open shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* open hummock grassland to hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Cymbopogon ambiguus* scattered tussock grasses and *Heliotropium ovalifolium*, *Corchorus lasiocarpus* subsp. *parvus* scattered herbs.	691	72 (0.6)	0
Cleared	Disturbed areas	4,900	1,432 (11.5)	695


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Figure 6-4: Distribution of Vegetation Types within the Development Envelope - Overview
690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Map 1
Map 2
Pebble Mouse Creek
Weeli Wolli Creek
Bedded Hilltop
Hope Downs 2
Legend
Development Envelope
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172536v3
Date: October 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @ A4
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Figure 6-4: Distribution of Vegetation Types within the Development Envelope - Map 1
Legend
Development Envelope
Proposed Conceptual Footprint
Major Creek
Pit
Waste Rock Landform
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172536v3
Date: October 2022
Proj: GDA 1994 MGA Zone 50
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705,000
710,000
715,000
720,000
7,460,000
7,455,000
7,450,000
Bedded Hilltop
Pebble Mouse Creek
Weeli Wolli Creek

RioTinto

Figure 6-4: Distribution of Vegetation Types within the Development Envelope - Map 2



Drawn: D von Holdt
Plan: PDE0172536v3
Date: October 2022

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Figure 6-4: Vegetation communities within the Development Envelope - Legend

Hilltops/Hillslopes

H1
Eucalyptus leucophloia subsp. *leucophloia, Corymbia hamersleyana* sens. lat. scattered low trees to low open woodland over *Petalostylis labicheoides, Senna glutinosa* subsp. *glutinosa* scattered tall shrubs over *Gompholobium oreophilum, Acacia hilliana, A. spondylophylla* low open shrubland to low shrubland over *Triodia vanleeuwenii, T. wiseana, T. pungens* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses

H2
Eucalyptus repullulans scattered low mallees over *Acacia catenulata* subsp. *occidentalis, A. aptaneura, (Grevillea saxicola)* tall shrubland to tall open scrub over *Scaevola acacioides, Dodonaea pachyneura, Eremophila latrobei* subsp. *filiformis* scattered shrubs to open shrubland over *Triodia* pungens scattered hummock grasses to very open hummock grassland with *Eriachne mucronata* scattered tussock grasses to very open tussock grassland

H3
Corymbia deserticola subsp. *deserticola* scattered low trees over *Acacia inaequilatera, Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp. *pruinosa* scattered shrubs over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses to very open tussock grassland

H4
Eucalyptus leucophloia subsp. *leucophloia* scattered low trees over *Senna glutinosa* subsp. *glutinosa, S. glutinosa* subsp. *pruinosa* scattered shrubs over *Triodia vanleeuwenii* and/or *T. wiseana* open hummock grassland to hummock grassland

H5
Eucalyptus socialis subsp. *eucentrica* scattered low mallees to low open mallee woodland over *Acacia bivenosa* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp. × *luerssenii* scattered shrubs over *Ptilotus obovatus* scattered low shrubs over *Triodia wiseana* very open hummock grassland to open hummock grassland

H6
Acacia aptaneura, A. catenulata subsp. *occidentalis* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii, Senna stricta* scattered shrubs to open shrubland over *Triodia pungens* and/or *T. vanleeuwenii* and/or *T. wiseana* scattered hummock grasses to very open hummock grassland with *Eriachne mucronata* scattered tussock grasses

H7
Eucalyptus leucophloia subsp. *leucophloia* scattered low trees to low open woodland over *Senna glutinosa* subsp. *glutinosa, Acacia maitlandii* scattered shrubs over *Triodia wiseana* and/or *T. vanleeuwenii* and/or *T. pungens* open hummock grassland to hummock grassland

H8
Eucalyptus leucophloia subsp. *leucophloia* scattered low trees to low open woodland over *Acacia pruinocarpa, Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Triodia vanleeuwenii, (T. pungens)* open hummock grassland to hummock grassland with *Amphipogon sericeus* scattered tussock grasses

H9
Acacia arida, Grevillea wickhamii subsp. *hispidula* open shrubland over *Triodia wiseana* open hummock grassland with *Themeda sp. Mt Barricade (M.E. Trudgen 2471)* very open tussock grassland

Hilltops/Hillslopes cont.

H10
Eucalyptus leucophloia subsp. *leucophloia* scattered low trees with *E. repullulans* and/or *E. socialis* subsp. *eucentrica* and/or *E. pilbarensis* scattered low mallees to low open mallee woodland over *Acacia bivenosa* scattered shrubs over *Triodia wiseana, (T. angusta)* open hummock grassland to hummock grassland

H11
Eucalyptus leucophloia subsp. *leucophloia* scattered low trees with *E. gamophylla* low open mallee woodland over *Acacia ancistrocarpa* scattered tall shrubs to tall open shrubland over *A. hilliana* scattered low shrubs to low open shrubland over *Triodia vanleeuwenii, (T. pungens)* open hummock grassland to hummock grassland

H12
Corymbia hamersleyana sens. lat. scattered low trees over *Acacia inaequilatera, Hakea chordophylla, A. bivenosa* scattered tall shrubs to tall open shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* open hummock grassland to hummock grassland with *Themeda* sp. *Mt Barricade (M.E. Trudgen 2471), Cymbopogon* ambiguus scattered tussock grasses and *Heliotropium ovalifolium, Corchorus lasiocarpus* subsp. *parvus* scattered herbs

Drainage

D1
Corymbia hamersleyana sens. lat., *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Petalostylis labicheoides, Acacia monticola, A. maitlandii* scattered tall shrubs to tall shrubland over *Dodonaea lanceolata* var. *lanceolata, Androcalva luteiflora* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland to open hummock grassland with *Themeda triandra, Eriachne mucronata* very open tussock grassland to open tussock grassland

D2
Acacia aptaneura, A. catenulata subsp. *occidentalis, A. pruinocarpa* tall shrubland to tall open scrub over *Petalostylis labicheoides* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland with *Chrysopogon fallax* scattered tussock grasses

D3
Corymbia ferriticola, Eucalyptus leucophloia subsp. *leucophloia* low open woodland over *Petalostylis labicheoides, Acacia hamersleyensis, Dodonaea viscosa* subsp. *spatulata* tall open shrubland over *Triodia pungens* very open hummock grassland with *Eriachne mucronata, Themeda* sp. *Mt Barricade* (M.E. Trudgen 2471), *Cymbopogon ambiguus* very open tussock grassland to tussock grassland

D4
Eucalyptus victrix, (E. camaldulensis subsp. *obtusa)* low open woodland to open woodland over *Acacia citrinoviridis, Petalostylis labicheoides* scattered tall shrubs to tall shrubland over *Androcalva luteiflora, Gossypium sturtianum* var. *sturtianum* scattered shrubs to open shrubland over *Triodia longiceps* scattered hummock grasses to very open hummock grassland with *Themeda triandra, Eulalia aurea, (*Cenchrus ciliaris)* very open tussock grassland to tussock grassland and **Bidens bipinnata* scattered herbs

Drainage cont.

D5
Eucalyptus xerothermica scattered low trees to low open woodland over *Petalostylis labicheoides, Acacia maitlandii, A. pyrifolia* tall open shrubland to tall shrubland over *Androcalva luteiflora* scattered shrubs over *Triodia longiceps* very open hummock grassland to open hummock grassland with *Themeda triandra, Eulalia aurea* open tussock grassland to tussock grassland and **Bidens bipinnata* scattered herbs

D7
Acacia citrinoviridis, A. aptaneura, A. pruinocarpa scattered tall shrubs to tall shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia longiceps* open hummock grassland to hummock grassland

D8
Eucalyptus xerothermica scattered low trees to low open woodland over *Acacia aptaneura, A. catenulata* subsp. *occidentalis* tall open shrubland to tall open scrub over *Triodia pungens* scattered hummock grasses to very open hummock grassland with *Themeda triandra* very open tussock grassland to open tussock grassland

Plains

P1
Acacia aptaneura, A. catenulata subsp. *occidentalis, (A. pruinocarpa)* tall shrubland to tall open scrub over *Eremophila forrestii* subsp. *forrestii* open shrubland to shrubland over *Triodia pungens, (T. vanleeuwenii)* scattered hummock grasses to very open hummock grassland

P2
Acacia aptaneura, A. pruinocarpa, A. tetragonophylla scattered tall shrubs to tall open shrubland over *Eremophila forrestii* subsp. *forrestii, A. synchronicia* scattered shrubs over *Ptilotus obovatus, Sida fibulifera* scattered low shrubs over *Aristida latifolia, Astrebla elymoides, Eragrostis xerophila* open tussock grassland to tussock grassland

P3
Acacia aptaneura, A. catenulata subsp. *occidentalis, A. pruinocarpa* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii* scattered shrubs to open shrubland over *Triodia pungens* open hummock grassland to hummock grassland

P4
Acacia pruinocarpa, A. aptaneura, A. catenulata subsp. *occidentalis* tall open shrubland to tall shrubland over *Rhagodia eremaea* scattered shrubs

Special Cases

HD - Area cleared of vegetation

6.3.2.3. Significant Vegetation

Vegetation types within the Development Envelope have been rated in terms of their environmental significance, using the Rio Tinto *Biological Significance Guidelines for Flora and Vegetation* (Appendix B4). The criteria used in the Rio Tinto guidelines are consistent with and expand on those listed in EPA Guidance (EPA 2016a) and are summarised in Table 6-5 below.

Table 6-5: Criteria used to Assign Significance to Flora and Vegetation

Ranking	Criteria for Inclusion
Regionally Significant	Flora and vegetation directly protected under State and Commonwealth legislation; including features which potentially warrant this level of recognition, including: • Vegetation representative of a Threatened Ecological Community (TEC) • Threatened flora populations and associated habitat • Significant permanent aquatic GDE features and wetlands or significant and highly restricted obligate terrestrial GDE features • Flora and vegetation in a Formal Conservation reserve • Priority 1 and 2 PEC's, or high cluster/population densities (and associated vegetation) of Priority 1 and 2 flora species.
High Local Significance (potentially sub-regionally significant)	Flora and vegetation recognised as being of conservation interest, for example: • Local representation/examples of Regionally Significant flora and vegetation • Groundwater-dependent vegetation (GDV) associated with major drainage features • Clearly obligate GDV on moderate (or lower) drainage, or core riparian vegetation on major drainage. • High density P2 flora populations, and communities similar to P1 and P2 PEC's.
Moderate Local Significance	Flora and vegetation of elevated interest but with no formal recognition for conservation purposes, for example: • Priority 3 and 4 PEC's or vegetation types similar to listed PEC's • Priority 2 and high density P3 flora • Significantly restricted vegetation/flora • Potential GDV on major or moderate drainage and GDV on moderate drainage • Clearly representative of an Ecosystem at Risk (EAR) (Kendrick 2001)
Low Local Significance	• P3 and P4 flora • Riparian vegetation on minor drainage and other vegetation/flora with limited representation.
Low to Negligible Local Significance	All remaining vegetation/flora with no formal or informal significance (acknowledging that all native flora and vegetation possess environmental value and potential significance).

Regionally significant, and high and moderate locally significant vegetation types that have been identified within the Development Envelope are discussed below and are shown in Figure 6-5.

Regionally Significant Vegetation Types

Threatened or Priority Ecological Communities

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) listed by the BC Act or EPBC Act occur within the Development Envelope.

The Weeli Wolli Spring Community Priority 1 PEC is located approximately 7 km downstream of the confluence of Pebble Mouse Creek and Weeli Wolli Creek, approximately 9.7 km to the northeast of the Development Envelope (Figure 6-5). The PEC includes Ben's Oasis (approximately 5 km south-west of BHT Deposit) and Weeli Wolli Spring (approximately 16 km north-east of BHT Deposit). No vegetation within the Development Envelope corresponds with the PEC.

Other nearby PECs are West Angelas Cracking Clays (P1) and Coolabah – Lignum Flats both of which occur 9 km or further from the Development Envelope (Astron 2020a).

Vegetation of Local Significance

Vegetation of High Local Significance

The detailed flora and vegetation assessment (Astron 2019a), rated two vegetation types as having high local significance within the Development Envelope:

- The D4 (Drainage #4) vegetation type (Plate 6-1) is considered riparian vegetation and occurs along drainage lines, including Pebble Mouse Creek and Weeli Wolli Creek. In certain reaches, this vegetation type also supports high density populations of *Aristida lazaridis* (P2). The overall condition of the D4 vegetation type was between Good and Very Good.
- The H2 (Hills and Slopes #2) vegetation type (Plate 6-2) occurs on the south-facing slopes of the ridgeline of the BHT deposit and supports relatively dense populations of *Eremophila* sp. West Angelas (P2) and *Eremophila naaykensii* (P3). This vegetation type also has a close affinity to the 'lower-slope mulga' which is defined as an EAR (Astron 2019a). The overall condition of the H2 vegetation type was between Very Good and Excellent.



Plate 6-1: D4 'High' Locally Significant Vegetation Type



Plate 6-2: H2 'High' Locally Significant Vegetation Type

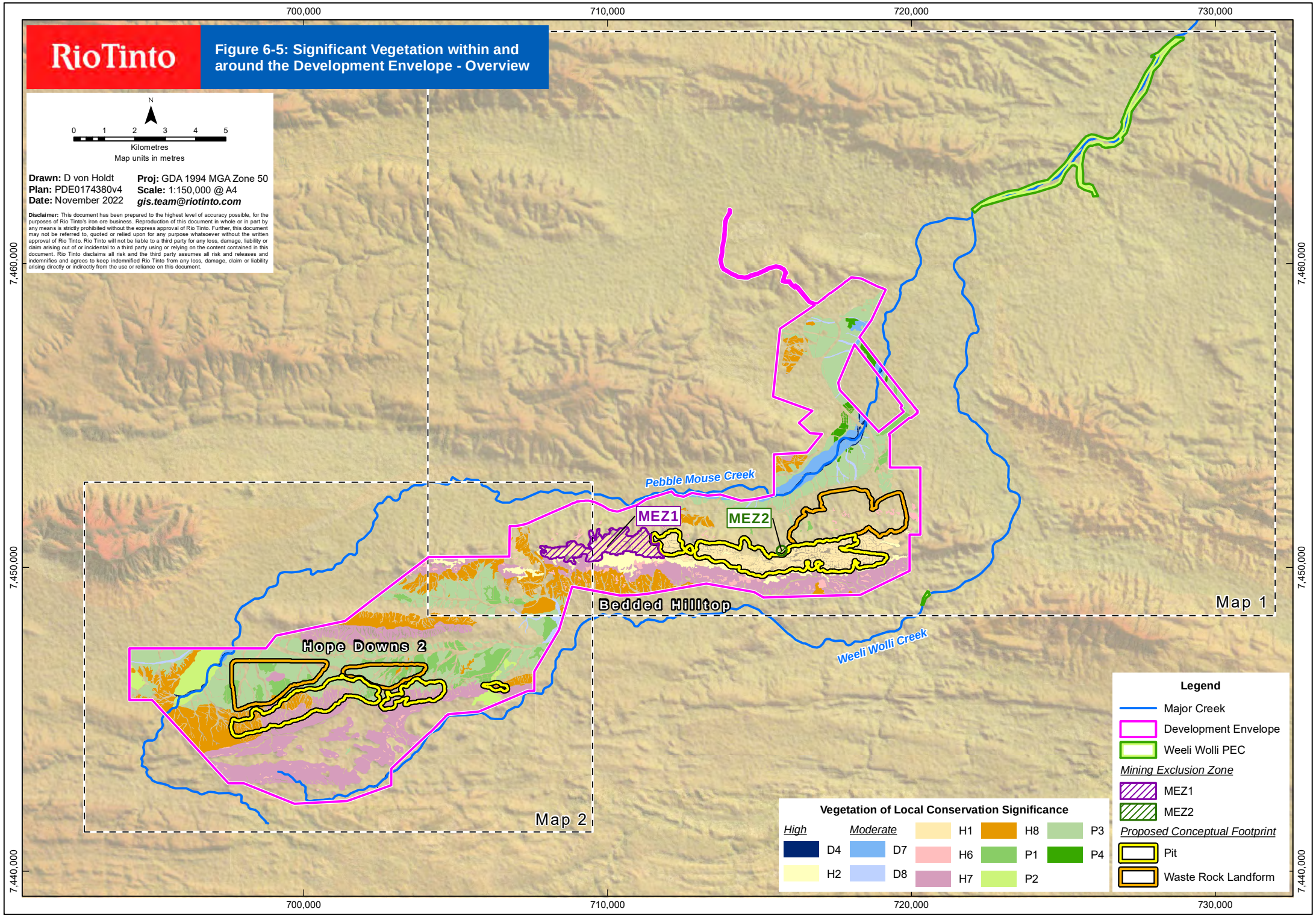
The Proponent undertook a subsequent targeted riparian vegetation assessment (Rio Tinto 2022), which assessed the characteristics of riparian ecosystem values in and around the Development Envelope, and is discussed specifically in Section 6.3.2.4.

Vegetation of Moderate Local Significance

Nine vegetation types within the Development Envelope are considered to be of Moderate local significance, the justification for this classification is provided below in Table 6-6.

Table 6-6: Vegetation Types of Moderate Local Significance and Justification for Rating

Vegetation Type	Justification for Significance Rating
D7 (Drainage #7)	Supports populations of *Aristida lazaridis* (P2)
D8 (Drainage #8)	Represents an EAR
P1 (Plains #1)	Is likely to represent the 'Grove/intergrove mulga, Eastern Hamersley range' vegetation community which is considered to be an EAR.
P2 (Plains #2)	Supports populations of *Aristida lazaridis* (P2)
P3 (Plains #3)	Supports populations of *Aristida lazaridis* (P2) and is likely to represent the 'Valley Floor mulga' vegetation community which is considered to be an EAR.
P4 (Plains #4)	Represents an EAR
H1 (Hills and Slopes #1)	Supports high number of P3 flora species, *Eremophila naaykensii, Grevillea saxicola* and *Triodia* sp. Mt Ella (M.E. Trudgen 12739)
H6 (Hills and Slopes #6)	Represents an EAR
H7 (Hills and Slopes #7)	Supports populations of *Hibiscus* sp. Gurinbiddy Range (P2)


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Figure 6-5: Significant Vegetation within and around the Development Envelope - Overview
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0174380v4
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @ A4
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700,000
710,000
720,000
730,000
7,460,000
7,450,000
7,440,000
Pebble Mouse Creek
MEZ1
MEZ2
Bedded Hilltop
Map 1
Hope Downs 2
Map 2
Weeli Wolli Creek
Legend
Major Creek
Development Envelope
Weeli Wolli PEC
Mining Exclusion Zone
MEZ1
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Vegetation of Local Conservation Significance
High
D4
H2
Moderate
D7
D8
H1
H6
H7
H8
P1
P2
P3
P4

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Figure 6-5: Significant Vegetation within and around the Development Envelope - Map 1

Legend

- Major Creek
- Development Envelope
- Weeli Wolli PEC

Proposed Conceptual Footprint

- Pit
- Waste Rock Landform

Vegetation of Local Conservation Significance

High		*Moderate*				
D4	H2	D7	D8	H1	H6	H7
H8	P1	P3	P4			

710,000 720,000 730,000

7,460,000

7,450,000

Weeli Wolli Creek

Weeli Wolli Spring PEC

MEZ2

MEZ1

Pebble Mouse Creek

Bedded Hilltop

Weeli Wolli Creek

Weeli Wolli Spring PEC

N

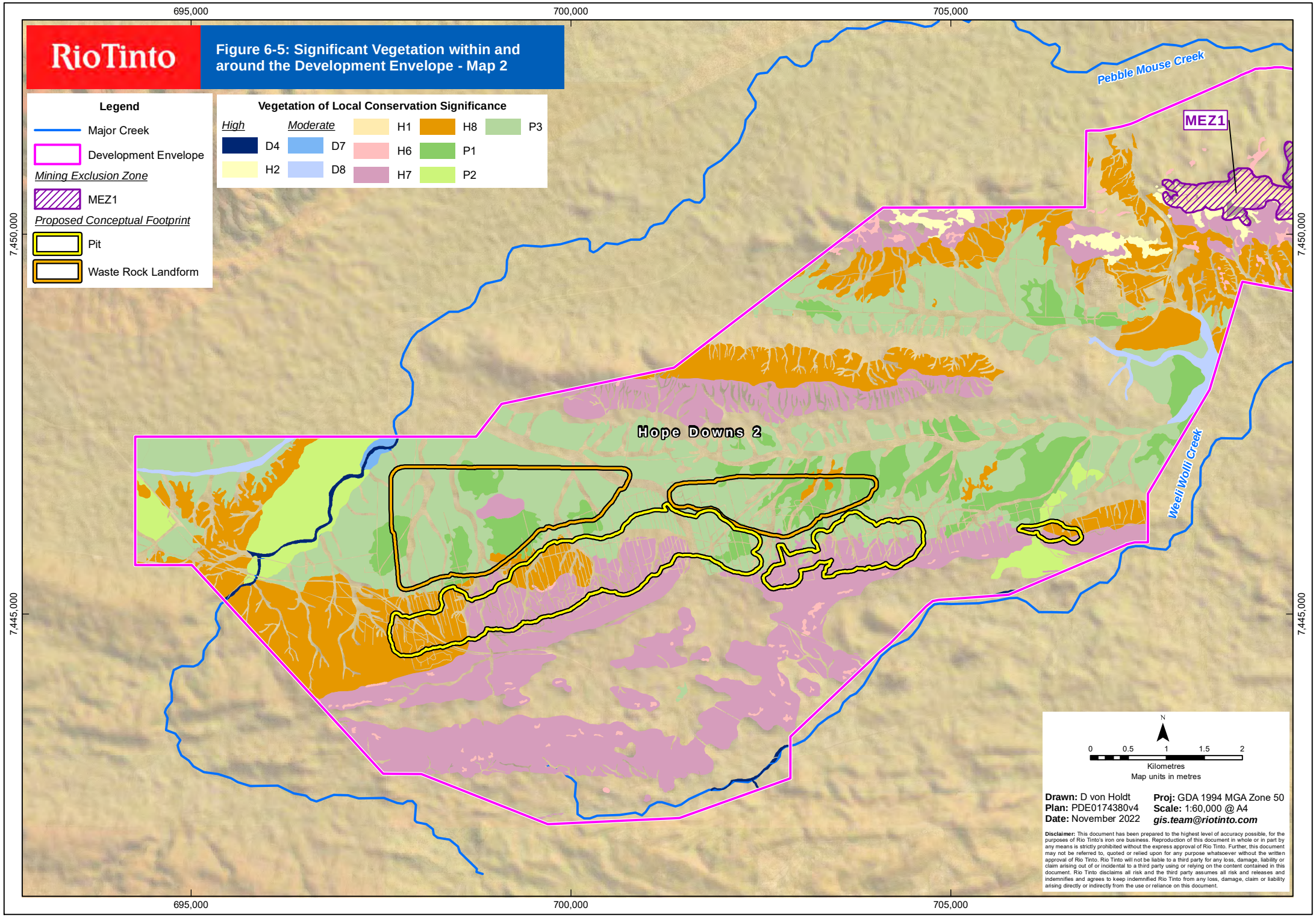
0 1 2 3 4 5

Kilometres
Map units in metres

Drawn: D von Holdt
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Figure 6-5: Significant Vegetation within and around the Development Envelope - Map 2
Legend
Major Creek
Development Envelope
Mining Exclusion Zone
MEZ1
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Vegetation of Local Conservation Significance
High
D4
H2
Moderate
D7
D8
H1
H6
H7
H8
P1
P2
P3
Pebble Mouse Creek
MEZ1
Hope Downs 2
Weeli Wolli Creek
695,000
700,000
705,000
7,450,000
7,445,000
N
0
0.5
1
1.5
2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0174380v4
Date: November 2022
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6.3.2.4. Riparian Vegetation

Pebble Mouse Creek, a major tributary of Weeli Wolli Creek, represents the dominant drainage line within the Development Envelope (Weeli Wolli Creek has been largely excluded from the Development Envelope). Numerous minor drainage lines extend from the ridgelines and hills and, when flowing, discharge into Pebble Mouse Creek or Weeli Wolli Creek. Further details on the ephemeral surface drainage system are provided in the Inland Water chapter (Section 9.3.3).

Eight broad vegetation types (D1-D8) have been recorded along the drainage lines present within the Development Envelope during baseline surveys (Astron 2020a). Further work has been completed as part of a targeted riparian survey (Rio Tinto 2022d), and this work identified five vegetation units within the Development Envelope likely to be classed as riparian vegetation. This is where vegetation communities/habitats possessed an adequate structural complexity and suite of fluvial and riparian characteristics which was deemed to possess appropriately elevated biodiversity and ecohydrological values to warrant the riparian vegetation classification and receive appropriate management. More generally this definition excludes the broad floodplain formations often associated with and thus flanking the core-riparian zone where such characteristics are clearly and significantly reduced in value. RTIO (2023) provides definitions to clarify the key riparian zones of relevance in order to outline the approach applied the conclusions made. The main distinction proposed is that while the riparian zone and associated riparian vegetation does more broadly cover the floodplain, where water flows much less frequently, instead the low flow channel and bench/bank complex where core riparian vegetation will generally establish, is what we propose to define as riparian vegetation worthy of increased management provisions.

Targeted Study

To acknowledge that the biota supported by larger drainage systems (both flora and fauna), possess elevated biodiversity and ecohydrological values, and because there is a lack of conservation listings in this space available to help inform the hierarchy of significance applied to riparian values; a targeted flora and vegetation survey was conducted to better assess riparian values.

The targeted riparian survey was undertaken (including both desktop and field survey components) to produce, among other outputs, a high detail map of riparian vegetation, and a review of all moderate to major drainage communities within and surrounding the development envelope (Rio Tinto 2022d). The study utilises hierarchical guidance on which species occupying the riparian zone are increasingly sensitive to hydrology and increasingly restricted in their distribution within such habitats.

This study confirmed that the baseline vegetation units D4 and D5, represent core-riparian vegetation, as defined above. The riparian assessment further delineated seven distinct vegetation units occurring in the riparian zone within the four baseline vegetation types (Table 6-7). Vegetation unit C4C, situated outside the Development Envelope, represents restricted habitat. Through detailed mapping, as part of the targeted survey, 1.4ha of vegetation unit C4C was delineated. Typically, under a baseline flora and vegetation survey, small discrete units would be mapped under broader creek line vegetation units.

The results of this assessment are shown in Table 6-7 and in Figure 6-6. Appendix C of Appendix B3 expands on this assessment further. The results of the targeted assessment helped to contextualise the outcomes presented in the detailed flora and vegetation study. In conclusion, when the vegetation within the Development Envelope are considered in relation to the spectrum of riparian vegetation values present in the broader Hope Downs Hub locality, none were found to be locally restricted and these units were found to be represented both in the study area and surrounding area.

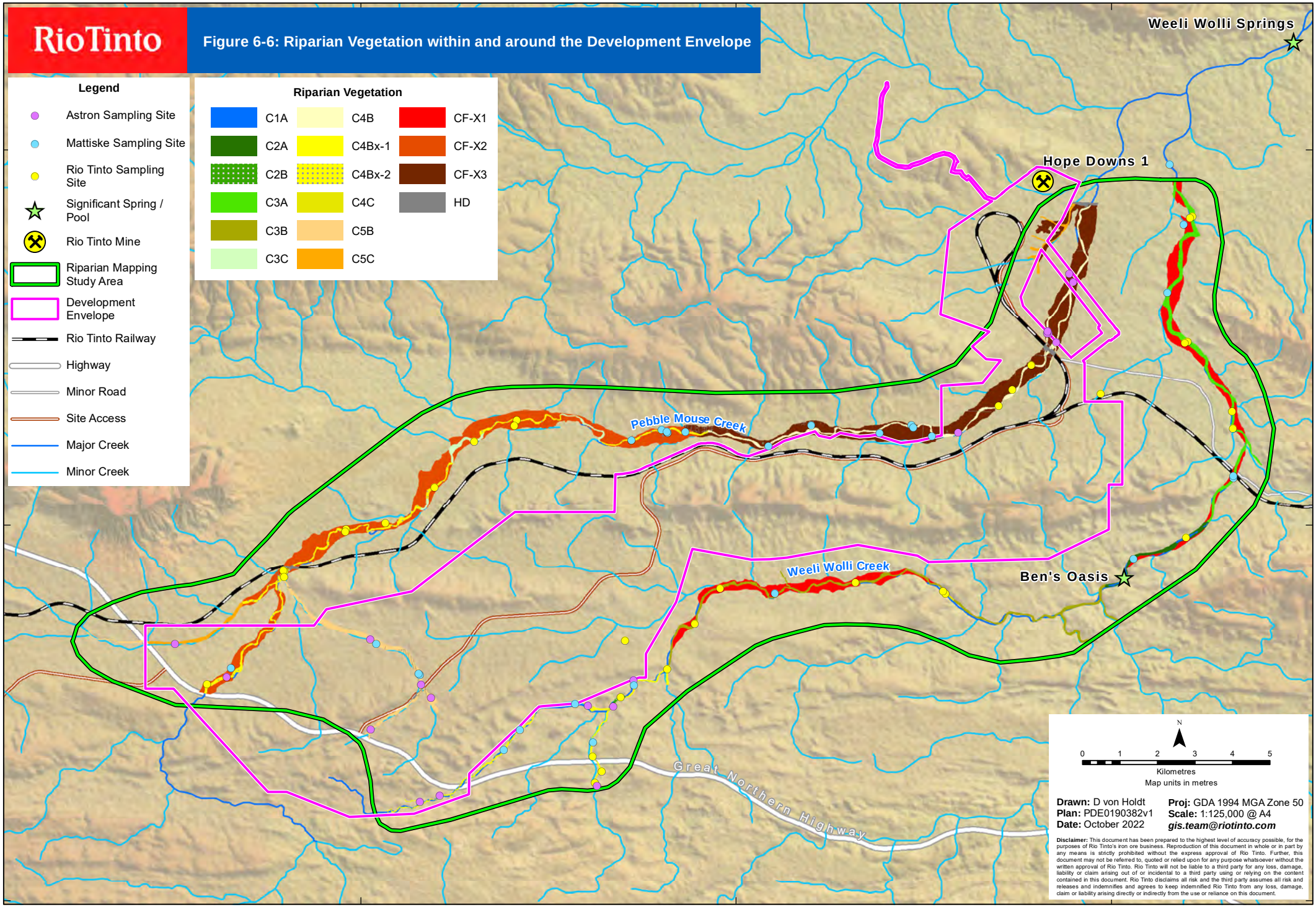
Table 6-7: Characteristics of Riparian Vegetation Types within the Development Envelope

Riparian Vegetation Units	Astron Vegetation Unit	Ecotype	Representation	Vegetation Extent Inside the Development Envelope (ha)	Vegetation Extent Outside Development Envelope in Study Area (ha)	Total Area (ha)	Amount of vegetation directly impacted by the proposal (ha)	Percentage in Hope Downs Hub Impacted by Proposal (%)	Amount of similar vegetation in RTIO regional database* (ha)
C1A	-	Type 2	Restricted	0	6.48	6.48	0	0	2616.81
C2A	-	Type 2	Restricted	0	23.74	23.74	0	0	1,466.58
C2B	-	Type 3	Restricted	0	2.89	2.89	0	0	392.11
C3A	-	Type 3	Restricted	0	106.85	106.85	0	0	140.3
C3B	-	Type 3	Well represented	0	98.95	98.95	0	0	7,556.01
C4C	-	Type 3	Restricted	0	1.41	1.41	0	0	1.41
C4Bx-1	D5	Type 3	Restricted	10.29	39.29	49.58	0	0	2537.63
C3C	-	Type 3	Restricted*	0	21.15	21.15	0	0	381.94
C4B	D4	Type 3	Well represented	28.24	58.42	86.66	10.88	12	14,996.45
C4Bx-2	D4	Type 3	Restricted*	18.34	69.97	88.31	0.35	0.39	381.94
C5B	D5	Type 4	Well represented	63.72	17.27	80.98	39.65	48.96	20,253.46
C5C	-	Type 4	Well represented	24.5	15.92	40.43	5.37	13.28	14,428.97
CF-X1	-	Type 4	Well represented	284.09	284.09	284.09	0	0	1408.87
CF-X2	D7	Type 4	Well represented	46.53	404.07	450.60	1.17	0.25	9561.37
CF-X3	D7	Type 4	Well represented	185.16	309.74	494.90	53.86	10.98	9,782.50

Restricted based on the comparison of targeted and detailed mapping completed compared to database records which contains broader baseline vegetation mapping units.

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Figure 6-6: Riparian Vegetation within and around the Development Envelope



Drawn: D von Holdt
Plan: PDE0190382v1
Date: October 2022

Proj: GDA 1994 MGA Zone 50
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6.3.2.5. Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDE) are terrestrial, aquatic or subterranean ecosystems that require access to groundwater to persist in the landscape and therefore only occur where the water table is shallow (Rio Tinto 2022d). Terrestrial GDEs rely on relatively shallow groundwater and are typified by groundwater dependent vegetation (GDV). The key plant species that indicate the presence of GDV are known as phreatophytes. Phreatophytes may be classified as either being obligate or facultative depending on their reliance on groundwater (Eamus et al. 2016). Obligate phreatophytes are confined to habitats with access to and are highly dependent on groundwater. Within the Pilbara the keystone obligate phreatophyte is *Melaleuca argentea* (Rio Tinto 2022d), but this class may also include *Sesbania formosa*. Facultative phreatophytes use groundwater where it is available but can also exist in environments without access to groundwater. Within the Pilbara the keystone facultative phreatophytes are *Eucalyptus camaldulensis* subsp. *refulgens*, and *E. victrix* (Rio Tinto 2022d), but this class may also include *E. xerothermica. E. victrix* and particularly *E. xerothermica* are also known to operate as vadophytes, which rely on unsaturated moisture within the soil profile.

The framework for assessing 'Environmental Water requirements of Groundwater Dependent Ecosystems' published by REM, CSIRO and SKM (2007) defines facultative GDEs as plants that require access to groundwater in some landscapes, but in other landscapes can utilise alternate sources of water to maintain ecosystem function, i.e. the presence or absence of groundwater is not critical in determining ecosystem occurrence (compared with obligate GDEs). This definition supports the outcomes of RTIO riparian studies, that not all riparian vegetation in the study area is groundwater dependent as many of the species present are either facultative phreatophytes or vadophytes.

All of the mapped riparian vegetation units within the Development Envelope were identified as supporting at least one of the species above described, and thus possess some potential to be GDV. While this potential was not generally supported by local groundwater monitoring, the Proponent undertook a GDV likelihood assessment (Rio Tinto 2022d) to determine the likelihood of these vegetation types supporting GDV.

Through this assessment it was determined that the likelihood that these riparian vegetation units support GDV or potential GDV ranges between low and very low (Rio Tinto 2022d). This outcome is primarily due to the generally low density of vegetation occurring within the riparian zone throughout the Development Envelope, and that the average depth to groundwater is between 15 m and 30 m below ground level (and greater), which is generally beyond the rooting depth of these plants (Rio Tinto 2022d). A summary of the findings of the GDV likelihood assessment is presented in Table 6-8 and shown on Figure 6-7. The Proponent notes that while there is the potential for local perched aquifers to occur, no vegetation communities usually representative of such aquifers being present in the Development Envelope were recorded during surveys (Rio Tinto 2022d).

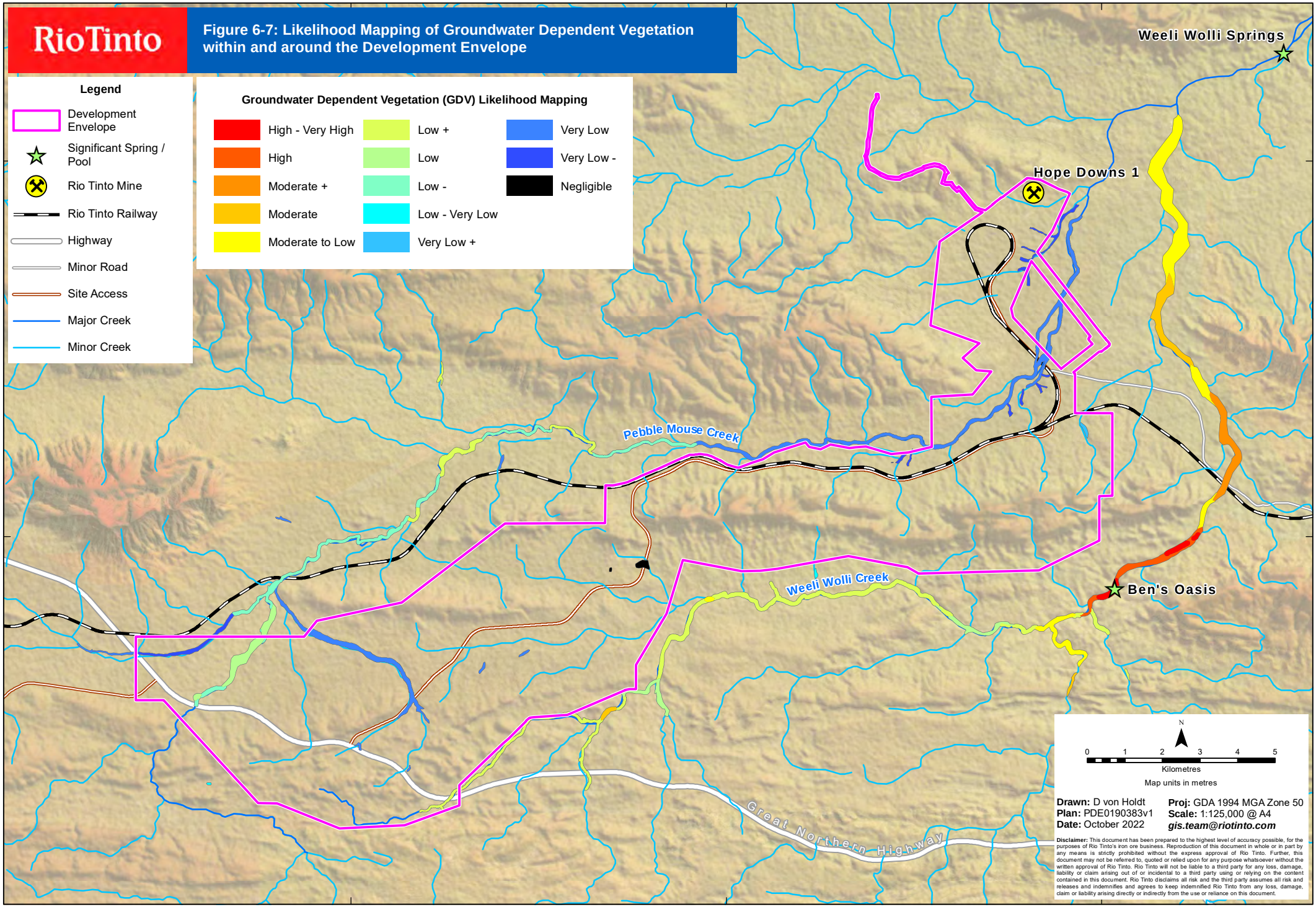
Table 6-8: Likelihood of GDV in the Development Envelope

Riparian Vegetation Units	Vegetation Type*	Drainage Type	Keystone Species Recorded & Abundance	GDV Likelihood
C4Bx-2	D4	Moderate	Abundant *Eucalyptus xerothermica*, isolated E. camaldulensis and abundant *E. victrix*	Low
C4B	D4	Moderate	Isolated *Eucalyptus camaldulensis* and abundant *E. victrix*	Very Low
C4Bx-1	D5	Moderate	Abundant *Eucalyptus xerothermica*, isolated *E. camaldulensis* and abundant *E. victrix*	Low
C5B	D5	Moderate	Abundant *Eucalyptus xerothermica*, isolated *E. camaldulensis* and isolated *E. victrix*	Very Low
CF-x2	D7	Moderate	Abundant *Eucalyptus xerothermica*, isolated *E. camaldulensis* and isolated E. victrix	Very Low

CF-x3	D7	Moderate	Isolated Eucalyptus xerothermica and E. victrix	Very Low
C5C	D8	Moderate	Isolated Eucalyptus victrix	Very Low

** Astron (2019a)*

The RVA recorded two clear and confirmed GDEs as occurring along Weeli Wolli Creek, both outside of the Development Envelope. These were Ben's Oasis and Weeli Wolli Spring, both of which are known to support riparian vegetation including obligate phreatophytes (Rio Tinto 2022d).


RioTinto
Figure 6-7: Likelihood Mapping of Groundwater Dependent Vegetation within and around the Development Envelope
Legend
Development Envelope
Significant Spring / Pool
Rio Tinto Mine
Rio Tinto Railway
Highway
Minor Road
Site Access
Major Creek
Minor Creek
Groundwater Dependent Vegetation (GDV) Likelihood Mapping
High - Very High
High
Moderate +
Moderate
Moderate to Low
Low +
Low
Low -
Low - Very Low
Very Low +
Very Low
Very Low -
Negligible
Weeli Wolli Springs
Hope Downs 1
Pebble Mouse Creek
Weeli Wolli Creek
Ben's Oasis
Great Northern Highway
700,000
710,000
720,000
7,460,000
7,450,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0190383v1
Date: October 2022
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6.3.2.6. Vegetation Condition

Vegetation condition within the Development Envelope ranges from Excellent to Completely Degraded (cleared), shown in Table 6-9 and Figure 6-8. The majority of the vegetation within the Development Envelope (approximately 88 %) is classified as being in Good to Excellent condition.

Higher quality vegetation (i.e., in Good to Excellent condition) is important as a decline in the extent and condition of vegetation may precede the loss of its species and provide an indicator of the health of other elements of the environment. Loss of vegetation can impact many terrestrial factors; for example, degraded, fragmented vegetation can affect species' survival and increase competition from non-native species (EPA 2016a). Riparian vegetation types were observed to be subject to varying levels of weed infestation, impacting condition.

Table 6-9: Vegetation Condition of Remnant Vegetation in the Development Envelope in the Development Envelope (Astron 2019a)

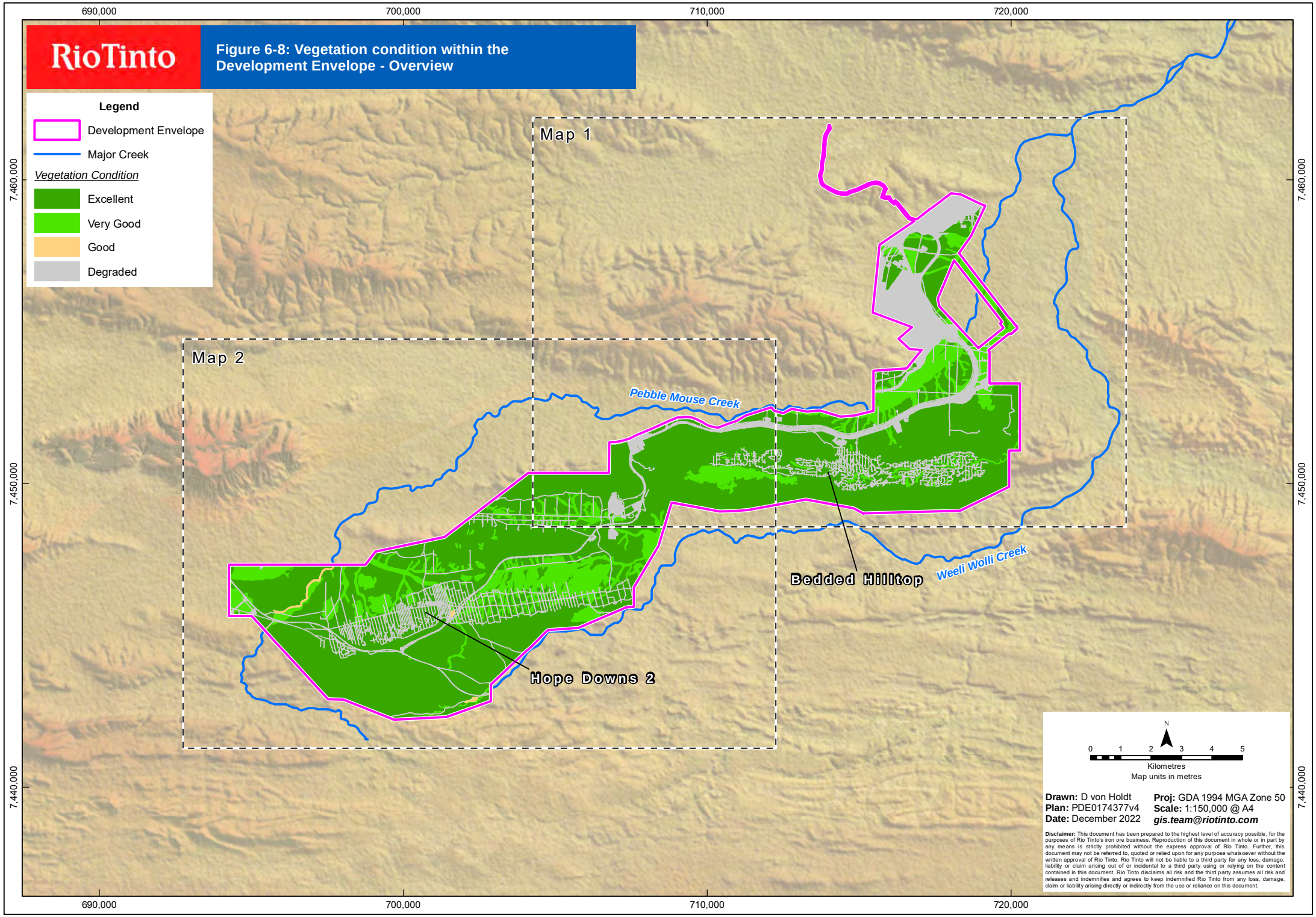
Vegetation Condition	Extent in Development Envelope	
	Area (ha)	**% Development Envelope**
Excellent	9,202.2	74.2
Very good	1,758.3	14.2
Good	16.5	0.1
Completely Degraded	1,432.5	11.6
Total	12,409.5	100

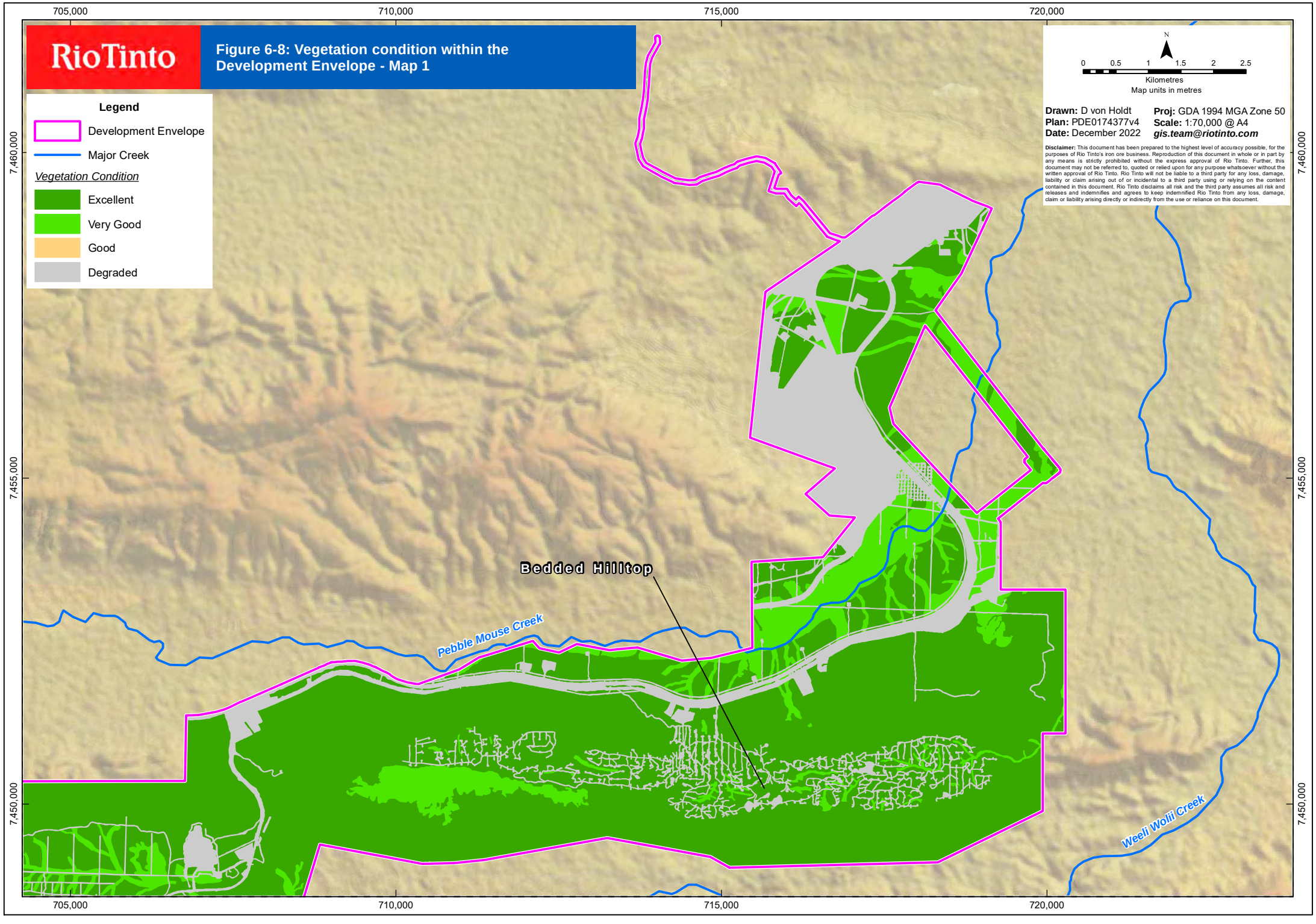
6.3.2.7. Fire History

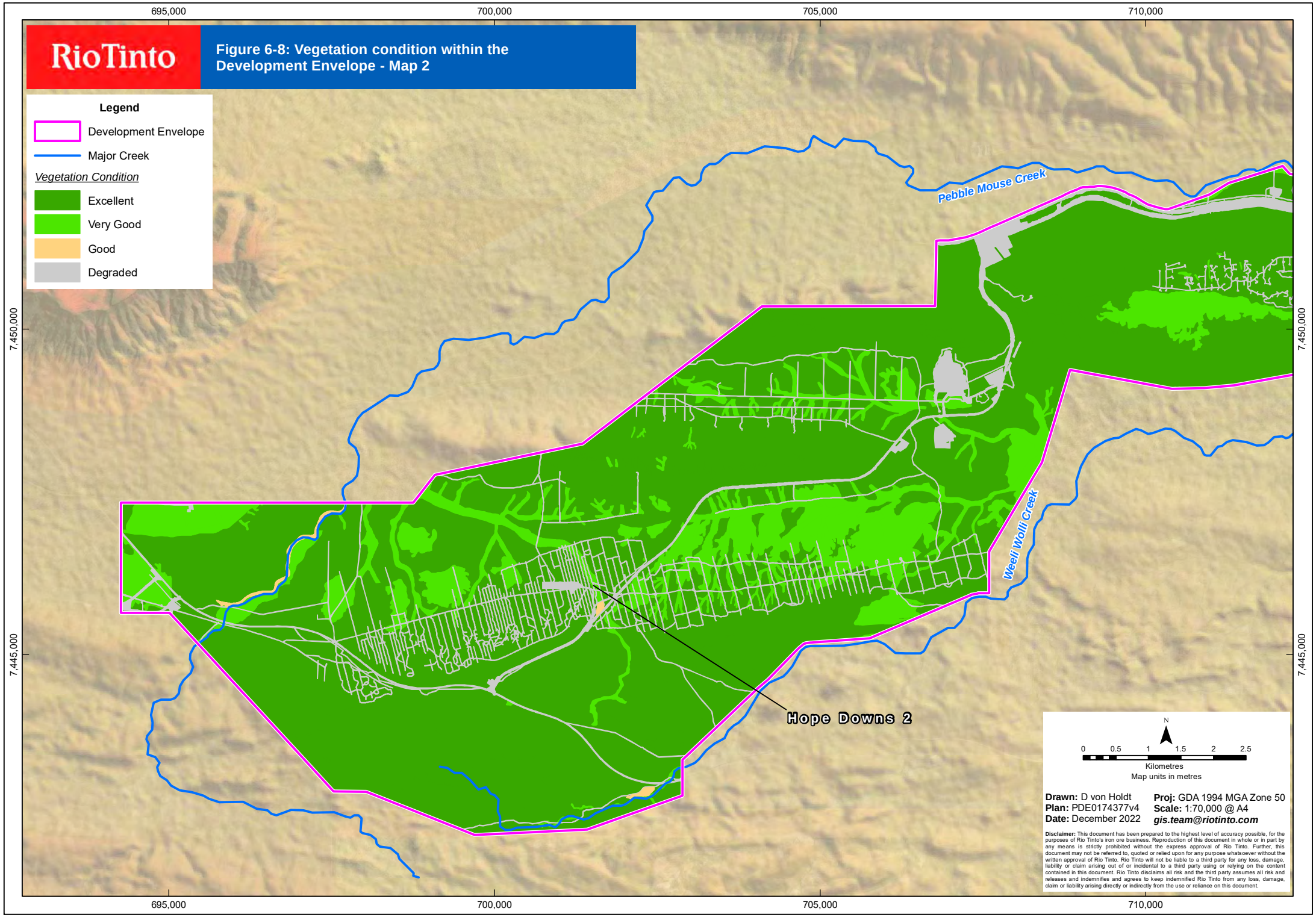
The Development Envelope has been impacted by several bushfires in recent times between 2007 and 2016. During the 2019 Astron survey, all fire-impacted areas showed evidence of fire responsive regeneration species (Astron 2019a). The fire history of the Development Envelope is summarised in Table 6-10 and Figure 6-9.

Table 6-10: Fire History of the Development Envelope

Year of Bushfire	Location and Extent of Fire
2007	Widespread impact to the northeast of the Development Envelope in close association to Hope Downs 1 operations.
2014	Isolated impacts to the north of the Development Envelope
2015	Most widespread of the recent fires, impacting most of the BHT deposit area
2016	Widespread impacts to the southwest of the Development Envelope, around the HD2 deposit area.

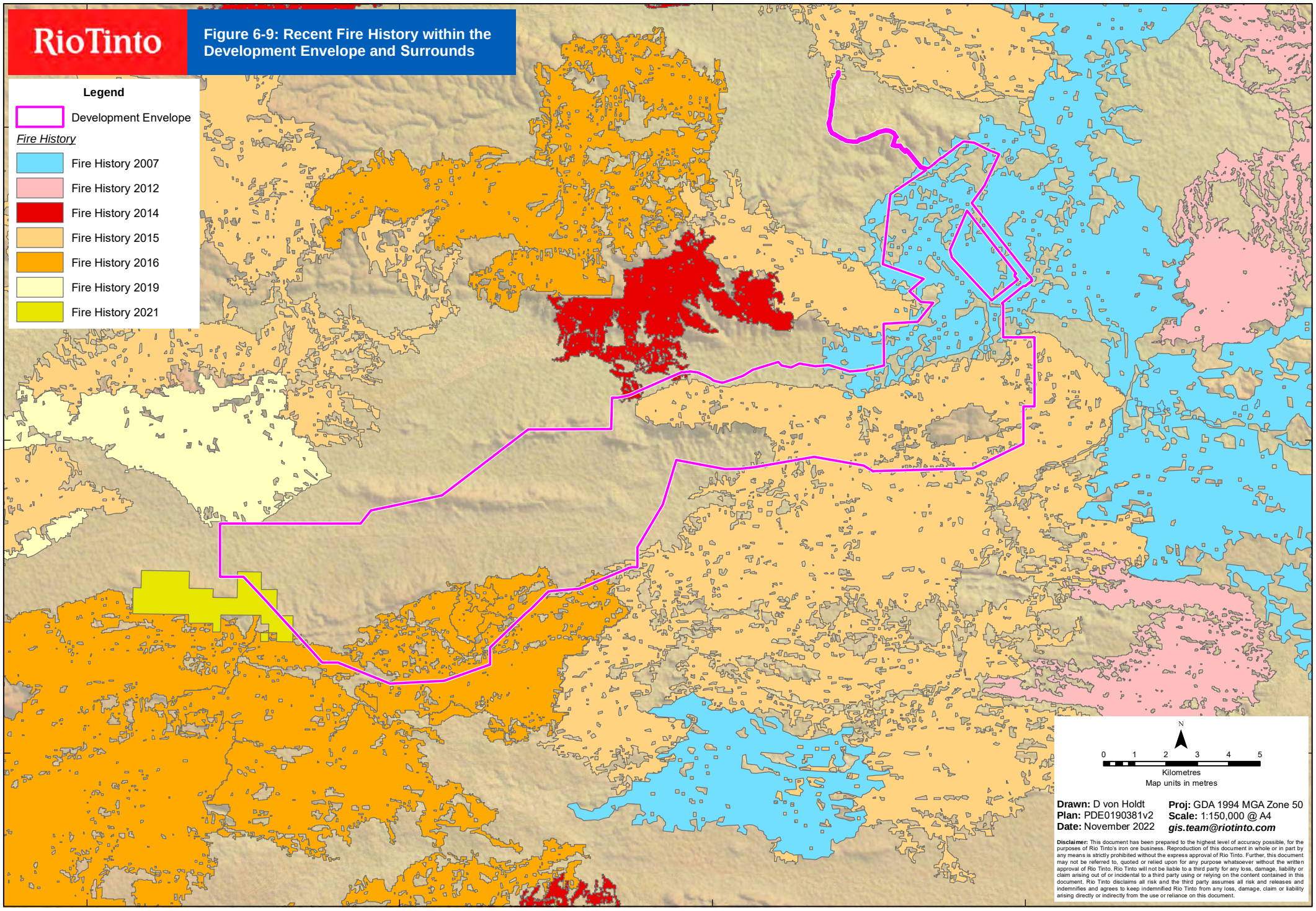

RioTinto
Figure 6-8: Vegetation condition within the Development Envelope - Overview
Legend
Development Envelope
Major Creek
Vegetation Condition
Excellent
Very Good
Good
Degraded
Map 1
Map 2
Pebble Mouse Creek
Bedded Hilltop
Weeli Wolli Creek
Hope Downs 2
690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0174377v4
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @ A4
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Figure 6-8: Vegetation condition within the Development Envelope - Map 1
Legend
Development Envelope
Major Creek
Vegetation Condition
Excellent
Very Good
Good
Degraded
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0174377v4
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:70,000 @ A4
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705,000
710,000
715,000
720,000
7,460,000
7,455,000
7,450,000
Bedded Hilltop
Pebble Mouse Creek
Weeli Wolii Creek


RioTinto
Figure 6-8: Vegetation condition within the Development Envelope - Map 2
Legend
Development Envelope
Major Creek
Vegetation Condition
Excellent
Very Good
Good
Degraded
695,000
700,000
705,000
710,000
7,450,000
7,445,000
Pebble Mouse Creek
Weeli Wolli Creek
Hope Downs 2
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0174377v4
Date: December 2022
Proj: GDA 1994 MGA Zone 50
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Figure 6-9: Recent Fire History within the Development Envelope and Surrounds



Drawn: D von Holdt
Plan: PDE0190381v2
Date: November 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @ A4
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6.3.2.8. Hope Downs Hub Vegetation Mapping

Astron (2020a) prepared a consolidation of previous vegetation mapping across the Proposal's Development Envelope and the existing approved Hope Downs 1 operations, and corridors linking the West Angelas and Yandicoogina operations (36,944 ha). This report is included as Appendix B2, outlines the methodology and results of the study.

The study was prepared to provide a single, consolidated vegetation units mapping GIS layer for the Proposal and the existing Hope Downs 1 operations, in order to support understanding the context of the Proposal's impacts and cumulative impacts.

Figure 6-10 shows the extent and results of the mapping and Table 6-11 provides a summary of vegetation units within the consolidated mapping area.

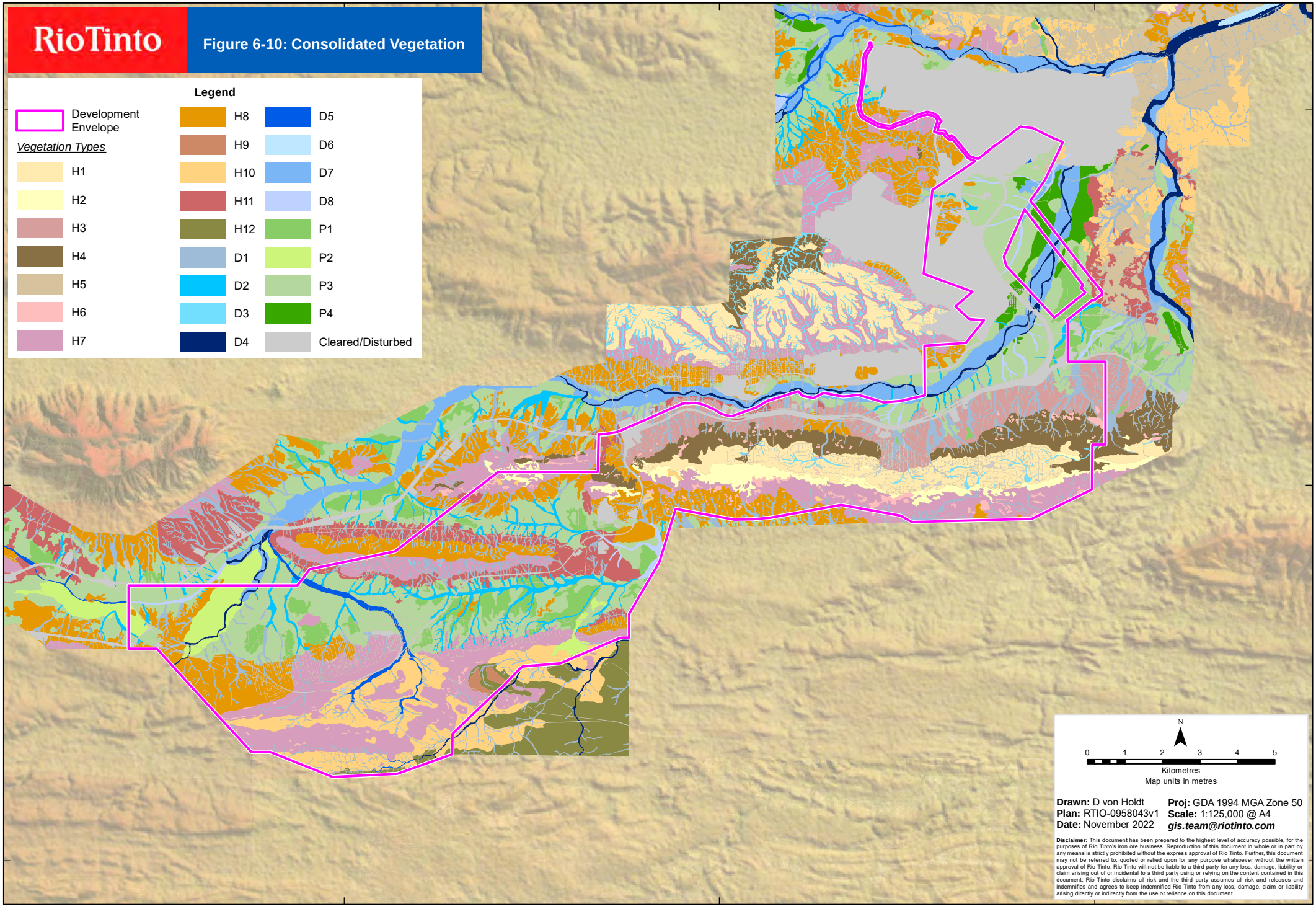
Table 6-11: Consolidated Vegetation Mapping Extents

Vegetation Type	Mapped Extent (ha)
High local significance	
D4	440
H2	439
Medium local significance	
D7	1,293
D8	162
P1	1,077
P2	453
P3	5,520
P4	296
H1	1,628
H6	171
H7	4,169
H8	3,749
Other	
D1	2,547
D2	807
D3	420
D5	165
D6	88
H10	1,681
H11	1,681
H12	691
H3	917
H4	1,221

Vegetation Type	Mapped Extent (ha)
H5	1,118
H9	32
P5	353
P6	432
P7	495
Cleared	4,900
Grand Total	**36,944**

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Figure 6-10: Consolidated Vegetation



Drawn: D von Holdt
Plan: RTIO-0958043v1
Date: November 2022

Proj: GDA 1994 MGA Zone 50
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6.3.3. Flora

A total of 411 taxa have been recorded within the Development Envelope, including 17 introduced taxa (Astron 2019a, Astron 2020a). These taxa represent a total of 52 families and 161 genera, with diverse families recorded as Fabaceae (74 taxa), Poaceae (74 taxa), Malvaceae (44 taxa), Asteraceae (21 taxa) and Myrtaceae (16 taxa). The most species rich genera were *Acacia* (37 taxa)*, Eremophila* (16 taxa)*, Senna* (16 taxa) *Ptilotus* (14 taxa) and *Sida* (13 taxa).

6.3.3.1. Threatened and Priority Flora

Significant flora are threatened flora species listed under the EPBC Act, the BC Act, or Priority flora species identified by DBCA as requiring further protection. Significant flora can also include species that are locally endemic or associated with a restricted habitat type, occur as range extensions, are a new species or have anomalous features that indicate a potential new species, represent a restricted subspecies, varieties or hybrid, or are relictual representatives of a taxonomic groups that no longer occur widely in the broader landscape.

No Threatened flora species listed under the EPBC Act or the BC Act have been recorded within the Proposal Development Envelope.

Twelve Priority flora species (Priority 2 to Priority 4) have been recorded within the Proposal Development Envelope (Table 6-12 and Figure 6-11). The majority of Priority flora records were located along ridges, although calcrete flats and rises, mulga plains and drainage lines also provided habitat for some Priority flora.

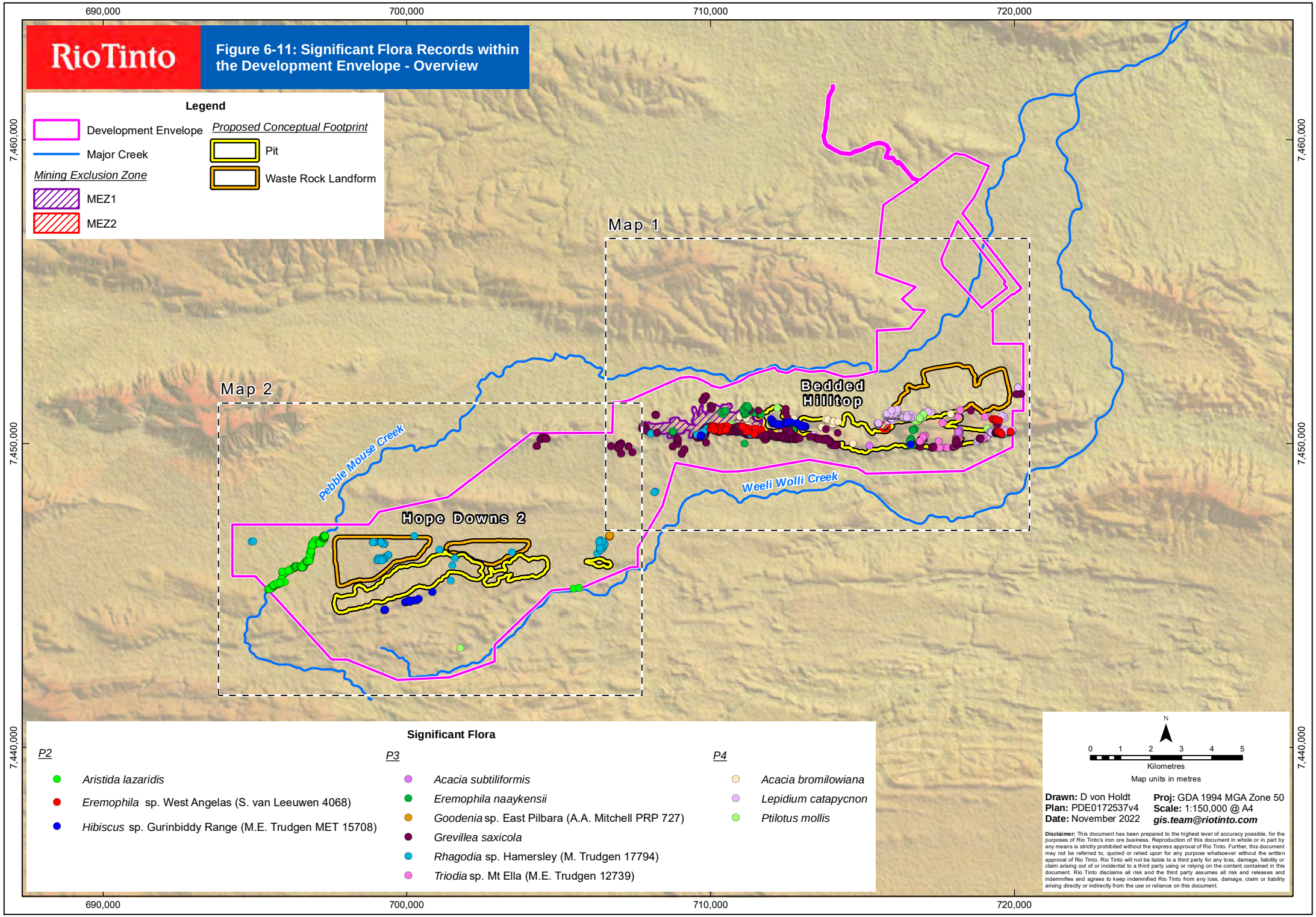
Astron (2019a) notes that there remains the possibility of further conservation significant flora taxa occurring within the survey area; specifically the following eight taxa, which are considered annuals and/or short lived perennials:

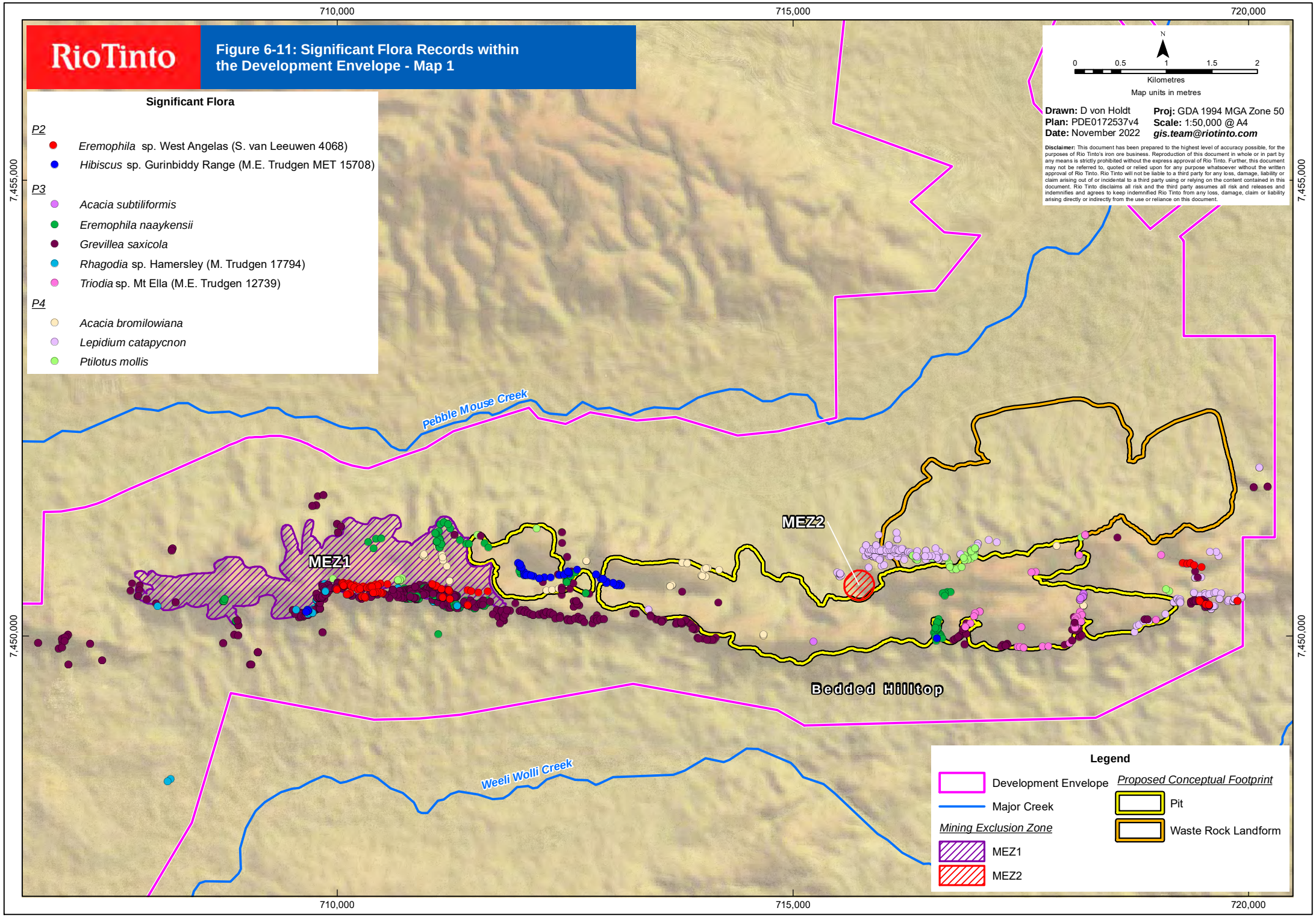
- *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) P1, now listed as P3,
- *Ipomoea racemigera* P2,
- *Isotropis parviflora* P2, now listed as P3,
- *Oxalis* sp. Pilbara (M.E. Trudgen 12725) P2,
- *Amaranthus centralis* P3,
- *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) P3
- *Swainsona thompsoniana* P3, and
- *Goodenia nuda* P4, no longer listed as a priority species, so not considered further.

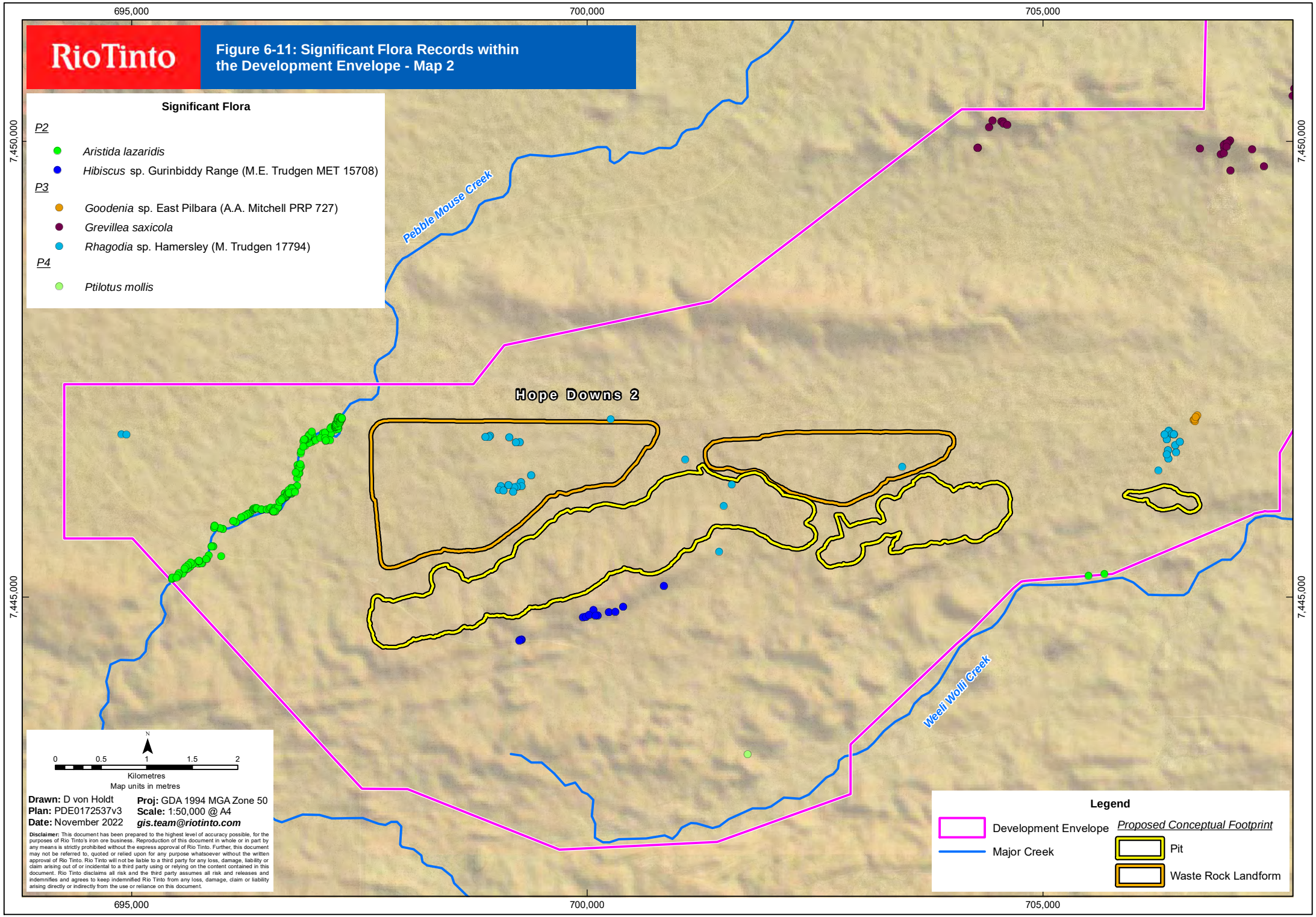
Section 6.6.1.2 discusses the potential impact of the Proposal on these species.

Table 6-12: Significant Flora Species Recorded in Development Envelope

Taxon	Development Envelope		State-wide (Regional)
	No. of Individuals	Vegetation Association	No. of Individuals
Priority 2			
Aristida lazaridis	2,304	D1, D2 D4, D7, H8, P2, P3 and P5	10,681
Eremophila sp. West Angelas (S. van Leeuwen 4068)	656	H1 and H2	950
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	473	D3, H1, H2 and H7	5,563
Priority 3			
Acacia subtiliformis	1	H5	179,099
Eremophila naaykensii	1,860	D3, H1, H10 and H12	13,628
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	140	P2	73,635
Grevillea saxicola	1,859	D1, D8, H1, H2, H4 H6, H7, H8 and H10	4,929
Rhagodia sp. Hamersley (M. Trudgen 17794)	93	D1, D5, D8, H2, P1, P2, P3, P5, P6 and P7	100,001
Triodia sp. Mt Ella (M.E. Trudgen 12739)	4,447	D3, H1 and H2	142,995
Priority 4			
Acacia bromilowiana	377	D1. D3 and H1	3,612
Lepidium catapycnon	8,997	D1, H1, H2, H3, H4 and H7	38,156
Ptilotus mollis	432	D1, H1, H2, H3, H4 and H7	6,495


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Figure 6-11: Significant Flora Records within the Development Envelope - Overview
Legend
Development Envelope
Major Creek
Mining Exclusion Zone
MEZ1
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Map 1
Map 2
Bedded Hilltop
Hope Downs 2
Pebble Mouse Creek
Weeli Wolli Creek
690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Significant Flora
P2
Aristida lazaridis
Eremophila sp. West Angelas (S. van Leeuwen 4068)
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
P3
Acacia subtiliformis
Eremophila naaykensii
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)
Grevillea saxicola
Rhagodia sp. Hamersley (M. Trudgen 17794)
Triodia sp. Mt Ella (M.E. Trudgen 12739)
P4
Acacia bromilowiana
Lepidium catapycnon
Ptilotus mollis
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172537v4
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @ A4
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Figure 6-11: Significant Flora Records within the Development Envelope - Map 1
Significant Flora
P2
Eremophila sp. West Angelas (S. van Leeuwen 4068)
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
P3
Acacia subtiliformis
Eremophila naaykensii
Grevillea saxicola
Rhagodia sp. Hamersley (M. Trudgen 17794)
Triodia sp. Mt Ella (M.E. Trudgen 12739)
P4
Acacia bromilowiana
Lepidium catapycnon
Ptilotus mollis
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172537v4
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710,000
715,000
720,000
7,455,000
7,450,000
Pebble Mouse Creek
MEZ1
MEZ2
Bedded Hilltop
Weeli Wolli Creek
Legend
Development Envelope
Major Creek
Mining Exclusion Zone
MEZ1
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform


RioTinto
Figure 6-11: Significant Flora Records within the Development Envelope - Map 2
Significant Flora
P2
Aristida lazaridis
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
P3
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)
Grevillea saxicola
Rhagodia sp. Hamersley (M. Trudgen 17794)
P4
Ptilotus mollis
Pebble Mouse Creek
Hope Downs 2
Weeli Wolli Creek
695,000
700,000
705,000
7,450,000
7,445,000
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172537v3
Date: November 2022
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Legend
Development Envelope
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform

6.3.3.2. Introduced Flora (Weeds)

A total of 17 weed species from multiple surveys have been recorded within the Development Envelope (Astron 2019a). All weed species are widespread throughout the bioregion, and none represents a declared pest as listed under the *State Biosecurity and Agricultural Management Act 2007* (BAM Act) or as a Weed of National Significance (WoNS) on the Western Australian Organism List (WAOL) database.

Indicative weed locations, abundance and habitat within the Development Envelope are also discussed in the key flora and vegetation studies provided in Appendix B1.

6.3.4. Culturally Significant Vegetation and Flora

Some vegetation types and flora species recorded within the Development Envelope are of cultural significance to the local Traditional Owner groups of the area. Section 11.5.8 of the Social Surroundings chapter addresses these vegetation types and species.

6.3.5. Summary of Key Flora and Vegetation Values

The key Flora and Vegetation values identified in the Development Envelope include:

- **Native vegetation in good to excellent condition**
- **Two vegetation types classed as being of high local* significance:**
  - **D4 and H2 vegetation types**
- **Nine vegetation types of moderate local significance:**
  - **D7, D8, P1, P2, P3, P4, H1, H6 and H7 vegetation types**
- **Presence of riparian vegetation along Pebble Mouse Creek and associated drainage lines**
- **Twelve Priority flora species recorded:**
  - **Three Priority 2 species: *Aristida lazaridis, Eremophila sp.* West Angelas *(S. van Leeuwen* 4068) and *Hibiscus sp.* Gurinbiddy Range (M.E. Trudgen MET 15708)**
  - **Six Priority 3 species: *Acacia subtiliformis, Eremophila naaykensii, Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727*), Grevillea saxicola*, *Rhagodia* sp. Hamersley (M. Trudgen 17794) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739)**
  - **Three Priority 4 species: Acacia bromilowiana, Lepidium catapycnon and Ptilotus mollis**
- **Generally low abundance of weeds**

** Local scale in the context of the extent of the Development Envelope*

6.4. Potential Environmental Impacts

6.4.1. Direct Impacts

Potential direct impacts of the Proposal to flora and vegetation have been identified as:

- Clearing of native vegetation (including riparian vegetation)
- Removal of individuals of Priority flora species.

6.4.1.1. Clearing of Native Vegetation (including Riparian Vegetation)

The Proposal will clear up to 4,900 ha of native vegetation. This represents the total extent of clearing for this Proposal and is the culmination of detailed design and application of avoidance and minimisation measures, as outlined in Section 6.5.

Table 6-12 presents the approximate clearing of vegetation types of high and moderate local significance based on the Conceptual Footprint; however, the Proposal includes flexibility to alter the location of the Proposal elements within the Development Envelope.

To ensure environmental impacts to vegetation types are not greater than assessed, the Proponent has proposed maximum clearing extents for vegetation types of high local significance. These extents are explained and rationalised in Section 6.5. No vegetation of regional significance exists within the Conceptual Footprint or Development Envelope.

Table 6-13: Indicative Disturbance – High and Moderate Local Significance Vegetation Types

Vegetation Type	Mapped Vegetation Extent			Percentage in Development Envelope Impacted from Proposal (%)	Mapped Vegetation Extent - Hope Downs Hub	Percentage in Hope Downs Hub Impacted from Proposal (%)
	Development Envelope (ha)	Conceptual Footprint (ha)	Extent Protected in MEZ* (ha)			
High Local Significance						
D4	48.08	11.7		24%	440	3%
H2	296.81	18.6	43.53	6%	439	4%
Moderate Local Significance						
D7	191.43	53.6	N/a	28%	1,293	4%
D8	108.47	41.0	N/a	38%	162	25%
P1	448.66	300.5	N/a	67%	1,077	28%
P2	214.56	19	N/a	9%	453	4%
P3	2,066.47	1,016.2	N/a	49%	5,520	18%
P4	60.28	35.1	N/a	58%	296	12%
H1	597.42	376.5	128.35	63%	1,628	23%
H6	145.64	25.2	0.92	17%	171	15%
H7	1,798.21	381.6	3.21	21%	4,169	9%
H8	1,186.15	313.6	N/a	26%	3,749	8%

**MEZ: Mining Exclusion Zones - See Section 6.5.2.2 for details.*

High Local Significance

D4 (Drainage Line – Riparian)

The D4 vegetation type has been highlighted via the detailed flora and vegetation assessment (Astron 2019a) to be of high local significance as it represents riparian vegetation, occurs on the larger of the drainage features within the development envelope (i.e. Pebble Mouse and upper reaches of Weeli Wolli Creek), includes areas of relatively abundance populations of *Aristida lazaridis* (P2), and possesses elevated cultural significance. The targeted riparian survey and mapping that was completed by Rio Tinto (2022d) superseded the baseline vegetation work completed by Astron (2019a) which mapped the D4 unit to occur across most of the riparian zone for moderate to major sized drainage in the greater Hope Downs 1 area. As a result of the targeted riparian survey outcomes, Astron's D4 vegetation assemblage along Pebble Mouse and Weeli Wolli Creeks was split further into seven detailed vegetation units, as shown in Table 6-7.

The Proposal will remove approximately 12 ha of the 48 ha of the D4 vegetation type within the Development Envelope, which represents 24.2% of its occurrence within the Development Envelope. An additional 440 ha of this vegetation type has been recorded outside of the Development Envelope (Table 6-11), which brings the level of impact to approximately 2.6% of its local representation. The D4 vegetation type has a relatively wide distribution in the local area compared to the scale of the proposed clearing.

H2 (Hills and Slope)

The H2 vegetation type is of high local significance due to its affinity with the 'Lower-Slope Mulga', which is an EAR in the Hamersley subregion due to frequent fires (Kendrick 2001 as cited in Astron 2019a) and that it hosts numerous Priority flora taxa, including *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2).

The Proposal will remove up to 19 ha (6.3%) of this vegetation type, leaving approximately 278 ha remaining within the Development Envelope. 43.5 ha (14.7% of extent within the Development Envelope) of H2 vegetation type will be protected within MEZ1. The vegetation within the MEZ is an area where a high proportion of *Eremophila* sp. West Angelas (S. van Leeuwen 4068) were recorded. An additional 439 ha of this vegetation type has been recorded outside of the Development Envelope (Table 6-11), bringing the level of impact to approximately 4.2% of its local representation.

The H2 vegetation type has a relatively wide distribution compared to the scale of the proposed clearing (within and outside of the Development Envelope).

The Priority 2 flora species *Eremophila* sp. West Angelas (S. van Leeuwen 4068) will be protected within a MEZ and all other Priority taxa occur within other vegetation types

Vegetation Condition

The Proposal will result in the clearing of up to 4,205 ha of native vegetation in good to excellent condition. This is considered a significant residual impact, and thus the Proponent proposes to apply an offset to this clearing (Chapter 13).

6.4.1.2. Removal of Individuals of Priority Flora Species

Potential impacts to significant flora individuals within the Development Envelope and proposed conceptual footprint is presented in Table 6-14.

Table 6-14: Impacts to Significant Flora Species within the Development Envelope

Taxon	Conceptual Footprint	Population within Development Envelope				State-wide (Regional)	
	No. of Individuals	No. of Individuals	Percentage Impacted	No. of individuals in MEZ*	Percentage. of individuals in MEZ*	Total Number of Individuals in the State	Percentage Known Population Impacted
Priority 2							
Aristida lazaridis	395	2,304	17%	0	0	10,681	3.7
Eremophila sp. West Angelas (S. van Leeuwen 4068)	0	656	0%	558	85%	950	0.0
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	301	473	64%	37	8%	5,563	5
Priority 3							
Acacia subtiliformis	1	1	100%	0	0%	179,099	<0.1
Eremophila naaykensii	182	1,860	10%	1,022	55%	13,628	1
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	0	140	0%	0	0%	73,635	0.0
Grevillea saxicola	143	1,859	8%	555	30%	4,929	3
Rhagodia sp. Hamersley (M. Trudgen 17794)	56	93	60%	15	16%	100,001	0.1
Triodia sp. Mt Ella (M.E. Trudgen 12739)	3,877	4,447	87%	0	0%	142,995	3
Priority 4							
Acacia bromilowiana	202	377	53%	151	40%	3,612	6
Lepidium catapycnon	8,494	8,997	94%	50	1%	38,156	22
Ptilotus mollis	284	432	66%	45	10%	6,495	4

*MEZ: Mining Exclusion Zones -See Section 6.5.2.2 for details

6.4.2. Indirect Impacts

Potential indirect impacts of the Proposal to flora and vegetation have been identified as:

- Degradation of vegetation condition due to increased abundance and diversity of weeds
- Degradation of vegetation from dust deposition and altered bushfire regime.
- Other typical indirect impacts to flora and vegetation typically associated with mining proposals in the region have been either avoided or discounted, including:
- Impacts to GDV are considered highly unlikely on the basis that natural depth to regional groundwater sources is 25 m or deeper below ground surface, and that all mining is above water table
- Indirect impacts to riparian vegetation from the construction of crossings and subsequent alteration of important hydrological regimes are also highly unlikely owing to the highly ephemeral nature of Pebble Mouse Creek and the absence of permanent or semi-permanent pools in the Development Envelope.

6.4.2.1. Degradation of Vegetation Condition due to Increased Abundance and Diversity of Weeds

Weeds can be spread by several mechanisms including disturbance, wind, water, vehicles, machinery and fauna (inclusive of native and feral fauna). Historically, weeds in the Pilbara have been introduced through pastoral activities (EPA 2014). However, weeds can often also rapidly invade locations subject to disturbance, land clearing and/or altered hydrological regimes. This can result in the replacement of native species and the simplification of natural ecosystems.

No weed species which are considered to be Declared Pests as defined by the BAM Act or WoNS were identified within the Development Envelope (Astron 2019a).

The most relevant mechanisms for weed spread or introduction concerning the Proposal's implementation are vehicle and earthmoving activities.

6.4.2.2. Degradation of Vegetation from Dust Deposition and Altered Bushfire Regime

Dust emissions from the Proposal are expected during vegetation clearing activities and certain activities with the operation of the mine such as a vehicle, heavy haulage, machinery movements, blasting, crushing and conveying. Dust modelling has been conducted for the Proposal (ETA 2022), with dust deposition on vegetation expected to be limited to areas immediately adjacent to dust-generating activities (ETA 2022).

The Development Envelope has a history of fire (Section 6.3.2.6). Given the increase in potential ignition sources (i.e., vehicle movement and clearing), there is also the potential for increased fire risk. However, ignition sources and fire incidents are generally effectively managed on mine sites, and it is unlikely that there will be an increased frequency of uncontrolled fires in the mining area compared to the surrounding vegetation.

6.4.2.3. Degradation or Alteration of Vegetation as a Result of Altered Hydrological Regimes

Surface water features within and adjacent to the Development Envelope support important vegetation communities. Impacts to GDV are considered highly unlikely on the basis that natural depth to regional groundwater sources is 25 m or deeper below ground surface, and that all mining is above water table. Indirect impacts to riparian vegetation from the construction of crossings and subsequent alteration of important hydrological regimes are also highly unlikely owing to the highly ephemeral nature of Pebble Mouse Creek and the absence of permanent pools in the Development Envelope.

Surface water features that are surface water dependent and the potential changes resulting from catchment loss, have been assessed in Chapter 9 (Inland Waters). The hydrological assessment concludes that there will not be a significant change to the hydrological regimes of the Pebble Mouse Creek or Weeli Wolli Creek, therefore, their vegetation values will be maintained.

Due to the deposits being AWT, no mine pit dewatering is required and therefore the Proposal does not require discharge of surplus water which may affect local watercourses.

6.4.3. Cumulative Impacts

Cumulative impacts refer to the effect of the Proposal in addition to the combined, incremental effects of surrounding disturbing land uses to the environment resulting from other iron ore mining projects within the bounds of the Hamersley subregion and within 50 km of the Proposal. This section outlines the potential cumulative impacts to flora and vegetation values as a result of the Proposed Amendment and other surrounding mining activities either approved or currently under assessment.

Cumulative impacts have been considered against the following flora and vegetation aspects:

- Beard Vegetation Associations
- Conservation Significant Flora

In undertaking a cumulative impact assessment, the following assumptions have been made:

- Cumulative impacts have been considered against both third-party operations and other Rio Tinto regional operations (Table 6-14),
- Cumulative impacts to flora and vegetation resulting from third-party operations are based on information available in the public domain for third party operators and does not encapsulate impacts for all third-party operations in the Pilbara.
- Cumulative impact calculations do not take into consideration areas outside of those assessed under Part IV of the EP Act for each relevant proposal.
- Priority flora taxa considered has been reduced to only those taxa that are identified as being impacted by this Proposal and in third-party approval documents
- The accuracy of data from external sources has not been verified and it is assumed that data publicly available is accurate and collected in accordance with standard industry guidelines
- Survey effort within the Pilbara is largely undertaken within mining tenure and there will be a resultant bias in the occurrence of species on mining and exploration tenements due to the increased survey effort taking place within mining tenure
- Cumulative impact calculations do not take into consideration areas outside of those assessed by each relevant proposal.

Table 6-15: Extent of Other Current and Forecast Mining Proposal within 50 km of the Proposal and in the Hamersley Subregion

Proposal	Status	Approved Clearing (ha)	Distance from Proposal
Rio Tinto Managed Operations			
Hope Downs 1 (including Baby Hope)	Existing	5,723	Adjacent
Hope Downs 4	Existing	5,470	42 km
West Angelas Iron Ore Mine (including deposits C, D and G)	Existing	12,205	28 km

Proposal	Status	Approved Clearing (ha)	Distance from Proposal
West Angelas Iron Ore Mine (Revised Proposal)	Proposed	5,350	28 km
Yandicoogina Iron Ore Project	Existing	7,400	29 km
Koodaideri* Iron Ore Mine and Infrastructure Project	Existing	12,171	36 km
Third-party Operations			
Mining Area C (including Southern Flank) – BHP	Existing	21,824	15 km
Marillana Creek – Yandi – BHP	Existing	4,558	37 km
Central Marra Mamba – Wonmunna Iron	Existing	555	10 km
Iron Valley – Mineral Resources Limited	Existing	988	49 km

** now referred to as Gudai-Darri Iron Ore Mine*

6.4.3.1. Cumulative Impacts on Native Vegetation

The Proposal will contribute to the following cumulative impacts at a regional scale:

- Clearing of native vegetation
- Removal of individuals of Priority flora species

Cumulative impacts have been considered within the bounds of the Hamersley subregion, based on an assessment of all major mining projects (current and foreseeable future projects) located within the same pre-European vegetation associations as the Development Envelope. There are ten projects within the bounds of the Hamersley subregion and within 50 km of the Proposal that had publicly accessible data on which the cumulative impact assessment could be based.

Regional vegetation mapping at the scale completed for the Development Envelope is not available or in a format that is consistent and comparable for the Pilbara bioregion more broadly. Therefore, identifying and assessing potential cumulative impacts on vegetation types is limited to regional vegetation datasets, e.g. Beard's Vegetation Associations (Section 6.3.2.1).

The cumulative effect iron ore mining operations on clearing of native vegetation at a regional scale (i.e. within the Hamersley sub-region) is presented in Table 6-16. The current extent of vegetation within the Hamersley subregion is 2,156,547 ha for Vegetation Association 82 and 575,808 ha for Vegetation Association 18.

It is noted that there is no publicly available data of impacts resulting from pastoral and/or grazing activities and, therefore, is not able to be included in cumulative impacts calculations.

The National Objectives and Targets for Biodiversity Conservation include avoiding clearance of existing vegetation with a pre-European extent of below 30% (Commonwealth of Australia 2001). Following the implementation of the Proposal and cumulative impacts from reasonably foreseeable projects, approximately 93% or more of pre-European extent for Vegetation Association 82 will remain within the subregion and approximately 84% for Vegetation Association 18.

Table 6-16: Cumulative Impacts on Beard (Beard 1975) Vegetation Associations within the Hamersley Subregion

Vegetation Association	Pre-European Extents (ha)	Current Extent (ha)	Clearing from this Proposal (ha (%))	Other Regional Projects	Cumulative Impact		Proposal Contribution (%)	Vegetation Remaining (%)
			Extent (ha)	Disturbance (ha)	Total Cumulative Disturbance (ha)	Cumulative Reduction in Current Extent (%)		
18 - low woodland, open low woodland or sparse woodland; mulga (*Acacia aneura*).	580,513	575,808	3,067	84,454	87,521	15.2	3.5	84.8
82 - hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	2,168,703	2,156,547	1,790	138,738	140,528	6.5	1.3	93.5

**Areas proposed to be cleared for each vegetation association are based on the area of the Development Footprints for reasonably foreseeable projects listed in Section 2.3.2.2 and 2.3.2.3.*

6.4.3.2. Cumulative Impacts on Conservation Significant Flora

Ten Priority flora species have the potential to be impacted cumulatively by the Proposal when considering other major projects within the Hamersley sub-region (Table 6-17). The estimate of the number of plants potentially impacted by other projects includes all individuals within their respective Proposal development envelopes, not the disturbance footprint as indicated by publicly available information. Several projects, such as the Flinders Pilbara Iron Ore Project (MS 924), do indicate the potential to disturb Priority species that occur within their development envelopes, but an estimated number of individuals is not provided. Due to this lack of data, these projects have been excluded from this cumulative assessment.

The Proposal does not significantly contribute to the cumulative impacts to most of the Priority flora species, as the proportion on individuals impacted as a result of implementation of the Proposal is less than 6% of the total known population (Table 6-17). The only exception is the Priority 4 species: *Lepidium catapycnon* (22%) of the known population could be impacted by the Proposal.

Table 6-17: Cumulative Impacts on Significant Flora Species within the Hamersley IBRA Subregion

Taxon	Proposal – Total number of Individual Taxa Impacted	Other Regional Projects - Total Number of Individual Taxa Impacted	Total Cumulative Impact – Individuals	No. of Known Individuals	Proportion of Known Individuals Impacted by the Proposal (%)	Total Cumulative Impact – Individuals (%)
Priority 2						
Aristida lazaridis (P2)	395	1,502	1,897	10,641	4	18%
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	301	770	1,071	5,563	5	19%
Priority 3						
Acacia subtiliformis	1	695	696	179,099	0	0%
Eremophila naaykensii	182	6,163	6,345	13,628	1	46%
Grevillea saxicola	143	351	494	4,929	3	10%
Rhagodia sp. Hamersley (M. Trudgen 17794)	56	1,843	1,899	100,000	0.1	2%
Triodia sp. Mt Ella (M.E. Trudgen 12739)	3,877	91,802	95,679	142,995	3	67%
Priority 4						
Acacia bromilowiana	202	240	442	3,612	6	12%
Lepidium catapycnon	8,494	219	8,713	38,156	22	23%
Ptilotus mollis	284	1	285	6,495	4	4%

6.5. Mitigation

The Proponent is committed to ensuring that, wherever possible, the Proposal avoids or minimises potential impacts on locally significant native vegetation types and Priority flora species present in the Development Envelope.

6.5.1. Summary of Mitigation Hierarchy

The Proponent has applied the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) during the Proposal design process to develop mechanisms to address potential impacts to key Flora and Vegetation values within the Development Envelope.

The mechanisms applied to each key Flora and Vegetation value are discussed below and summarised in Table 6-17.

6.5.2. Avoidance

6.5.2.1. Proposal Design Refinements

The Proponent has sought to develop and subsequently refine the Proposal to avoid both direct and indirect impacts to the Flora and Vegetation values within the Development Envelope. The Proponent has adopted a number of key measures, with the aim of achieving the following outcomes for flora and vegetation. These measures have been informed through consultation with Traditional Owners and relevant SMEs, and include:

- Reduction of the Development Envelope avoids impacts to Priority flora, as shown in Table 6-18 and on Figure 6-12:
    - Priority 2 flora species *Aristida lazaridis* (2,639 individuals avoided, approximately 50% of the population is now outside the Development Envelope),
    - Priority 2 flora species *Eremophila* sp. West Angelas (121 individuals avoided, approximately 16% of the population is now outside the Development Envelope) and
    - Priority 4 flora species *Lepidium catapycnon* (2,345 individuals avoided, approximately 21% of the population is now outside the Development Envelope)
- Reduction of the Development Envelope avoids impacts to high local significance vegetation units, as shown in Table 6-19 and on Figure 6-12:
    - D4 (48ha avoided, which reduced impacts to this vegetation unit by half),
    - H2 (34 ha avoided, which reduced impacts to this vegetation unit by 10%),
    -
- The avoidance of groundwater impacts on flora and vegetation, including riparian/ groundwater dependent vegetation, related to large-scale dewatering activities by restricting mining to AWT
- Reduction of the Development Envelope to minimise impacts to Weeli Wolli Creek, which also reduced impacts to Priority 2 flora species *Aristida lazaridis*
- Ensuring creek crossings are suitably designed and constructed to avoid potential flooding of upstream vegetation and avoidance of stream flow reduction or impingement downstream.

The result of these avoidance measures for Flora and Vegetation values are displayed in Figure 6-12.

Table 6-18: Changes in Impacts to Priority Flora from Changes in Proposal Design

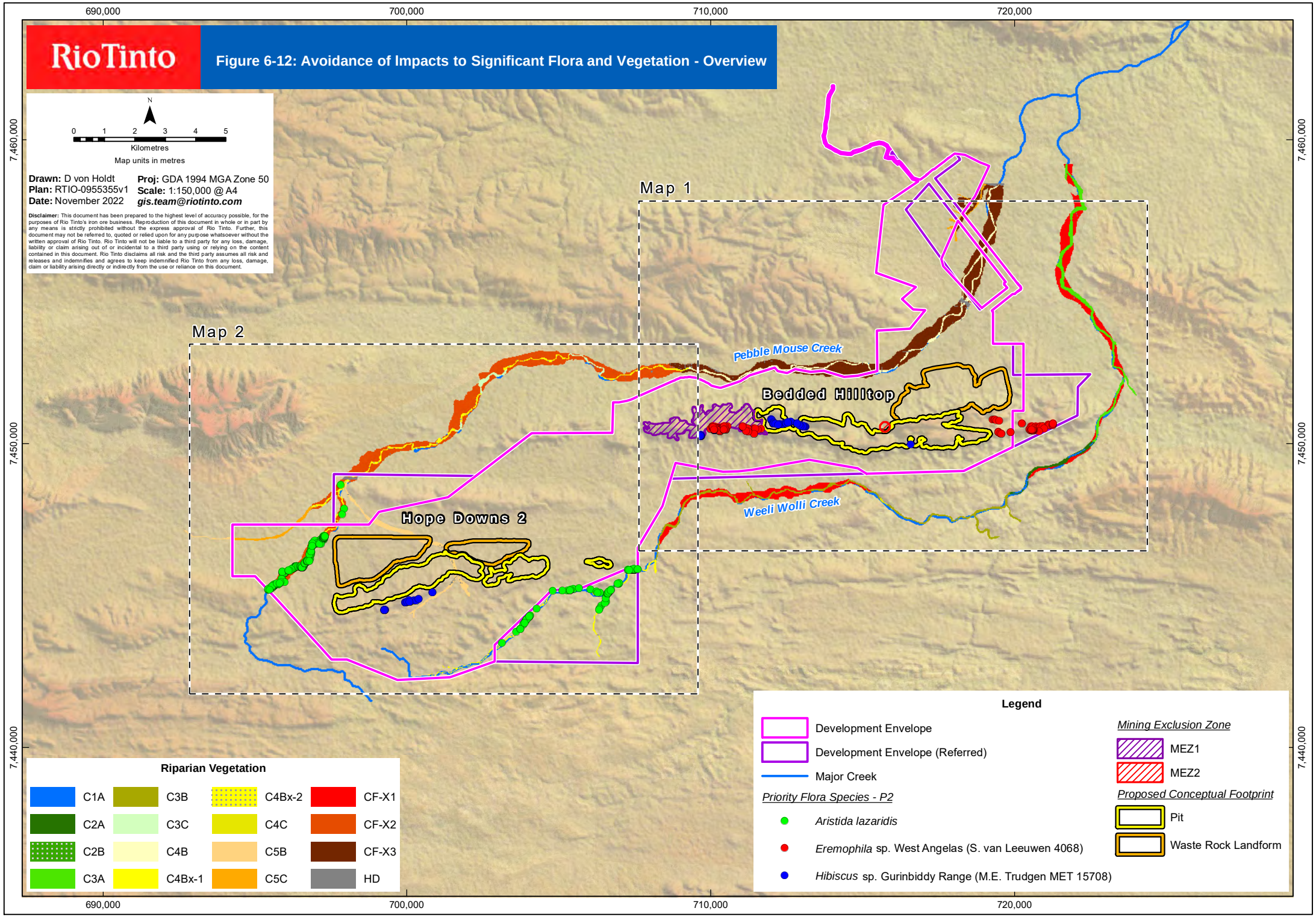
Species	Population within Referred Development Envelope	Population within ERD Development Envelope	Change in Impact
Priority 2			
Aristida lazaridis	4,943	2,304	2,639 (-53%)
Eremophila sp. West Angelas (S. van Leeuwen 4068)	777	656	121 (-16%)
Priority 3			
Grevillea saxicola	1,892	1,859	33 (-2%)
Rhagodia sp. Hamersley (M. Trudgen 17794)	95	93	2 (-2%)
Priority 4			
Lepidium catapycnon	11,342	8,997	2,345 (-21%)

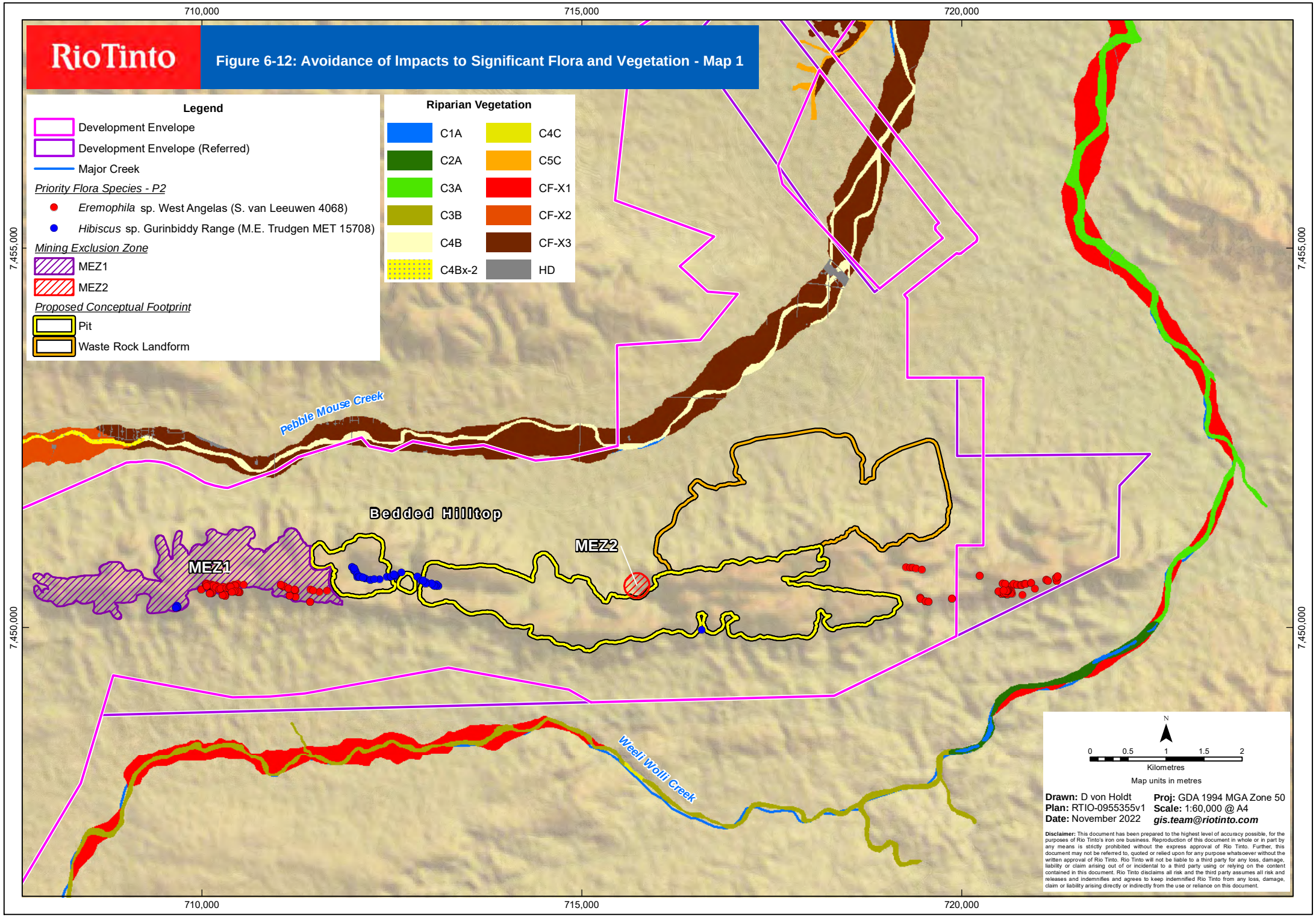
Table 6-19: Changes in Impacts to Vegetation Units from Changes in Proposal Design

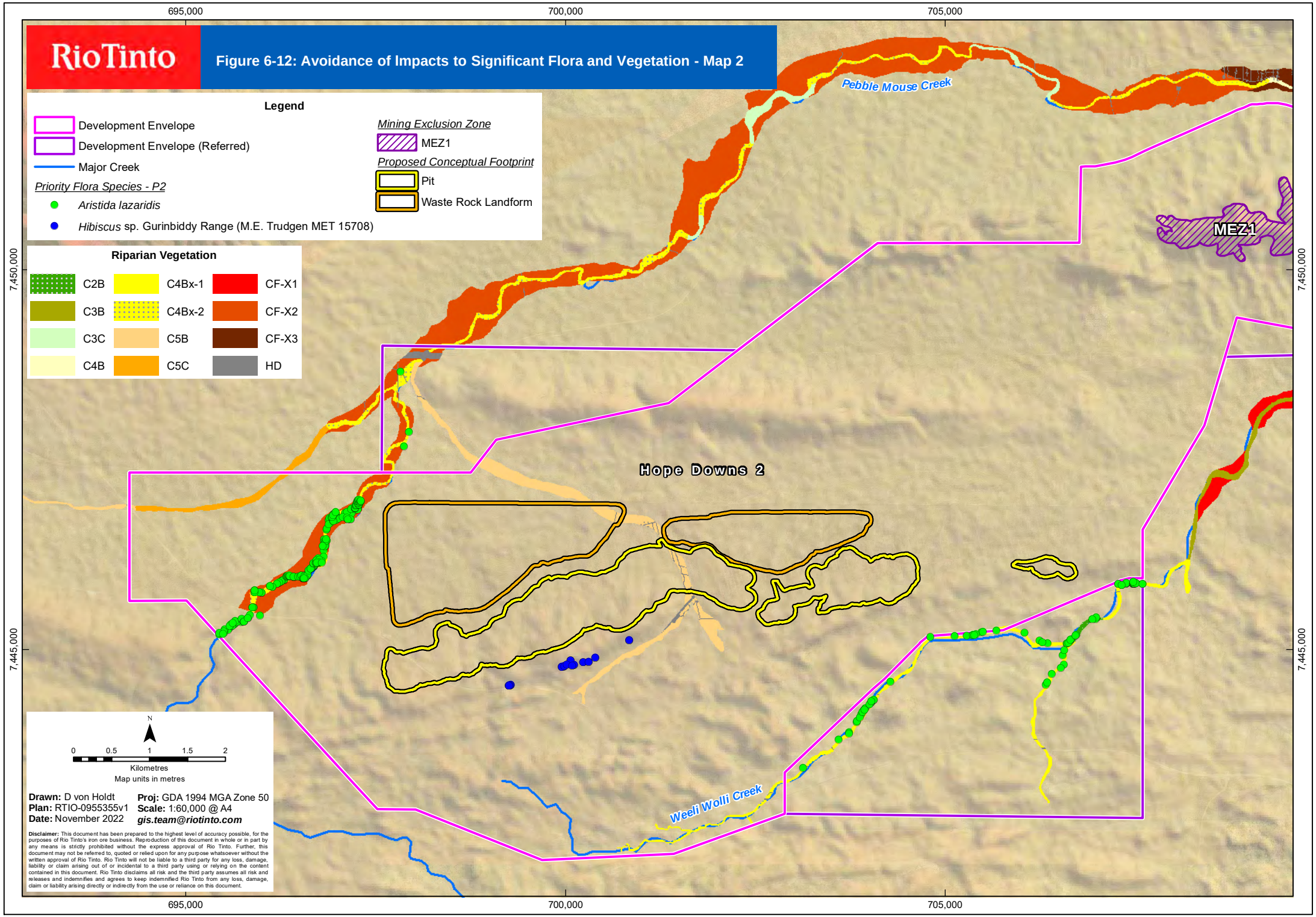
Vegetation Type	Mapped Vegetation Extent in Referred Development Envelope (ha)	Mapped Vegetation Extent in ERD Development Envelope (ha)*	Difference in Mapped Vegetation Extent between the Referred Development Envelope and ERD Development Envelope (ha)	Difference in Mapped Vegetation Extent between the Referred Development Envelope and ERD Development Envelope (%)
High Local Significance				
D4	95	48	-47	-98%
H2	331	297	-34	-11%
Moderate Local Significance				
D7	191	202	-10	-5%
D8	108	93	15	**14%**
P1	449	453	-4	-1%
P2	215	237	-22	-10%
P3	2,066	1,951	116	**6%**
P4	60	54	6	**10%**
H1	597	647	-49	-8%
H6	146	153	-7	-5%
H7	1,798	1,966	-168	-9%
H8	1,186	1,364	-178	-15%
Low Local Significance				
D1	883	1076	-194	0%
D2	350	359	-9	0%
D3	49	52	-3	0%
D5	76	87	-11	0%
H10	668	917	-250	0%
H11	414	536	-122	0%
H12	72	691	-619	-9%

Vegetation Type	Mapped Vegetation Extent in Referred Development Envelope (ha)	Mapped Vegetation Extent in ERD Development Envelope (ha)*	Difference in Mapped Vegetation Extent between the Referred Development Envelope and ERD Development Envelope (ha)	Difference in Mapped Vegetation Extent between the Referred Development Envelope and ERD Development Envelope (%)
Low Local Significance				
H3	641	634	8	0%
H4	623	801	-178	0%
H5	7	1	5	1%
H9	31	32	-1	0%
P4	60	54	6	0%
Cleared	1432	1353	79	0%

*Note: Numbers have been rounded up to the nearest whole number or percentage


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Figure 6-12: Avoidance of Impacts to Significant Flora and Vegetation - Overview
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0955355v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @ A4
gis.team@riotinto.com
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690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Map 1
Map 2
Pebble Mouse Creek
Bedded Hilltop
Hope Downs 2
Weeli Wolli Creek
Riparian Vegetation
C1A
C2A
C2B
C3A
C3B
C3C
C4B
C4Bx-1
C4Bx-2
C4C
C5B
C5C
CF-X1
CF-X2
CF-X3
HD
Legend
Development Envelope
Development Envelope (Referred)
Major Creek
Priority Flora Species - P2
Aristida lazaridis
Eremophila sp. West Angelas (S. van Leeuwen 4068)
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
Mining Exclusion Zone
MEZ1
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform


RioTinto
Figure 6-12: Avoidance of Impacts to Significant Flora and Vegetation - Map 1
Legend
Development Envelope
Development Envelope (Referred)
Major Creek
Priority Flora Species - P2
Eremophila sp. West Angelas (S. van Leeuwen 4068)
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
Mining Exclusion Zone
MEZ1
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Riparian Vegetation
C1A
C2A
C3A
C3B
C4B
C4Bx-2
C4C
C5C
CF-X1
CF-X2
CF-X3
HD
Pebble Mouse Creek
Bedded Hilltop
MEZ1
MEZ2
Weeli Wolli Creek
710,000
715,000
720,000
7,455,000
7,450,000
N
0
0.5
1
1.5
2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0955355v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:60,000 @ A4
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RioTinto
Figure 6-12: Avoidance of Impacts to Significant Flora and Vegetation - Map 2
Legend
Development Envelope
Development Envelope (Referred)
Major Creek
Priority Flora Species - P2
Aristida lazaridis
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
Mining Exclusion Zone
MEZ1
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Riparian Vegetation
C2B
C3B
C3C
C4B
C4Bx-1
C4Bx-2
C5B
C5C
CF-X1
CF-X2
CF-X3
HD
695,000
700,000
705,000
7,450,000
7,445,000
Pebble Mouse Creek
MEZ1
Hope Downs 2
Weeli Wolli Creek
N
0
0.5
1
1.5
2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0955355v1
Date: November 2022
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6.5.2.2. Mining Exclusion Zones

The proposed Mining Exclusions Zones (MEZs) refer to the areas within the Development Envelope where no mining excavation will occur, and only low impact activities associated with environmental or cultural heritage monitoring and management may be implemented. MEZ1 contains existing communications infrastructure that is to be maintained. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. There is to be no clearing of recorded P2 flora within MEZ.

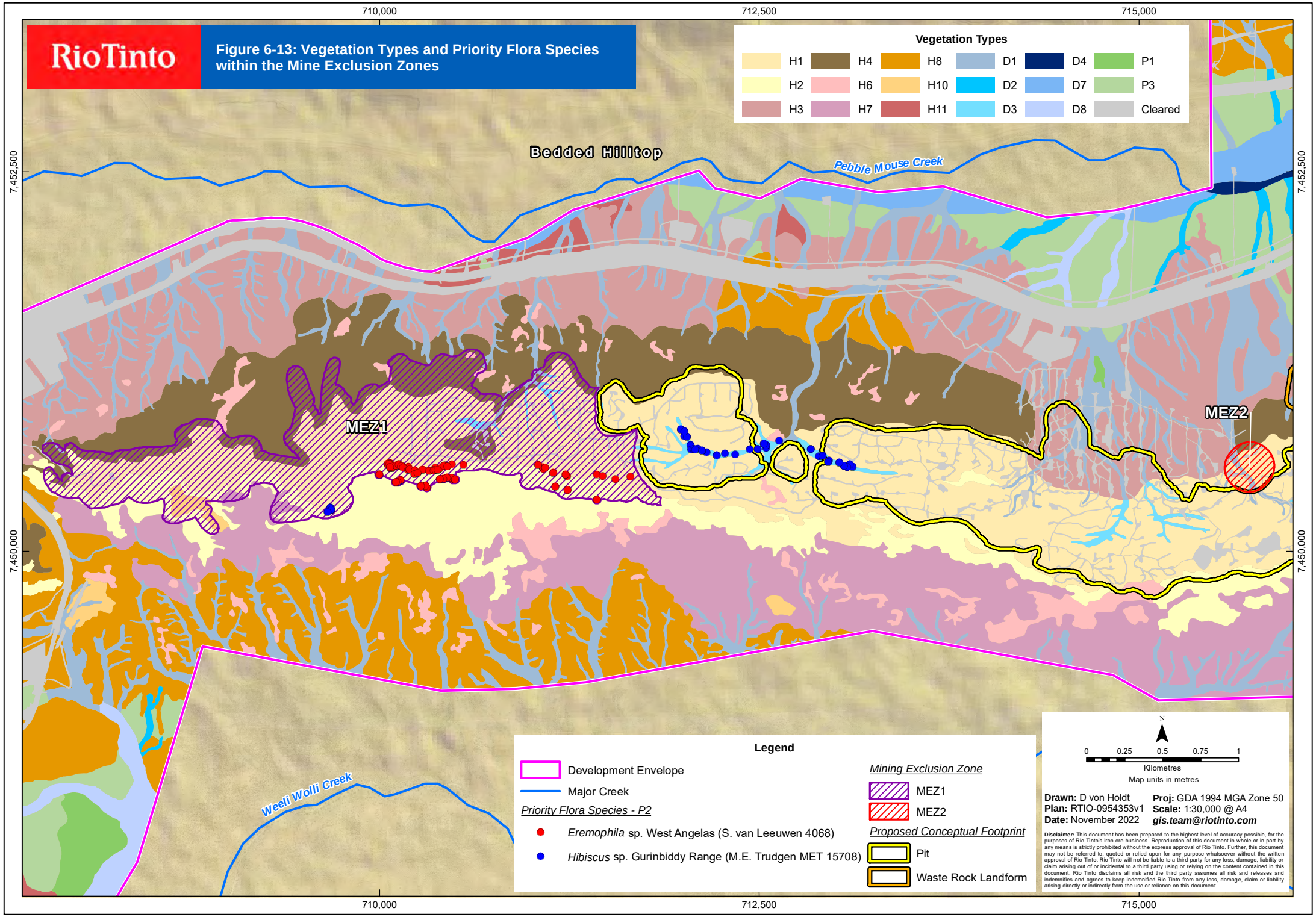
The establishment of two MEZs: MEZ1 and MEZ2 near the BHT deposit (Figure 6-13) will contain 241.5 ha of native vegetation, limit impact to nine vegetation units, including one unit of high local significance (Table 6-20 and Figure 6-13), and limit impact to eight species of Priority flora from being directly impacted by the Proposal (Table 6-14).

The MEZs will avoid impacts to:

- High local significance vegetation unit H2 (43.5 ha avoided, Figure 6-13)
- Moderate local significance vegetation units H1, H6 and H7 (131.5 ha avoided)
- Priority 2 flora species *Eremophila* sp. West Angelas (558 individuals avoided, 85% of recorded population within the Development Envelope); and
- Priority 2 flora species *Hibiscus* sp. Gurinbiddy Range (37 individuals avoided, 13% of recorded population within the Development Envelope)
- 2,433 recorded priority flora individuals are located within MEZ1 and MEZ2.

Table 6-20: Vegetation Units within Mining Exclusion Zones 1 and 2

Vegetation Unit	Area (ha) within MEZ 1 & 2
High Local Significance	
H2	43.5
Moderate Local Significance	
H1	128.3
H6	0.9
H7	3.2
Other	
D1	2.4
D3	2.5
H10	3.9
H3	0.2
H4	47.6
Cleared	8.9


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Figure 6-13: Vegetation Types and Priority Flora Species within the Mine Exclusion Zones
Vegetation Types
H1
H2
H3
H4
H6
H7
H8
H10
H11
D1
D2
D3
D4
D7
D8
P1
P3
Cleared
Bedded Hilltop
Pebble Mouse Creek
MEZ1
MEZ2
Weeli Wolli Creek
710,000
712,500
715,000
7,452,500
7,450,000
Legend
Development Envelope
Major Creek
Priority Flora Species - P2
Eremophila sp. West Angelas (S. van Leeuwen 4068)
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
Mining Exclusion Zone
MEZ1
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform
N
0
0.25
0.5
0.75
1
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0954353v1
Date: November 2022
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6.5.3. Minimisation

6.5.3.1. Proposal Design Refinements

The Proposal design includes the transport of ore from HD2 deposit to the Hope Downs 1 operations ore processing facilities via road trains on a sealed road or via conveyor, which would minimise the dust generated from ore transport.

Proposal design was altered to avoid higher conservation vegetation units and priority flora.

6.5.3.2. Environmental Management – Indirect Impacts

The implementation of the Proposal may result in indirect impacts to flora and vegetation values within the Development Envelope. The introduction/spread of weeds, increase in dust emissions, and increased risk of bushfires can cause a decline in the quality of the vegetation present in the Development Envelope.

The Proponent is committed to the implementation of specific management strategies to:

- Avoid the introduction of any species that are listed as WoNS
- Minimise the spread of introduced species, currently present within the Development Envelope
- Minimise impacts to flora and vegetation from dust emissions; and
- Avoid the occurrence of bushfires due to Proposal related activities.

The proposed management strategies are summarised in Table 6-21. The Proponent implement the measures in the EMP (Appendix A7).

6.5.4. Rehabilitation and Closure

The MCP has been prepared to address closure requirements for the Proposal (Appendix A4). The MCP will be updated regularly to ensure its objectives remain relevant and aligned to stakeholder expectations and that its strategies and plan are appropriate to achieve closure outcomes.

A summary of the approach to the closure of the Proposal and how it relates to flora and vegetation is provided below.

The proposed final land use post-mining assumes that the site will be rehabilitated to create a safe, stable and non-polluting landscape revegetated with native species, which considers environmental and cultural heritage outcomes and ensures the site does not result in significant residual impact on the current surrounding land use.

Due to the nature of the mining activity undertaken, the final landform will include large voids and waste dumps and will therefore be unlikely to support pastoral activities in the immediate disturbed areas. However, it is recognised that surrounding areas are likely to remain subject to pastoral activity. It is assumed that the post closure landforms will be shaped and rehabilitated to support ongoing pastoral activity where underlying tenure is pastoral, and elsewhere be returned to native vegetated land.

The final land use will be confirmed prior to closure during the final planning phases and in consultation with relevant stakeholders.

General rehabilitation practices will include:

- Topsoil and vegetation (including woody debris) would be re-spread over rehabilitated areas to act as a seed source and to protect the soil from erosion
- Local provenance seed and propagated material used (if required) to rehabilitate disturbed areas
- Weed spraying during rehabilitation, especially if progressive during LOM

- The water management strategy includes the preferential discharge of surplus water to mine pits when they are available.
- Indicative closure completion criteria include:
    - Seed used in rehabilitation works is of local provenance
    - Native plants within rehabilitated areas are observed to flower and/or fruit
    - Recruitment of native perennial plants is observed
    - Species richness of native perennial plants within rehabilitated areas is not less than reference sites
    - Any weed species recorded within rehabilitation areas are present within the local area.

The Proponent has prepared a progressive rehabilitation summary regarding current practice and outcomes at the existing operations. Rehabilitation at the existing operations is conducted in accordance with Rio Tinto standard procedures. Cleared areas are rehabilitated to create a safe, stable and non-polluting landscape vegetated with native species of local provenance, to maximise environmental and cultural heritage outcomes, and ensure the site is compatible with the surrounding and proposed post-mining land use. Local undisturbed vegetation is used to guide rehabilitation activities such as seed list development and rehabilitation quality assessment.

Table 6-21: Application of the Mitigation Hierarchy for Flora and Vegetation

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Clearing of native vegetation	**Measures to Avoid**			
	The Proponent has avoided impacts to flora and vegetation, specifically riparian vegetation units, through the reduction of the Development Envelope, especially through excluding approximately 6 km of Weeli Wolli Creek.	Project Specific	No	The Proponent has optimised the Development Envelope of the Proposal and excluded were possible vegetation of high local significance, such as along Weeli Wolli Creek, to ensure they are not affected by direct mining impacts. The complete avoidance of an impact is always considered to be a highly effective control and is the first and preferred strategy in the EPA's mitigation hierarchy.
	Measures to Minimise			
	MEZs will minimise impacts to nine vegetation types, including one of high local significance and three of moderate local significance.	Project Specific	No	MEZ will only allow limited clearing, minimising impacts to vegetation types within MEZ. The minimising an impact is considered to be a highly effective control measures and is high in the EPA's mitigation hierarchy.
	Ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System	Standard business practice	No	The Proponent's Approval Request System is a well-established mechanism for prioritising the avoidance of higher value areas, providing a high level of certainty that clearing will not be greater than what has been assessed in the document and as such is an effective control.
	Measures to Rehabilitate			
	The Proponent will implement a Mine Closure Plan (MCP) following DMIRS Guidelines (DMIRS 2020a). The Mine Closure Plan is expected to be a	Project specific MCP has been developed, based on Rio Tinto standard	Yes – DMIRS for development of the Mine Closure	MCP will be implemented and continually updated to be consistent with the MCP Statutory Guidelines, which are also

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	condition of any Ministerial Statement associated with the Proposal.	approach to closure planning.	Plan (see Appendix A4)	consistent with industry-leading practice (DMIRS 2020a and 2020b. The MCP will detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b. Rehabilitation will be required to provide a stable landform with certain habitat features maintained. However, the uncertainty in relation to the recreation of habitat values following mining is acknowledged. Therefore, clearing is treated as long-term or permanent impact for this assessment.
	The Proponent is committed to progressive rehabilitation to minimise the amount of cleared land open at any one time and to revegetate using local native species, where possible.	Project specific MCP has been developed, that includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use.	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	
	The MCP (Appendix A4) includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use, including: • Topsoil and vegetation (including woody debris) would be re-spread over rehabilitated areas to act as a seed source and to protect the soil from erosion • Local provenance seed and propagated material will be used (if required) to rehabilitate disturbed areas.		Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	
Removal of Priority Flora Species	**Measures to Avoid**			
	The establishment of the MEZ1 results in the protection of the majority of the known population of *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2), recorded within the Development Envelope.	Project Specific	No	The use of MEZ will prevent the clearing of the majority of *Eremophila* sp. West Angelas individuals and habitat within the Development Envelope. The complete avoidance of an impact is always considered to be a highly effective control measures and is the first and preferred strategy in the EPA's mitigation hierarchy.
	Measures to minimise			
	Ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System	Standard business practice	No	The Proponent's Approval Request System is a well-established mechanism for prioritising the avoidance of higher value areas, providing a high level of certainty that the number of priority flora clearing will not

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
				be greater than what has been assessed and has been demonstrated to be an effective control.
	Measures to Rehabilitate			
	The Proponent commits to undertake progressive rehabilitation where practicable, to minimise the extent of cleared areas and to restore vegetation using local native species.	Standard Business Practice	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	MCP will be implemented and continually updated to be consistent with the MCP Statutory Guidelines, which are also consistent with industry-leading practice (DMIRS 2020a and 2020b. The MCP will detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b. Rehabilitation will be required to provide stable landform with habitat features. However, the uncertainty in relation to the recreation of habitat values following mining is acknowledged. Therefore, clearing is treated as long-term or permanent impact for this assessment.
Indirect Impacts				
Introduction/Spread of weeds	**Measures to Avoid**			
	The Proponent will avoid introducing new weeds species listed as WoNS entering the Development Envelope by implementing the measures in the EMP (Appendix A7) and internal procedures and includes key actions such as periodic spraying and equipment hygiene.	Standard business practice	No	The measures in the EMP (Appendix A7) and the Proponent's internal procedures have been developed to meet the current industry standards for managing the potential introduction and spread of weeds. The EMP weed management measures will minimise the spread and introduction of weed species within the Development Envelope These management measures have been implemented across the Proponents

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
				operations in the Pilbara and are regarded being a highly effective control.
	Measures to Minimise			
	The Proponent will take measures, outlined in EMP (Appendix A7), to minimise the introduction or spread of any new weed species. This will include key actions such as periodic weed spraying and equipment weed hygiene protocols.	Standard business practice	No	The measures in the EMP (Appendix A7) and the Proponent's internal procedures have been developed to meet the current industry standards for managing the potential introduction and spread of weeds. The EMP weed management measures will minimise the spread and introduction of weed species within the Development Envelope These Management Strategies have been implemented across the Proponents operations in the Pilbara and are regarded as being an highly effective control.
	Measures to Rehabilitate			
	A site undergoing rehabilitation will be opportunistically sprayed to remove any weed species present	Standard business practice	No	Weed control during rehabilitation is an established standard practice within the mining industry.
	Indicative closure completion criteria will ensure that only weeds that are already found locally are present within rehabilitated areas.	Standard business practice	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	Weed control during rehabilitation is an established standard practice within the mining industry.
Degradation of vegetation through dust deposition	**Measures to Minimise**			
	• Dust suppression techniques such as sprayers on crushers and water trucks which will source water in accordance with the operational water supply strategy, outlined in Section 2.1.3.6. These are	Standard business practise	No	These measures have been developed to meet the current industry standards for managing dust suppression. The management strategy will minimise the amount of dust generated within the

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	expected to help minimise dust generated during construction and operation. • Limiting the amount of disturbed land to as small as reasonable, reducing the amount of dust producing surfaces. • The implementation of speed limits on unsealed roads and tracks to reduce dust creation.			Development Envelope as a result of the Proposal. These management strategies have been implemented across the Proponent's operations in the Pilbara and are regarded as being highly effective.
Degradation of vegetation through the potential increase in bushfire risk	**Measures to Avoid**			
	Clearing activities would not be undertaken when fire danger ratings are severe or high	Standard business practise	No	The measure is a standard industry practice and will prevent the ignition of fire due to clearing activities in unsafe conditions. Similar measures have been implemented in the Proponent's other operations in the region and are shown to be an effective control measure
	Measures to Minimise			
	• Implementation of fire management measures carefully managed and monitored hot works (implementation of hot works permit system), vehicle movement (not leaving cleared tracks) and disposal of potential fire-starting waste [e.g., cigarette butts]) is expected to minimise the risk of bushfires as a result of the Proposal. • Firefighting equipment will be located around the site and in vehicles. Fire response procedures and personnel training, including site inductions on fire prevention and management, will also be provided.	Standard business practise	No	These measures are standard industry practice and will minimise the ignition of fires and the level of impact with early intervention. Similar measures have been implemented in the Proponent's other operations in the region and are shown to be effective and as such provides a high level of certainty.

6.6. Assessment and Significance of Residual Impact

6.6.1. Assessment of Direct Residual Impacts

6.6.1.1. Clearing of Native Vegetation

The Proposal will result in the clearing of up to 4,900 ha of native vegetation within a 12,409.5 ha Development Envelope. The Development Envelope does not contain any vegetation of regional significance, including TECs or PECs.

Significance of Impact to Regional Vegetation Associations

The Proposal will reduce the pre-European extent of vegetation associations Hamersley 18 and Hamersley 82 by 1.4% and 0.2% respectively (Table 6-3). Both associations have more than 10% of their original extents in reserves and, even with implementation of the Proposal, both will have more than 97% of their original extent remaining. Accordingly, the Proposal will not have a significant impact on the representation of regional vegetation associations.

Significance of Impact to Local Vegetation Types

The assessment of direct impacts to high and moderate local significance native vegetation within the Development Envelope are described in Table 6-18 with the key impacts summarised as:

- None of the vegetation types present are of high regional significance as they do not represent or are associated with any recognised TECs or PECs.
- All the vegetation types within the Development Envelope are well represented in the local area surrounding the Development Envelope.
- None support flora species not found in any other vegetation type or are highly restricted in its distribution.
- When compared to the broader locality, biodiversity values within the riparian zone and associated vegetation/ecosystems, are:
    - Generally low in significance,
    - Well represented,
    - Ephemeral in nature, and
    - Highly unlikely to represent GDV/GDE.
- No high or moderate local significance vegetation type will be significantly impacted within the Hope Downs Hub, as outlined in Table 6-18.

Table 6-22: Assessment of Impacts to Significant Vegetation

Vegetation Type	Extent within Development Envelope (ha)	Clearing Extent (ha)	Priority Flora Recorded	Assessment of Impacts
High Local Significance Vegetation				
D4	48	12	*Aristida lazaridis* (P2)	The D4 vegetation type has been classed as being of high local significance as it occurs along the larger sized drainage systems in the development envelope and certain reaches of this unit supports abundant populations of *Aristida lazaridis* (P2). The Proposal will remove approximately 12 ha of this vegetation type, which represents 24% of its occurrence within the Development Envelope. Changes to the Proposal Design resulted in 47 ha are no longer within the Development Envelope. An additional 392 ha of this vegetation type has been recorded within the broader locality and outside of the Development Envelope, which brings the level of impact to approximately 3% of its local representation. Due to the D4 vegetation type being relatively widely distributed in the local area compared to the scale of the proposed clearing, and that *Aristida lazaridis* (P2) is not restricted to the vegetation type, **the Proposal is not expected to represent a significant impact to the D4 vegetation type.**
H2	297	18.6	*Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2) *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) *Eremophila naaykensii* (P3) Grevillea saxicola (P3) *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3) Lepidium catapycnon (P4) Ptilotus mollis (P4)	The H2 vegetation type is of high local significance due to its affinity with the 'Lower-Slope Mulga', which is an EAR in the Hamersley subregion due to frequent fires (Kendrick 2001 as cited in Astron 2019a) and that it hosts numerous Priority flora taxa, including *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2). The Proposal will remove up to 18.6 ha (6%) of this vegetation type, leaving approximately 278 ha remaining within the Development Envelope. 43.5 ha (15% of extent within the Development Envelope) of H2 vegetation type will be protected within MEZ1 and changes to the Proposal Design resulted in 34 ha no longer being within the Development Envelope. The vegetation within the MEZ is an area where a high proportion of *Eremophila* sp. West Angelas (S. van Leeuwen 4068) were recorded. An additional 143 ha of this vegetation type has been recorded outside of the Development Envelope, bringing the level of impact to approximately 4% of its local representation. Due to the H2 vegetation type having a relatively wide distribution compared to the scale of the proposed clearing (within and outside of the Development Envelope), that *Eremophila* sp. West Angelas (S. van Leeuwen 4068) will be protected within a MEZ, and all other Priority taxa occur within other vegetation types, **the Proposal is not expected to represent a significant impact to the H2 vegetation type**.

Vegetation Type	Extent within Development Envelope (ha)	Clearing Extent (ha)	Priority Flora Recorded	Assessment of Impacts
Moderate Local Significance Vegetation				
D7	191	54	*Aristida lazaridis* (P2)	The D7 vegetation type is of moderate local significance due to the presence of several *Aristida lazaridis* (P2) individuals. However, the occurrence of *Aristida lazaridis* is significantly less than those recorded within other vegetation types, such as D4, P2 and H8. The Proposal will result in the clearing of approximately 54 ha of this vegetation type, which represent 28% of its occurrence within the Development Envelope. An additional 1,102 ha of this vegetation type has been recorded outside of the Development Envelope, which brings the level of impact to approximately 4.2% of its local representation. Due to the D7 vegetation type being relatively wide distribution in the local area compared to the scale of the proposed clearing, and that the vegetation type does not represent the sole or even the most optimal habitat for *Aristida lazaridis* (P2), **the Proposal is not expected to represent a significant impact to the D4 vegetation type.**
D8	108.5	41	*Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)	The D8 vegetation type is of moderate significance due to its affinity with the regional 'Valley Floor Mulga' which is considered to be an EAR (Kendrick 2001 as cited by Astron 2019a), due to grazing from cattle and feral animals, weed invasion and changes to surface hydrological regimes. The vegetation type also supports a small population of *Rhagodia* sp. Hamersley (M. Trudgen 17794). The Proposal will result in the clearing of approximately 41 ha of this vegetation type, which represents approximately 37.8% of its occurrence within the Development Envelope. Changes to the Proposal Design resulted in 15 ha are no longer within the Development Envelope. An additional 53 ha of this vegetation type has been recorded outside of the Development Envelope, which brings the level of impact to approximately 25.4% of its local representation. Due to the D8 vegetation type having a wider distribution compared to the scale of the proposed clearing and that the EAR is a vegetation type present across the Hamersley subregion, **the Proposal is not expected to have a significant impact on the D8 vegetation type.**
P1	449	301	*Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)	The P1 vegetation type is of moderate local significance due to its affinity with the regional 'Grove/inter-grove Mulga, Eastern Hamersley Range', which is an EAR (Kendrick 2001 as cited by Astron 2019a) due to grazing from feral animals and interruption to sheet flows. The Proposal will result in the clearing of approximately 301 ha of this vegetation type, which represents approximately 67% of its occurrence within the Development Envelope. An additional 628 ha of this vegetation type has been recorded outside of the Development Envelope, which brings the level of impact to approximately 27.9% of its local representation. It is noted that the mapping outside of the Development Envelope has only been mapped to a low- moderate level of confidence; however, there is a sufficient margin to compensate for the lower level of mapping

Vegetation Type	Extent within Development Envelope (ha)	Clearing Extent (ha)	Priority Flora Recorded	Assessment of Impacts
				certainty. Furthermore, on the basis that the P1 site vegetation type has affinity with an EAR, it can be safely inferred that it is even more widespread than the local area (Astron 2019a). Due to the P1 vegetation types having a wider distribution compared to the scale of the proposed clearing, and that the EAR is a vegetation type present across the Hamersley subregion **the Proposal is not expected to have a significant impact on the P1 vegetation type.**
P2	215	19	Aristida lazaridis (P2) *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) (P3) *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)	The P2 vegetation type is of moderate significance due to its affinity with the regional 'Valley Floor Mulga' which is considered to be an EAR (Kendrick 2001 as cited by Astron 2019a), due to grazing from cattle and feral animals, weed invasion and changes to surface hydrological regimes. The vegetation type also supports one of the largest populations of *Aristida lazaridis* (P2) within the Development Envelope and is likely to be a locally restricted vegetation type. The Proposal will result in the clearing of approximately 19 ha of this vegetation type, which represents 9% of its occurrence within the Development Envelope. An additional 239 ha of this vegetation type has been recorded outside the Development Envelope, which brings the level of impact to approximately 4% of its local representation. It is noted that the mapping outside of the Development Envelope has only been mapped to a low- moderate level of confidence; however, there is a sufficient margin to compensate for the lower level of mapping certainty. Despite the P2 vegetation type potentially representing a locally restricted vegetation type, it still has a much wider distribution compared to the scale of the proposed clearing. As such **the Proposal is not expected to have a significant impact on the P2 vegetation type.**
P3	2,066	1,016	Aristida lazaridis (P2) *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) (P3) *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)	The P3 vegetation type is of moderate local significance due to its affinity with the regional 'Valley Floor Mulga' which is considered to be an EAR (Kendrick 2001 as cited by Astron 2019a), due to grazing from cattle and feral animals, weed invasion and changes to surface hydrological regimes. The vegetation type also supports a small population of *Aristida lazaridis* (P2). The Proposal will result in the clearing of approximately 1,016 ha of this vegetation type, which represents 49% of its extent within the Development Envelope. Changes to the Proposal Design resulted in 116 ha are no longer within the Development Envelope. An additional 3,454 ha of the vegetation type has been recorded outside the Development Envelope, which brings the level of impact to approximately 18.4% of its local representation. It is noted that the mapping outside of the Development Envelope has only been mapped to a low- moderate level of confidence; however, there is a sufficient margin to compensate for the lower level of mapping certainty. Furthermore, on the basis that the P3 site vegetation type has affinity with regional vegetation unit, it can be safely inferred that it is even more widespread (Astron 2019a). Due to the P3 vegetation type having a wider distribution compared to the scale of the proposed clearing, that the vegetation type present across the Hamersley subregion and is not the only or

Vegetation Type	Extent within Development Envelope (ha)	Clearing Extent (ha)	Priority Flora Recorded	Assessment of Impacts
				most optimal habitat for the *Aristida lazaridis* (P2), **the Proposal is not expected to have a significant impact on the P3 vegetation type.**
P4	60.3	35	-	The P4 vegetation type is of moderate significance due to its affinity with the regional 'Valley Floor Mulga' which is considered to be an EAR (Kendrick 2001 as cited by Astron 2019a), due to grazing from cattle and feral animals, weed invasion and changes to surface hydrological regimes. This vegetation type does not support any Priority flora taxa within the Development Envelope. The Proposal will result in the clearing of approximately 35 ha of this vegetation type, which represents 58% of its extent within the Development Envelope. Changes to the Proposal Design resulted in 6 ha are no longer within the Development Envelope. An additional 236 ha of this vegetation type occurs outside of the Development Envelope, which brings the level of impact to approximately 12% of its local representation. It is noted that the mapping outside of the Development Envelope has only been mapped to a low- moderate level of confidence; however, there is a sufficient margin to compensate for the lower level of mapping certainty. Furthermore, on the basis that the P3 site vegetation type has affinity with regional vegetation unit, it can be safely inferred that it is even more widespread (Astron 2019a). Due to the P4 vegetation type having a wider distribution compared to the scale of the proposed clearing and that the vegetation type present across the Hamersley subregion, **the Proposal is not expected to have a significant impact on the P4 vegetation type.**
H1	597	376.5	*Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2) *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) *Acacia subtiliformis* (P3) *Eremophila naaykensii* (P3) Grevillea saxicola (P3) *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3) *Acacia bromilowiana* (P4) *Ptilotus mollis* (P4)	The H1 vegetation type is of moderate local significance due to the presence of numerous Priority flora taxa, including *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2) and *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2). The Proposal will reduce the extent of the vegetation type within the Development Envelope by up to 376.5 ha (63%). Approximately 128 ha (21.5%) of the vegetation type will be protected within MEZ1 and MEZ2. An additional 1,031 ha of this vegetation type has been recorded outside of the Proposal's Development Envelope. In this context, the vegetation type will continue to persist outside of the Development Envelope and the local extent of the vegetation type will only be reduced by 23%. The H1 vegetation type does support a wide range of Priority flora taxa, however, all taxa present are also recorded within other vegetation types. Additionally, the vegetation type is not restricted or rare. Accordingly, when also considering the extent of its representation outside of the Development Envelope, **the Proposal is not expected to represent a significant impact to the H1 vegetation type**.

Vegetation Type	Extent within Development Envelope (ha)	Clearing Extent (ha)	Priority Flora Recorded	Assessment of Impacts
H6	145.6	25.2	*Eremophila naaykensii* (P3) *Grevillea saxicola* (P3) *Ptilotus mollis* (P4)	The H6 vegetation type is of moderate local significance due to its affinity with the 'Lower-Slope Mulga', which is an EAR in the Hamersley subregion due to frequent fires (Kendrick 2001 as cited in Astron 2019a) and that it hosts numerous Priority flora taxa. The Proposal will result in the clearing of approximately 25 ha of this vegetation type, which represents 17% of its extent within the Development Envelope. Given the Priority taxa present within the H6 vegetation type are also recorded within other vegetation types and that the EAR is a vegetation type present across the Hamersley subregion, **the Proposal is not expected to have a significant impact on the P4 vegetation type.**
H7	1,798	382	*Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) *Grevillea saxicola* (P3) *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3)	The H7 vegetation type is of moderate local significance due to the high number of *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) being recorded within the vegetation type. The Proposal will result in the clearing of approximately 382 ha of this vegetation type, which represents 21% of its extent within the Development Envelope. A small proportion of the remaining vegetation will be protected within MEZ1, approximately 3.2 ha (0.2%). An additional 2,371 ha of the vegetation type has been recorded outside the Development Envelope, which brings the level of impact to approximately 9% of its local representation. It is noted that the mapping outside of the Development Envelope has only been mapped to a low- moderate level of confidence; however, there is a sufficient margin to compensate for the lower level of mapping certainty. Due to the H7 vegetation type having a much wider distribution compared to the scale of the proposed clearing and that the *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) are known to occur elsewhere, **the Proposal is not expected to have a significant impact on the H7 vegetation type.**

Good to Excellent Condition Vegetation

The clearing of vegetation classified as being between Good and Excellent condition is considered a significant impact. This is despite all vegetation types within the Development Envelope also occurring in the surrounding area which will not be directly impacted by the Proposal. Most of the vegetation within the Development Envelope has been classified as being in Excellent condition. Due to the direct clearing of 4,205 ha of native vegetation in Good to Excellent condition, it is considered to be a significant impact of the Proposal and will be required to be offset. This is discussed in Chapter 12.

Riparian Vegetation

Approximately 54 ha of core riparian vegetation, two vegetation types (D4 and D5) and 95 ha of floodplain riparian vegetation types (D7 and D8) within the Development Envelope will be impacted by the Proposal (Table 6-18). In addition, across the broad and detailed vegetation units mapped across the riparian zone of the Development Envelope, biodiversity values are generally well represented locally and are generally common at the regional level. These values are also broadly ephemeral in nature and so generally hydrologically resilient, and not dependent on regional groundwater sources to any meaningful extent. Given the disturbance proposed will not have a significant impact on the riparian zone nor the riparian vegetation it supports, the Proposal is not expected to result in a significant direct impact on the riparian vegetation within the Development Envelope.

Figure 6-14 demonstrates the occurrence of *Astrida Lazaridis* (P2) in both vegetation community D4 and detailed mapping of the riparian vegetation units. The occurrence of *Aristida lazaridis* in the area is likely connected to fine basaltic origin sediments from the upstream Fortescue Group lithologies. The detailed mapping of the riparian vegetation units showed that *Aristida lazaridis* species was commonly recorded within units C4Bx-2, CF-X2, C4Bx-1/2. In addition, this species had a scattered to isolated distribution within the C3B unit and the CF-X1 floodplain unit. However, within unit C4B, and its corresponding floodplain unit (CF-X3) (both of which were mapped as the D4 unit in Astron 2020), this species was not detected, despite targeted searches for this species. Figure 6-14 shows that *Aristida lazaridis* was found to occur consistently in these five vegetation units.

No groundwater dependant ecosystems were recorded within the Development Envelope, which would potentially be reliant on the regional aquifer. Additionally, the Proposal comprises AWT mining only, so no impacts associated with pit dewatering are part of the Proposal. Therefore, impacts to groundwater dependant ecosystems are not considered significant.

6.6.1.2. Removal of Individuals of Priority Flora Species

The clearing of vegetation associated with the Proposal will result in the direct disturbance of ten species of conservation significance. Priority flora are not protected by statute (they are not formally recognised as threatened) and the Proposal is not expected to cause any of the species to be elevated to a Threatened status. Assessment of the direct impacts to significant flora within the Development Envelope is provided in Table 6-23 and Table 6-14 provides the impacts to Significant Flora Species within the conceptual footprint.

There are six Priority flora species that could be significantly impacted within the Development Envelope:

- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2)
- Acacia subtiliformis (P3)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3)
- *Lepidium catapycnon* (P4), and
- *Ptilotus mollis* (P4).

These species will have greater than 60% of the individuals mapped within the Development Envelope directly disturbed by the Proposal. Despite this high level, the total known regional population of the species will not be significantly impacted by the Proposal (Table 6-23).

Table 6-23 shows that only one of the Priority species will have its overall population reduced by greater than 10%. This species, *Lepidium catapycnon* (Priority 4), will have the overall known population reduced by approximately 22%, leaving the majority of the population undisturbed by the Proposal and thus not considered to be a significant impact. *Lepidium catapycnon*'s preferred habitat includes shale like soils on hill slopes, this habitat is relatively common in the Development Envelope and the surrounding area and is a disturbance opportunist, being quick to recolonise areas impacted by minor disturbance such as tracks, ripping and fire. The species was delisted by DCCEEW in 2017.

Astron (2019a) notes that there remains the possibility of conservation significant flora taxa that are considered annuals and/or short lived perennials occurring within the survey area. Table 6-24 provides an assessment of the potential impacts of the Proposal on these seven taxa.

Additionally, the following taxa were identified as “possibly occurring” in Astron (2019), however subsequent work has identified the following:

- *Eremophila clarkei* is widespread and highly variable species. The *Eremophila aff. clarkei* locations at HD2 have more recently been resampled in 2022 as part of other works and the collections were subsequently confirmed as *Eremophila clarkei.*
- *Goodenia* sp. East Pilbara belongs to the *Goodenia pascua* complex, with specimens from these to taxa having historically been confused.
- The locations of the *Goodenia* sp. Interest., is located on a cracking clay substrate which is typically the habitat for *Goodenia pascua,* whilst *Goodenia* sp. East Pilbara (P3) is typically restricted to calcrete based habitats.
- The *Eremophila magnifica* subsp. *magnifica* locations recorded by Astron (2019) were not located with the Development Envelope and are located over 600m away from the boundary of the DE, as such they are not discussed further.

Table 6-23: Assessment of Impacts on Significant Flora Species

Species Name	Number of Individuals to be impacted in the Conceptual Footprint	Number of Individuals recorded in the Development Envelope	Percentage of Individuals to be impacted in the Conceptual Footprint	Individuals recorded within the Development Envelope as a Percentages of the Western Australian recorded population	Assessment of Impacts *
Priority 2					
Aristida lazaridis	395	2,304	17	22	The record population within the Development Envelope represents approximately 21.6% of the recorded population in the State. The Proponent has made changes to the Proposal design that avoid impacts to 2,639 individuals, approximately 50% of the recorded population is now outside the Development Envelope. The removal of approximately 395 of recorded individuals will result in the loss of 17% of the known population within the Development Envelope but only 3.7% of known records. The removal of these individuals is not expected to have a significant impact on the known local and regional populations.
Eremophila sp. West Angelas	0	656	0	69	Proponent has made changes to the Proposal design that avoid impacts to 121 individuals, approximately 16% of the population is now outside the Development Envelope. None of the recorded population of *Eremophila* sp. West Angelas are expected to be impacted by the Proposal: 85% of the recorded population within the Development Envelope is with MEZ, mostly in MEZ1 and the remainder are located outside the Conceptual Footprint. The Proposal is not expected to result in a residual impact on the known local and regional populations.
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	301	473	64	9	The removal of 301 individuals will result in the loss of 64% of the known population within the Development Envelope. The Proponent has established MEZ, which includes 37 individual records. Approximately, 91% of the recorded population of the *Hibiscus* sp. Gurinbiddy Range occurs outside of the Development Envelope, therefore, at a regional level the Proposal will result in only a 9% reduction in the known population. The removal of these individuals as a result of the Proposal may impact on the local population but is not expected to have a significant impact on the regional population as this species occurs widely within the surrounding area including a population within the Karijini National Park.

Species Name	Number of Individuals to be impacted in the Conceptual Footprint	Number of Individuals recorded in the Development Envelope	Percentage of Individuals to be impacted in the Conceptual Footprint	Individuals recorded within the Development Envelope as a Percentages of the Western Australian recorded population	Assessment of Impacts *
Priority 3					
Acacia subtiliformis	1	1	100	0.001	Approximately 99.99% of the recorded population of *Acacia subtiliformis* occurs outside of the Development Envelope, with a total of 179,099 known individuals recorded across the state. Although the Proposal will result in the loss of the only recorded individual in the Development Envelope, this will account for only a 0.001% impact to the known regional population. The removal of this individual as a result of the Proposal may impact on the local population within the Development Envelope, however, is not expected to have a significant impact on the known regional populations as the species occurs widely within the surrounding area.
Eremophila naaykensii	182	1,860	10	14	The removal of 182 individuals will result in the loss of 10% of the known population within the Development Envelope but only 1.3% of the known population across the state. 1,022 individuals, representing 55% of the recorded population within the Development Envelope, is within MEZ, mostly in MEZ1. The removal of these individuals is not expected to have a significant impact on the known local or regional populations.
Grevillea saxicola	143	140	8	37.7	The removal of 143 individuals will result in a loss of 8% of the known population within the Development Envelope but only 3% of the overall population across the state. 555 individuals, representing 30% of the recorded population within the Development Envelope, is within MEZs. The removal of these individuals is not expected to have a significant impact on the known local or regional populations.
Rhagodia sp. Hamersley (M. Trudgen 17794)	56	93	60	0.1	The removal of 56 individuals will result in a loss of 60% of the known population within the Development Envelope, but at a regional level will only result in a 0.1% reduction in the known population.

Species Name	Number of Individuals to be impacted in the Conceptual Footprint	Number of Individuals recorded in the Development Envelope	Percentage of Individuals to be impacted in the Conceptual Footprint	Individuals recorded within the Development Envelope as a Percentages of the Western Australian recorded population	Assessment of Impacts *
					The removal of these individuals as a result of the Proposal may impact on the local population but is not expected to have a significant impact on the regional population as this species occurs widely within the surrounding area.
Triodia sp. Mt Ella (M.E. Trudgen 12739)	3,877	4,447	87.2	3.1	Approximately, 97% of the recorded population of the *Triodia sp.* Mt Ella occurs outside of the Development Envelope. The removal of 3,877 individuals will result in a loss of 87% of the known population within the Development Envelope , but at a regional level will only have a 2.7% reduction on the population. The removal of these individuals is not expected to have a significant residual on the regional population due to high numbers of the species occurring elsewhere in the region. However, the removal of 87.2% of the local population may represent a significant residual impact on the local population.
Priority 4					
Acacia bromilowiana	202	377	53.6	10.4	Approximately 89.6% of the recorded population of *A. bromilowiana* occurs outside of the Development Envelope. The removal of 202 individuals will result in a loss of 53.6% of the known population within the Development Envelope but only 5.6% of the overall known regional population. 151 individuals, representing 40% of the recorded population within the Development Envelope, is within MEZs. The removal of these individuals is not expected to have a significant impact on the local or regional populations.
Lepidium catapycnon	8,494	8,997	94.4	23.6	Proponent has made changes to the Proposal that avoid impacts to approximately 21% of the recorded population in the Development Envelope. Approximately 76.4% of the recorded population of *L. catapycnon* occurs outside of the Development, with a total of 29,159 individuals recorded outside the Development Envelope. The removal of 8,494 individuals will result in a loss of 94.4% of the known population within the Development Envelope which equates to 22.3% of the overall known regional population. The removal of these individuals may impact the local population but is not expected to have a significant impact on the regional populations, given the

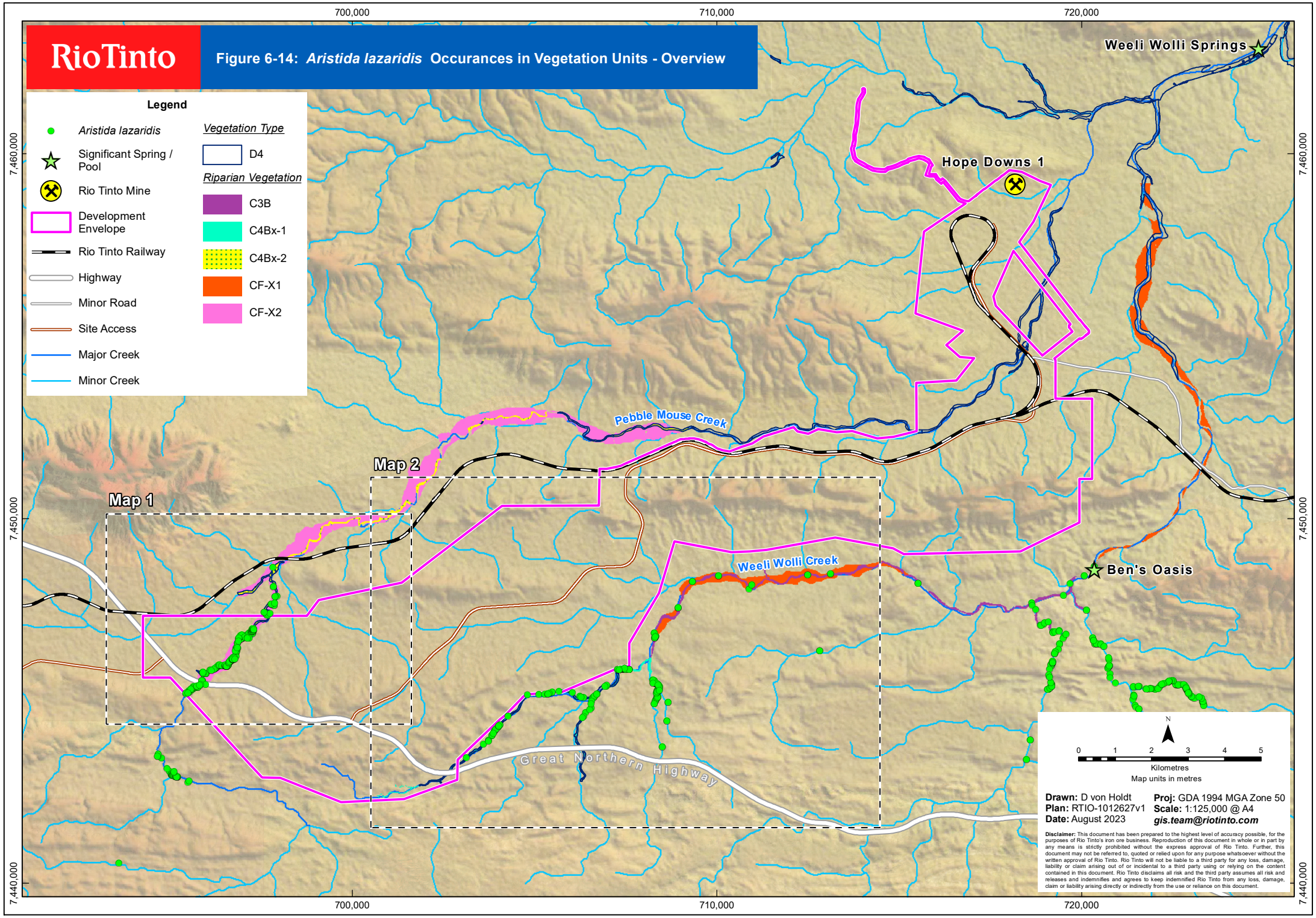
Species Name	Number of Individuals to be impacted in the Conceptual Footprint	Number of Individuals recorded in the Development Envelope	Percentage of Individuals to be impacted in the Conceptual Footprint	Individuals recorded within the Development Envelope as a Percentages of the Western Australian recorded population	Assessment of Impacts *
					species' preferred habitat is relatively common in the Development Envelope and the surrounding area and is quick to recolonise areas impacted by minor disturbance such as tracks, ripping and fire. The species was delisted by DCCEEW in 2017
Ptilotus mollis	284	432	66	7	Approximately 90% of the recorded population of *P. mollis* occurs outside of the Development Envelope. The removal of 284 individuals will result in a loss of 66% of the known population within the Development Envelope but only a 4% of the overall known regional population. The removal of these individuals may impact the local population but is not expected to have a significant impact on the regional populations.

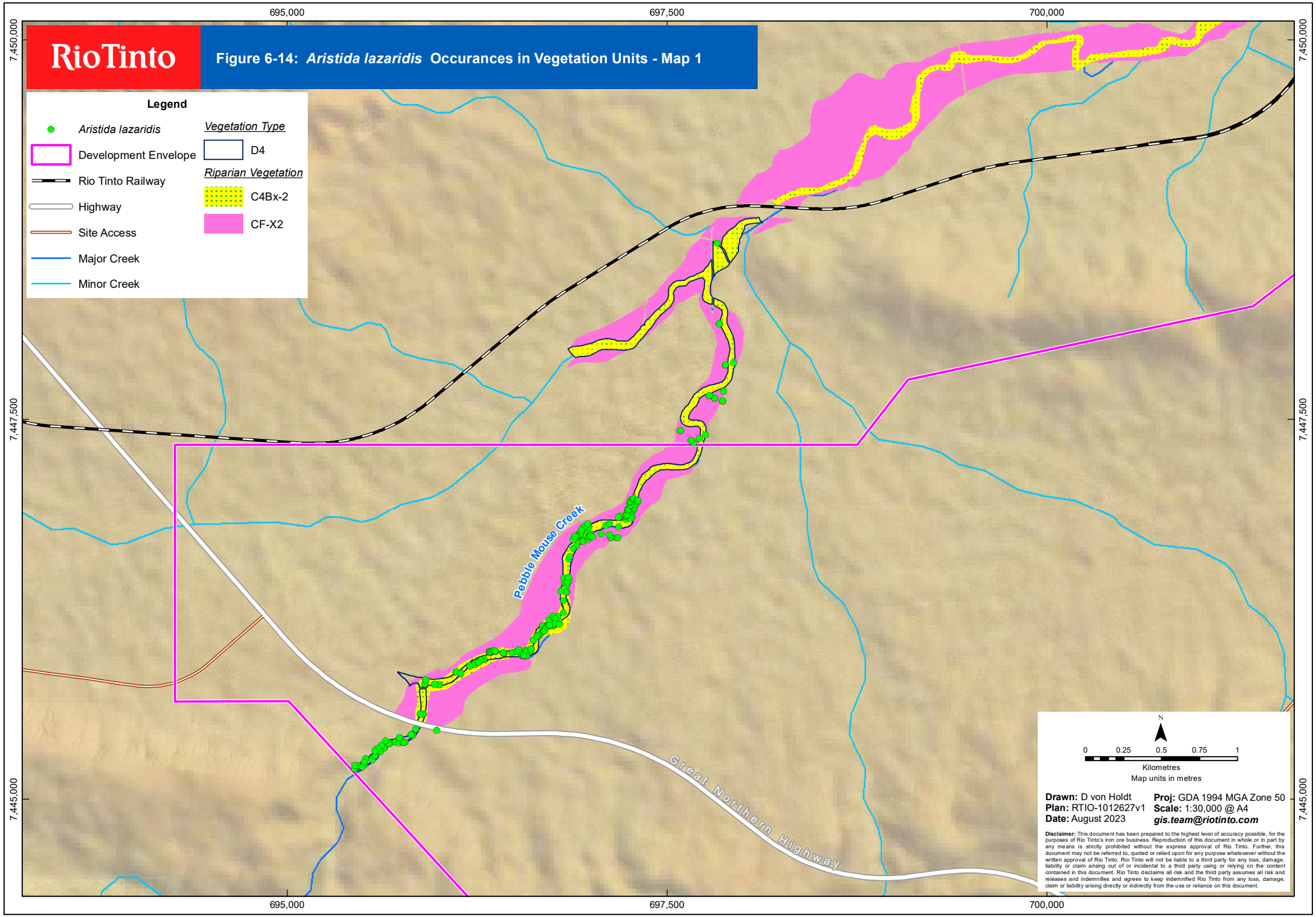
* Local Population size data was obtained from 11 surveys within the local HD2 area and was compiled by Astron (2019a)

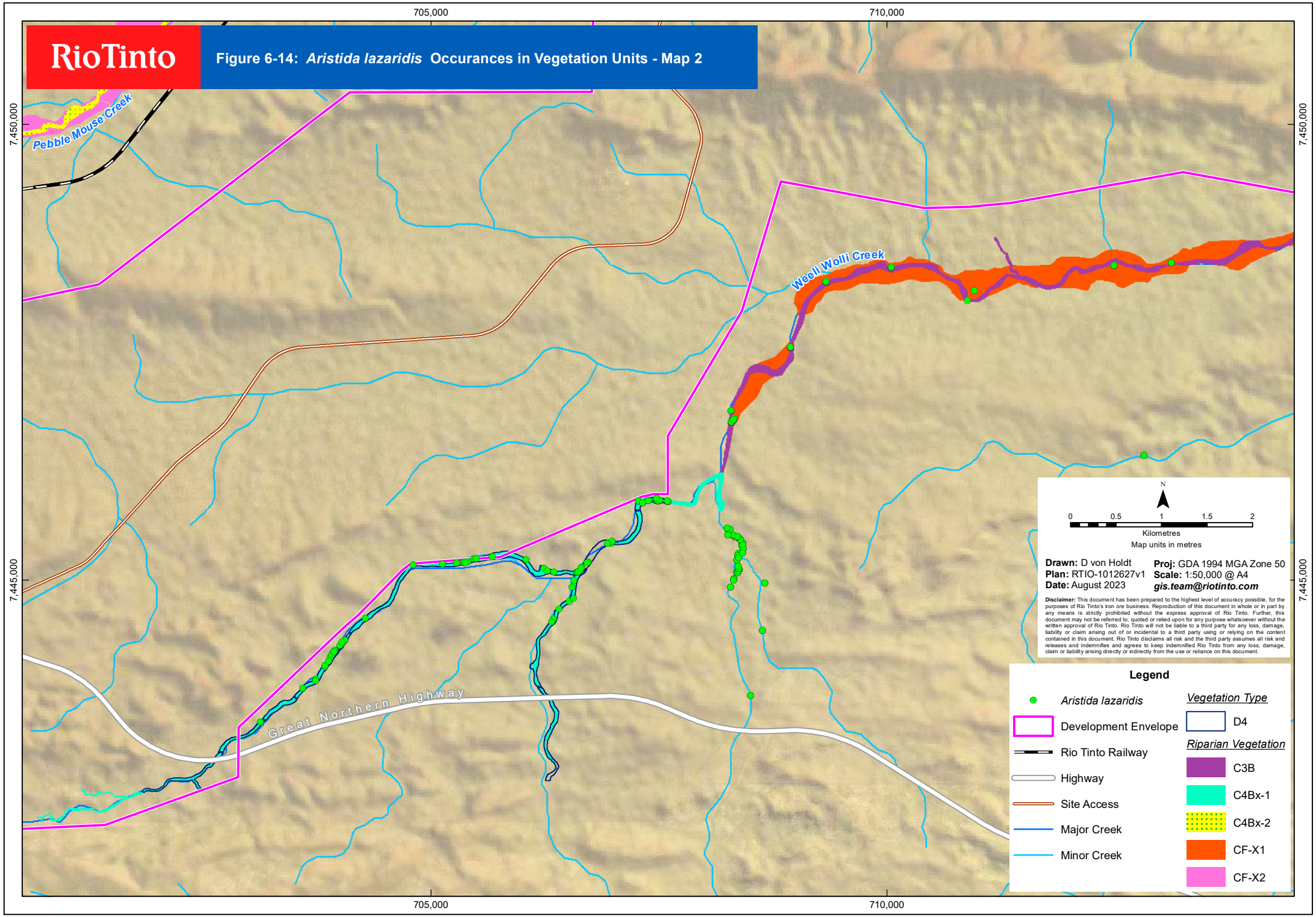
Table 6-24: Assessment of Impacts on Priority Annual or Short Lived Perennial Flora Species

Species Name	Vegetation unit	Mapped Extent (Astron 2020a)	Extent within Development Envelope	Extent within conceptual footprint	Assessment of Impacts
Ipomoea racemigera P2	D4	440	48	12	*Ipomoea racemigera* has a large distribution within the Pilbara, extending approximately 350km from Millstream Chichester National Park to just east of Newman. The Astron (2020a) survey identified vegetation units D4 and D5 as areas of suitable habitat for this taxon. Sections of these areas have previously been traversed by numerous other flora surveys such as Mattiske 1995, Ecologia 1997, Biota 2006, Biota 2014 and Mattiske 2013-2015 which have not located this taxon. Most of the identified preferred habitat is outside the clearing footprint. If this taxon was to occur in the DE footprint it is unlikely the proposal will have a significant impact, locally or regionally.
	D5	165	76	42	
	Total	**605**	**124**	**54**	
Isotropis parviflora P3	H3	917	641	520	*Isotropis parviflora* has a large distribution within the Pilbara, extending approximately 200 km from near Karijini National Park to just east of Newman. At the time of submission of the draft ERD in December 2022 this taxon was listed as Priority 2, it has subsequently been downlisted to P3 status. The Astron (2020a) survey identified vegetation units H3, H8 and H11 and possibly H4, H7 and H10 as areas of suitable habitat for this taxon. Most of the preferred habitat for this taxon will not be impacted by the proposal. If this taxon was to occur, it is unlikely the proposal will have a significant impact locally or regionally.
	H8	3,749	1,186	314	
	H11	1,681	414	42	
	H4	1,221	623	319	
	H7	4,169	1,798	382	
	H10	1,681	668	153	
	Total	**1,3418**	**5,330**	**1,730**	
Oxalis sp. Pilbara (M.E. Trudgen 12725) P2	D3	420	49	29	*Oxalis* sp. Pilbara (M.E. Trudgen 12725) has a large distribution within the Pilbara, extending approximately 200 km from near Brockman area to the Rhodes Ridge area west of Newman. The Astron (2020a) survey identified vegetation units D3, H1 and H2 as areas of suitable habitat for this taxon. Most of the preferred habitat within the DE footprint will not be impacted by the proposal. Additional large amounts of suitable habitat have also been identified outside the DE footprint. If this taxon was to occur it is unlikely the proposal would have a significant impact, locally or regionally.
	H1	1,628	597	376	
	H2	439	297	19	
	Total	**2,487**	**943**	**424**	

Species Name	Vegetation unit	Mapped Extent (Astron 2020a)	Extent within Development Envelope	Extent within conceptual footprint	Assessment of Impacts
Amaranthus centralis P3	D4	48	48	12	*Amaranthus centralis* has a large but scattered distribution within the Pilbara, extending approximately 200 km from Karijini National Park to just east of Roy Hill Station. The Astron (2020a) survey identified vegetation units D4 and D5 as areas of suitable habitat for this taxon. Sections of these areas have previously been traversed by numerous other flora surveys such as Mattiske 1995, Ecologia 1997, Biota 2006, Biota 2014 and Mattiske 2013-2015 which have not recorded this taxon. Most of the preferred habitat is outside the clearing footprint, as such the proposal would not have a significant impact, locally or regionally.
	D5	76	76	42	
	Total	**124**	**124**	**54**	
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479) P3	P2	453	215	19	*Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) has a large distribution within the Pilbara, extending approximately 400 km from the Karratha area to the West Angelas area. The Astron (2020a) survey identified vegetation unit P2 as an area of suitable habitat for this taxon. Most of the preferred habitat within the DE footprint will not be impacted by the proposal. Additional large amounts of suitable habitat have also been identified outside the DE footprint If this taxon was to occur it is unlikely the proposal would have a significant impact.
Swainsona thompsoniana P3	P2	453	215	19	*Swainsona thompsoniana* has a large distribution within the Pilbara, extending approximately 350 km from Millstream Chichester National Park area to the Newman area. The Astron (2020a) survey identified vegetation unit P2 as an area of suitable habitat for this taxon. Most of the preferred habitat within the DE footprint will not be impacted by the proposal. Additional large amounts of suitable habitat have also been identified outside the DE footprint If this taxon was to occur it is unlikely the proposal would have a significant impact.
Goodenia nuda – no longer listed					


RioTinto
Figure 6-14: Aristida lazaridis Occurances in Vegetation Units - Overview
Legend
Aristida lazaridis
Significant Spring / Pool
Rio Tinto Mine
Development Envelope
Rio Tinto Railway
Highway
Minor Road
Site Access
Major Creek
Minor Creek
Vegetation Type
D4
Riparian Vegetation
C3B
C4Bx-1
C4Bx-2
CF-X1
CF-X2
Weeli Wolli Springs
Hope Downs 1
Pebble Mouse Creek
Map 2
Map 1
Weeli Wolli Creek
Ben's Oasis
Great Northern Highway
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-1012627v1
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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RioTinto
Figure 6-14: Aristida lazaridis Occurances in Vegetation Units - Map 1
Legend
Aristida lazaridis
Development Envelope
Rio Tinto Railway
Highway
Site Access
Major Creek
Minor Creek
Vegetation Type
D4
Riparian Vegetation
C4Bx-2
CF-X2
695,000
697,500
700,000
7,450,000
7,447,500
7,445,000
Pebble Mouse Creek
Great Northern Highway
N
0
0.25
0.5
0.75
1
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-1012627v1
Date: August 2023
Proj: GDA 1994 MGA Zone 50
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RioTinto
Figure 6-14: *Aristida lazaridis* Occurances in Vegetation Units - Map 2
705,000
710,000
7,450,000
7,445,000
Pebble Mouse Creek
Weeli Wolli Creek
Great Northern Highway
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-1012627v1
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:50,000 @ A4
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Legend
Aristida lazaridis
Development Envelope
Rio Tinto Railway
Highway
Site Access
Major Creek
Minor Creek
Vegetation Type
D4
Riparian Vegetation
C3B
C4Bx-1
C4Bx-2
CF-X1
CF-X2

6.6.2. Assessment of Indirect Residual Impacts

Potential indirect impacts of the Proposal to flora and vegetation have been identified as:

- Introduction/spread of weeds.
- Degradation/Alteration of vegetation as a result of altered hydrological regimes

6.6.2.1. Degradation of Vegetation Condition due to Increased Abundance and Diversity of Weeds

The Development Envelope has a moderate weed diversity, however, none of the species recorded are Weeds of National Significance or Declared Pest (Astron 2019a). The weed species within the Development Envelope were generally associated with the Minor drainage, Mulga plains and Hillslopes.

The clearing of these areas has the inherent risk of spreading these weeds to other areas within the Development Envelope. The Proponent has developed weed hygiene procedures and weed management strategies at their other operation sites throughout the Pilbara region to minimise the risk of weed species introduction and spread. These measures will be introduced at the Proposal site to minimise the introduction and spread of weed species. Measures will include but are not limited to periodic spraying of weed populations and the maintenance of equipment hygiene.

On this basis the introduction and spread of weed species are **unlikely to have a significant residual impact** on the vegetation present within the Proposal. Any potential impacts are predicted to be localised to the area of disturbance and will not impact the vegetation in the wider area or regionally.

6.6.2.2. Degradation of Vegetation from Dust Deposition and Altered Bushfire Regime

The Proponent has well-established strategies for managing dust emissions at its Pilbara operations. These strategies will continue to be implemented during the construction and operation of the Proposal and will be improved upon when necessary.

A study conducted by Matsuki et al. (2016) examined the impacts of dust on plant health in semi-arid environments similar to the Pilbara. The study found no evidence of negative impacts on plant health as a result of dust deposition when deposition rates were less than 77 g/m^2/month. While the Proposal may result in an increase in localised dust deposition on vegetation near to areas of disturbance, it is likely to be temporary and will be maintained below 77 g/m^2/month by the implementation of the dust deposition mitigation measures outlined in Table 6-17. The Proponent will undertake dust monitoring to assess the performance of the dust deposition mitigation measures and will make refinements as required

With vegetation clearing being restricted to periods when the fire danger rating less than severe, and the careful management of hot works, vehicle movement and the proper disposal of fire-starting waste, the Proposal is not expected to alter the fire regimes within the area.

The potential impacts from dust and alter fire regime on native vegetation are **unlikely to be significant**.

6.6.3. Assessment of Cumulative Residual Impacts

6.6.3.1. Cumulative Impacts on Vegetation

The Proposal will necessitate the clearing of 4,900 ha of vegetation, the majority of which is considered to be in Good to Excellent condition. Vegetation within the Development Envelope comprises two vegetation associations; Hamersley 18 and Hamersley 82 (Table 6-3).

As determined in Section 6.4.3.1, implementation of the Proposal will not result in significant cumulative impacts to regional vegetation associations, with approximately 93% of pre-European extent for

vegetation association Hamersley 82 remaining within the subregion and approximately 85% of vegetation association Hamersley 18 remaining.

6.6.3.2. Cumulative Impacts on Significant Flora Species

As a result of the implementation of the Proposal, the cumulative impacts to most of the Priority flora species, as the proportion of individuals impacted as a result of implementation of the Proposal, is less than 6% of the total known population (Table 6-17). The only exception is the Priority 4 species: *Lepidium catapycnon* (22%) of the known population could be impacted by the Proposal, leaving the majority of the population undisturbed by the Proposal and thus not considered to be a significant impact. *Lepidium catapycnon*'s preferred habitat includes shale like soils on hill slopes, this habitat is relatively common in the Development Envelope and the surrounding area and is a disturbance opportunist, being quick to recolonise areas impacted by minor disturbance such as tracks, ripping and fire. The species was delisted by DCCEEW in 2017.

Cumulative impacts of significant flora species within the Development Envelope that occur across multiple nearby projects are not likely to alter the conservation status for any of the Priority flora species within the Development Envelope.

Therefore, cumulative impacts to Priority Flora are not expected to be significant.

6.6.4. Assessment of Significance of Residual Impacts

6.6.4.1. Non-significant residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Flora and Vegetation values:

- Direct impact to vegetation units of high local significance, of up to 31 ha, consisting of:
    - 12 ha of the vegetation type D4, which represents 24% of its occurrence within the Development Envelope. Changes to the Proposal Design resulted in 47 ha are no longer within the Development Envelope. The residual impact to the D4 vegetation type is not considered to be significant given the D4 vegetation type is relatively widely distributed in the local area compared to the scale of the proposed clearing, and that *Aristida lazaridis* (P2) is not restricted to the vegetation type.
    - 19 ha of the vegetation type H2, which represents 6% of its occurrence within the Development Envelope, leaving approximately 278 ha remaining within the Development Envelope. 43.5 ha (15% of extent within the Development Envelope) of H2 vegetation type will be protected within MEZ1 and changes to the Proposal Design resulted in 34 ha no longer being within the Development Envelope. The residual impact to the H2 vegetation type is not considered significant as the H2 vegetation type has a relatively wide distribution compared to the scale of the proposed clearing (within and outside of the Development Envelope), and that a high number of *Eremophila* sp. West Angelas (S. van Leeuwen 4068) will be protected within a MEZ, and all other Priority taxa occur within other vegetation types.
- Direct disturbance of up to 12 ha of riparian vegetation, represented by vegetation type D4, is not considered a significant residual impact on the riparian zone nor the riparian vegetation it supports.
- Direct impact to Priority 2 flora species consisting of:
    - No direct disturbance of *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2) individuals recorded within the Development Envelope. With 558 recorded individuals, representing 85% of recorded population within the Development Envelope, are located

within MEZ. As such, there is not significant residual impact to the P2 species *Eremophila* sp. West Angelas.

- Direct disturbance of up to 301 *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) individuals (64%) recorded within the Development Envelope. The removal of these individuals as a result of the Proposal may impact on the local population but is not expected to have a significant residual impact on the regional population as this species occurs widely within the surrounding area.
- Direct disturbance of up to 395 *Aristida lazaridis* (P2) individuals recorded within the Conceptual Footprint, representing 17% of the 2,304 individuals recorded within the Development Envelope. Changes to the Proposal Design resulted in avoidance of 2,639 individual recorded locations no longer being within the Development Envelope. The removal of these individuals as a result of the Proposal may impact on the local population but is not expected to have a significant residual impact on the local or regional population as this species occurs widely within the surrounding area.

- Cumulative impacts: implementation of the Proposal will not result in significant residual cumulative impacts to regional vegetation associations, given approximately 93% of pre-European extent for vegetation association Hamersley 82 is remaining within the subregion and approximately 85% of vegetation association Hamersley 18 is remaining.

6.6.4.2. Significant Residual Impacts

The assessment of residual impacts, after application of mitigation measures, concluded following residual impacts are considered to be significant to Flora and Vegetation values:

- Clearing of up to 4,205 ha of native vegetation in 'Good' to 'Excellent' condition. In line with the EPA's section 16e advice on the cumulative environmental impacts of development in the Pilbara region (EPA 2014), any of native vegetation in 'Good' to 'Excellent' condition is considered significant. This clearing is proposed to be offset as per Chapter 12.

6.7. Environmental Outcomes

6.7.1. Summary of Significant Residual Impacts and Proposed Conditions

A summary of the significant residual impacts to Flora and Vegetation assessment and the proposed conditions is provided in Table 6-25.

Table 6-25: Summary of assessment for Flora and Vegetation

Significant Residual Impact to Environmental Value	Assessment Finding	Recommended conditions
Clearing of up to 4,205 ha of native vegetation in 'Good' to 'Excellent' condition	• Clearing vegetation in 'Good' to 'Excellent' condition is considered a significant residual impact. • The environmental outcome is likely to be consistent with the EPA's objective for this factor with the implementation of Proposal extent condition (recommended condition 1) and counterbalanced by the provision of offsets as outlined in Chapter 12.	Regulated through recommended conditions: • Condition 1 – Proposal extents limited to the Development Envelope (12,409.5 ha) and clearing extent of up to 4,900 ha

Significant Residual Impact to Environmental Value	Assessment Finding	Recommended conditions
		• Condition 2 – Offset Pilbara Environmental Offsets Fund: Payment of $890 AUD (excluding GST) per hectare of 'Good' to 'Excellent' vegetation, cleared as a result of the Proposal within the Hamersley IBRA subregion

6.7.2. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit; and
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

In consideration of the proposed avoidance and management measures and likely significant residual impacts associated with the Proposal, the anticipated environmental outcome that applies to Flora and Vegetation is:

- The clearing of no more than 4,900 ha of native vegetation, of which approximately 4,205 ha is in Good to Excellent condition
- No direct disturbance of P2 flora recorded within the Mining Exclusion Zones. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities.
- There will be no impacts on threatened ecological communities (TECs) or priority ecological communities (PECs) located outside the Development Envelope.

Environmental offsets are proposed for this clearing of native vegetation and are discussed in Chapter 12. Subject to conditions recommended in Table 6-25 and implementation of offsets (Chapter 12), the Proponent considers the Proposal can be managed to meet the EPA's objective to protect Flora and Vegetation so that biological diversity and ecological integrity are maintained.

7. TERRESTRIAL FAUNA

7.1. EPA Environmental Factor and Objective

The EPA's objective for terrestrial fauna is to protect terrestrial fauna so that biological diversity and ecological integrity are maintained (EPA 2021c).

For this EIA, Terrestrial Fauna are animals living on land or using land for all or part of their lives. Terrestrial Fauna include vertebrates (birds, mammals including bats, reptiles and amphibians) and invertebrates (arachnids, crustaceans, insects, molluscs and worms) (EPA 2016c). Fauna habitat is defined as the natural environment of an animal or assemblage of animals, including biotic and abiotic elements, that provides a suitable place for them to live (e.g., breed, forage, roost, or seek refuge) (EPA 2016c).

All conservation significant terrestrial fauna and habitats relevant to the Proposal are discussed in this chapter. Additional information specific to MNES fauna is provided in the MNES Chapter (Chapter 13).

7.2. Relevant Policy and Guidance

Table 7-1 presents relevant policy and guidance for terrestrial fauna and explains how they have been considered for the Proposal.

Table 7-1: Relevant Policy and Guidance for Terrestrial Fauna

Relevant Policy or Guidance	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for terrestrial fauna forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c)	This assessment has considered the objective for the Terrestrial Fauna factor.
Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a)	Considered in the design (methods and approach) of fauna surveys (previous guidelines were used where surveys were undertaken before current guidelines).
Technical Guidance: Sampling of Short-Range Endemic Invertebrate Fauna (EPA 2016d)	
Instructions on how to prepare an Environmental Review Document (EPA 2021e)	This document forms the basis of the headings and content provided in this ERD.
Instructions on how to prepare *Environmental Protection Act* 1986 Part IV Environmental Management Plans (EPA 2021h)	Considered during the development of this document and the EMP.
Template for *Environmental Protection Act 1986* Part IV Reconciliation Procedures (EPA 2021k)	Considered during the development of this document and the IRP.
Other State or Commonwealth	
Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DoE 2013)	Considered in the development of this document

Relevant Policy or Guidance	Explain How the Policy and Guidance has been Considered
Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	The MCP has been prepared in accordance with the guidance and addresses matters related to terrestrial fauna (Appendix A4).
Statutory Guidelines for Mine Closure Plans (DMIRS 2020b)	
WA Environmental Offsets Policy (GoWA 2011)	Considered in the determination of significant residual impacts and offset strategy for terrestrial fauna.
WA Environmental Offsets Guidelines (GoWA 2014)	
Commonwealth of Australia Guidelines for Biological Survey and Mapped Data (DotEE 2018)	Considered in the design (methods and approach) of fauna surveys.
EPBC Act Environmental Offsets Policy (DSEWPaC 2012a)	Considered in the impact assessment and offset strategy for terrestrial fauna.
EPBC Act referral guideline for the endangered Northern Quoll (*Dasyurus hallucatus*) (DoE 2016a)	Considered in the design (methods and approach) of the fauna surveys.
Interim guideline for the preliminary surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017)	
Survey guidelines for Australia's threatened bats (DEWHA 2010a)	
Survey guidelines for Australia's threatened birds (DEWHA 2010b)	
Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a)	
Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b)	

7.3. Receiving Environment

7.3.1. Studies and Survey Effort

Table 7-2 summarises the Proposal specific and other relevant regional surveys and studies undertaken for Terrestrial Fauna. The Proposal-specific study/survey reports are provided in Appendix C1 to C9.

Figure 7-2 shows the spatial extent of these two surveys. The Proponent has also undertaken a long-term baseline monitoring program for Northern Quoll utilisation of the HD2 and BHT deposits using a network of motion cameras (Astron 2023a, 2023b, 2023c, 2023d), as well as further assessments of potential Ghost Bat caves (Astron 2020c) and Grey Falcon presence/habitat utilisation (Astron 2023f).

The Proponent also commissioned Astron (2020d) to undertake a review of all historical fauna and habitat surveys conducted across the Hope Downs Hub (including Rio Tinto studies listed in Table 7-2, shown on Figure 7-1a) and reconcile the survey outcomes with those of the more recent assessments in order to create a consolidated map of the fauna habitats across the Hope Downs Hub to provide additional context on the local distribution of different habitat types. The results of this review are outlined in Section 7.3.2.2.

Table 7-2: Summary of Technical Studies for Terrestrial Fauna Environmental Factor

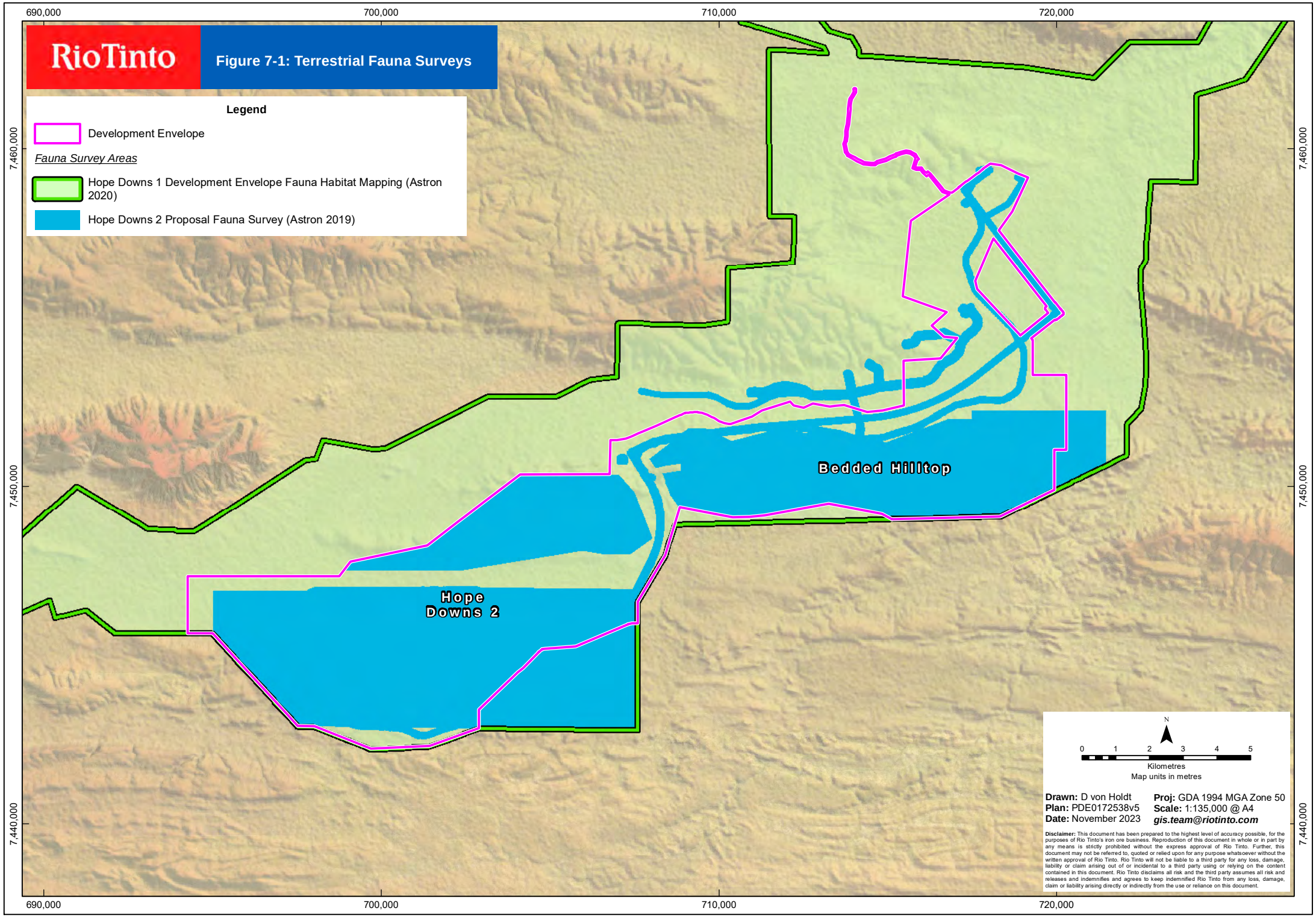
Studies/Survey	Study Area, Type and Timing	Consistency with Guidance
Key Studies/Surveys		
Hope Downs 2 Proposal Fauna Survey (Astron 2019b) **Appendix C1**	**Survey Area:** Hope Downs 2 Proposal Survey Area **Type:** Detailed Fauna and SRE survey **Timing:** Phase 1 – 21st November to 2nd December 2017. Phase 2 – 18th to 27th May 2018. Phase 3 – 8th March to 18 March 2019	The survey predates the current technical guidance (EPA 2020a), however it was conducted in accordance with: • Position Statement No. 3 (EPA 2002) • Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016e) • Technical Guidance – Sampling of Short-Range Endemic Invertebrate Fauna (EPA 2016d) • Technical Guidance - Terrestrial Fauna Surveys (EPA 2016c) • Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) referral guideline for the Endangered Northern Quoll *Dasyurus hallucatus* (DoE 2016a) • Survey Guidelines for Australia's Threatened Reptiles, Birds, Mammals and Bats (DSEWPaC 2011b; DEWHA 2010b; DSEWPaC 2011a; DEWHA 2010a) • Interim Guidelines for Preliminary Surveys of the Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017) Due to changes in Proposal design, the survey area (10,818 ha) does not cover the entire 12,409.5 ha Development Envelope. Fauna habitat mapping for unsurveyed areas has been extrapolated using detailed aerial photography and ground-truthed (Astron 2020d).
Hope Downs Development Envelope – Fauna Habitat Mapping (Astron 2020d) **Appendix C2**	**Survey Area:** Hope Downs 1 Development Envelope including Hope Downs 2 Proposal Area **Type:** Desktop assessment and ground-truthing to reconcile all previous mapping within the HD1 Development Envelope with the outcomes of the HD2 fauna habitat surveys **Timing:** January 2020	The consolidated mapping study used Astron (2019b) as its basis for rationalising historical (see list of supporting surveys at end of table) and interpolated classification and mapping of habitats and was prepared largely to provide contextual information regarding the size and distribution of fauna habitats across the greater project area. There is no specific guidance for fauna habitat reconciliation; but historical surveys used in the reconciliation were from published EIAs so should have satisfied survey standards in place at the time.

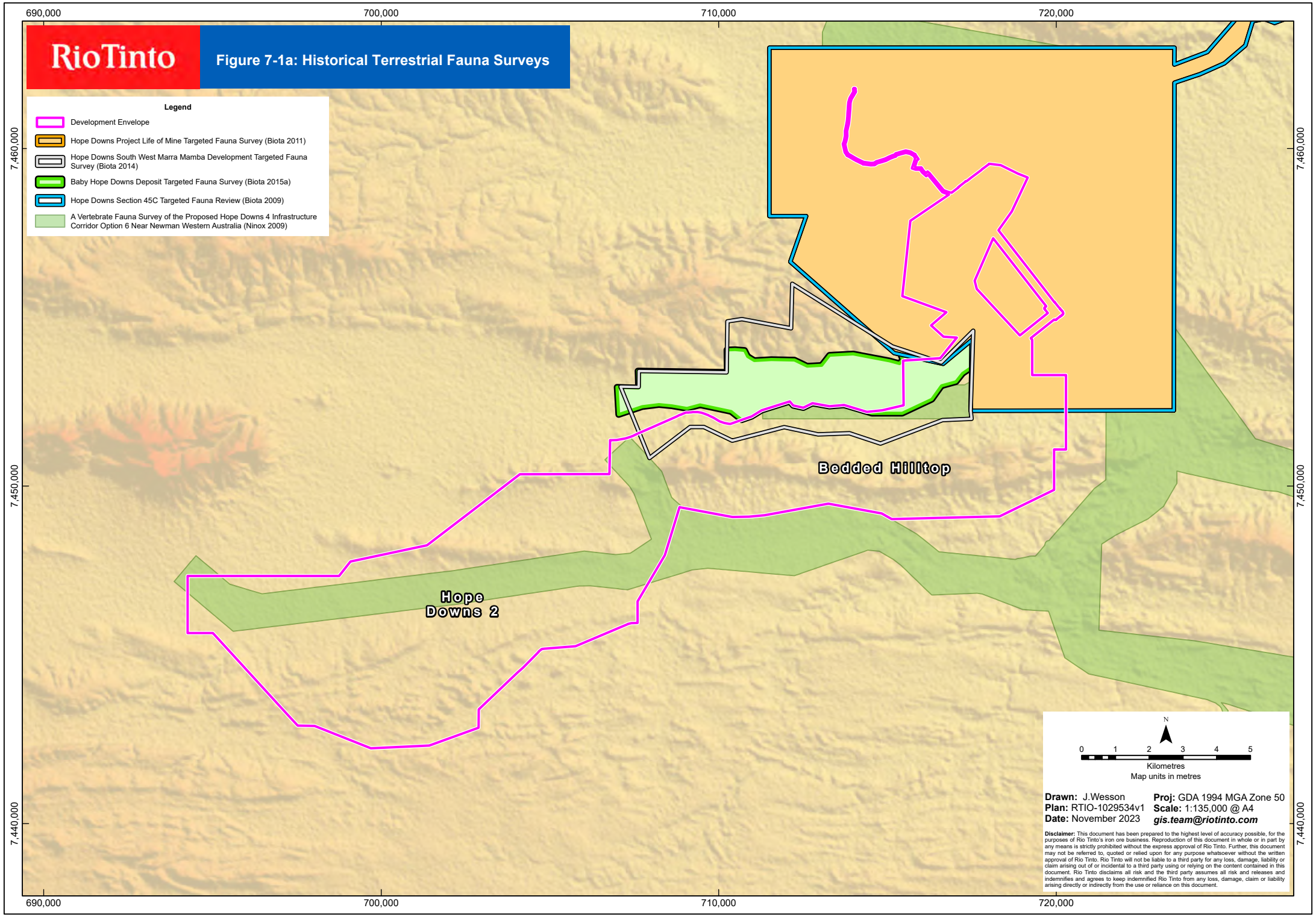
Studies/Survey	Study Area, Type and Timing	Consistency with Guidance
Hope Downs 2 Proposal – Ghost Bat Cave Characteristics (Astron 2020c) **Appendix C3**	**Survey Area:** Hope Downs 2 Proposal Survey Area **Type:** Ghost Bat cave characteristic survey. It was to expand on the characteristics of the caves which had been identified in the 2019 Fauna Survey **Timing:** 25th February – 2nd March 2019	The survey predates the current technical guidance (EPA 2020a) However it was conducted in accordance with: • Position Statement No. 3 (EPA 2002) • Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016e) • Technical Guidance - Terrestrial Fauna Surveys (EPA 2016f) • Survey Guidelines for Australia's Threatened Reptiles, Birds, Mammals and Bats (DSEWPaC 2011b; DEWHA 2010b; DSEWPaC 2011a; DEWHA 2010a)
Hope Downs 2 Proposal – Ghost Bat Memo (Astron 2023e) **Appendix C4**	**Survey Area:** Hope Downs 2 Proposal Survey Area **Type:** Ghost Bat cave desktop assessment summarising the results of work undertaken to date on the Ghost Bats in the 2019 Fauna Survey and MNES Fauna Assessment and following the recent publication on Ghost Bats (Bat Call WA 2021a) **Timing:** 2022	Ghost Bat cave desktop assessment summarising the results of work undertaken to date on the Ghost Bat primarily to provide categorisation of the Ghost Bat caves identified in the 2019 Fauna Survey and MNES Fauna Assessment in accordance with the guidance provided in the Bat Call WA (2021a) publication on Ghost Bats.
Hope Downs 2 Proposal – Grey Falcon Environmental Impact Assessment, May 2022 (Astron 2023f) **Appendix C5**	**Survey Area:** Hope Downs 2 Proposal and surrounding region **Type**: Desktop review of likelihood of Grey Falcon within the HD2 Proposal area and the impact of the Proposal **Timing:** Reviewed fauna surveys from 2008 – present	The desktop review sourced records from government databases and literature, as well as published scientific literature. Nine fauna survey reports (mostly published) conducted across and in the vicinity of the HD2 Proposal were also reviewed. The adherence of the surveys to relevant guidance was not assessed.
Hope Downs 2 Proposal MNES Fauna Assessment (Astron 2020b) **Appendix C6**	**Survey Area:** Hope Downs 2 Proposal Survey Area **Type:** Targeted terrestrial MNES Vertebrate Fauna Survey **Timing:** 17th – 27th September	The survey predates the current technical guidance (EPA 2020a), however, it was conducted in accordance with: • EPBC Act referral guideline for the Endangered Northern Quoll (*Dasyurus hallucatus*) (DoE 2016a)

Studies/Survey	Study Area, Type and Timing	Consistency with Guidance
		• Survey Guidelines for Australia's Threatened Reptiles, Birds, Mammals and Bats (DSEWPaC 2011b; DEWHA 2010b; DSEWPaC 2011a; DEWHA 2010a) • Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016e) • Position Statement No. 3 (EPA 2002) • Technical Guidance - Terrestrial Fauna Surveys (EPA 2016c) • Pilbara Northern Quoll Project: Surveying and Monitoring *Dasyurus hallucatus* in the Pilbara, Western Australia (Dunlop et al. 2014) • Interim Guidelines for Preliminary Surveys of the Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017)
Hope Downs 2 Proposal Matters of National Environmental Significance Northern Quoll Monitoring – Phase 3 of 3 Results (July – October 2022) and Phases 1 to 3 Summary Report (Astron 2023d) **Appendix C7**	**Survey Area:** Hope Downs 2 Proposal Survey Area **Type:** Long term camera monitoring of Northern Quoll expanding on the results obtained from the 2019 MNES survey effort. Includes a summary of the Phase 1, 2 and 3 survey monitoring. **Timing**: Phase 1 September 2020 – November 2020 (Astron 2023b); Phase 2 October 2021 – February 2022 (Astron 2023c); Phase 3 July 2022 – October 2022 (Astron 2023d)	All phases of survey were conducted in accordance with: • EPBC Act referral guideline for the Endangered Northern Quoll (*Dasyurus hallucatus*) (DoE 2016a) • Survey Guidelines for Australia's Threatened Reptiles, Birds, Mammals and Bats (DSEWPaC 2011b; DEWHA 2010b; DSEWPaC 2011a; DEWHA 2010a) • Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016e) • Position Statement No. 3 (EPA 2002) • Technical Guidance - Terrestrial Fauna Surveys (EPA 2016c) • Pilbara Northern Quoll Project: Surveying and Monitoring *Dasyurus hallucatus* in the Pilbara, Western Australia (Dunlop et al. 2014) • Interim Guidelines for Preliminary Surveys of the Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017) Phase 1 predates the current technical guidance (EPA 2020a), however, Phases 2 and 3 were undertaken in accordance with the current technical guidance.
Memorandum: Hope Downs 2 Short-Range Endemic Invertebrate Fauna Preliminary Risk Assessment – July 2022 (Biologic 2022)	**Survey Area:** Hope Downs 2 Proposal Development Envelope	The purpose of the preliminary SRE risk assessment is to provide a consolidation of SRE species and habitat information from all surveys to date within the Development Envelope, and to undertake a preliminary risk

Studies/Survey	Study Area, Type and Timing	Consistency with Guidance
Appendix C8	**Type:** Desktop preliminary risk assessment for short-range endemic (SRE) invertebrate fauna identified from the Hope Downs 2 Baseline survey report (Astron 2019b, Appendix C1) **Timing:** July 2022	assessment of SRE species values and habitat values in relation to potential impacts of the project, as much as practicable within the constraints of available data.
Hopes Downs 2 Proposal – Long-term Motion Cameras, February to September 2020 (Astron 2023a) **Appendix C9**	**Survey Area:** Hope Downs 2 Proposal Survey Area. **Type:** Long term camera monitoring of Northern Quoll expanding on the results obtained from the 2019 MNES survey effort **Timing:** 27th February – 13th September 2019	The survey predates the current technical guidance (EPA 2020a) and was instead conducted in accordance with: • Position Statement No. 3 (EPA 2002) • Technical Guidance - Sampling Methods for Terrestrial Fauna (EPA 2016e) • Technical Guidance - Terrestrial Fauna Surveys (EPA 2016c) • Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) referral guideline for the Endangered Northern Quoll *Dasyurus hallucatus* (DoE 2016a) • Survey Guidelines for Australia's Threatened Reptiles, Birds, Mammals and Bats (DSEWPaC 2011b; DEWHA 2010b; DSEWPaC 2011a; DEWHA 2010a) • Interim Guidelines for Preliminary Surveys of the Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017)
Historical Studies/Surveys		
Baby Hope Downs Deposit Targeted Fauna Survey (Biota 2015a) **Prepared for Rio Tinto**	**Survey Area:** Portion of Hope Downs 2 Development Envelope **Type:** Targeted Terrestrial Fauna and SRE Survey **Timing:** 9th to 16th September 2013	Survey predates the current *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020a). However, was conducted in accordance with all relevant guidance available at the time of the survey.
Pilbara Regional Ghost Bat Review (Biologic 2014) **Prepared for BHP**	**Survey Area:** Pilbara Region **Type:** Desktop Regional Review of the Ghost Bat	There is no specific guidance for a desktop Ghost Bat habitat review.

Studies/Survey	Study Area, Type and Timing	Consistency with Guidance
	Timing: 2014	
Hope Downs South West Marra Mamba Development Targeted Survey (Biota 2014) **Prepared for Rio Tinto**	**Survey Area:** Previous iteration of Hope Downs 2 Development Envelope **Type:** Targeted Fauna Survey **Timing:** 9th to 16th September 2013	Survey predates the current *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020a). However, was conducted in accordance with all relevant guidance available at the time of the survey.
Targeted Ghost Bat Survey at Karijini National Park (Biologic 2012) **Prepared for BHP**	**Survey Area:** Karijini National Park **Type:** Targeted Ghost Bat Survey **Timing:** Phase 1 – 14th to 17th November 2011. Phase 2 – 7th to 15th June 2012	Survey predates the current *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020a). However, was conducted in accordance with all relevant guidance available at the time of the survey.
Hope Downs Project Life of Mine Targeted Fauna Survey (Biota 2011) **Prepared for Rio Tinto**	**Survey Area:** Hope Downs 1 Development Envelope **Type:** Targeted SRE, Troglobitic fauna and Northern Quoll **Timing:** 21st to 27th June 2010	Survey predates the current *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020a). However, was conducted in accordance with all relevant guidance available at the time of the survey.
Hope Downs Section 45C Targeted Fauna Review (Biota 2009) **Prepared for Rio Tinto**	**Survey Area:** Hope Downs 1 Development Envelope **Type:** Desktop and Habitat based review of SRE's and Troglobitic Fauna Timing: 2009	Survey predates the current *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020a). However, was conducted in accordance with all relevant guidance available at the time of the survey.
A Vertebrate Fauna Survey of the proposed Hope Downs 4 Option 6 Infrastructure corridor (Ninox Wildlife Consulting 2009a) **Prepared for Mattiske Consulting/Rio Tinto**	**Survey Area:** Hope Downs 4 Infrastructure corridor **Type:** Detailed Vertebrate and SRE Invertebrate survey **Timing:** 19th to 25th September 2008 and 21st to 27th April 2009	Survey predates the current *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020a). However, was conducted in accordance with all relevant guidance available at the time of the survey.


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Figure 7-1: Terrestrial Fauna Surveys
Legend
Development Envelope
Fauna Survey Areas
Hope Downs 1 Development Envelope Fauna Habitat Mapping (Astron 2020)
Hope Downs 2 Proposal Fauna Survey (Astron 2019)
Bedded Hilltop
Hope Downs 2
690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172538v5
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:135,000 @ A4
gis.team@riotinto.com
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Figure 7-1a: Historical Terrestrial Fauna Surveys
Legend
Development Envelope
Hope Downs Project Life of Mine Targeted Fauna Survey (Biota 2011)
Hope Downs South West Marra Mamba Development Targeted Fauna Survey (Biota 2014)
Baby Hope Downs Deposit Targeted Fauna Survey (Biota 2015a)
Hope Downs Section 45C Targeted Fauna Review (Biota 2009)
A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor Option 6 Near Newman Western Australia (Ninox 2009)
690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Bedded Hilltop
Hope Downs 2
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: J.Wesson
Plan: RTIO-1029534v1
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:135,000 @ A4
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7.3.2. Fauna Habitat

7.3.2.1. Habitat Types

Eight broad fauna habitat types were identified within the Development Envelope (Astron 2020d). These are described in Table 7-4 and shown in Figure 7-2. The habitat types were identified based on observations in the field, vegetation mapping and interpretation of aerial photography.

Significance of Habitat Types

The detailed understanding of local species occurrence and habitat use has been used to assign habitat significance ratings based on their value to significant fauna species listed under the EPBC Act or BC Act. Table 7-3 describes the criteria used to inform the significance rating for each habitat. Where used, the term “Critical habitat” refers to a habitat type that is used for breeding; such as denning, roosting and nesting, and “Supporting habitat” is any foraging habitat within the home range of a significant species (home ranges are different for each species).

Table 7-3: Fauna Habitat Significance Assessment Criteria for Significant Species

Habitat Significance	Criteria
High	Provides core breeding/refugia/shelter sites (i.e., denning, roosting or water sources) for significant fauna species. These habitats are considered Critical to the survival of significant species within the Development Envelope.
Moderate	Provides foraging and dispersal habitat for significant fauna species. These habitats are considered Supporting habitat, when they are within the home range of the fauna species. These habitats are more widespread and of lower importance than the high significance (Critical) habitats.
Low	Habitat does not directly support any significant fauna species but may represent limited foraging and dispersal habitat. Significant fauna species are not dependent on this habitat. This habitat is widespread in the local and regional areas.
Nil	Cleared areas that do not provide any fauna habitat.

Of the eight habitat types, two are considered to provide high significance habitat:

- **Gorge/Gully habitat:** Collectively comprises 63 ha (0.5%) of the Development Envelope and is considered the most locally significant fauna habitat due to the microhabitats it provides such as caves, overhangs, crevices, and also due to the potential to support semi-permanent surface water features (Astron 2019b). This habitat is considered to potentially be suitable for denning, shelter, roosting and foraging for several significant fauna species including Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Gane’s Blind Snake.
- **Breakaway habitat:** Collectively comprises 224 ha (1.8%) of the Development Envelope. This habitat is considered of high significance as it can form shelters such as caves, overhangs and crevices that represent microhabitats that are potentially suitable for conservation significant species including Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python.

The remaining habitat types are considered to be of moderate to low significance. None of the identified fauna habitats, including the two of high significance, are confined to the Development Envelope and all are well represented in the wider Hamersley sub-region (Astron 2019b). This aspect is addressed in more detail in Section 7.6.

Table 7-4: Fauna Habitat Types within the Development Envelope (Astron 2020d)

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within Development Envelope	Representative Photograph
High Significance						
Breakaway • Limited extent • High significance • High SRE potential	Single sided rock faces, generally on steep mid-upper slopes comprising of bare rock outcrops or cliffs.	Vegetation within this habitat type tends to include *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia* spp. tall shrubs over *Triodia pungens* very open hummock grassland, sometimes with scattered tussock grasses	Caves (roost/feed caves), cracks and crevices, sheltered leaf litter	Critical habitat for: • Northern Quoll • Ghost Bat • Pilbara Olive Python Supporting habitat for: • Grey Falcon Suitable Habitat for: • Gane's Blind Snake • Pilbara Leaf-nosed Bat	223.6 ha	
Gorge/Gully • Limited extent • High significance • High SRE potential	Incised rock features that have moderate to steep sides and slopes. Deeper examples can support distinctly different vegetation from surrounding landscape and provide refugia for moisture and from fire.	Vegetation within this habitat type tends to include *Eucalyptus* and *Corymbia ferriticola* scattered low trees scattered over *Triodia pungens* open hummock grassland and scattered tussock grasses	Overhangs, crevices, caves, tree hollows, ephemeral, semi-permanent water	Critical habitat for: • Northern Quoll • Ghost Bat • Pilbara Olive Python Supporting habitat for: • Grey Falcon Suitable habitat for: • Gane's Blind Snake • Pilbara Leaf-nosed Bat	63.2 ha	
Moderate Significance						
Minor Drainage • Limited extent • Moderate significance • Moderate SRE potential	Small drainage channels less than 10 m in width. Often with thick Acacia growth along banks. It does not include the minor drainage depressions that flow off of high ground. This habitat is less likely to support surface water for long periods after rainfall events.	Vegetation within this habitat type tends to include Scattered *Eucalyptus victrix* woodland over *Petalostylis labicheoides* and *Acacia* spp. Tall open shrubland over tussock grassland.	Hollow bearing trees and logs, thick ground cover/vegetation, deep leaf litter	Supporting habitat for: • Northern Quoll • Grey Falcon • Ghost Bat • Pilbara Olive Python Suitable habitat for: • *Lerista macropisthopus remota* • Pilbara Leaf-nosed Bat	917.9 ha	

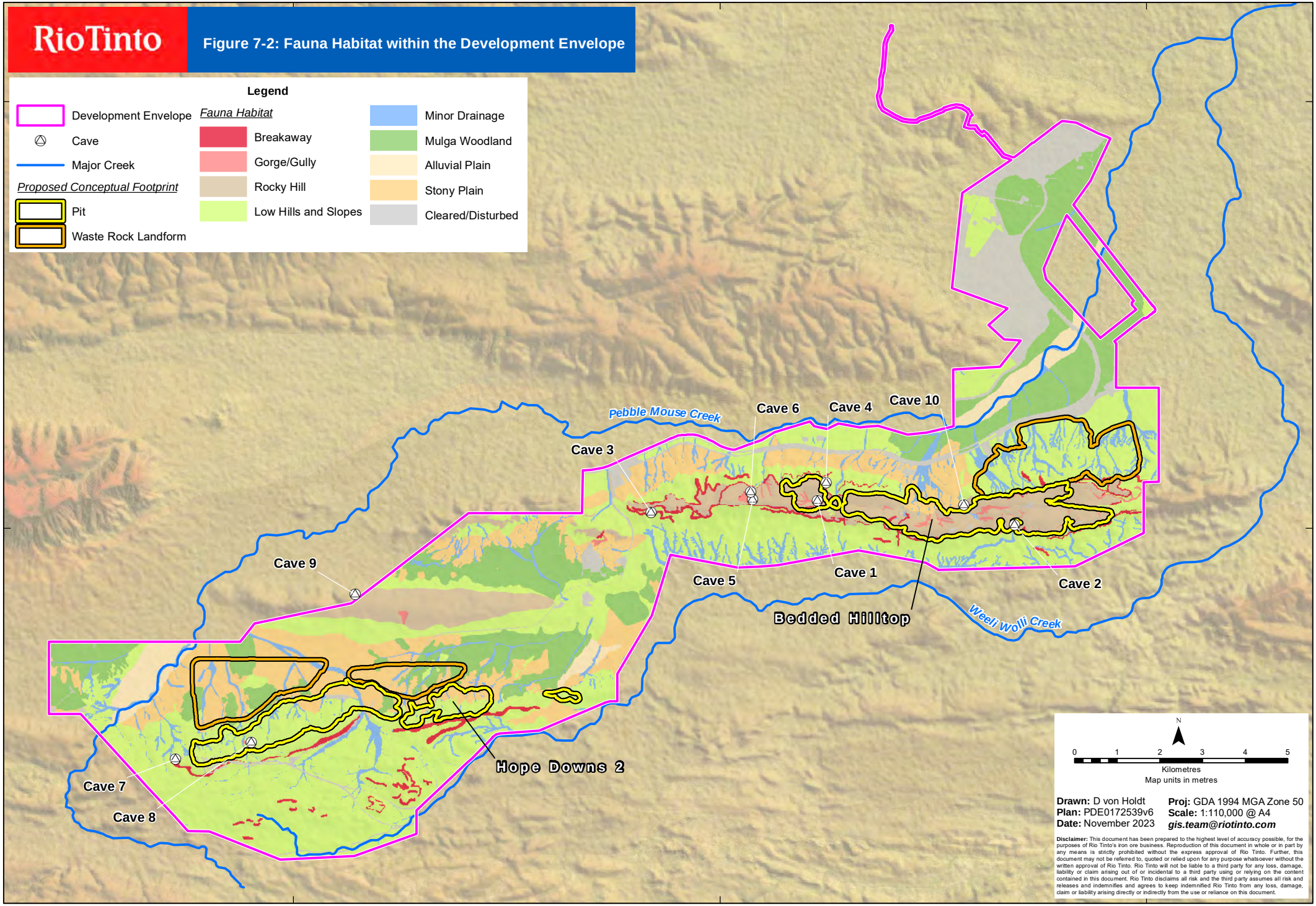
Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within Development Envelope	Representative Photograph
Rocky Hill • Widespread • Moderate significance • High SRE potential	Encompasses hill features from footslopes to ridges and hilltop plateaus. The hills are greater in heightened steepness of gradient then the lower hills and slopes. This habitat can be on isolated hills or a series of ridgelines.	Vegetation within this habitat type tends to include *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* scattered low trees to low open woodland over mixed open shrubland over open *Triodia wiseana, T. pungens, T. vanleeuwenii* hummock grassland.	Shallow overhangs, boulders and crevices	Supporting habitat for: • Northern Quoll • Grey Falcon • Ghost Bat Suitable habitat for: • Gane's Blind Snake • Pilbara Barking Gecko • Western Pebble Mound Mouse • Pilbara Leaf-nosed bat	967.3 ha	
Low Significance						
Alluvial Plain • Widespread • Low Significance • Low SRE potential	Habitat type is associated with flood plains adjacent to drainage lines. Often contains tussock grasses and has a high vegetation cover. The substrate is generally alluvial silt loamy clay. The low lying areas have a very slight to negligible height gradient.	Vegetation within this habitat type tends to include *Acacia pruinocarpa, A. aptaneura, Eremophila longifolia* tall open shrubland over tussock grassland.	Dense leaf litter, termite mounds and spinifex clumps, cracking clays	Supporting habitat for: • Grey Falcon • Ghost Bat Suitable habitat for: • *Lerista macropisthopus remota* • Letter-winged Kite • Western Pebble Mound Mouse	340.5 ha	
Low Hills and Slopes • Widespread • Low Significance • Low SRE Potential	Low undulating hills and extensive footslopes with a gradual gradient. The low hills have rounded summits without plateaus and generally do not contain cliff faces or rocky outcropping. Allow for movement of fauna through landscape.	Vegetation within this habitat type tends to include *Eucalyptus leucophloia* subsp. *leucophloia* and/or *Corymbia hamersleyana* scattered low trees over mixed *Acacia spp*. Open shrubland over open *Triodia pungens, T. vanleeuwenii* hummock grassland.	Termite mounds, *Triodia* hummocks, minimal leaf litter	Supporting habitat for: • Grey Falcon • Ghost Bat Suitable habitat for • Western Pebble-mound Mouse	5,116.3 ha	
Mulga Woodland • Widespread • Moderate significance • Moderate SRE potential	Stands of Mulga over clay or stony substrate. Differs from other plains with Mulga vegetation habitat types, by having a monoculture of Mulga.	Vegetation within this habitat type tends to include *Acacia catenulata* tall shrubland over *Eremophila fraseri* scattered tall shrubs over *Triodia pungens* very open hummock grassland.	Limited microhabitats, termite mounds, minimal leaf litter	Supporting habitat for: • Grey Falcon • Ghost Bat Suitable habitat for: • Lerista macropisthopus remota • Letter-winged Kite • Western Pebble-mound Mouse	1,831.2 ha	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within Development Envelope	Representative Photograph
Stony Plain • Widespread • Low Significance • Low SRE Potential	Substrate of the Stony plains is predominately made of stones, gravel and cobbles. The areas generally have a very slight to no gradient. This habitat type also contains grasses and ground story vegetation.	Vegetation within this habitat type generally includes *Acacia aptaneura, A. pruinocarpa, A. catenulata* tall shrubland over *Triodia pungens* (and sometimes *T. vanleeuwenii*) hummock grassland or tussock grassland.	Limited leaf litter, termite mounds and spinifex clumps	Supporting habitat for: • Grey Falcon • Ghost Bat Suitable habitat for: • Letter-winged Kite • Western Pebble Mound Mouse	1,517.5 ha	
Negligable Significance						
Cleared / Disturbed	Historical disturbance, including tracks and drill pads, as well as full-scale mining activities within the approved Hope Downs mining area.	NA	None	None	1,432.2 ha	
Total					12,409.5 ha	

** Areas (ha) are rounded. # Source of photo Astron (2019b)*

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Figure 7-2: Fauna Habitat within the Development Envelope



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7.3.2.2. Hope Downs Hub Habitat Assessment

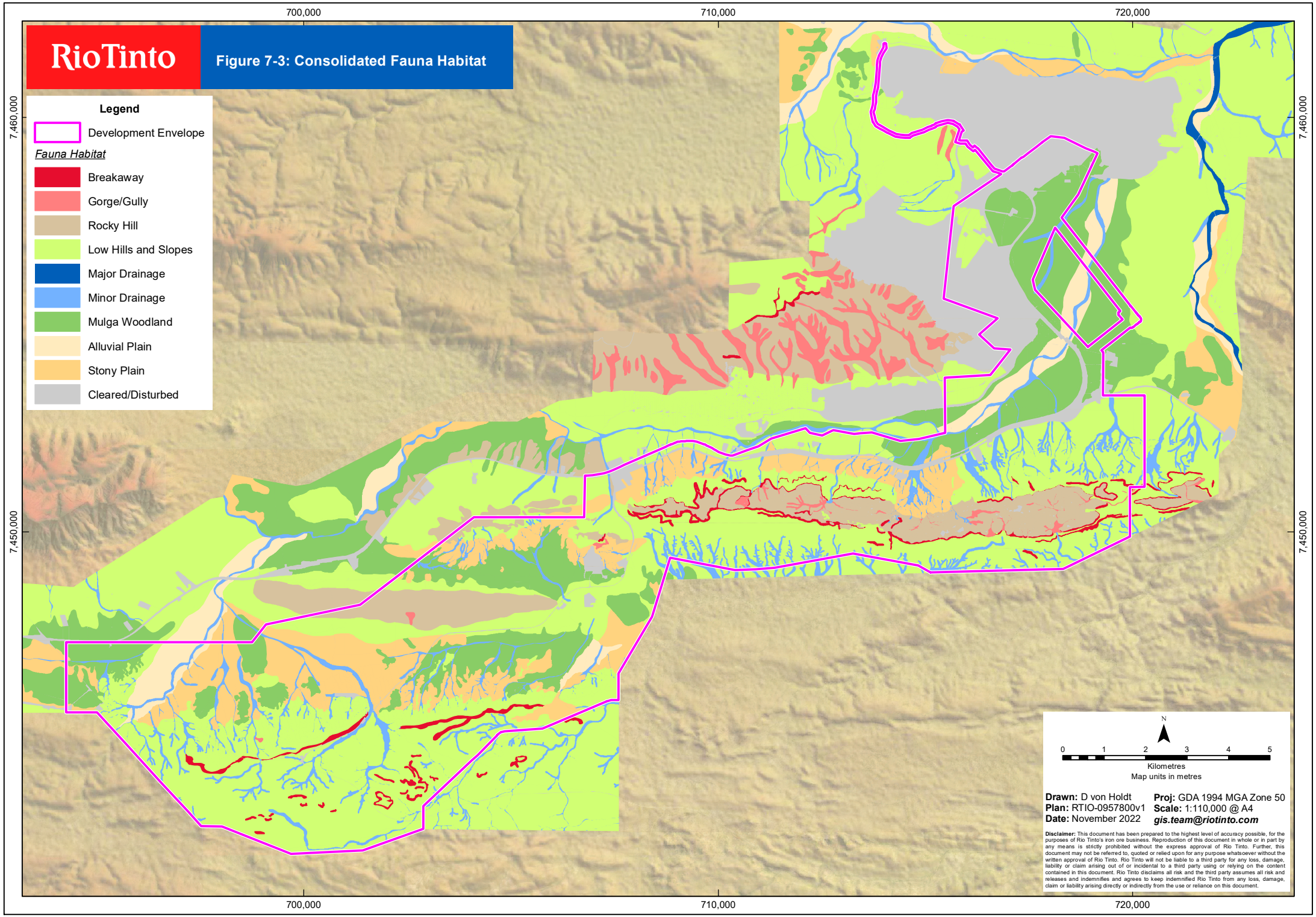
Astron (2019b) prepared a consolidation of previous fauna habitat mapping across the Proposal's Development Envelope and the existing Hope Downs 1 operations, and corridors linking the West Angelas and Yandicoogina operations (36,944 ha). This report is included as Appendix C2, which outlines the methodology and results of the assessment. This consolidation exercise was undertaken in order to support understanding the context of the Proposal's impacts and cumulative impacts.

The study was prepared to provide a single, consolidated fauna habitat mapping GIS layer for the Proposal and the existing Hope Downs 1 operations, in order to support understanding the context of the Proposal's impacts and cumulative impacts.

Figure 7-3 shows the extent and results of the mapping and Table 7-5 provides a summary of the extent of habitat within the Proposal area.

Table 7-5: Consolidated Mapping Habitat Extents

Fauna Habitat	Consolidated Extent (ha)
Alluvial Plain	1,332.66
Breakaway	298.47
Gorge/Gully	621.96
Low Hills and Slopes	16,472.65
Major Drainage	244.15
Minor Drainage	1,648.88
Mulga Woodland	5,818.77
Rocky Hill	2,921.18
Stony Plain	2,693.78
Cleared	4,891.13


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Figure 7-3: Consolidated Fauna Habitat
Legend
Development Envelope
Fauna Habitat
Breakaway
Gorge/Gully
Rocky Hill
Low Hills and Slopes
Major Drainage
Minor Drainage
Mulga Woodland
Alluvial Plain
Stony Plain
Cleared/Disturbed
700,000
710,000
720,000
7,460,000
7,450,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0957800v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
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7.3.2.3. Significant Habitat Features

Significant habitat features are elements within a broader fauna habitat that provide important microhabitats that support significant fauna species or have a highly diverse or abundant faunal assemblage. In the Pilbara, significant habitat features typically include caves and surface water expressions in the form of pools in drainage lines or gorges, each of which is discussed in detail below.

Caves

Caves are considered important ecological habitat features in the Pilbara due to the stable microclimate and shelter they provide to a range of fauna including the significant species Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python. A total of nine caves (including overhangs) were recorded within the Development Envelope[3]. These caves have been characterised in Table 7-6 and Table 7-7, and shown on Figure 7-2, according to Ghost Bat usage, including for roosting and breeding (further detail on Ghost Bat cave type classification is provided in Section 7.3.4.2) (Astron 2020c and Astron 2023e).

Table 7-6: Characteristics and Utilisation of Ghost Bat caves identified within the Development Envelope

Ghost Bat Cave Categories (Ball Call WA 2021a)	Caves Within Development Envelope
Category 1: Maternity/diurnal roost sites with permanent Ghost Bat occupancy (Critical Habitat)	None identified
Category 2: Maternity/diurnal roost caves with regular Ghost Bat occupancy (Critical Habitat)	Cave 10 (BHT)
Category 3: Diurnal roost caves with occasional Ghost Bat occupancy (Supporting Habitat)	Cave 1 (BHT), Cave 5 (BHT)
Category 4: Nocturnal roost caves with opportunistic Ghost Bat usage (Supporting Habitat)	Cave 2 (BHT), Cave 3 (BHT), Cave 4 (BHT), Cave 6 (BHT), Cave 7 (HD2) and Cave 8 (HD2)

Table 7-7: Categories of Caves identified within the Development Envelope for Ghost Bat and Pilbara Leaf-nosed Bats

Caves Within Development Envelope	Habitat Type	Ghost Bat Cave Category (Ball Call WA 2021a)	Pilbara Leaf-nosed Bat Cave Category (Bat Call WA 2021b)
Cave 1 (BHT)	Gorge / Gully	Category 3	Category 4
Cave 2 (BHT)	Gorge / Gully	Category 4	Category 4
Cave 3 (BHT)	Breakaway	Category 4	Category 4
Cave 4 (BHT)	Breakaway	Category 4	Category 4
Cave 5 (BHT)	Breakaway	Category 3	Category 4
Cave 6 (BHT)	Breakaway	Category 4	Category 4
Cave 7 (HD2)	Breakaway	Category 4	Category 4
Cave 8 (HD2)	Gorge / Gully	Category 4	Category 4
Cave 10 (BHT)	Rocky Hill	Category 2	Category 4

[3] One cave (Cave 9) was recorded outside the Development Envelope (Astron 2019b and Astron 2020b)

Five of the caves (Cave 3, 4, 5, 6 and 7) occur within the Breakaway habitat, one (Cave 10) within Rocky Hill habitat and the remaining three caves within Gorge/Gully habitat (Figure 7-2). This is typical of Ghost Bat cave locations throughout the Pilbara bioregion (Astron 2020b).

In terms of utilisation of the caves by Pilbara Leaf-nosed Bat, the nine caves are all classified as Category 4 roosts (nocturnal refuges), which are caves occupied at night for resting or feeding. These caves are not considered Critical habitat but are important for the persistence of a species within an area (Bat Call WA 2021b).

Surface Water Features

Permanent and semi-permanent/ephemeral water features are considered to be significant habitat features as they can provide drinking and foraging resources for many species including those of significance such as the Pilbara Olive Python (Astron 2019b). This is especially important in the Pilbara bioregion due to the natural relative scarceness of water.

Astron (2019b) described the Gorge/Gully habitats as potentially containing semi-permanent surface water; however, none were identified during the field surveys and all refuge areas in the gorges or gullies of the Development Envelope were typically dry. Given the general current low utilisation of the Development Envelope by significant fauna, it is unlikely that these ephemeral features are of significance. Two near-permanent water features are located outside but within 5 km of the Development Envelope, being Weeli Wolli Spring and Ben's Oasis. Both are likely to be of high significance to local fauna as they provide drinking and foraging resources for all year round (Rio Tinto 2022a).

Two waterholes, Pool HD214_04HD2 at HD2 deposit and GHD19-17-WS at the BHT deposit, were identified via Nyiyaparli Social Surroundings Report (KNAC 2022) and are discussed further in Chapters 9 and 11. These pools are protected as heritage sites and provide general habitat values to fauna, rather than being classified as critical habitat for MNES species.

Depending on the recent rainfall, pools can occur across the landscape in lower lying areas. The ecological significance of a pool comes down to the persistence of surface water after these rainfall events. Pool HD214_04HD2 is located in a gully system that has been surveyed by Zoologists (see Figure 7-2) and not recorded, indicating it was not considered a significant water feature for fauna. The location GHD19-17-WS is 5 small cracks/holes in bedrock of a drainage line. The small, constricted shape of these holes may have cultural values, but do not represent significant fauna habitat.

These pools were identified as surface water fed, are very shallow <1m and constitute a temporary pool, rather than a permanent/semi-permanent pool. As such, they would only hold water episodically after significant rainfall events and do not represent significant or critical habitat for the MNES species.

7.3.3. Fauna Assemblage and Species Diversity

The fauna assemblage recorded within the Development Envelope is considered typical of the Hamersley sub-region. A database search and literature review by Astron (2019b) indicated that 312 vertebrate fauna species have previously been recorded within the vicinity of the Development Envelope, including eight amphibians, 147 birds, 109 reptiles and 48 mammals (nine of which are introduced).

Within the detailed survey area, a total of 174 vertebrate species were recorded, including two amphibians, 84 birds, 55 reptiles and 33 mammals (Astron 2019b). The overall species diversity and occurrence of both native and introduced fauna are presented below. Further information on significant fauna is presented in Section 7.3.4.

7.3.3.1. Amphibians

Two amphibian species were recorded, neither of which are of conservation significance (Astron 2019b). They were the Desert Tree Frog (*Litoria rubella*) – 19 records, and Mains' Frog (*Cyclorana maini*) – 4 records.

7.3.3.2. Birds

Birds were the most diverse group of fauna, with 84 bird species recorded (Astron 2019b). The most common species recorded were:

- Weebil (*Smicronis brevirstris*) – 50 records
- Zebra finch (*Taeniopygia guttata*) – 44 records
- Singing Honeyeater (*Gavicalis virescens*) – 43 records.

Two significant bird species were also recorded: Letter-winged Kite (*Elanus scriptus*) (Priority 4) and Oriental Plover (*Charadrius veredus*) (Migratory). Both were opportunistically recorded; the former was flying over the survey area, and the latter was foraging on the Hope Downs 1 camp soccer pitch.

7.3.3.3. Reptiles

Fifty-five reptile species were recorded (Astron 2019b), with the most common being:

- Shaded-Litter Rainbow-Skink *(Carlia munda)* – 30 records
- Leopard Ctenotus *(Ctenotus patherianus)* – 20 records
- Westered Marbled Velvet Gecko *(Oedura fimbria*) – 17 records.

One significant reptile species, *Lerista macropisthopus remotas* (Priority 2), was recorded within the Mulga Woodland habitat type.

7.3.3.4. Mammals

Thirty-three mammal species were recorded (Astron 2019b) with the most common being:

- Common Rock-rat *(Zyzomys argurus)* – 37 records
- Kaluta (*Dasykaluta rosmondae*) – 33 records

Four significant mammal species were recorded:

- Northern Quoll (Endangered) were recorded from fourteen different instances with most sightings/evidence occurring within Gorge/Gully and Breakaway habitat
- Ghost Bat (Vulnerable) and the Pilbara Leaf-nosed Bat (Vulnerable) were both recorded through echolocation calls, and the presence of scats for the Ghost Bat
- Western Pebble-mound Mouse (*Pseudomys chapmani*) (Priority 4) was recorded nine times within the survey area, within the Stony Plain, Rocky Hill and Mulga Woodland habitat types.

7.3.3.5. Introduced Fauna Species

A total of seven introduced fauna species were recorded within the survey area (Astron 2019b): Cat (*Felis catus*), Dog/Dingo (*Canis familiaris*), European Cattle (*Bos taurus*), Camel (*Camelus dromedarius*), Donkey (*Equus assinus*), Rabbit (*Oryctolagus cuniculus*) and House Mouse (*Mus musculus*).

7.3.4. Significant Fauna

Seven significant vertebrate fauna species were recorded within the survey area, while an additional seven species were considered to have a high to moderate likelihood of occurring (Table 7-8). One

other species, which is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act (Night Parrot - *Pezoporus occidentalis*) was considered to have only a low likelihood of occurring within the Development Envelope due to lack of suitable habitat and scarcity of nearby records, despite extensive surveys. However, it has been included as a controlling provision under the EPBC Act and as such will be discussed in this section.

Table 7-8: Significant Fauna Recorded at or Likely to Occur within the Development Envelope

Species	Likelihood of Occurrence within Development Envelope	EPBC Act Listing	BC Act Listing	DBCA Priority Species
Northern Quoll (*Dasyurus hallucatus*)	Recorded (low numbers)	Endangered	Endangered	-
Night Parrot (*Pezoporus occidentalis*)	Negligible	Endangered	Critically Endangered	-
Grey Falcon (*Falco hypoleucos*)	Moderate	Vulnerable	Vulnerable	-
Ghost Bat (*Macroderma gigas*)	Recorded	Vulnerable	Vulnerable	-
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	Recorded	Vulnerable	Vulnerable	-
Pilbara Olive Python (*Liasis olivaceus barroni*)	High	Vulnerable	Vulnerable	-
Oriental Plover (*Charadrius veredus*)	Recorded	Migratory	Migratory	-
Fork-tailed Swift (*Apus pacificus*)	Moderate	Migratory	Migratory	-
Peregrine Falcon (*Falcon peregrinus*)	Moderate	-	Other	-
Gane's Blind Snake (*Anilios ganei*)	High	-	-	Priority 1
Lerista macropisthopus remota	Recorded	-	-	Priority 2
Pilbara Barking Gecko (*Underwoodisaurus seorsus*)	High	-	-	Priority 2
Letter-winged Kite (*Elanus scriptus*)	Recorded	-	-	Priority 4
Western Pebble-mound Mouse (*Pseudomys chapmani*)	Recorded	-	-	Priority 4
Short-tailed Mouse (*Leggadina lakedownensis*)	Moderate	-	-	Priority 4

Detailed assessments of species listed under the EPBC Act are provided in Chapter 13.

7.3.4.1. Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll (Plate 7-1) is listed as Endangered under the BC Act and EPBC Act. The species was originally found across northern Australia, from the Northwest Cape of Western Australia to southeast Queensland; however, in recent years its abundance has significantly declined. The Northern Quoll is currently restricted to five regional populations across Queensland, the Northern Territory and Western Australia on the mainland and some offshore islands (DoE 2022).



Source: Nature 2018

Plate 7-1: Northern Quoll

A total of 4,537 records are scattered across the four subregions (Hamersley, Fortescue Plains, Chichester and Roebourne Plains) of the Pilbara bioregion (Dunlop et al. 2019). Records extend as far west as the Little Sandy Desert and as far south as Karijini National Park (DoE 2022). In the Pilbara, the most recent records have come from the Rocklea, Macroy and Robe land systems (DoE 2022). The species' distribution is now considered to be fragmented and mostly confined to the larger conservation reserves such as Millstream Chichester National Park (Henandez Santin et al. 2018), as well as the Burrup Peninsula (DoE 2022). The Northern Quoll population within the Pilbara is genetically distinct from the nearest population in the Kimberley. This is considered to be due to the prevention of gene flow between the populations due to physical separation created by the Great Sandy Desert (Dunlop et. al. 2019).

Records within the Development Envelope

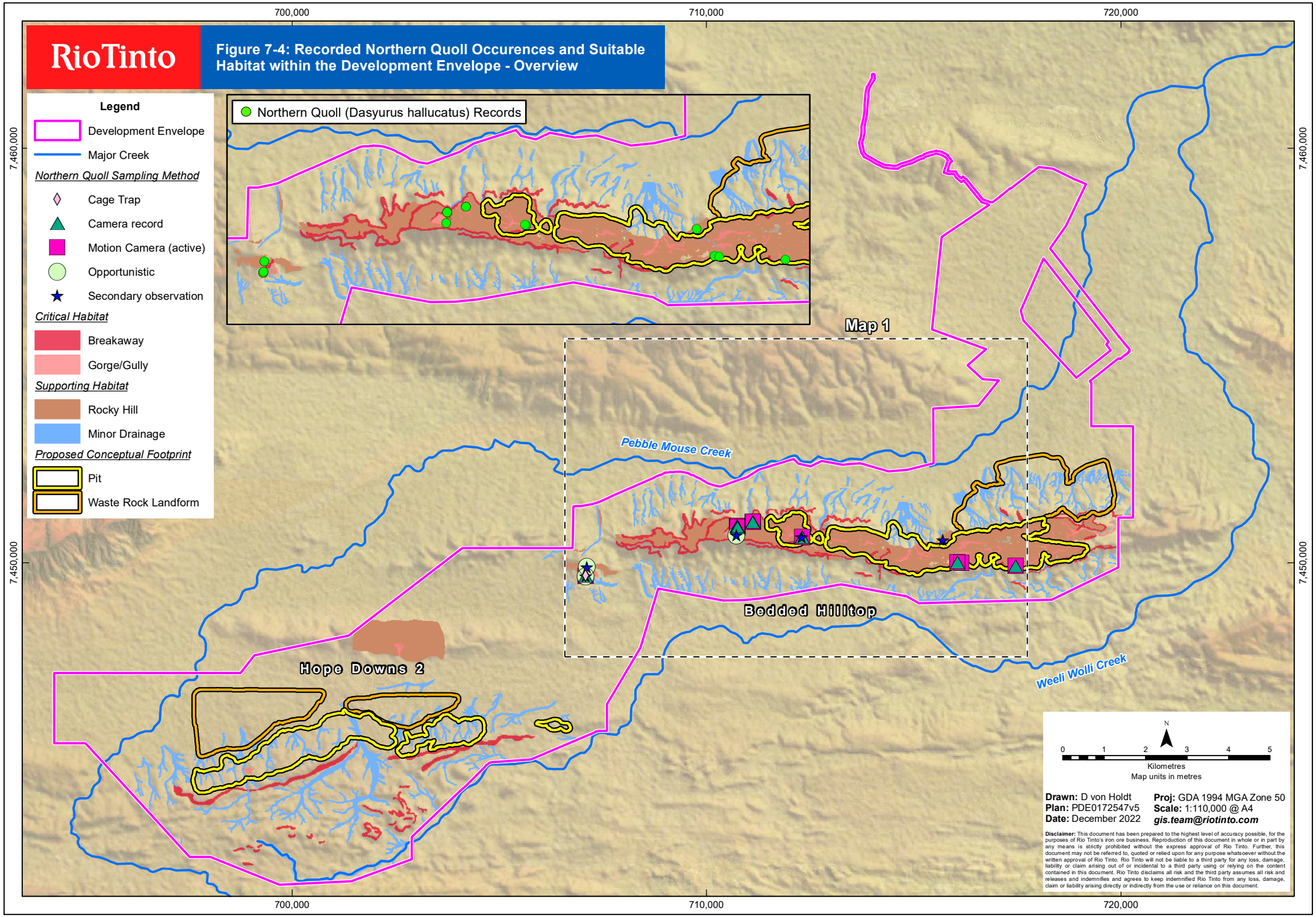
A total of 14 records of Northern Quoll were collected during the three-year Astron survey period (Astron 2023c). The majority of the records were captured on motion cameras (8 records), followed by fresh scats (5 records), and one male quoll was captured (Astron 2023a) (Figure 7-4). The majority of the records came from west of the BHT deposit in both Gorge/Gully and Breakaway habitats. No recordings were made around the HD2 deposit, despite the similarity of habitats and utilisation of near-identical monitoring strategies. The limited number of sightings from motion cameras makes an accurate population analysis unachievable, however, the results indicate that the area supports a low-density population (Astron 2023c).

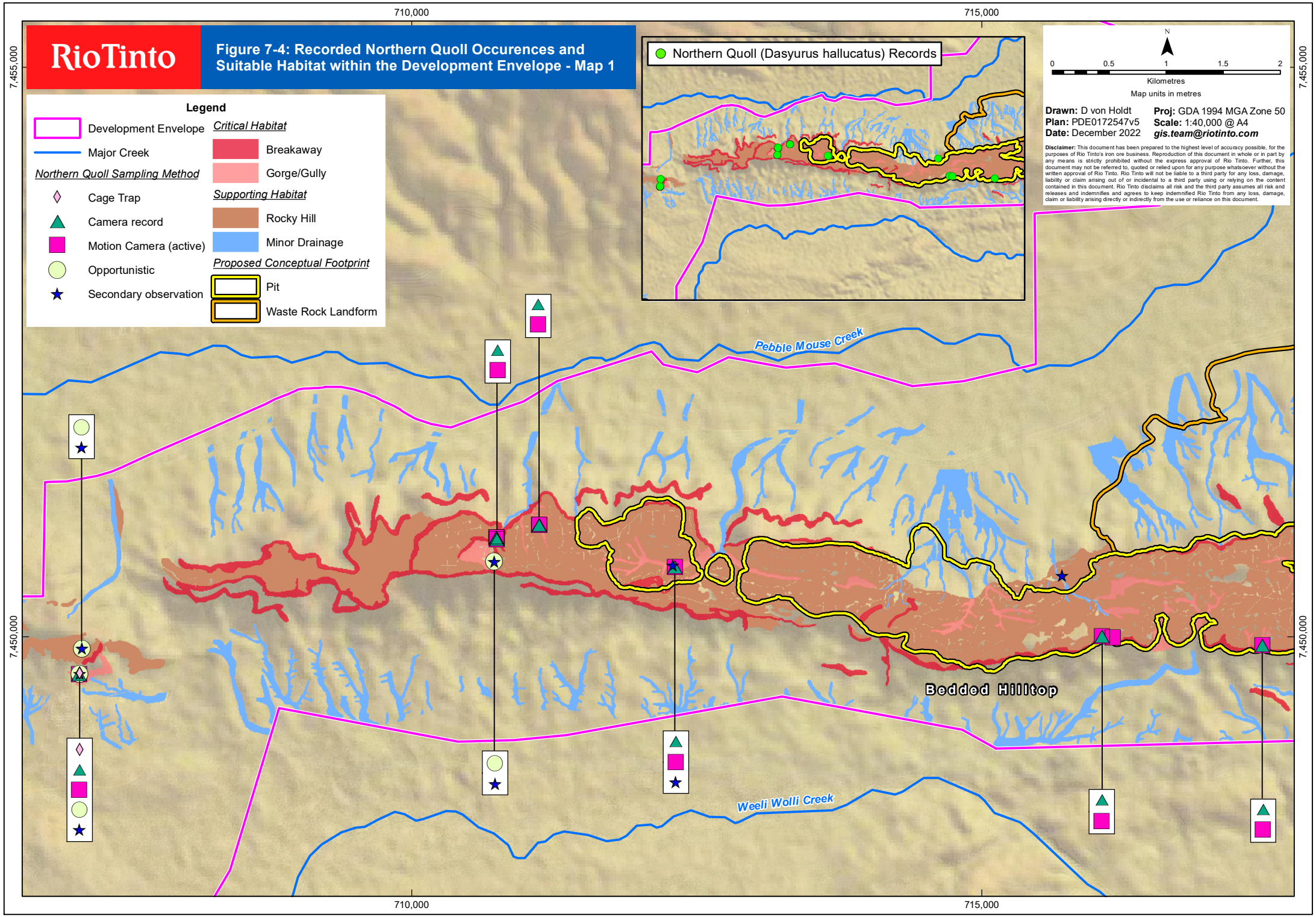
Since 2020, a long-term motion camera monitoring program recorded few Northern Quolls within the Development Envelope, with two Northern Quolls being recorded in May 2020 and no Northern Quolls recorded in 2021 or 2022 (Astron 2023a, 2023b, 2023c and 2023d). Astron (2023d) suggest the decline in recorded numbers is strongly associated with one or more of the following factors: a fire that burnt

through the BHT ridgeline in 2019; drier than average conditions; and an observed increase in the number of feral cats.

Suitable Habitat within the Development Envelope

The Gorge/Gully and Breakaway habitats in the Development Envelope are considered Critical habitat for Northern Quoll as it meets the definition of rocky areas habitat outlined in the *National Recovery Plan* (Hill and Ward 2010) (Figure 7-4). These areas have the potential to possess semi-permanent water features as well as microhabitat structures that can be used for denning. Minor Drainage and Rocky Hill habitats within 1 km (species home range) of Northern Quoll records are considered to be Supporting habitat for the local Northern Quoll population, as the habitat types provide microhabitats and support the presence of prey species for Northern Quoll.


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Figure 7-4: Recorded Northern Quoll Occurences and Suitable Habitat within the Development Envelope - Overview
Legend
Development Envelope
Major Creek
Northern Quoll Sampling Method
Cage Trap
Camera record
Motion Camera (active)
Opportunistic
Secondary observation
Critical Habitat
Breakaway
Gorge/Gully
Supporting Habitat
Rocky Hill
Minor Drainage
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Northern Quoll (Dasyurus hallucatus) Records
Map 1
Pebble Mouse Creek
Bedded Hilltop
Hope Downs 2
Weeli Wolli Creek
700,000
710,000
720,000
7,460,000
7,450,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172547v5
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
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Figure 7-4: Recorded Northern Quoll Occurences and Suitable Habitat within the Development Envelope - Map 1
Legend
Development Envelope
Major Creek
Northern Quoll Sampling Method
Cage Trap
Camera record
Motion Camera (active)
Opportunistic
Secondary observation
Critical Habitat
Breakaway
Gorge/Gully
Supporting Habitat
Rocky Hill
Minor Drainage
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Northern Quoll (Dasyurus hallucatus) Records
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172547v5
Date: December 2022
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710,000
715,000
7,455,000
7,450,000
Pebble Mouse Creek
Bedded Hilltop
Weeli Wolli Creek

7.3.4.2. Ghost Bat (*Macroderma gigas*)

The Ghost Bat (Plate 7-2) is listed as Vulnerable under the BC Act and EPBC Act. Historically, the Ghost Bat occurred across much of mainland Australia; but its range is now restricted to disjunct populations across parts of northern Australia. In Western Australia, Ghost Bats occur in two separate regions, the Pilbara and the Kimberley (TSSC 2016a).



Source: Perth Zoo, 2022

Plate 7-2: Ghost Bat

The Pilbara population has recently been estimated to comprise between 1,300 and 2,000 individuals (TSSC 2016a). While the Ghost Bat has been recorded in all four biogeographic subregions within the Pilbara, it is mainly known from the Hamersley and Chichester subregions, where colonies utilise natural caves and disused underground mines. (TSSC 2016a).

Records within the Development Envelope

Ghost Bats have been recorded on 12 occasions within the Development Envelope in the form of direct observation (sightings), echolocation recordings and scats. Two individuals were sighted within the Development Envelope; one while foraging and the other roosting in a cave (Cave 8) (Astron 2020c).

Suitable Habitat within the Development Envelope

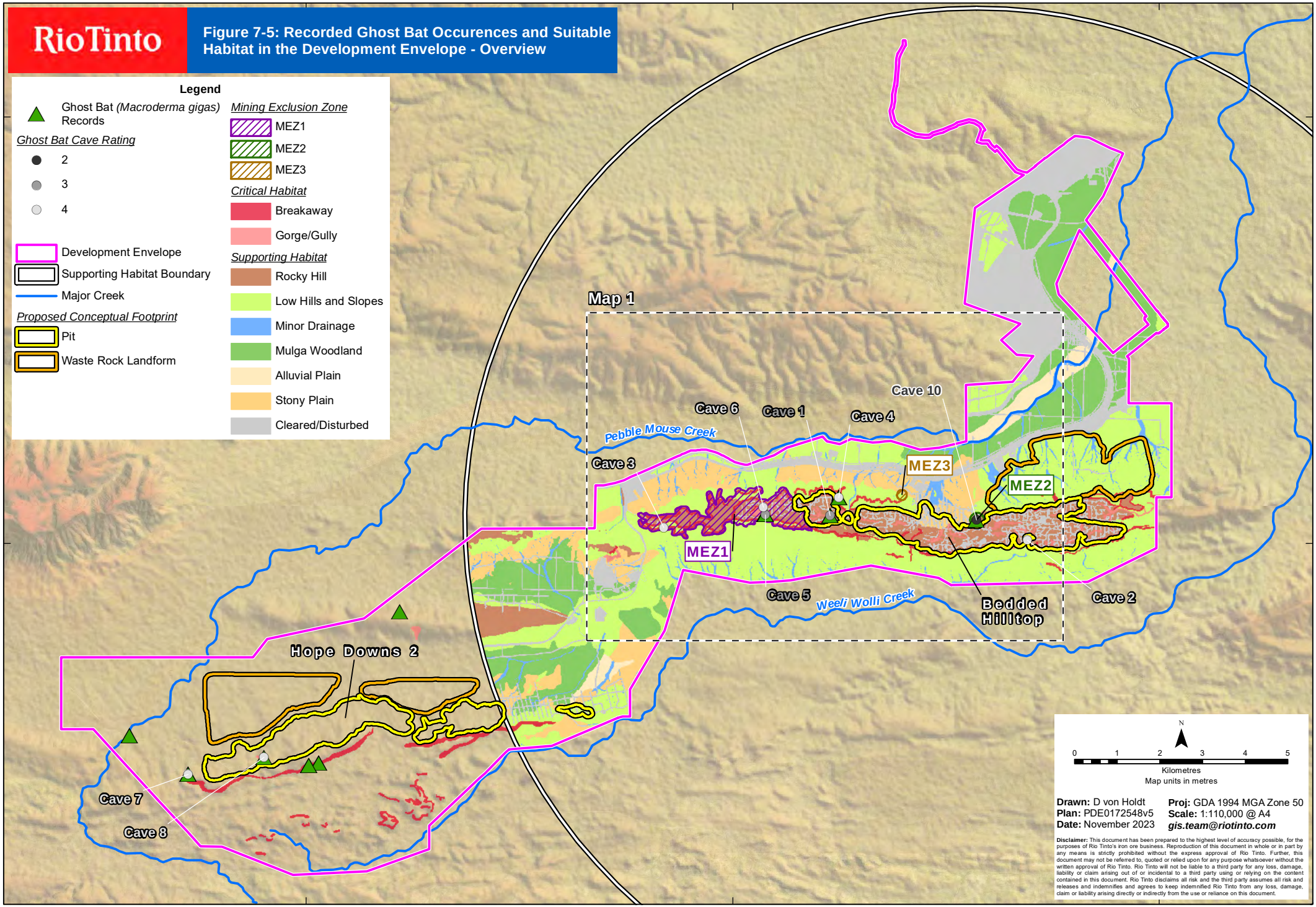
Nine cave structures were recorded within the Development Envelope (Section 7.3.2.2 and Figure 7-2). One was categorised as a Category 2 maternity/diurnal roost cave (Cave 10) due to it being regularly occupied by Ghost Bats (Astron 2020c). Two Category 3 diurnal roost caves (Cave 1 and Cave 5) were recorded, both near the BHT deposit. Due to the distance from Cave 10 (3.4 km and 4.9 km

respectively), neither are regarded as Critical habitat. Despite the single recorded occurrence of a roosting bat in Cave 8, it was categorised as a Category 4 nocturnal roost cave due to the lack of scat and echolocation records as well as the dimensions of the cave. All other caves identified within the Development Envelope (Cave 2, 3, 4, 6, and 7) were also categorised as Category 4 caves. The locations of Ghost Bat caves and recording sites are presented in Figure 7-5.

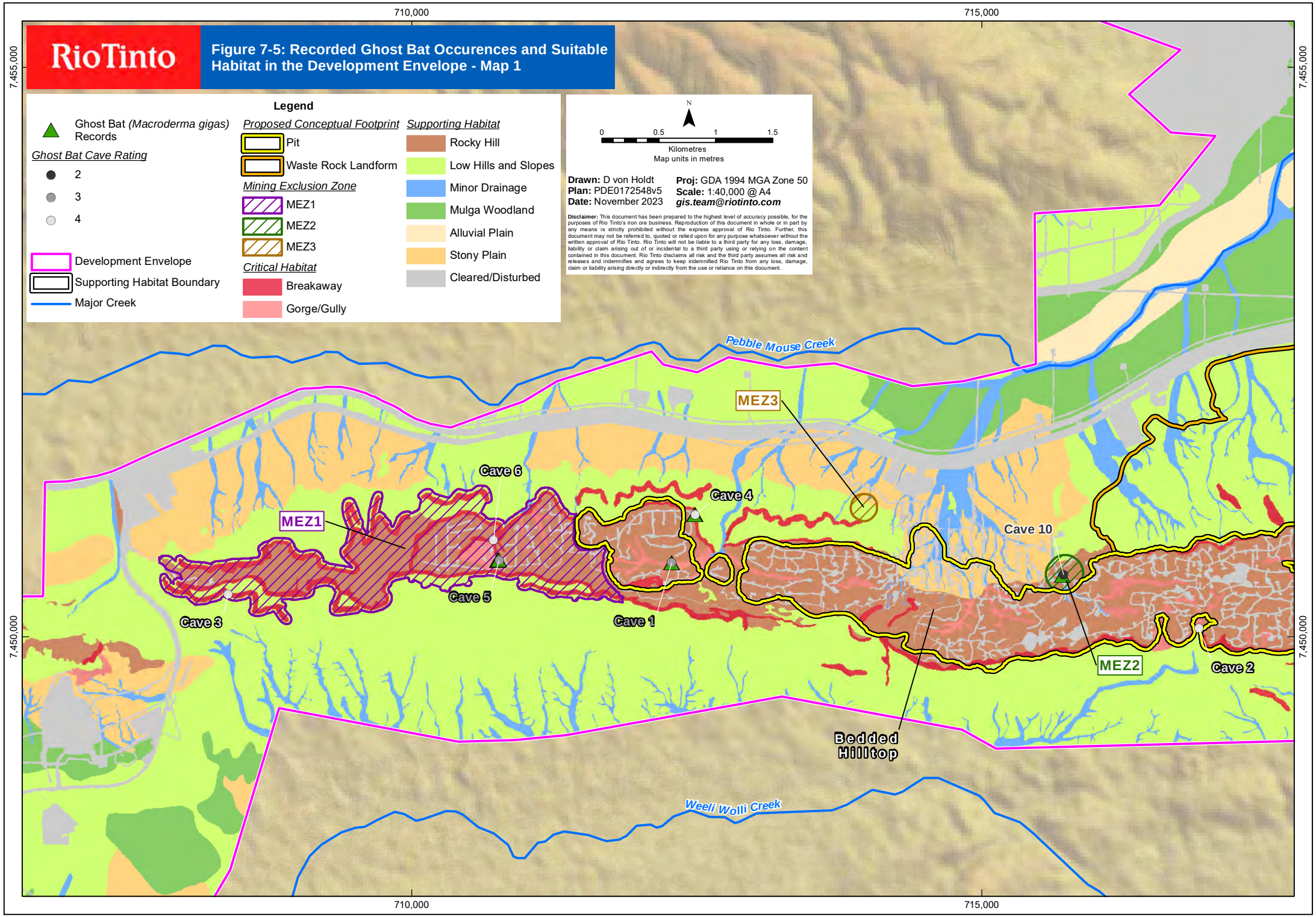
Most of the caves (7) within the Development Envelope were recorded within the Breakaway and Gorge/Gully habitat types and are considered to be Critical habitat and of high significance for the Ghost Bat. Supporting habitat for the species is considered to be all non-Critical habitat within the species home range (12 km from the Category 2 roost). Further characterisation of habitats within the Development Envelope and associated impact assessment is provided in Chapter 13.

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Figure 7-5: Recorded Ghost Bat Occurences and Suitable Habitat in the Development Envelope - Overview



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Figure 7-5: Recorded Ghost Bat Occurences and Suitable Habitat in the Development Envelope - Map 1
Legend
Ghost Bat (Macroderma gigas) Records
Ghost Bat Cave Rating
2
3
4
Development Envelope
Supporting Habitat Boundary
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3
Critical Habitat
Breakaway
Gorge/Gully
Supporting Habitat
Rocky Hill
Low Hills and Slopes
Minor Drainage
Mulga Woodland
Alluvial Plain
Stony Plain
Cleared/Disturbed
N
0
0.5
1
1.5
Kilometres
Map units in metres
Drawn: D von Holdt
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710,000
715,000
7,455,000
7,450,000
Pebble Mouse Creek
MEZ3
Cave 6
Cave 4
MEZ1
Cave 10
Cave 5
Cave 3
Cave 1
MEZ2
Cave 2
Bedded Hilltop
Weeli Wolli Creek

7.3.4.3. Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The Pilbara Leaf-nosed Bat (Plate 7-1) is listed as Vulnerable under the BC Act and EPBC Act. Within the Pilbara, the species is recognised as a geographically isolated population (or form) of the Orange Leaf-nosed Bat, distributed across northern Australia and separated from the Pilbara population by approximately 400 km of the Great Sandy Desert (Armstrong 2001). The Pilbara population represents a single interbreeding population comprising multiple colonies (TSSC 2016b). Currently, there are 48 confirmed permanent diurnal (Category 1 and 2) roost sites within the Pilbara region. Thirty-eight of these roosts are in BIFs in the Hamersley Ranges and eastern Pilbara (Bat Call WA 2021b). However, this is likely to be an underestimate based on unpublished data.



Source Rio Tinto:

Plate 7-3: Pilbara Leaf-nosed Bat

Pilbara Leaf-nosed Bats typically roost in undisturbed caves, deep fissures or abandoned mine shafts (Armstrong and Anstee 2000; Armstrong 2001). The species' limited ability to conserve heat and water (Baudinette et al. 2000) means they require warm (28 – 32ºC) and very humid (85 – 100%) roost sites to persist in arid and semi-arid climates (Armstrong 2001; Churchill 1991). Roost sites with such attributes are relatively uncommon in the Pilbara and the limiting factor of the species' distribution (Armstrong 2001). During the dry season (June to November), individuals are believed to aggregate in roosts that provide a suitably warm, humid microclimate (Armstrong and Anstee 2000; Armstrong 2001; Bullen and McKenzie 2011). While in the wet season (December to May), when conditions are generally wetter and more humid, individuals typically disperse roosting in seasonally suitable features (Armstrong and Anstee 2000; Armstrong 2001; Bullen and McKenzie 2011).

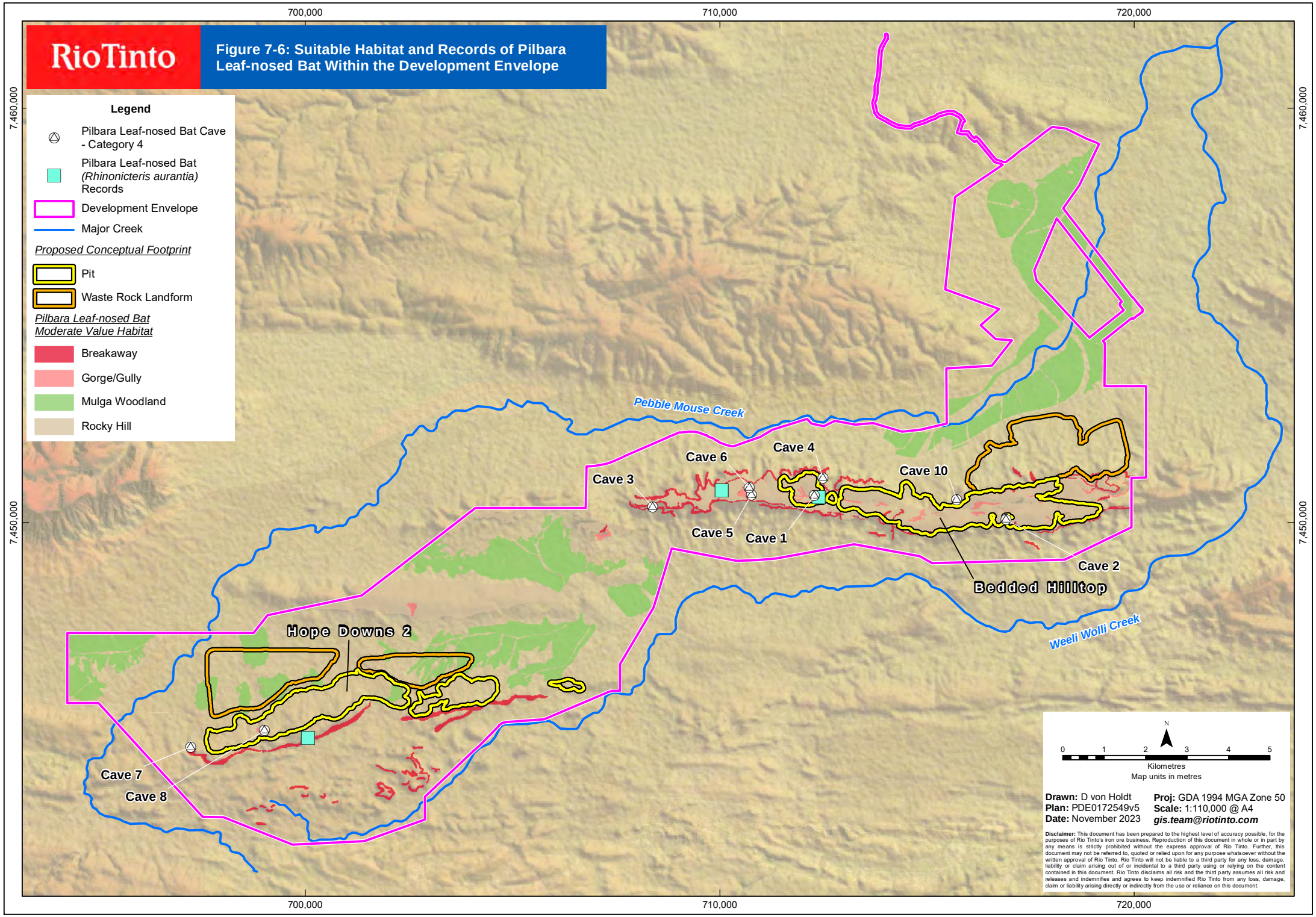
Records within the Development Envelope

The Hamersley subregion is known to support important populations of the Pilbara Leaf-nosed Bat. However, during bat surveys in the Development Envelope (a total of 125 nights of echolocation sampling), only three of the bat detection locations recorded any calls. This suggests a low level of activity within the Development Envelope (Astron 2019b). The locations where the calls were recorded

are presented in Figure 7-6. These recordings are believed to be from individuals foraging within the Gorge/Gully and Breakaway habitats present within the Development Envelope within three hours after dusk. Additionally, there have only been nine other recordings near the Development Envelope as recorded by the DBCA Threatened and Priority Fauna Database (Astron 2019b).

Suitable Habitat within the Development Envelope

The nine caves identified within the Development Envelope (Figure 7-2) were all categorised as nocturnal refuges for the Pilbara Leaf-nosed Bat (Category 4 roosts) (Figure 7-6) (Bat Call WA 2021b). This is supported by the limited number of Pilbara Leaf-nosed Bat calls recorded, which is consistent with the absence of any permanent roosts. The Development Envelope is not considered to contain Critical habitat for the Pilbara Leaf-nosed Bat. Further characterisation of habitats within the Development Envelope and associated impact assessment is provided in Chapter 13.


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Figure 7-6: Suitable Habitat and Records of Pilbara Leaf-nosed Bat Within the Development Envelope
Legend
Pilbara Leaf-nosed Bat Cave - Category 4
Pilbara Leaf-nosed Bat (Rhinonicteris aurantia) Records
Development Envelope
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Pilbara Leaf-nosed Bat Moderate Value Habitat
Breakaway
Gorge/Gully
Mulga Woodland
Rocky Hill
700,000
710,000
720,000
7,460,000
7,450,000
Pebble Mouse Creek
Cave 3
Cave 6
Cave 4
Cave 10
Cave 5
Cave 1
Cave 2
Bedded Hilltop
Hope Downs 2
Weeli Wolli Creek
Cave 7
Cave 8
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172549v5
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7.3.4.4. Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python (Plate 7-4) is listed as Vulnerable under the BC Act and EPBC Act. The species is Western Australia's largest snake, averaging 2.5 m, with records up to 4.5 m (Bush & Maryan 2011; Cogger 2014). It is endemic to the Pilbara and northern parts of the Gascoyne bioregions, distributed from Burrup Peninsula, Ord Ranges and Meentheena south to Nanutarra and Newman in the Pilbara, with an isolated population occurring at Mt Augustus in the Gascoyne region (Bush & Maryan 2011; Storr et al. 2002).



Source: Rio Tinto

Plate 7-4: Pilbara Olive Python

Records within the Development Envelope

The Pilbara Olive Python was not recorded either during the targeted MNES survey (Astron 2020b) or during the Level 2 Fauna Survey (Astron 2019b). However, the lack of sightings does not directly indicate the absence of the species from the Development Envelope. The species is notoriously difficult to sight directly due to its cryptic, elusive, and nocturnal nature (DEWHA 2008a). While only 14 historical records have been made of the python within 40 km from the centre of the Development Envelope, it is highly likely that Pilbara Olive Python would use the two creeklines as movement corridors and may even be resident on occasion.

Suitable Habitat within the Development Envelope

Pilbara Olive Pythons can be found in a variety of habitats but are found more often in moist habitats such as gorges, rivers, pools, and surrounding hills (Burbidge 2004; DSEWPaC 2011b). In the Hamersley region, this species is often noted near permanent waterholes in rocky ranges or among riverine vegetation (DSEWPaC 2011b; Pearson 1993). The species is most active in the summer months soon after dark, emerging from daytime shelters and foraging until the early morning hours

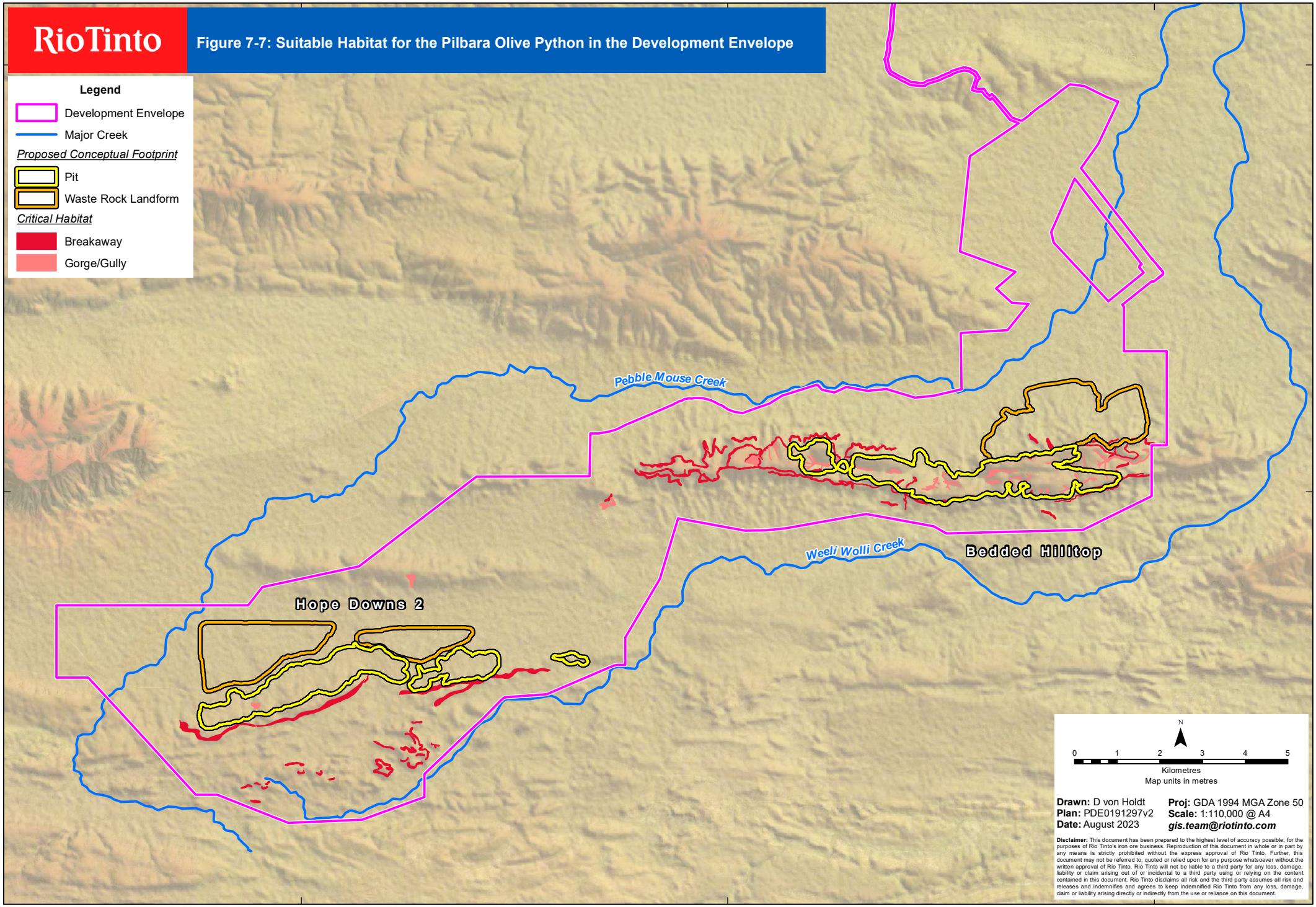
(DSEWPaC 2011b). Individuals spend the cooler winter months within caves and rock crevices away from water sources. Individuals occupy distinct home ranges (87 to 449 ha), and males can travel distances of up to 4 km during the breeding season (June to August) to locate females (DotEE 2019).

Despite the absence of records, the Development Envelope contains habitat types which are considered to be of high significance and critical for the survival of the species, specifically the Gorge/Gully and Breakaway habitat types. These habitats provide microhabitats such as ephemeral pools (Section 7.3.2.2), caves and overhangs which can be used for denning/breeding and foraging. The Minor Drainage habitat becomes seasonally inundated with water and has the potential to provide foraging and dispersal opportunities for the species and thus makes it of moderate significance. The Minor Drainage habitat type is considered to be Supporting habitat when it occurs within 1 km of recorded locations of the Pilbara Olive Python. There have been no records of the Pilbara Olive Python within the Development Envelope, therefore no Supporting habitat has been defined within the Development Envelope. The suitable habitat types are shown in Figure 7-7.

The Development Envelope also occurs between two major creek lines (Weeli Wolli Creek and Pebble Mouse Creek) which are highly likely to provide suitable foraging and dispersal habitat for the species.

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Figure 7-7: Suitable Habitat for the Pilbara Olive Python in the Development Envelope



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Plan: PDE0191297v2
Date: August 2023

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7.3.4.5. Oriental Plover (*Charadrius veredus*)

The Oriental Plover is listed as a Migratory species under the BC and EPBC Act. The Oriental Plover is a medium-size migratory bird that is a non-breeding visitor to Australia. The species is most often recorded on the north-western coast of Western Australia between Exmouth and Derby (DAWE 2021). The species breeding habitat includes arid grasslands and salt pans, while nonbreeding habitat includes grasslands, salt fields and coastal regions (Astron 2020b).

Records within the Development Envelope

One Oriental Plover was recorded within the Development Envelope by Astron (2019b). It was observed foraging on the oval at the Hope Downs 1 camp within the Development Envelope and was most likely attracted to the area due to the foraging opportunities. This record is likely to be from a vagrant individual as this species has never been recorded before within the Development Envelope and was not recorded during any subsequent surveys (Astron 2020b).

Suitable Habitat within the Development Envelope

The species is unlikely to occur within the Development Envelope on a regular basis and is unlikely to be highly dependent on any of the habitats present.

7.3.4.6. Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is listed as Vulnerable under the BC Act and EPBC Act. The species is endemic to mainland Australia and is the rarest of the six Australian members of the raptor genus Falco (Schoenjahn et al. 2019). Its small population size, estimated at fewer than 1,000 individuals, is the main factor, along with predation by feral cats, climate change, habitat loss and fragmentation caused by exotic herbivore grazing and land clearing, threatening the species (Schoenjahn et al.2019; TSSC 2020).

Records within the Development Envelope

Despite at least 448 hours across 22 surveys conducting searches, there have been no Grey Falcon records inside the survey area. The next closest record is approximately 45 km south-east of the survey area. The Proposal will not disturb this area; therefore, the Grey Falcon nest site will not be impacted.

Suitable Habitat within the Development Envelope

Potential suitable breeding and nesting habitat is available along sections of Weeli Wolli Creek, particularly at Weeli Wolli Spring (5 km to the east of the Development Envelope) (Astron 2023f) with Supporting foraging and dispersal habitat available within the Development Envelope.

7.3.4.7. Night Parrot (*Pezoporus occidentalis*)

The Night Parrot is listed as Endangered under the EPBC Act. The Night Parrot is a medium-sized ground dwelling bird associated with mature Spinifex habitat in arid and semi-arid regions. The species was not recorded during any of the fauna surveys and is considered unlikely to be present within or to occasionally utilise the habitats within the Development Envelope (Astron 2020b).

Records within the Development Envelope

No Night Parrot calls were recorded during the two consecutive fauna surveys (Astron 2019b and 2020b) which involved passive acoustic surveys using Autonomous Recording Units (ARUs) at multiple locations within the prospective habitat (Stony Plain habitat containing *Triodia* and Minor Drainage Line containing *Triodia*) over a total effort of 34 recording nights. The ARU data was analysed by Dr. Robert Bullen (Appendix I in Astron 2019b and Appendix G in Astron 2020b).

Previous fauna surveys conducted for the nearby Baby Hope (Biota 2015a), Hope Downs 4 (Ninox Wildlife Consulting 2009b), Mining Area C (Biologic 2017), West Angelas (Ecologia 2014, N. Jackett 2019) and Roy Hill (Ecologia 2009, Strategen 2018) proposals have not been able to confirm

the presence of the Night Parrot beyond the Fortescue Marshes, approximately 50 km north of the Development Envelope. This supports the work undertaken by Northover et.al. (2023) that demonstrates that the species is not known in or around the area of the Proposal. As of May 2023, the only occurrences of the Night Parrot within the Pilbara IBRA region have been in the Fortescue Marsh and there have been no new Night Parrot locations confirmed and announced from within the Pilbara IBRA region (Northover et.al. 2023).

Suitable Habitat within the Development Envelope

Astron (2019b) undertook a habitat assessment for the Night Parrot and concluded that the species was considered as having a Low likelihood of occurrence due to lack of old growth spinifex and chenopod shrublands, recent fires and prolonged presence of pastoral and mining activities in the area.

7.3.4.8. Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift is listed as a Migratory species under the BC and EPBC Act. The Fork-tailed Swift is a medium sized bird that has been recorded as occurring across much of the Australian continent from September to April, particularly in the continent's northern half (Higgins 1999). Within Western Australia, they are widespread on the nearshore and offshore islands and the coastal to subcoastal areas between Augusta and Carnarvon (Higgins 1999). The species has been recorded across the Pilbara region but being more common closer to the coast.

Records within the Development Envelope

The species is entirely aerial in Australia, foraging for flying insects and even sleeping on the wing. The species has not been recorded within the Development Envelope but was previously recorded in the Greater West Angelas Development Envelope in 2014 which is to the west of the Proposal Development Envelope (Astron 2019b.

Suitable Habitat within the Development Envelope

Due to its migratory and aerial nature the species is unlikely to occur within the Development Envelope on a regular basis and thus the habitat present is likely to only have a low to negligible significance for the species. No habitats within the Development Envelope are considered to be either Critical or Supporting habitat for the species.

7.3.4.9. Priority Fauna

A summary of the significant species, as listed by DBCA, recorded within the Development Envelope is presented in Table 7-9 and Figure 7-8. Some significant fauna species that were not recorded within the Development Envelope but have a high likelihood of occurring within the Development Envelope are presented in Table 7-10 and Figure 7-8.

Table 7-9: Priority Fauna Recorded within the Development Envelope

Species	Listed under DBCA	Broad Habitat Type	Presence within Development Envelope
Lerista macropisthopus remota	Priority 2	Species favours sandy to sandy loam soils which support *Acacia* shrublands and woodlands (Wilson and Swan 2010, as referenced by Astron 2019b.	This species has been recorded once during Phase 3 of the 2019 Fauna Survey (Astron 2019b) within the Mulga Woodland habitat. Other suitable habitat would include Alluvial Plain and Minor Drainage.
Letter-winged Kite (*Elanus scriptus*)	Priority 4	Species predominately occurs in open country and grasslands in arid and semi-arid regions of Australia. The bird roosts in the canopy of tall leafy trees in close proximity to streams and watercourse (Birdlife 2021).	One individual was sighted during Phase 2 of the 2019 Fauna Survey (Astron 2019b) within the Minor Drainage habitat. Other suitable habitat would include Stony Plain, Alluvial Plain and Mulga Woodland.
Western Pebble-mound Mouse (*Pseudomys chapmani*)	Priority 4	The species is common across the central and southern portions of the Pilbara (Start 2008 as referenced by Astron 2019b. Colonies generally occur on gentle slopes of rocky ranges where ground cover is dominated by Stony mulch and vegetated by hard *spinifex* and generally have a sparce overstory of *Eucalyptus.*	Nine records of this species were taken during the 2019 Fauna Survey (Astron 2019b). This includes three captured individuals and six mounds, four of which were active at the time. The records for this species came from a range of habitats including Stony Plain Rocky Hill and Mulga Woodland habitat.

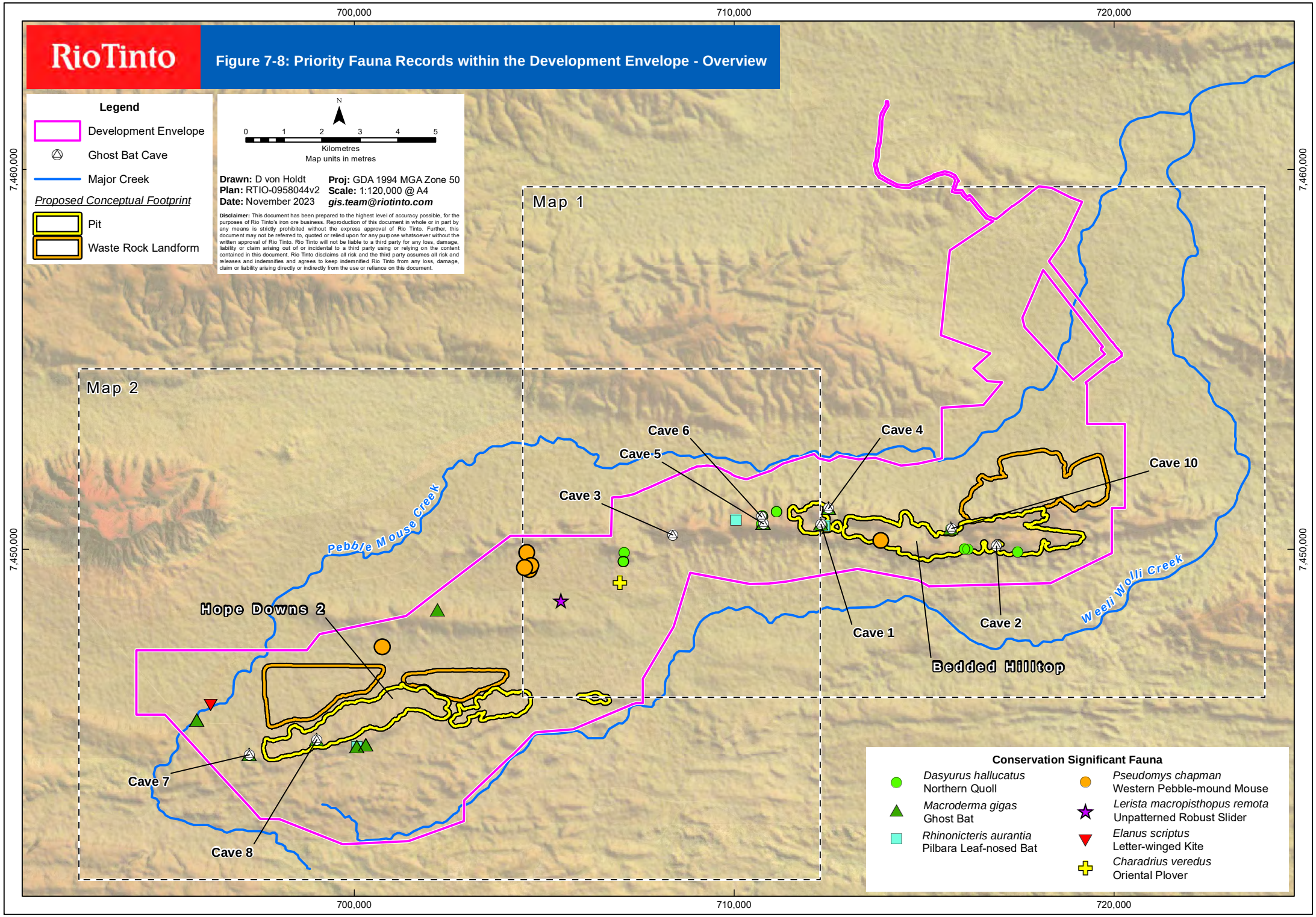
Table 7-10: Priority Fauna with a High Likelihood to Occur within the Development Envelope but Not Recorded

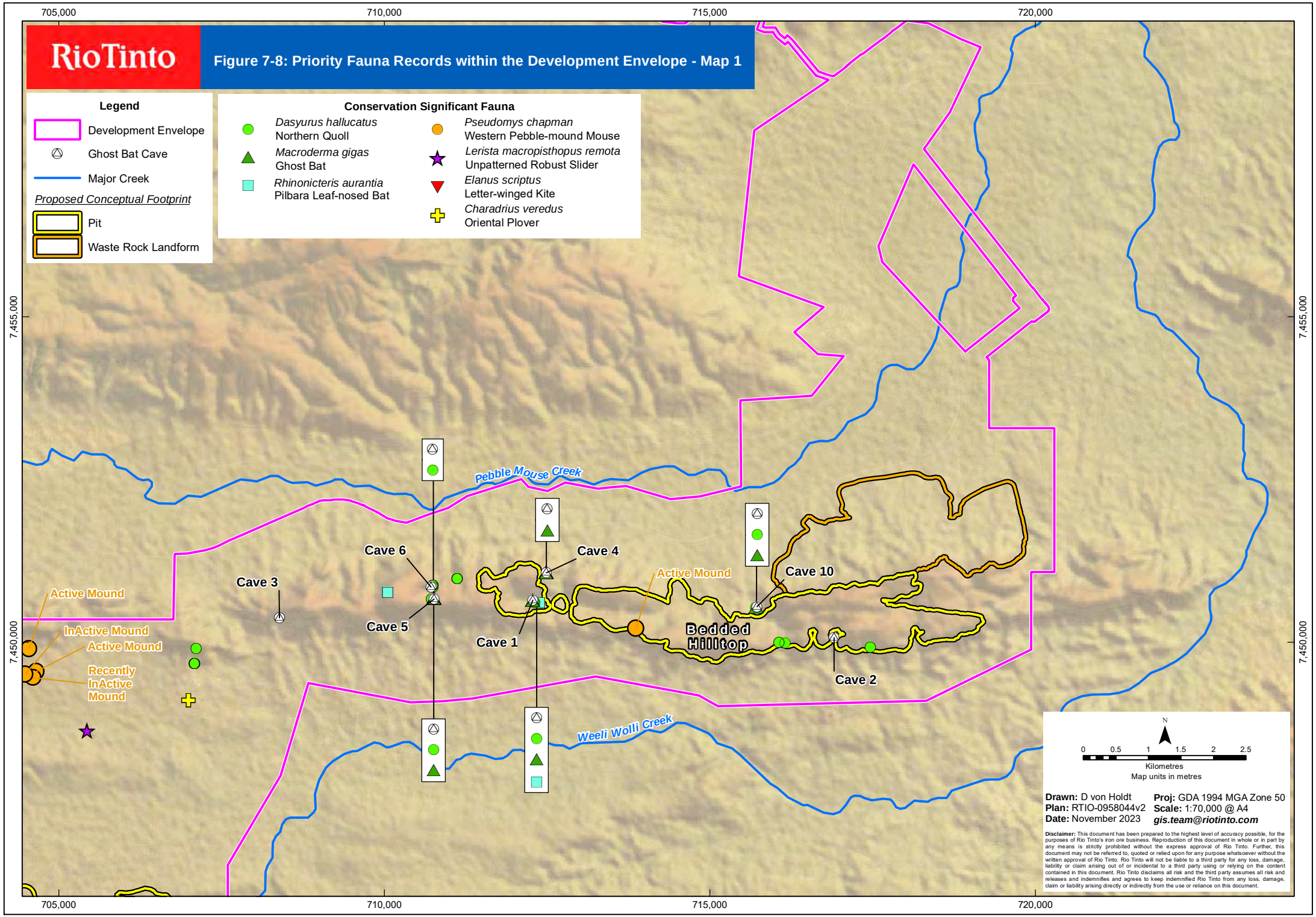
Species	Listed under DBCA	Broad Habitat Type	Presence within the Development Envelope
Gane's Blind Snake (*Anilios ganei*)	Priority 1	The ecology and habitat preference of the Gane's Blind Snake is poorly known. Records collected suggest that these species are likely to occur within moist gorges and gullies but may occur over a wide range of other Stony habitats such as Mulga woodlands and rocky slopes (Wilson and Swan as referenced in Astron 2019b).	The species has previously been identified within the Hope Downs Hub according to a 40 km Naturemap database search. However, there is limited knowledge on its preferred habitat. The species is considered highly likely to occur within suitable habitat within the Development Envelope including Gorges/Gully and Rocky Hill habitat.
Pilbara Barking Gecko (*Underwoodisaurus seorsus*)	Priority 2	Confined in the Pilbara to the Hamersley Ranges. Occurs in rocky areas with spinifex and low tree cover (Astron 2019b).	The species has been recorded within 30 km of the Hope Downs Hub. It is considered highly likely to occur in the Gorge/Gully and Rocky Hill fauna habitat within the BHT.

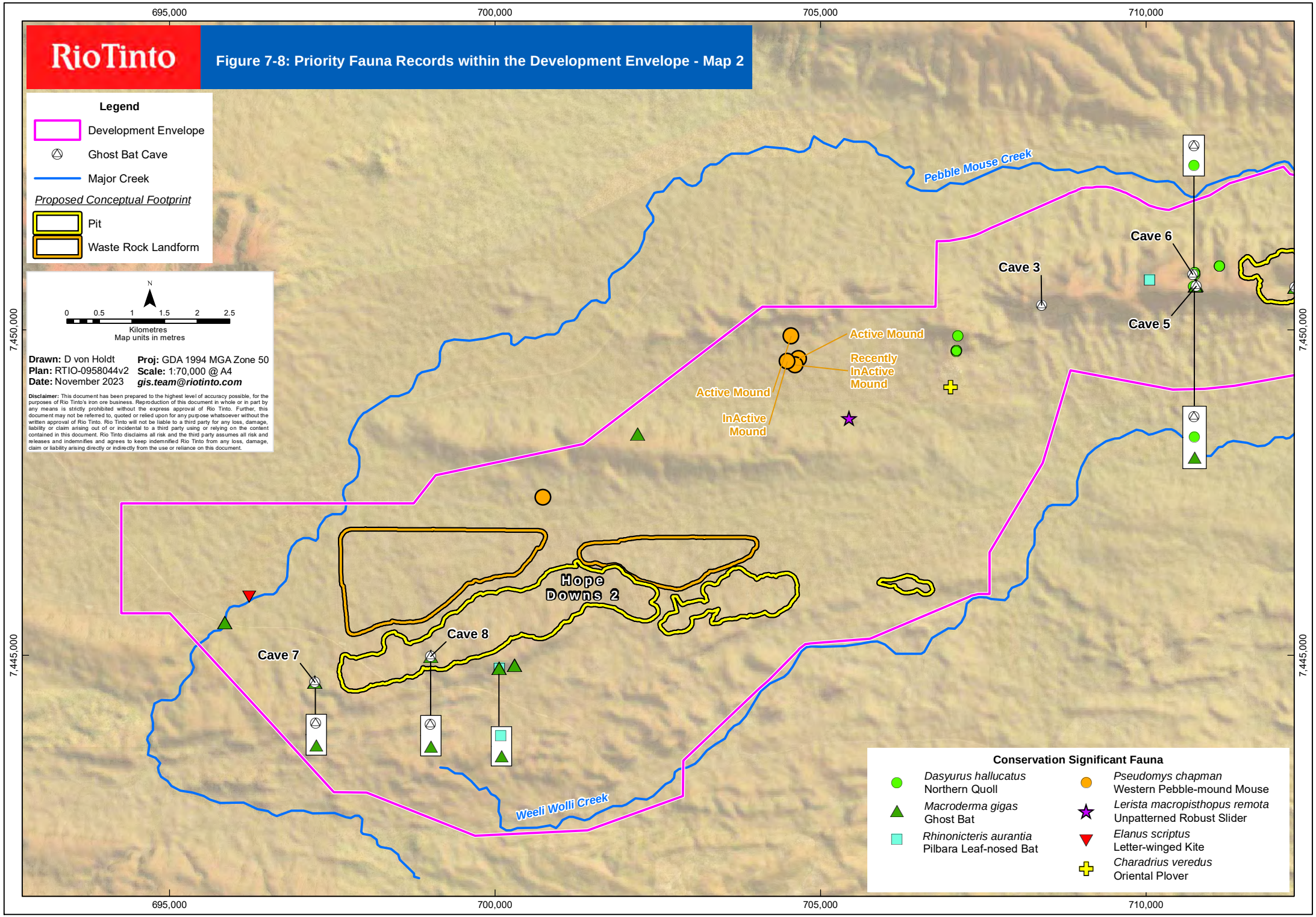
Desktop reviews indicated fourteen other significant species could also occur within the Development Envelope (Astron 2019b); however, only two of these species have a moderate likelihood to be present. These two species are the Peregrine Falcon and the Short-tailed Mouse, and they are discussed below:

- The Peregrine Falcon (*Falcon peregrinus*) (OS[4]) is considered to have a moderate likelihood of occurrence due to historical sightings of individuals within 40 km of the Development Envelope. Additionally, the Development Envelope contains suitable nesting habitat in the form of Gorge/Gully and Breakaway habitat and foraging habitat in the form of Minor Drainage. It is noted that even though this habitat is present, due to the species' ability to forage across multiple habitat types, it would be unlikely to be solely or chiefly reliant on habitat present within the Development Envelope.
- The Short-tailed Mouse *(Leggadina lakedownensis*) (P4) is considered to have a moderate likelihood of occurrence due to historical sightings of individuals within 40 km of the Development Envelope. This species generally occurs within open tussock and hummock grassland, *Acacia* shrubland and savannah woodland on alluvial clay/sandy soils. As such, the Short-tailed Mouse is likely to occur within the Alluvial Plain, Mulga Woodland and Minor Drainage habitat types within the Development Envelope. Despite the presence of these habitat types, it is generally difficult to confirm the presence of the species due to their elusive nocturnal nature and large home ranges, which on average are 5.3 ha (Watts 1976). Due to the large home ranges and widespread nature of their preferred habitat it is unlikely for the species to be solely or chiefly reliant on the habitat present within the Development Envelope and any impact to this habitat is unlikely to change the conservation status of the species.

[4] Protected under Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice under the (WA) *Biodiversity Conservation Act 2016* as fauna that is in need of special protection.


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Figure 7-8: Priority Fauna Records within the Development Envelope - Overview
Legend
Development Envelope
Ghost Bat Cave
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0958044v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @ A4
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700,000
710,000
720,000
7,460,000
7,450,000
Map 1
Map 2
Cave 6
Cave 5
Cave 4
Cave 10
Cave 3
Pebble Mouse Creek
Hope Downs 2
Cave 1
Cave 2
Weeli Wolli Creek
Bedded Hilltop
Cave 7
Cave 8
Conservation Significant Fauna
Dasyurus hallucatus
Northern Quoll
Macroderma gigas
Ghost Bat
Rhinonicteris aurantia
Pilbara Leaf-nosed Bat
Pseudomys chapman
Western Pebble-mound Mouse
Lerista macropisthopus remota
Unpatterned Robust Slider
Elanus scriptus
Letter-winged Kite
Charadrius veredus
Oriental Plover


RioTinto
Figure 7-8: Priority Fauna Records within the Development Envelope - Map 1
Legend
Development Envelope
Ghost Bat Cave
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Conservation Significant Fauna
Dasyurus hallucatus
Northern Quoll
Macroderma gigas
Ghost Bat
Rhinonicteris aurantia
Pilbara Leaf-nosed Bat
Pseudomys chapman
Western Pebble-mound Mouse
Lerista macropisthopus remota
Unpatterned Robust Slider
Elanus scriptus
Letter-winged Kite
Charadrius veredus
Oriental Plover
705,000
710,000
715,000
720,000
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7,450,000
Pebble Mouse Creek
Weeli Wolli Creek
Cave 1
Cave 2
Cave 3
Cave 4
Cave 5
Cave 6
Cave 10
Bedded Hilltop
Active Mound
InActive Mound
Active Mound
Recently InActive Mound
Active Mound
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
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Figure 7-8: Priority Fauna Records within the Development Envelope - Map 2
Legend
Development Envelope
Ghost Bat Cave
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0958044v2
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695,000
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7,445,000
Pebble Mouse Creek
Cave 6
Cave 3
Cave 5
Active Mound
Recently InActive Mound
Active Mound
InActive Mound
Hope Downs 2
Cave 8
Cave 7
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Conservation Significant Fauna
Dasyurus hallucatus
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Rhinonicteris aurantia
Pilbara Leaf-nosed Bat
Pseudomys chapman
Western Pebble-mound Mouse
Lerista macropisthopus remota
Unpatterned Robust Slider
Elanus scriptus
Letter-winged Kite
Charadrius veredus
Oriental Plover

7.3.4.10. Summary of Critical Fauna Habitat Types

The habitat types within the survey area and Development Envelope that are considered Critical to significant fauna species are summarised in Table 7-11 and shown in Figure 7-2.

Table 7-11: Critical and Supporting Fauna Habitat within the Survey Area and Surroundings

Species	Home Range	Critical Habitat in the Development Envelope	Supporting Habitat in the Development Envelope
Northern Quoll	Within 1 km of Northern Quoll record	• Gorge/Gully • Breakaway	• Rocky Hill (M) • Minor Drainage (M)
Ghost Bat	Within 12 km of a diurnal Category 2 roost (Cave 10)		• Alluvial Plain • Low Hills and Slopes • Rocky Hill (M) • Minor Drainage (M) • Mulga Woodland • Stony Plain
Pilbara Olive Python	Within 1 km of Pilbara Olive Python record		• N/A
Pilbara Leaf-nosed Bat	Within 10 km of a Category 2 or 3 roost	• No Critical habitat within the Development Envelope	• Category 4 Pilbara Leaf-nosed Bat caves

7.3.5. Short-range Endemics

7.3.5.1. SRE Habitat

Widespread habitat includes the generally low-lying landscape units with greater extent and connectivity throughout and beyond the Development Envelope. From the Astron (2020d) habitat mapping, this comprises the Alluvial Plain, Cleared, Low Hills and Slopes, Minor Drainage, and Stony Plain habitat units, all also considered of Low suitability for SRE fauna. Mulga Woodland, while considered of Moderate suitability for SRE fauna, is also widespread throughout and beyond the Development Envelope. Any SRE taxa recorded from these landscape units are likely to be at low risk from the Proposal.

Restricted habitat within the Development Envelope includes the largely elevated landscape units that are disconnected from other areas of similar habitat, this comprises the Rocky Hill habitat (of Moderate suitability for SRE fauna) and the Gorge/Gully and Breakaway habitat units (both considered of High suitability for SRE fauna).

The available habitat mapping, as well as local topographic and aerial mapping, indicate that the areas of restricted habitat within the central section of the BHT deposit, comprising Rocky Hill and associated Breakaway and Gorge/Gully, is highly isolated. The ridgeline of the BHT deposit lies almost entirely within the Development Envelope and is separated from other ridgelines by a large drainage system at the eastern end and a large expanse of low hills, plains, and woodland on the other three sides. In addition, the proposed Conceptual Footprint covers much of the ridgeline.

Habitat suitability for SREs is summarised in Table 7-12 and Figure 7-9.

Table 7-12: Suitability of SRE Habitat within the Development Envelope

Habitat Type	Suitability for SREs	SRE Habitat Description	Extent within the Development Envelope (ha)*
Breakaway	High	Habitat possess abundance of boulders and screes providing diverse microhabitats for both habitat specialist and moisture dependent species.	224
Gorge/Gully		Habitat has deeply carved rock incisions that provide shade, creating microhabitats that contain a high diversity.	63
Rocky Hill		Habitat possess abundance of high elevation rock feature which provide high diversity of microhabitats	967
Alluvial Plain	Moderate	Habitat has good diversity of microhabitats with some tree hollows and logs with some areas of sandy soil and dense leaf litter.	340
Minor Drainage		Habitat generally has reduced diversity and density of vegetation. However, it also does possess areas of moist leaf litter and semi-permanent water features.	918
Mulga Woodland		Habitat dominated by Mulga with stony mantle, soil generally soft (suitable borrowing species) and deep leaf litter layer.	1,831
Low Hills and Slopes	Low	Habitat had low vegetation complexity and low diversity of habitats.	5,116
Stony Plain		Habitat was generally exposed with low microhabitat diversity.	1,517

*Area (ha) rounded

Although SRE suitability of the Alluvial Plain habitat was considered to be low overall, targeted 'blacklighting' searches within specific microhabitats recorded a number of scorpions and pseudoscorpions. Several potential SRE species were also recorded at the vertebrate trapping sites within the Alluvial Plain habitat, including some trapdoor spider species, millipedes and isopods.

7.3.5.2. SRE Records

In total, two Confirmed and 35 Potential SRE invertebrate taxa have been recorded within the Development Envelope. Of these, 19 Potential SRE taxa are known only from within the Development Envelope, ten of which are currently only known from within the proposed Conceptual Footprint (Table 7-12, Figure 7-9). Two confirmed SRE taxa, *Aurecocrypta* `HD1` and *Pseudodiploexochus* `C75046` were recorded within the Development Envelope (Biologic 2022).

Of the highly suitable habitats within the Development Envelope:

- The Breakaway habitat type recorded four potential SRE species
- The Gorge/Gully habitat type recorded 15 potential SRE species and one confirmed SRE species
- The Rocky Hill habitat type recorded eight potential SRE species and one confirmed SRE species.

The highest number of SRE species recorded within the moderately suitable habitats was the Mulga Woodland with eight potential SRE species. It is also noted that despite the Stony Plain being identified as being of low suitability for SRE species, 16 potential SRE species were recorded (the highest out of all habitats present). This is potentially due to the sampling bias of pitfall traps being used in the Stony

Plain habitat type. It is noted that even though these potential SREs were recorded in the Stony Plain habitat, they are less likely to be true SRE species as the habitats they are recorded from are widespread and typically do not support SRE species (Astron 2019b).

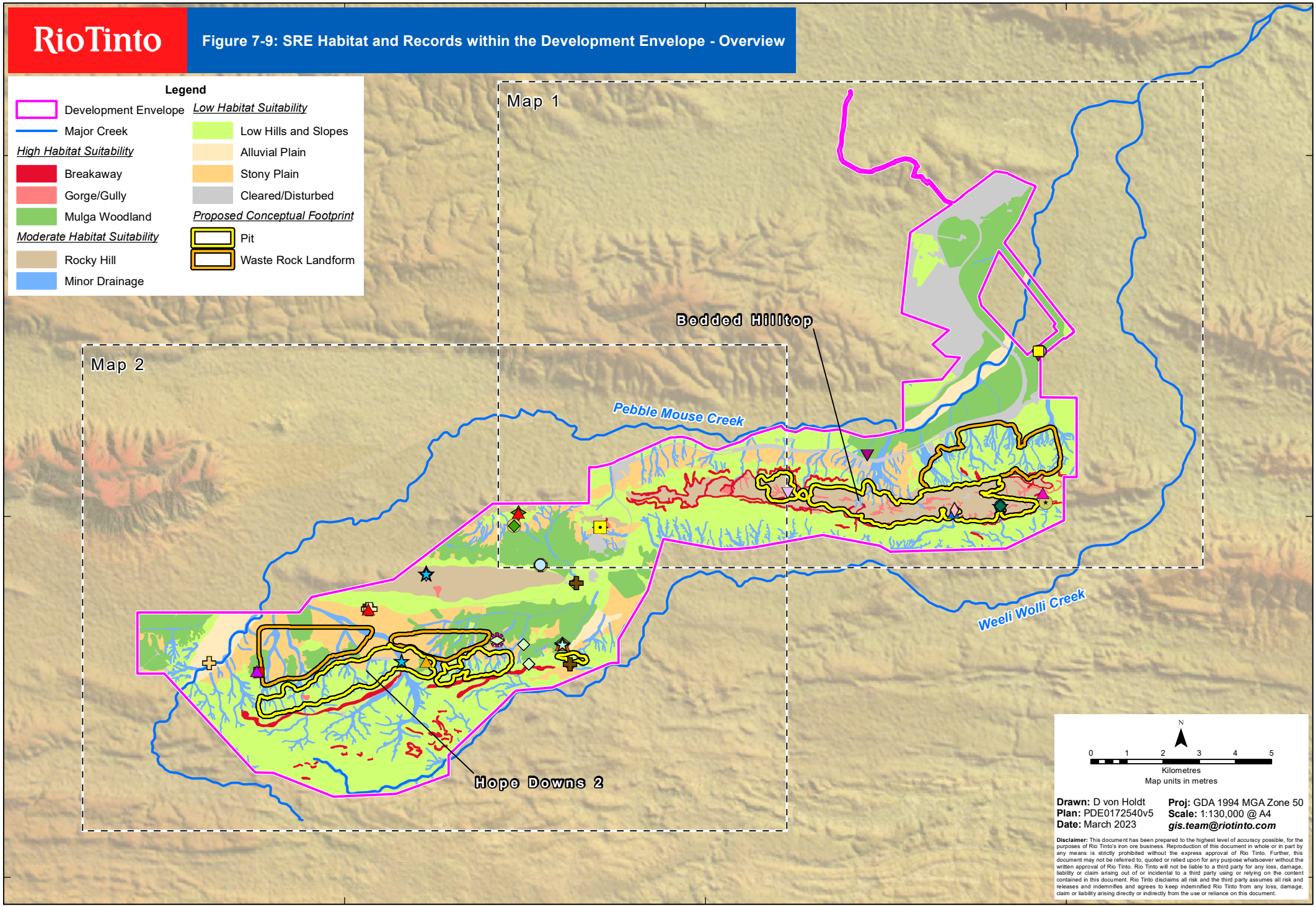
Table 7-13: SRE Species Recorded within the Development Envelope

Taxon	SRE Classification	Habitat Type
Spiders		
Missulena 'MYG04'	Potential SRE	Mulga Woodland
Aname 'R6'	Potential SRE	Stony Plain
Kwonkan 'MYG339'	Potential SRE	Mulga Woodland
Teyl heuretes	Confirmed SRE	Mulga Woodland
Aurecocrypta 'HD1'	Potential SRE	Stony Plain
Aurecocrypta 'MYG315'	Potential SRE	Stony Plain
Synothele 'MYG055' DNA	Potential SRE	Mulga Woodland
Synothele 'MYG309'	Potential SRE	Mulga Woodland
Synothele 'MYG311'	Potential SRE	Mulga Woodland
Conothele 'MYG002'	Potential SRE	Mulga Woodland
Karaops banyjima	Confirmed SRE	Gorge/Gully and Rocky Hill
Karaops sp. 'ARA001'	Potential SRE	Gorge/Gully
Pseudoscorpions		
Austrochthonius 'PSE135', pilbara	Potential SRE	Mulga Woodland
Tyrannochthonius 'HD2'	Potential SRE	Gorge/Gully
Austrohorus 'HD5'	Potential SRE	Gorge/Gully
Euryolpium 'HD6'	Potential SRE	Stony Plain
Euryolpium 'HD7'	Potential SRE	Breakaway
Olpiidae 'Genus 7/4' 'PSE118'	Potential SRE	Gorge/Gully
Olpiidae 'PSEAAA' 'HD4'	Potential SRE	Mulga Woodland
Scorpions		
Lychas 'bituberculatus complex'	Potential SRE	Low Hills and Slopes, Minor Drainage, Stony Plain
Lychas 'hairy tail complex'	Potential SRE	Stony Plain
Lychas 'multipunctatus complex'	Potential SRE	Minor Drainage and Stony Plain
Urodacus 'HD1' DNA	Potential SRE	Gorge/Gully

Taxon	SRE Classification	Habitat Type
Centipedes		
Sepedonophilus 'HD1'	Potential SRE	Gorge/Gully and Rocky Hill
Sepedonophilus 'HD2'	Potential SRE	Cleared
Mecistocephalus 'HD1'	Potential SRE	Gorge/Gully and Rocky Hills
Mecistocephalus 'HD2'	Potential SRE	Cleared
Mecistocephalus 'HD3'	Potential SRE	Stony Plain
Orphnaeus 'HD1'	Potential SRE	Cleared
Cryptops 'HD1'	Potential SRE	Stony Plain
Millipedes		
Antichiropus 'wonmunna, DIP163'	Potential SRE	Mulga Woodland
Austrostrophus 'Clade A'	Potential SRE	Breakaway
Austrostrophus 'Clade E'	Potential SRE	Minor Drainage, Mulga Woodland and Stony Plain
Isopods		
Buddelundia '10ma'	Potential SRE	Low Hills and Slopes and Stony Plain
Buddelundia '10ts'	Potential SRE	Various Habitats
Buddelundia '77'	Potential SRE	Gorge/Gully, Rocky Hill and Stony Plain
Pseudodiploexochus 'C75046'	Potential SRE	Gorge/Gully

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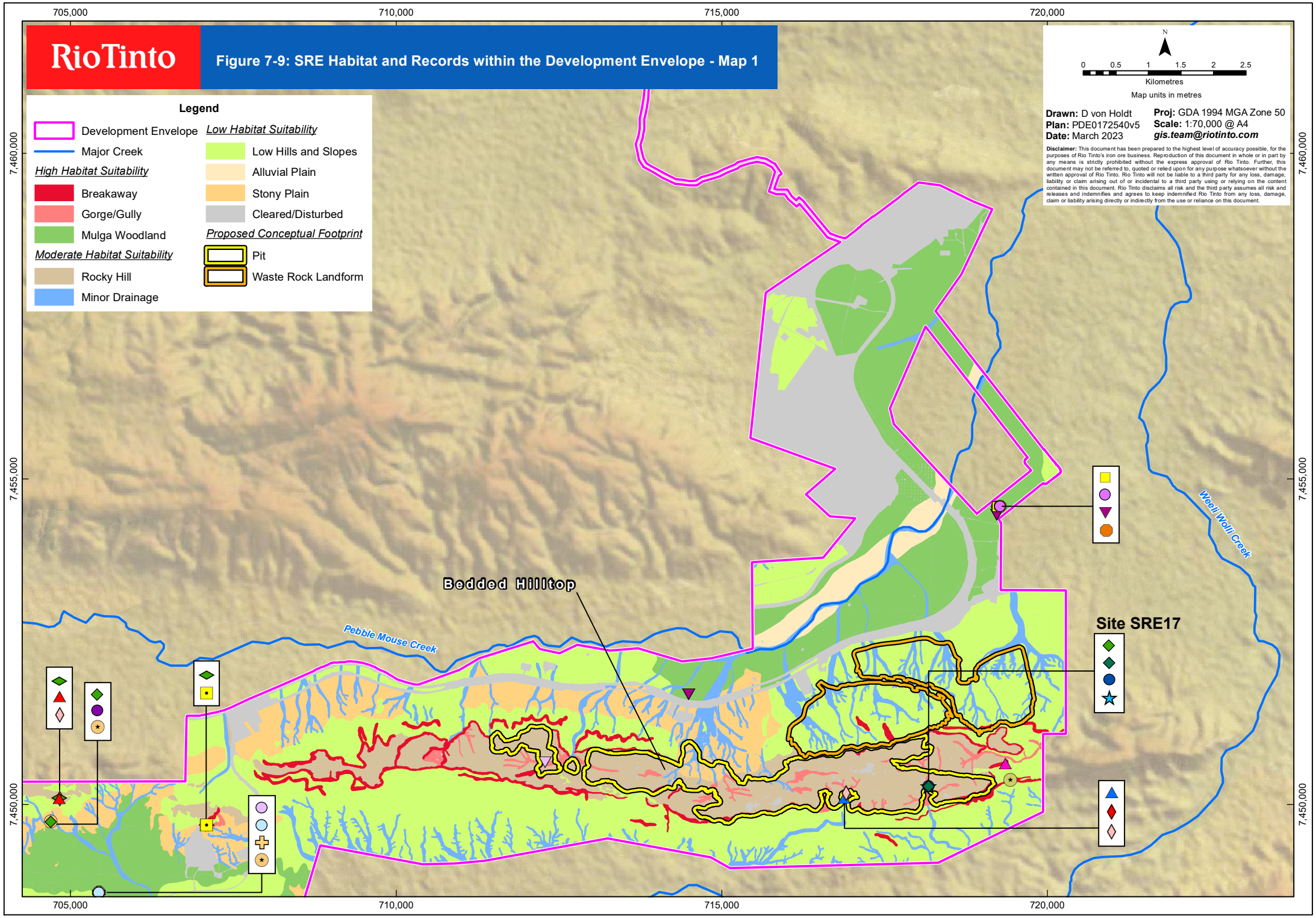
Figure 7-9: SRE Habitat and Records within the Development Envelope - Overview

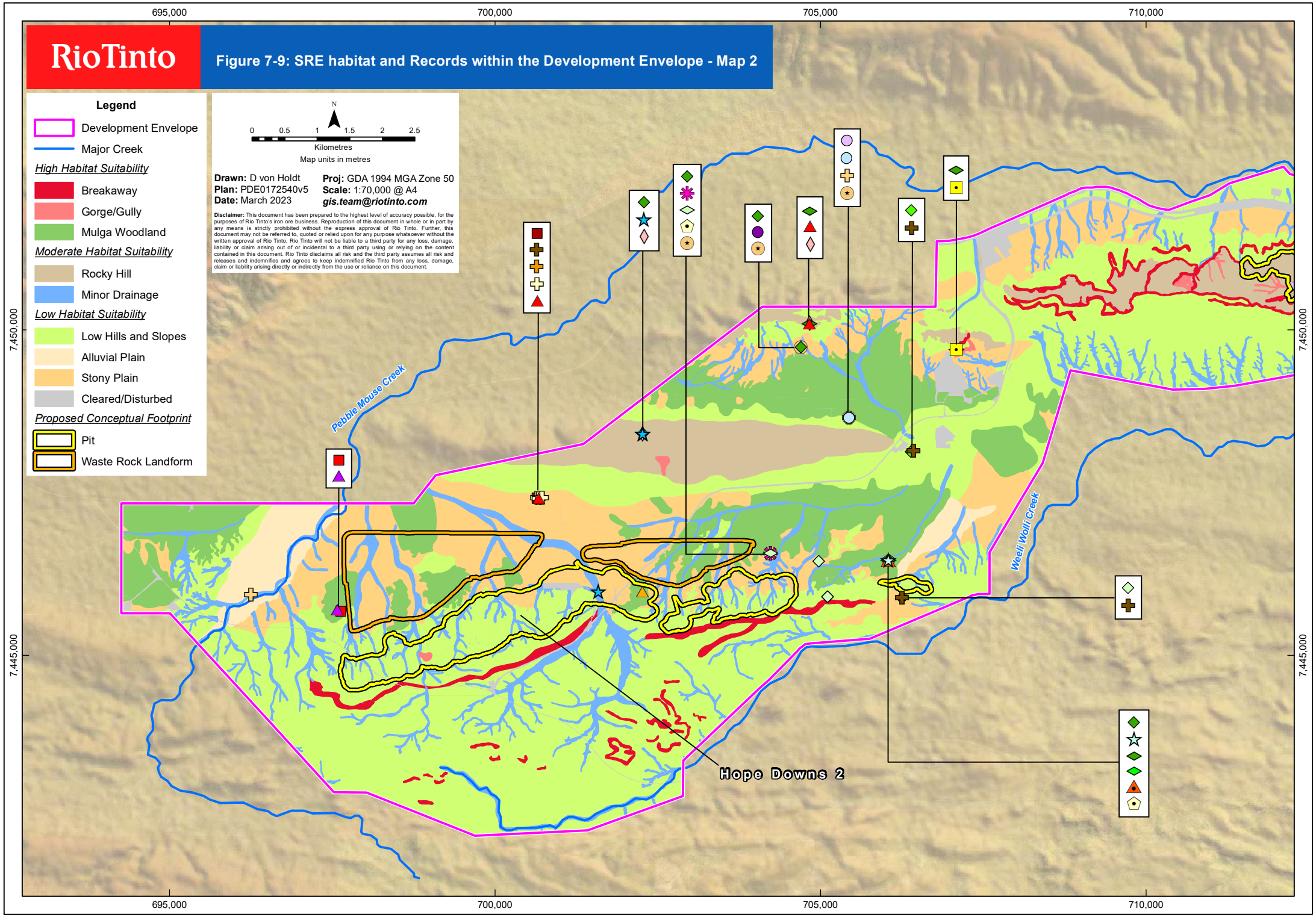


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Plan: PDE0172540v5
Date: March 2023

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Figure 7-9: SRE Habitat and Records within the Development Envelope - Map 1
Legend
Development Envelope
Major Creek
High Habitat Suitability
Breakaway
Gorge/Gully
Mulga Woodland
Moderate Habitat Suitability
Rocky Hill
Minor Drainage
Low Habitat Suitability
Low Hills and Slopes
Alluvial Plain
Stony Plain
Cleared/Disturbed
Proposed Conceptual Footprint
Pit
Waste Rock Landform
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
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705,000
710,000
715,000
720,000
7,460,000
7,455,000
7,450,000
Bedded Hilltop
Site SRE17
Pebble Mouse Creek
Weeli Wolli Creek


RioTinto
Figure 7-9: SRE habitat and Records within the Development Envelope - Map 2
Legend
Development Envelope
Major Creek
High Habitat Suitability
Breakaway
Gorge/Gully
Mulga Woodland
Moderate Habitat Suitability
Rocky Hill
Minor Drainage
Low Habitat Suitability
Low Hills and Slopes
Alluvial Plain
Stony Plain
Cleared/Disturbed
Proposed Conceptual Footprint
Pit
Waste Rock Landform
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
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695,000
700,000
705,000
710,000
7,450,000
7,445,000
Pebble Mouse Creek
Weeli Wolli Creek
Hope Downs 2

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Figure 7-9: SRE Habitat and Records within the Development Envelope - Legend

Family, Full Name

- Anamidae, *Aname* `R6`
- Anamidae, *Kwonkan* `MYG339`
- Anamidae, *Teyl heuretes*
- Armadillidae, *Buddelundia* `10ma`
- Armadillidae, *Buddelundia* `10ts`
- Armadillidae, *Buddelundia* `77`
- Armadillidae, *Pseudodiploexochus* `C75046`
- Barychelidae, *Aurecocrypta* `HD1`
- Barychelidae, *Aurecocrypta* `MYG315`
- Barychelidae, *Synothele* `MYG055`
- Barychelidae, *Synothele* `MYG309`
- Barychelidae, *Synothele* `MYG311`
- Buthidae, *Lychas* `bituberculatus complex`
- Buthidae, *Lychas* `hairy tail complex`
- Buthidae, *Lychas* `harveyi complex`
- Buthidae, *Lychas* `multipunctatus complex`
- Chilenophilidae, *Sepedonophilus* `HD1`
- Chilenophilidae, *Sepedonophilus* `HD2`
- Chthoniidae, *Austrochthonius* `PSE135`
- Chthoniidae, *Tyrannochthonius* `HD2`
- Cryptopidae, *Cryptops* `HD1`
- Halonoproctidae, *Conothele* `MYG002`
- Mecistocephalidae, *Mecistocephalus* `HD1`
- Mecistocephalidae, *Mecistocephalus* `HD2`
- Mecistocephalidae, *Mecistocephalus* `HD3`
- Olpiidae, *Austrohorus* `HD5`
- Olpiidae, *Euryolpium* `HD6`
- Olpiidae, *Euryolpium* `HD7`
- Olpiidae, `Genus 7/4` `PSE118`
- Olpiidae, `PSEAAA` sp. `HD4`
- Oryidae, *Orphnaeus* `HD1`
- Paradoxosomatidae, *Antichiropus* `DIP163`
- Selenopidae, *Karaops* `ARA001`
- Selenopidae, *Karaops banyjima*
- Trigoniulidae, *Austrostrophus* `clade A`
- Trigoniulidae, *Austrostrophus* `clade E`
- Urodacidae, *Urodacus* `HD1`

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7.3.6. Key Terrestrial Fauna Values

The key environmental values associated with Terrestrial Fauna include:

- **Significant fauna:**
  - **Northern Quoll (EN)**
  - **Ghost Bat (VU)**
  - **Pilbara Leaf-nosed Bat (VU)**
  - **Pilbara Olive Python (VU)**
  - **Oriental Plover (M)**
  - **Grey Falcon (VU)**
  - **Fork-tailed Swift (M)**
- **Critical and Supporting habitat in the Development Envelope for significant fauna:**
  - **Critical denning, roosting and/or shelter habitats:**
    - **Breakaway – high significance (223.6 ha)**
    - **Gorge/gully – high significance (63.2 ha)**
  - **Supporting foraging and dispersal habitats:**
    - **Minor Drainage – moderate significance (917.9 ha)**
    - **Rocky Hill – moderate significance (967.3 ha)**
    - **Alluvial Plain – low significance (340.5 ha)**
    - **Low Hills and Slopes – low significance (5,116.3 ha)**
    - **Mulga Woodland – low significance (1,831.2 ha)**
    - **Stony Plain – low significance (1,517.5 ha)**
- **Suitable habitat for the Oriental Plover (M), Grey Falcon (VU), Fork-tailed Swift (M), *Lerista macropisthopus remota* (P2), Pilbara Barking Gecko (P2), Gane's Blind Snake (P1), Western Pebble-mound Mouse (P4), and Letter-winged Kite (P4)**
- **Nine Category 4 roosts for the Pilbara Leaf-nosed Bat within the Development Envelope**
- **One Category 2 roost, two Category 3 roosts and six Category 4 roosts for the Ghost Bat within the Development Envelope.**
- **Approximately 1,254 ha of Gorge/Gully, Breakaway and Rocky Hill habitat within the Development Envelope considered to be of high significance to potential SRE species.**

7.4. Potential Environmental Impacts

7.4.1. Direct Impacts

Direct impacts of the Proposal to fauna and fauna habitat have been identified as:

- Clearing of fauna habitat and habitat fragmentation
- Loss of fauna individuals
- Clearing of SRE habitat and loss of SRE individuals.

7.4.1.1. Clearing of Fauna Habitat and Habitat Features and Habitat Fragmentation

Clearing of Habitat

Clearing of habitat can lead to the direct mortality of individuals, forced relocation of fauna and reduction of breeding and foraging habitat. The Proposal will result in the clearing of up to 4,900 ha of fauna habitat across eight habitat types. Indicative clearing requirements for each habitat type (except areas already cleared), based on the proposed Conceptual Footprint, are outlined in Table 7-15 and shown in Figure 7-2. Based on the proposed Conceptual Footprint, the Proposal will necessitate the clearing of approximately:

- 105 ha of high value habitat, comprising:
  - 67 ha of Breakaway habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python
  - 38 ha of Gorge/Gully habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python.
- 2,659 ha of moderate value, comprising:
  - 369 ha of Rocky Hill habitat – considered to be Supporting for Northern Quoll, Grey Falcon and Ghost Bat
  - 269 ha of Minor Drainage habitat – considered to be Supporting for Northern Quoll, Ghost Bat, and Grey Falcon.
  - 70 ha of Alluvial Plain habitat – considered to be Supporting for Ghost Bat
  - 917 ha of Low Hills and Slopes habitat – considered to be Supporting for Ghost Bat
  - 601 ha of Mulga Woodland habitat – considered to be Supporting for Ghost Bat
  - 433 ha of Stoney Plain habitat – considered to be Supporting for Ghost Bat

The remainder of the clearing will involve low value habitats as well as those areas that are already cleared / disturbed.

In terms of significant habitat features (Figure 7-2), the Proposal has the potential to impact on two of the nine caves recorded within the Development Envelope, comprising Cave 1 (Category 3 Ghost Bat roost) and Cave 8 (Category 4 Ghost Bat roost), both caves are also classified as Category 4 Pilbara Leaf-nosed Bat caves (Table 7-14). Neither of these caves are considered to be critical to the survival of either species.

Table 7-14: Caves potentially impacted within the Development Envelope for Ghost Bat and Pilbara Leaf-nosed Bats

Caves Potentially Impacted	Ghost Bat Cave Category (Ball Call WA 2021a)	Pilbara Leaf-nosed Bat Cave Category (Bat Call WA 2021b)
Cave 1 (BHT)	Category 3	Category 4
Cave 8 (HD2)	Category 4	Category 4

Habitat Fragmentation

Fragmentation, the process by which contiguous areas of habitat are interrupted or separated into two or more smaller areas, can result in the following impacts on fauna:

- Altered movement patterns or reduced ability to disperse and recolonise
- Genetic isolation
- Increased competition for resources
- Habitat degradation
- Reduced species richness.

The impacts of habitat fragmentation as a result of clearing for the Proposal have the greatest potential along Pebble Mouse Creek and other ephemeral drainage lines, as well as where Breakaway and Gorge/Gully habitats are intersected by linear infrastructure, such as roads and corridors. Extensive areas of Low Hills and Slopes habitat allow for movement of fauna through the landscape.

Table 7-15: Indicative Disturbance – Fauna Habitat Types

Fauna Habitat Type	Total Area within the Development Envelope (ha)*	Approximate Impact within the Development Envelope		Approximate Remaining within the Development Envelope	
		Area Impacted (ha)	Proportion of Total Extent within Development Envelope (%)	Area Remaining (ha)	Proportion of Total Extent Remaining within Development Envelope (%)
High Value					
Breakaway	224	57	25.4	167	74.6
Gorge/Gully	63	36	57	27	43
Moderate Value					
Minor Drainage	918	475	51.8	442	48.2
Rocky Hill	967	369	38.2	598	61.8
Low Value					
Alluvial Plain	340	77.5	22.5	264	77.5
Low Hills and Slopes	5,116	1,530	29.9	3,587	70.1
Mulga Woodland	1,831	781	42.7	1,050	57.3
Stony Plain	1,517	879	57.9	638	42.1
Cleared/ Disturbed	1,432	695	48.6	737	51.4

* Areas (ha) have been rounded to the nearest hectare.

7.4.1.2. Loss of Fauna Individuals

Fauna within the Development Envelope may be at risk of death, injury or displacement due to:

- Fauna being injured/killed by collisions with or crushing of fauna due to earthmoving equipment or vehicles during operations
- Entrapment within excavations
- Injury or mortality because of entanglement in fencing.

Due to the direct interface between vehicle and machinery movement and fauna habitats, fauna would be most at risk of death or injury during clearing activities. Species at risk of vehicle strike include slow-moving, easily startled and nocturnal animals. Vehicle movements at night are more likely to strike native fauna as visibility is reduced, and many mammal species are nocturnal. Species such as birds of prey are also likely to feed off dead carcasses on roads and become victims of vehicle strikes during the day.

Direct loss of individuals may occur for small mammals, particularly burrowing species (e.g. Western Pebble-mound Mouse). As these species burrow below ground during the day, they are at risk of mortality from clearing as they may not move away from the clearing front.

Trenches, excavations, and water storage structures often have steep, slippery sides which prevent fauna that fall into them from escaping. Fauna may also be attracted to waste storage bins or domestic waste facilities and become trapped. Entrapment may lead to fauna injury or death from starvation, dehydration, drowning, bogging or injury.

Bat species (especially Ghost Bats) and some birds can become entangled in barbed-wire fences, causing injury and death.

7.4.1.3. Loss of SRE Individuals and Habitat due to Clearing

The level of impact to significant habitat or populations of SRE taxa from mining activities in a particular area can be assessed by considering the taxa recorded for an area and the level to which significant habitats have been surveyed. Table 7-16 describes the level of risk from impact based on what is known of a particular taxon's range, the habitat that it occurs in and the amount of that habitat that will be impacted by mining activities, i.e. the proposed footprint. This is of particular relevance to taxa that, to date, have been collected from single sites within the Development Envelope.

Table 7-16: Definition of Level of Risk for SRE Invertebrate Fauna and Habitats (Biologic 2022)

Category	Description
High	Taxonomic factors indicate that a species is likely to be restricted in range based on what is known of the genus or species, it has been collected from a restricted habitat type and a significant proportion of the known or likely habitat that it occurs in will be removed by mining activities (inside proposed Conceptual Footprint).
Medium	Taxonomic factors indicate that a species is possibly restricted in range based on what is known of the genus or species, it has been collected from a restricted habitat type and a significant proportion of the known or likely habitat that it occurs in will be removed by mining activities (inside proposed Conceptual Footprint).
Low	Taxonomic factors indicate that a species is possibly restricted in range based on what is known of the genus or species, it has been collected from a widespread habitat type.

Of the 38 taxa recorded within the Development Envelope, 27 were collected from outside the proposed Conceptual Footprint, most in widespread or varied habitats, and many also from beyond the Development Envelope (see Table 7-17 and Figure 7-9). These 27 taxa are considered not at risk from the Proposal as it is currently designed. Only the *Karaops banyjima* was collected in a restricted habitat type, however it has been collected at more than one site within and beyond the Development Envelope. Additionally, none of the indeterminate taxa are currently at risk from the Proposal, as all were recorded

in widespread habitat (Biologic 2022). This leaves 11 taxa for which the Proposal carries some form of risk (Table 7-17).

Clearing will directly impact up to 1,254 ha of high suitability SRE habitat (Breakaways, Gorge/Gullies and Rocky Hills) and approximately 2,749 ha of moderate suitability habitat (Minor Drainage and Mulga Woodland) within the Development Envelope.

Table 7-17: Assessment of Risk to SRE Fauna recorded within the Conceptual Footprint

Taxon	Taxonomic Factors Affecting Risk	Distribution and Habitat Factors Affecting Risk	Risk Level
Aurecocrypta `HD1`	Genus infrequently collected and needs review. No described species from the Pilbara. Specimen did not match any of the seven WAM sequences from the Pilbara. Several other Pilbara morphospecies seem to have restricted ranges.	Both were collected from a single site (SRE17) in restricted habitat (Gorge/Gully) within the proposed Conceptual Footprint.	High
Pseudodiploexochus `C75046`	Genus has only been collected twice in the Pilbara. This is the first terrestrial collection. Genus has no arid adaptations and is almost certainly restricted to areas that retain moisture all year round.		
Tyrannochthonius `HD2`	Could not be matched to any known sequences. Genus contains widespread and restricted taxa.	Collected from a single site in restricted habitat (Gorge/Gully).	Medium
Austrohorus `HD5`	Olpiidae taxonomy very limited and needs review. Molecular analysis seems to show many species with restricted ranges. Could not be matched to any other sequences.	Collected from a single site in restricted habitat (Gorge/Gully), on the edge of the proposed Conceptual Footprint, in area likely to be indirectly impacted.	
Synothele `MYG055`	Could not be matched to any known sequences. Genus contains widespread and restricted taxa.	Collected from a single site in widespread habitat (Mulga Woodland).	Low
Olpiidae `PSEAAA` `HD4`	Olpiidae taxonomy very limited and needs review. Molecular analysis seems to show many species with restricted ranges. Could not be matched to any other sequences.		
Sepedonophilus `HD2`	Taxonomic framework for geophilomorph centipedes severely lacking. Molecular analysis seems to show many species with restricted ranges.		
Mecistocephalus `HD2`			
Mecistocephalus `HD3`			
Orphnaeus `HD1`			
Cryptops 'HD1'	Could not be matched to any known sequences. Genus contains predominantly restricted taxa.	Collected from a single site in widespread habitat (Stony Plain).	

Source: *Biologic (2022)*

7.4.2. Indirect Impacts

Potential indirect impacts of the Proposal on terrestrial fauna have been identified as:

- Degradation or alteration of habitat as a result of altered hydrological regimes
- Habitat degradation is associated with construction, operational and closure activities, including dust and altered fire regimes
- Disturbance from light, noise and/or vibration, resulting in the displacement of fauna associated with construction, operational and closure activities
- Disturbance resulting from an increase in abundance and diversity of weeds and feral species.

7.4.2.1. Degradation or Alteration of Habitat as a Result of Altered Hydrological Regimes

Surface water features within and adjacent to the Development Envelope provide important habitat for significant fauna, such as the Pilbara Leaf-nosed Bat and Pilbara Olive Python. Surface water features that are surface water dependent and the potential changes resulting from catchment loss, have been assessed in Chapter 9 (Inland Waters). The hydrological assessment concludes that there will not be a significant change to the hydrological regimes of the Pebble Mouse Creek or Weeli Wolli Creek, therefore, their habitat values will be maintained.

Due to the deposits being AWT, no mine pit dewatering is required and therefore the Proposal does not require discharge of surplus water which may affect local watercourses.

7.4.2.2. Habitat Degradation Associated with Construction and Other Activities

Dust

The Pilbara region is naturally dusty, and the Proposal is located in and near an existing operational mine. In high wind conditions, dust may be temporarily generated during clearing and operation, which may deposit on vegetation adversely affecting fauna habitat quality.

Altered Fire Regimes

Fire may impact fauna directly or modify habitat through altered fire frequency and intensity (Jhariya and Raj 2014). Too frequent, hot, or extensive fires during hot, dry times of the year can reduce habitat capacity to support diverse fauna assemblages by altering the vegetation structure and composition, resulting in changes in food quantity and quality and changes in cover and microhabitats (Griffiths and Brook 2014).

7.4.2.3. Disturbance from Light, Noise and/or Vibration, Resulting in the Displacement of Fauna

Light

Light emissions can disorient flying birds, particularly during migration, and cause them to divert from efficient migratory routes or collide with infrastructure (DotEE 2020). Artificial lights may disrupt mammals' nocturnal foraging due to the light attracting invertebrate prey, potentially making small mammals vulnerable to predation.

Noise and Vibration

Noise emissions will arise from the construction and operation of the mine, particularly from blasting within the pits. These emissions generally dissipate with distance, with the habitats in close proximity to the pits the most impacted. Increased noise can disturb fauna. Potential impacts caused by noise can cause interruptions in feeding and resting behaviour, reducing reproductive success and complete abandonment of an area (Newport et al. 2014), including caves. The recognised noise threshold for

Ghost Bat and Pilbara Leaf-nosed Bat roosts is 70 dBZ (Bullen 2013; Bullen and Creese 2014). Noise attributable to the Proposal above this level may impact these species.

Modelling of unmitigated noise levels at Cave 10 (Category 2 Ghost Bat cave) predicts that levels of up to 74 dBZ may be experienced under certain conditions and mining scenarios (Wood 2022). For all other caves, modelling predicts that noise levels will be below the 70 dBA threshold.

Vibrations are generally associated with intermittent blasting occurring within the mine pits and can result in the loss of, or damage to, nearby cave and rocky shelter microhabitats. The vibrations may also impact species which utilise vibrations to detect threats or prey, such as the Pilbara Olive Python.

This assessment will use a vibration threshold for Ghost Bat and Pilbara Leaf-nosed Bat roosts of 10 mm/s (Bullen 2013; Bullen and Creese 2014; however, vibrations generated at a mine site are highly variable in nature, due primarily to variations in blast patterns. As such an overall assessment on vibration levels could not be conducted as each blast must be assessed on a case-by-case basis (Wood 2022).

7.4.2.4. Disturbance Resulting from an Increase in Abundance and Diversity of Weeds and Feral Species

Weeds

The construction and operation of the Proposal have the potential to result in the introduction or spread of weed species as a result of clearing and vehicle/machinery movements. Increased weed presence may degrade fauna habitats and increase fire risk and intensity. The degradation of habitat can cause a decline in the availability of resources for fauna species as well as making them more vulnerable to predation from feral predators.

Feral Species

Seven introduced fauna species were recorded within the Development Envelope (Cats, Dogs, European Cattle, Camels, Donkeys, Rabbits, and House Mice (Astron 2019b)). All of these species are known to be present in the surrounding region.

Activities associated with the construction and operation of the mine have the potential to increase the abundance of these species or introduce new species. These activities include inappropriate waste management of purifiable waste.

The clearing of vegetation may result in native fauna traversing the areas of cleared vegetation, which offer a significantly reduced level of protection from introduced predators. This has the potential to result in an increase in injury or mortality of significant fauna species by the predation of introduced fauna. Cats are of most concern as they are known to be one of the main reasons for population decline and a significant amount of cat activity was recorded within the Development Envelope. Three cats were captured across the Development Envelope during the Level 2 survey (Astron 2020b). Fauna surveys have shown that the BHT deposit has the highest concentration of introduced fauna species.

7.4.3. Cumulative Impacts

The Proposal will contribute to cumulative regional impacts on fauna habitats and significant fauna species present in the Development Envelope.

The following assumptions apply to the cumulative impact assessment:

- Cumulative impacts to fauna and fauna habitat resulting from third party operations are conservative and based on information available in the public domain
- The accuracy of data from external sources cannot been verified, so it has been assumed the data is accurate and collected following industry guidelines.

7.4.3.1. Significant Fauna

All significant fauna species that occur or are likely to occur within the Development Envelope may be affected by cumulative impacts from existing and foreseeable projects. Existing and reasonably foreseeable projects within the region that may contribute to cumulative impacts along with the Proposal are described in Chapter 2. Table 7-18 identifies the occurrence of conservation species within other project areas within 50 km of the Proposal.

7.4.3.2. Regional Fauna Habitat

Detailed fauna habitat mapping has been completed in the Development Envelope; however, detailed mapping at the same scale and using consistent descriptors is not available for the Pilbara region. Land System mapping at a regional level by the Department of Primary Industries and Regional Development (DPIRD) provides an opportunity to assess cumulative impacts on broad landscape units, as a surrogate for fauna habitat.

A total of nine land systems are present within the Development Envelope. However, two of the systems, Egerton and McKay, have been removed from the assessment as neither will be impacted directly by the implementation of the Proposal. The cumulative losses on each of the land systems from current and foreseeable future operations within a 50 km radius of the Proposal are shown in Table 7-19.

Following the implementation of the Proposal the direct impact on each of the land systems will not exceed 1% of their extent in the wider Hamersley subregion, with the exception of the Pindering Land System which will have a 2.5% reduction. The cumulative impacts of this Proposal as well as current/future operations are not predicted to exceed 6.0% for most of the Land Systems. The exceptions being the Wannamunna, Pindering and Boolgeeda Land Systems which will have a reduction ranging between 11.2 and 12.6%.

Table 7-18: Occurrence of Significant Fauna Species within Approved and Reasonably Foreseeable Projects within 50 km of the Proposal

Significant Fauna	Christmas Creek (30 km)	Hope Downs 4 (2 km)	West Angelas Deposits J, F and H (1 km)	Koodaideri Iron Ore Mine* (40 km)	Mining Area C Southern Flank (20 km)	Pilbara Expansion Strategic Proposal: Jinidi Iron Ore Mine (20 km)	West Angelas Deposits C, D and G (1 km)	Pilbara Expansion Strategic Proposal: Jinidi Iron Ore Mine (35 km)
Birds								
Grey Falcon	×	✓	✓	✓	✓	✓	✓	✓
Letter Wing Kite	×	×	×	×	×	×	×	×
Night Parrot	✓	×	×	×	×	✓	×	✓
Reptiles								
Pilbara Olive Python	✓	✓	✓	✓	✓	✓	✓	✓
Pilbara Barking Gecko	×	×	✓	×	✓	✓	✓	×
Gane's Blind Snake	×	✓	✓	×	✓	×	✓	✓
Lerista macropisthopus remota	×	×	×	×	×	×	×	×
Mammals								
Northern Quoll	✓	✓	✓	✓	✓	✓	✓	✓
Ghost Bat	×	×	✓	✓	✓	✓	✓	✓
Pilbara Leaf-nosed Bat	✓	×	✓	✓	✓	✓	✓	✓
Western Pebble-mound Mouse	✓	✓	✓	✓	✓	✓	✓	✓

** now referred to as the Gudai-Darri Iron Ore Mine*

Table 7-19: Cumulative Impacts on Land Systems within the Pilbara Region

Land System	Current Extent in Hamersley Subregion	Extent of Loss within Development Envelope		Extent of Loss in Current and Reasonably Foreseeable Future Projects*		Cumulative Impact	
Unit	Area (ha)	Area (ha)	% of Current Extent	Area (ha)	% of Current Extent	Area (ha)	% of Current Extent
Boolgeeda	607,323	707	<0.1	67,467	11.1	68,174	11.2
Calcrete	134,834	26	<0.1	2436	1.8	2,462	1.8
Newman	1,856,685	1,485	<0.1	99,914	5.4	101,399	5.5
Pindering	26,322	647	2.5	2,660	10.1	3,307	12.6
Platform	217,768	1,983	0.9	7,808	3.6	9,791	4.5
Rocklea	711,724	4	<0.1	13,266	1.9	13,270	1.9
Wannamunna	62,357	6	<0.1	7,529	12.1	7,535	12.1

*Areas proposed to be cleared for each land system are based on the area of the Development Footprints for the following projects: BHP's Mining Area C, BHP's Pilbara Expansion Strategic Assessment, Koodaideri Iron Ore Mine and Yandicoogina Iron Ore Expansions

7.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids or minimises, where practicable, impacts on terrestrial fauna values present in the Development Envelope.

7.5.1. Mitigation Hierarchy

The Proponent has applied the mitigation hierarchy (avoid, minimise, and rehabilitate) during the Proposal design process to develop mechanisms to address potential impacts on the key terrestrial fauna values within the Development Envelope. The mechanisms applied to each key fauna value are discussed below and summarised in Table 7-23.

BHT and HD2 deposits have different habitat characteristics. BHT deposit area has a concentration of the MNES values, both habitats and records of key species, and for this reason a large MEZ has been proposed to provide for broad habitat protection for all of the MNES species.

The HD2 deposit area has a low concentration of MNES values and recorded records of key MNES species.

Based on significant survey work and advice from Pilbara subject matter experts, the avoidance, mitigation, MEZ and offsets proposed are specific to these characteristics of the Proposal.

7.5.2. Avoidance

7.5.2.1. Proposal Design Refinements

Through the design process of the Proposal, the Proponent has ensured that, wherever possible, pits, waste rock landforms and associated infrastructure have been designed to avoid direct impacts on high value and Critical habitat types, namely Gorge/Gully and Breakaway.

Design changes that will minimise impacts on significant fauna and habitat include:

- Reduction in impacts to high value conservation significant species habitat: Gorge/Gully and Breakaway habitat types in the Development Envelope by approximately 33 ha and in the Conceptual Footprint by approximately 130 ha (Table 7-20, Figure 7-10)
- Reduction in the following moderate value significant species habitat types within the Development Envelope: Minor Drainage, Alluvial Plain, Low Hills and Slopes, Rocky Hill and Stony Plain
- A Category 4 Ghost Bat cave, Cave 9, is now outside the Development Envelope.

Table 7-20: Changes in Impacts to Critical Habitat Resulting from Changes in Proposal Design

Fauna Habitat	Extent within Referred Development Envelope	Extent within ERD Development Envelope	Extent within Referred Conceptual Footprint	Extent within ERD Development Envelope	Change in Impact (Conceptual Footprint)
Breakaway	250 ha	224 ha	189 ha	57 ha	-132 ha (-70%)
Gorge/Gully	70 ha	63 ha	33 ha	36 ha	3 ha (9%)
Total	320 ha	287 ha	222 ha	93 ha	-129 ha (-68%)

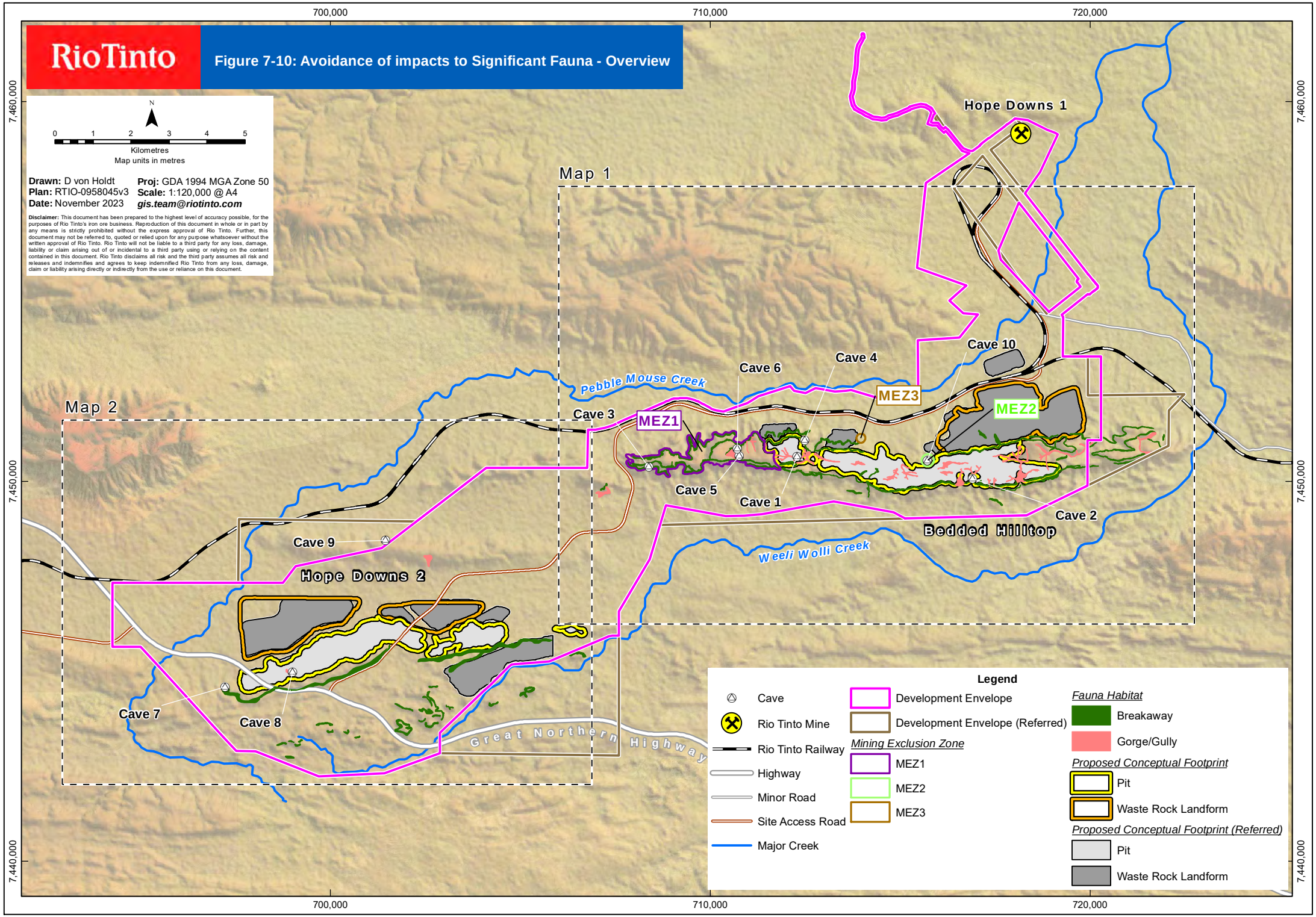
The Proponent has sought to minimise impacts to the Low Hills and Slopes habitat, to the south of the BHT deposit that is directly impacted by mining activities through limiting the Conceptual Footprint. The extent of Low Hills and Slopes habitat south of the BHT deposit is adjacent to Weeli Wolli Creek and functions as a fauna movement corridor for species dispersing between Pebble Mouse Creek and Weeli Wolli Creek thus maintaining connectivity within populations.

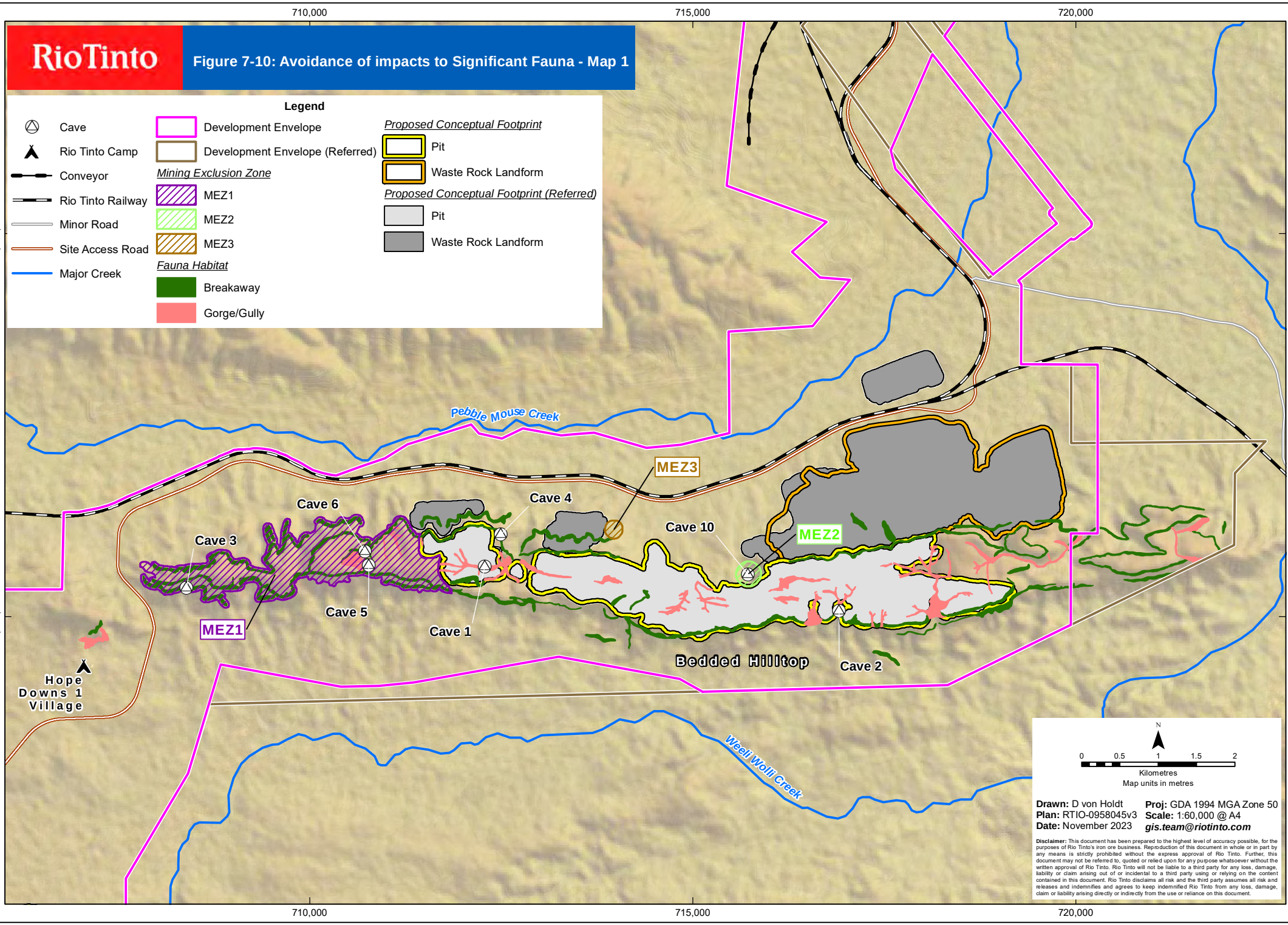
Other significant avoidance measures include:

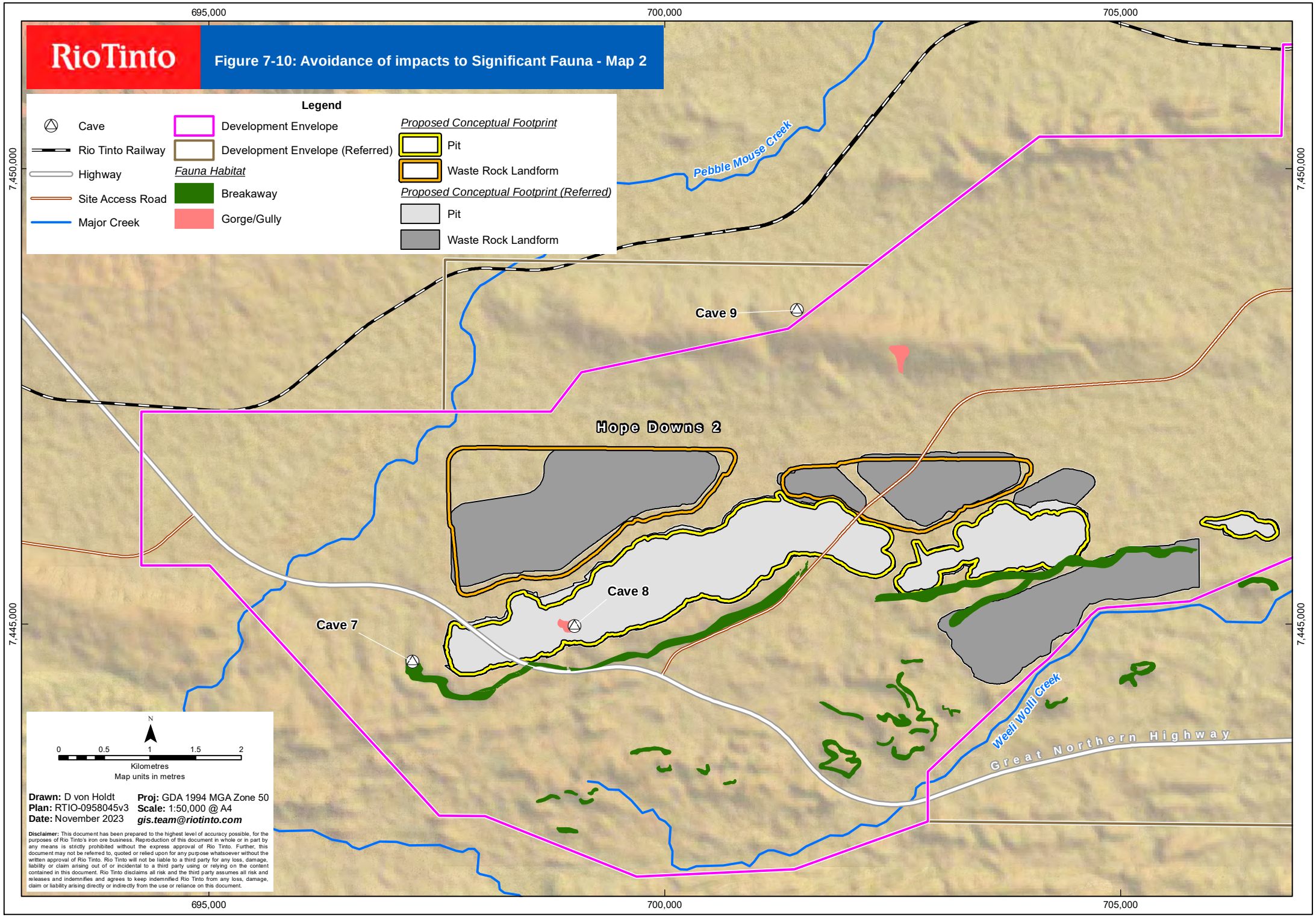
- The avoidance of groundwater-related and surplus water management impacts to fauna habitats by restricting mining to AWT
- The exclusion of Weeli Wolli Creek from the Development Envelope to as large an extent as practicable
- The removal of a large waste rock landform from the referred project design to, amongst other outcomes, avoid impacts to Weeli Wolli Creek and associated fauna and habitat values
- Ensuring creek crossings are suitably designed and constructed to avoid impacts to fauna movement.

Figure 7-10 shows the changes above, including the referred Development Envelope.

Figure 7-10: Avoidance of impacts to Significant Fauna - Overview




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Figure 7-10: Avoidance of impacts to Significant Fauna - Map 1
Legend
Cave
Rio Tinto Camp
Conveyor
Rio Tinto Railway
Minor Road
Site Access Road
Major Creek
Development Envelope
Development Envelope (Referred)
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3
Fauna Habitat
Breakaway
Gorge/Gully
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Proposed Conceptual Footprint (Referred)
Pit
Waste Rock Landform
710,000
715,000
720,000
7,455,000
7,450,000
Pebble Mouse Creek
MEZ3
MEZ2
MEZ1
Cave 1
Cave 2
Cave 3
Cave 4
Cave 5
Cave 6
Cave 10
Bedded Hilltop
Hope Downs 1 Village
Weeli Wolli Creek
N
0
0.5
1
1.5
2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0958045v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:60,000 @ A4
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RioTinto
Figure 7-10: Avoidance of impacts to Significant Fauna - Map 2
Legend
Cave
Rio Tinto Railway
Highway
Site Access Road
Major Creek
Development Envelope
Development Envelope (Referred)
Fauna Habitat
Breakaway
Gorge/Gully
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Proposed Conceptual Footprint (Referred)
Pit
Waste Rock Landform
695,000
700,000
705,000
7,450,000
7,445,000
Pebble Mouse Creek
Cave 9
Hope Downs 2
Cave 8
Cave 7
Weeli Wolli Creek
Great Northern Highway
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0958045v3
Date: November 2023
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7.5.2.2. Mining Exclusion Zones

Mining Exclusion Zones (MEZs) are an area within the Development Envelope where no mining excavation will occur, and only low impact activities associated with environmental and cultural heritage monitoring and management may be implemented. MEZ1 contains existing communications infrastructure that is to be maintained. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. There is to be no clearing of critical MNES habitat (Gorge/Gully and Breakaway types) and no impact to Ghost Bat caves within MEZ. The MEZ are defined in Section 1.3.

The Proponent recognised significant habitat of species protected under State and Commonwealth legislation recorded within the Development Envelope. In order to reduce impacts on significant species and their habitat a large exclusion zone is proposed (MEZ1) covering the western end of BHT deposit (Figure 7-11). A targeted MEZ, to protect the Category 2 Ghost Bat cave (Cave 10), is proposed as MEZ2.

The two MEZs have been established to protect the following terrestrial fauna values:

- MEZ1 (233 ha) – established to protect:
  - Northern Quolls recorded at the southern extent of the range of the species (as identified in the baseline surveys)
  - Northern Quoll habitat (55 ha of Critical habitat and 178 ha of Supporting habitat), which will retain a large area of potential habitat and minimise potential population fragmentation of Northern Quoll;
  - Ghost Bat habitat:
    - One Category 3 (Cave 5) and two Category 4 caves (Cave 3 and 6)
    - 55 ha of Critical habitat and 225 ha of Supporting habitat
  - Pilbara Leaf-nosed Bat supporting habitat is three Category 4 caves (Cave 1, 5 and 6)
- MEZ2 (8 ha) established to protect the integrity of the potential maternity Ghost Bat roost (a Category 2 cave, Cave 10), which is considered Critical habitat, and the surrounding Supporting habitat (Figure 7-12). The cave is also a Pilbara Leaf-nosed Bat Category 4 cave and considered supporting habitat for the species.

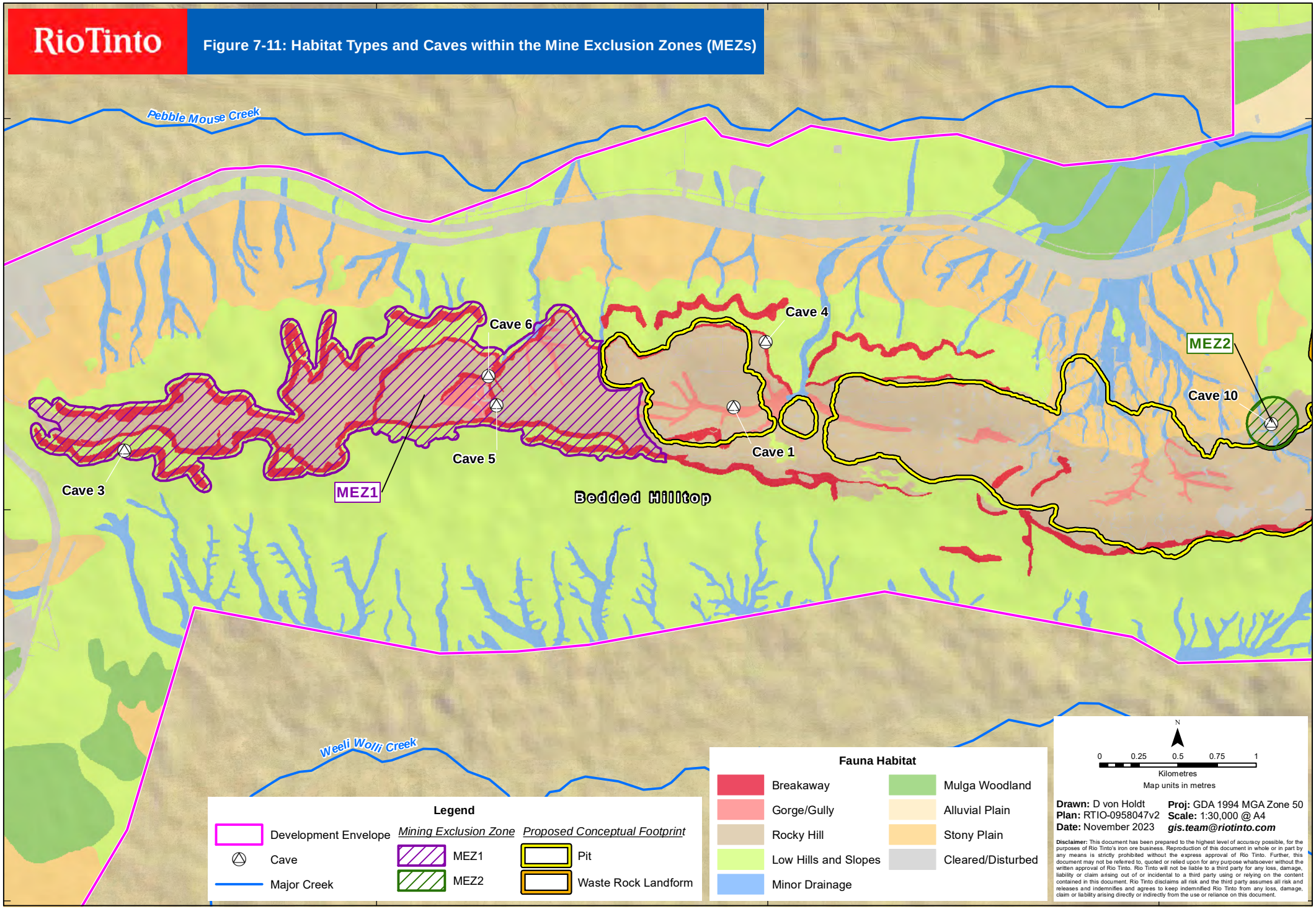
The extent to which each habitat type is protected by these MEZs is presented in Table 7-21 and Figure 7-11.

Table 7-21: Habitat Protected by MEZs within the Development Envelope

Habitat Types	MEZ	MEZ Area (ha)	Total Protected by MEZ	
			Area (ha)	Area (% of Total Habitat Type in the Development Envelope)
Breakaway	MEZ1	49.3	49.3	22.1
Gorge/Gully	MEZ1	5.7	5.7	9.0
Minor Drainage	MEZ1	0.6	1.3	0.1
	MEZ2	0.7		
Rocky Hill	MEZ1	116.6	122.2	12.6
	MEZ2	5.6		
Lower Hills and Slopes	MEZ1	53.3	53.9	1.1
	MEZ2	0.6		
Stony Plain	MEZ2	0.3	0.3	0.02

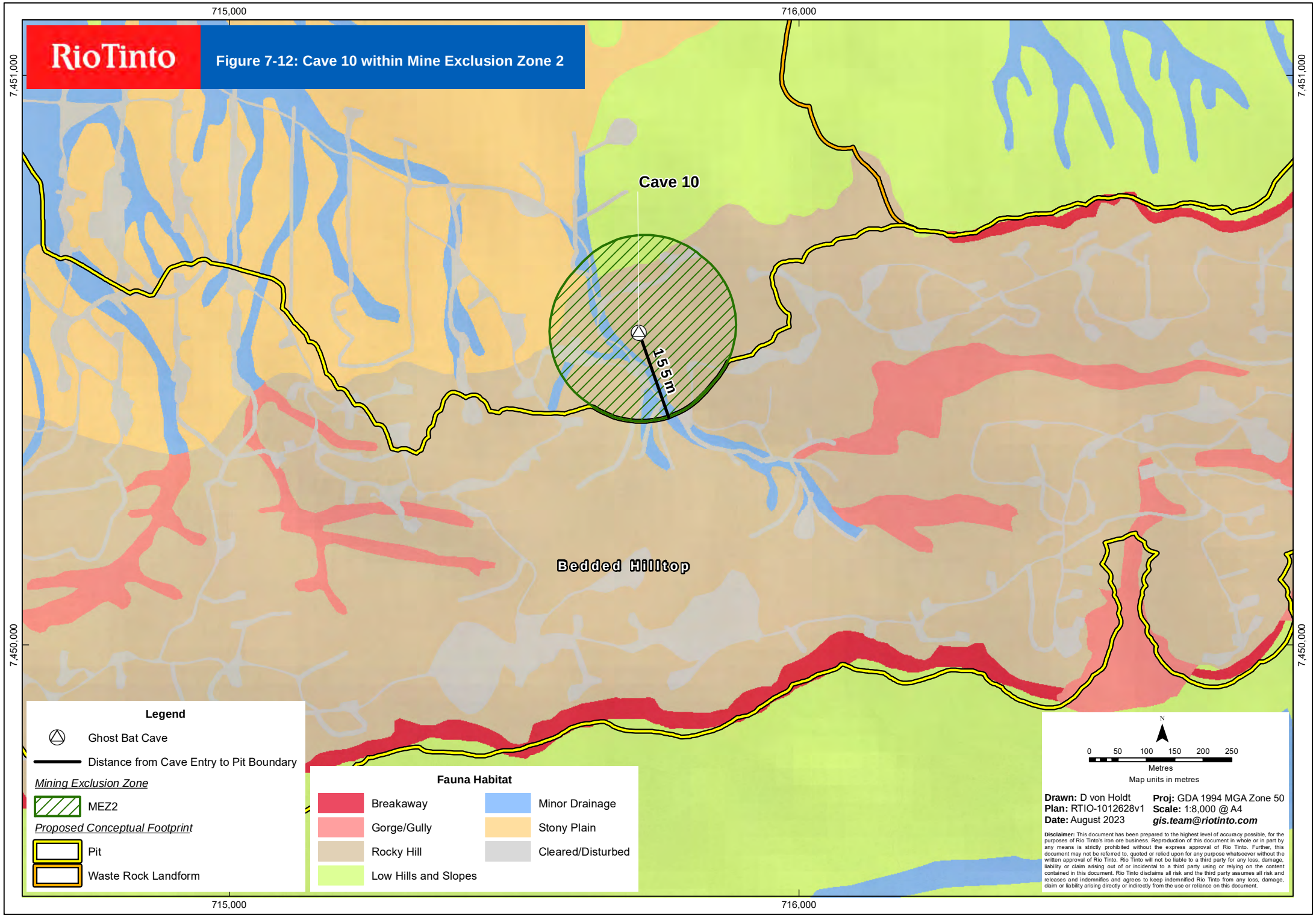
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Figure 7-11: Habitat Types and Caves within the Mine Exclusion Zones (MEZs)



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Figure 7-12: Cave 10 within Mine Exclusion Zone 2
715,000
716,000
7,451,000
7,450,000
Cave 10
155 m
Bedded Hilltop
Legend
Ghost Bat Cave
Distance from Cave Entry to Pit Boundary
Mining Exclusion Zone
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Fauna Habitat
Breakaway
Gorge/Gully
Rocky Hill
Low Hills and Slopes
Minor Drainage
Stony Plain
Cleared/Disturbed
N
0 50 100 150 200 250
Metres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-1012628v1
Date: August 2023
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7.5.3. Minimisation

7.5.3.1. Clearing Limits

In Section 7.4.1.1 the approximate clearing extent of habitat types within the Conceptual Footprint is presented. However, the Proposal includes flexibility to alter the location of the Proposal elements within the Development Envelope. To ensure environmental impacts are not greater than assessed, the Proponent proposes maximum clearing extents on habitat types and features of high significance, as per Table 7-22. These maximum extents would be conditioned within the Ministerial Statement, along with the maximum extent of clearing overall (4,900 ha).

Table 7-22: Upper Limit of Clearing for High Significance Habitat Types and Features

Fauna Habitat	Extent / Number Within Development Envelope	Total within Conceptual Footprint	Proposed Upper Limit of Clearing	Proportional Impact Within Development Envelope	Extent/Number Protected within MEZ
Breakaway	224 ha	57 ha	67 ha	30%	49.3 ha (22.1%)
Gorge/Gully	63 ha	36 ha	38 ha	60%	5.7 ha (9%)
Caves	9	2	2	N/A.	4, including the only Category 2 Ghost Bat cave (Cave 10)

7.5.3.2. Cave 10 Management Measures

Cave 10 is a category 2 Ghost Bat cave, and category 4 Pilbara Leaf-nosed Bat Cave.

MEZ2 was established with the entrance to Cave 10 as the centre-point to MEZ2, with a 150m buffer from Cave 10 forming the boundary of the MEZ. The 150 m buffer was established on the basis of expert advice on suitability of buffers to be designated around Hamersley Range Ghost Bat category 2 and 3 roosts. The intention of MEZ2 and PPV controls proposed in the EMP (Appendix A7) is to provide adequate protection to maintain the structural integrity and ecological function of the roost, providing a buffer predominantly from direct impacts.

Baseline acoustic monitoring data collected to date from Cave 10 has only recorded infrequent usage, indicating Cave 10 is only a category 2 cave, and not a category 1 permanent cave. It is likely that Ghost Bat usage at Cave 10 will be infrequent or close to nil for the life of the Proposal. Furthermore, Ghost Bat monitoring at other category 2 caves adjacent to mining operations has shown the Ghost Bats often disperse away from mining operations, when there are other suitable category 2 caves within flying range.

The combination of a MEZ and proposed PPV limits are designed to retain the cave as a viable roost post mining and allow recolonisation, based on consultation with industry experts.

To ensure indirect impacts to the Category 2 cave (Cave 10) from vibration are minimised, the Proponent will, in addition to protecting the cave within a MEZ with a 150 m buffer from mining activities:

- Establish vibration limits at the entrance to Cave 10 of 10 mm/s (Peak Particle Velocity (PPV)) during breeding months (1 October to 31 December), and 25 mm/s in non-breeding months, which will be monitored to ensure mining operations comply with the limit.
- Management as outlined in the MNES EMP (Appendix A7).

7.5.3.3. Management Strategies, Guidelines and Programs

The Proponent has also developed several management strategies, guidelines and programs to minimise the potential impact of the Proposal on the terrestrial fauna values within the Development Envelope, which are detailed in the EMP (Appendix A7). These include:

- **Vehicle and Fauna Interaction Guidelines** – this will describe the actions undertaken by drivers on-site that will minimise the likelihood of vehicle/fauna interactions from occurring. This includes restricting vehicles to only driving on established roads and tracks as well as adhering to the signed speed limits
- **Fence Construction Guidelines** – this will describe the situations where the utilisation of barbed wire is permitted on-site, and which measures need to be taken to minimise impact to fauna species. This includes the use of reflectors to help prevent the entanglement of bat species
- **Weed Management Strategy –** this describes actions that minimise the likelihood of weed species being introduced or spread within the Development Envelope. The key actions include the periodic spraying of cleared areas, particularly higher risk areas (such as sensitive receptors), and the management of vehicle, machinery and equipment hygiene
- **Dust Suppression Strategy** – this describes the techniques to minimise dust deposition within the Development Envelope. This will include the use of water carts
- **Feral Cat Control and Monitoring Program** – this describes the actions that will minimise the likelihood of the current feral cat population from increasing as a result of the Proposal. The key actions include the establishment of a trapping program and the establishment of a sighting log for feral animal species within the Development Envelope
- **Light Management Procedures** - this will describe the most appropriate positioning of lights on-site to facilitate a safe operating environment as well as minimise the amount of light overspill
- **Blasting Management Strategy** – this outlines actions that minimise the likelihood of any blasting activity impacting the structural integrity of caves and the behaviour of local fauna species such as bats.

7.5.4. Rehabilitation

The MCP has been prepared to address closure requirements for the Proposal (Appendix A4).

The MCP includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use, and final landforms are stable and consider ecological and hydrological factors do not represent a significant ecological risk.

Habitat elements considered part of the closure landform design can include, amongst others:

- Vegetation known to provide food or shelter for conservation and locally significant native fauna, including safe movement corridors
- Retaining and replacing woody debris
- Rapid generation and retention of leaf litter using small-scale topography
- Introducing or leaving rocky features such as oversized waste burden or scree slopes
- Creating greater depths of friable soil (or suitable mineral wastes) for burrowing fauna
- Preserving connectivity with unmined areas, and maintaining the quality of these habitats
- Managing feral predators and herbivores across both reference and rehabilitated areas.

Rehabilitation practices generally include spreading of topsoil or another growth medium where available and spreading native seed with the aim of creating self-sustaining ecosystems. Any rehabilitation will be conducted in accordance with the *Rio Tinto Iron Ore Rehabilitation Handbook* (the Rehabilitation Handbook) and will include fauna and habitat monitoring.

The MCP will be updated regularly to ensure its objectives remain relevant and aligned to stakeholder expectations and its strategies and plan are appropriate to achieve closure outcomes.

Table 7-23: Mitigation Measures for the Terrestrial Fauna Environmental Factor

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct				
Clearing of fauna habitat and habitat fragmentation	**Measures to Avoid**			
	Changes to the proposed Conceptual Footprint during the design phase to avoid direct impacts to high value fauna habitats, including significant cave structures, the southern flank of BHT from waste rock dumps and stockpiles.	Project specific.	No	Project optimisation and reduction of clearing required is the most effective control to ensure impacts are As Low As Reasonably Practicable (ALARP).
	The establishment of two MEZs at BHT avoids impacts to the following values: • Ghost Bat caves: one Category 2 cave (Cave 10), one Category 3 cave (Cave 5) and two Category 4 caves (Caves 3 and 6) • Four Category 4 Pilbara Leaf-nosed Bat caves • Critical habitat for Northern Quoll, Ghost Bat and high value SRE habitat	Project specific.	Yes – approval is required under the BC Act for the disturbance of habitat for listed species	Establishment of MEZ avoids impacts within the MEZ.
	Avoiding the areas of Low Hills and Slopes habitat south of the BHT deposit allows for movement of fauna through the landscape. Southern slopes of BHT maintains a fauna corridor that facilitates the movement of species between Pebble Mouse Creek and Weeli Wolli Creek thus maintain connectivity within populations.	Project specific.	No	Project optimisation and reduction of clearing required is the most effective control to ensure impacts are ALARP.
	Measures to Minimise			
	Development Envelope and proposed Conceptual Footprint have been designed to minimise where practicable disturbance of high significance Gorge/Gully and Breakaway habitats, as well as to Pebble Mouse Creek and Weeli Wolli Creek.	Project specific.	No	Project optimisation and reduction of clearing required is the most effective control to ensure impacts are ALARP.
	To minimise impacts to habitat considered to be of high local significance the Proponent will implement upper limits of clearing as outlined in Table 7-22.	Project specific limits, based on Rio Tinto	No	The use of upper clearing limits is a well-established management measure utilised in industry to

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
		standard approach to land clearing.		ensure that Proposal impacts on high value habitat types are limited. These limits will be enforced through a combination of the Proponent's Approval Request and GIS systems and as such is considered a highly effective control.
	Approval to clear in approved ground disturbance areas will be managed via the Proponent's Approvals Request system.	Standard business practice	No	
	Measures to Rehabilitate			
	Implementation of a Mine Closure Plan (MCP) following DMIRS Guidelines (DMIRS 2020a). The Mine Closure Plan is expected to be a condition of any Ministerial Statement associated with the Proposal.	Project specific MCP has been developed, based on Rio Tinto standard approach to closure planning.	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	These measures follow the Statutory Guidelines for Mine Closure Plans which are consistent with industry leading practices
	Progressive rehabilitation to minimise the amount of disturbed areas and therefore reduce fragmentation and barriers to fauna movement.	Project specific MCP has been developed, based on Rio Tinto standard approach to closure planning.	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	Progressive rehabilitation part of implementation of the HD2 MCP that includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use.
Loss or injury of fauna individuals	**Measures to Minimise**			
	The following operational measures will be put in place: • The Proponent will undertake progressive clearing that can allow fauna to migrate away from clearing activities or machinery movements • Relocate fauna away from active clearing area if the fauna does not move on its own accord • Speed limits would be implemented, minimising the risk of fauna injury or mortality from vehicle strike	Standard business practice	Yes – approval is required under the BC Act for the disturbance of habitat for listed species	The use of the controls listed are well-established management measures utilised in industry to ensure that Proposal impacts on native fauna are limited.

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Vehicle traffic will be confined to defined roads and tracks • Roadkill will be removed from trafficable areas, that reduces the risk of an increase in predators • Removal of barbed wire fences within the Development Envelope except where required by legislation. Reflectors will be placed on any retained barbed wire fences, which helps to prevent the entanglement of bats • Site induction programs will provide information on significant fauna including their appearance and habitats. Training would also discuss standard operating procedures in the event of fauna interactions • Artificial water sources will have egress points			
	Measures to Rehabilitate			
	Preparation and regular update of a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a)	Project specific MCP has been developed, based on Rio Tinto standard approach to closure planning.	Yes – DMIRS Guidelines for development of the Mine Closure Plan (see Appendix A4)	Implementation of the MCP required via Ministerial Statement condition
	Borrow pits would be designed, constructed, and rehabilitated to minimise surface water ponding.	Standard business practice	No	Implementation of the MCP required
Clearing of habitat and loss of SRE Individuals	**Measures to Minimise**			
	The Development Envelope and proposed Conceptual Footprint have been modified during the design phase to minimise direct impacts to high significance SRE habitats, where practicable.	Project specific.	No	Project optimisation and reduction of clearing required is the most effective control to ensure impacts are ALARP.
	The Proponent will ensure clearing occurs in approved ground disturbance areas through continued	Standard business practice	No	Clearing in approved ground disturbance areas will be enforced

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	implementation of the Proponent's Approvals Request system			through a combination of the Proponent's Approval Request and GIS systems and as such is considered a highly effective control.
	Known location of significant SRE habitat types will be included in the Proponent's GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents	Standard business practice	No	
	Measures to Rehabilitate			
	Implementation of a Mine Closure Plan (MCP), that follows DMIRS Guidelines (DMIRS 2020a) required via Ministerial Statement condition	Project specific MCP has been developed, based on Rio Tinto standard approach to closure planning.	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	These measures follow the Statutory Guidelines for Mine Closure Plans which are consistent with industry leading practices.
	Progressive rehabilitation to minimise the amount of cleared land.	Project specific MCP has been developed, based on Rio Tinto standard approach to closure planning.	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	Progressive rehabilitation part of implementation of the HD2 MCP that includes a closure objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use.
Indirect				
Habitat degradation associated with construction, operational and closure activities, including dust and altered fire regimes	**Measures to Avoid**			
	Clearing activities will not be undertaken when fire danger ratings are extreme or catastrophic	Standard business practice	No	The use of the controls listed are well-established management measures utilised in industry to ensure that Proposal impacts on native fauna are limited.
	Measures to Minimise			
	The Proponent will implement dust suppression management strategies to minimise the impact of fugitive dust including the utilisation of water carts.	Standard business practice	No	The use of the controls listed are well-established management measures utilised in industry to

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
				ensure that Proposal impacts on native fauna are limited.
	Measures to Rehabilitate			
	Weed spraying during rehabilitation, especially if progressive during the LOM.	Standard business practice	No	Measure follows the Statutory Guidelines for Mine Closure Plans which are consistent with industry-leading practices.
	Indicative closure completion criteria include any weed species recorded within rehabilitation areas that are present within the local uncleared area.	Standard business practice	No	Measure follows the Statutory Guidelines for Mine Closure Plans which are consistent with industry-leading practices.
Disturbance from Light, Noise and/or Vibration, Resulting in the Displacement of Fauna	**Measures to Avoid**			
	MEZs will be implemented around Cave 10, a high value cave, as well as Caves 3, 5 and 6 to prevent structural damage. This measure will also ensure avoidance of indirect impacts to other fauna species in the local area.	Project specific MEZ, based on Rio Tinto standard approach to bat cave management.	No	Establishment of MEZ avoids impacts within the MEZ.
	For Cave 10: • A vibration upper limit of 10 mm/s peak particle velocity (PPV) will apply during breeding months (1 October to 31 December), and 25 mm/s PPV in non-breeding months •	Standard business practice for bat cave MEZ. Implementation via the EMP	No	Limits are consistent with published research recommendations.
	Measures to Minimise			
	Lighting will be designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020). These include: • Permanent lighting will be installed where required, mainly in-pit and operational areas	Standard business practice	No	Measures are best practise and are consistent with conservation advice of MNES conservation advice or national recovery plans including those for Ghost Bats and Northern

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Permanent and temporary lighting will be shielded to minimise light spill • Permanent lighting will be directed away from the sensitive area (e.g. MEZ, MRZ, significant caves, Critical habitat Gorge/Gully and Breakaway) • Temporary lighting (e.g. trailer mounter units) may be required to provide safe working environments for short periods, where practicable. It will still provide a safe work environment, and these will be positioned to minimise direct light spill into sensitive areas			Quoll (TSSC 2016a, (Hill and Ward 2010).
	Machinery will be fitted with noise mufflers in accordance with manufacturing specifications.	Standard business practice	No	
	The implementation of two MEZs around BHT will minimise light, noise and vibrations received by the high value habitat and structures within this area.	Project specific	No	
	The implementation of Blast Management Plan to manage impacts from vibrations and maintenance of the structural integrity of significant caves.	Standard business practice	No	The Proponent has well-established blasting management procedures across their mine sites in the Pilbara region and management plans for significant cave structures.
Disturbance resulting from an increase in abundance and diversity of weeds and feral species.	**Measures to Minimise**			
	Manage feral animals by: Implement feral animal control, in co-operation with regional control programs and the Traditional Owners Fence landfills and regularly cover putrescible wastes	Standard business practice	No	The measures in the EMP (Appendix A7) and the Proponent's internal procedures have been developed to meet the current industry standards for managing the

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Implementation of feral cat control and monitoring program around the MEZs as well as waste management procedures to minimise the number of feral species attracted to the site.	Standard business practice	No	potential introduction and spread of weeds. The EMP weed management measures will minimise the spread and introduction of weed species within the Development Envelope. The use of the controls listed are well-established management measures utilised in industry to ensure that Proposal impacts on native fauna are limited.
	Weeds will be managed during operations following the measures in the EMP (Appendix A7) and include key actions such as periodic spraying and equipment hygiene.	Standard business practice	No	
	Measures to Rehabilitate			
	Rehabilitation will include of closure completion criteria for weed abundance and diversity, as well as post-closure feral animal control.	Standard business practice	No	Measure follows the Statutory Guidelines for Mine Closure Plans which are consistent with industry-leading practices.

7.6. Assessment and Significance of Residual Impacts

7.6.1. Assessment of Direct Residual Impacts

7.6.1.1. Clearing of Fauna Habitat and Habitat Fragmentation

The Proposal will result in the clearing of up to 4,900 ha of native vegetation representing fauna habitat within the Development Envelope.

Table 7-24 presents an assessment of the impacts to each fauna habitat type of high and moderate significance within the Development Envelope. The occurrence of similar habitat types outside of the Development Envelope and the ability of significant fauna species to persist in other habitat types within and outside the Development Envelope is considered in the assessment.

Table 7-24: Assessment of Impacts to Fauna Habitat

Fauna Habitat	Habitat Loss in Development Envelope		Assessment of Impact
	Ha	%	
High Value Habitat Types			
Breakaway	67 (capped)	30	This habitat is relatively restricted in the Pilbara region when compared to the other habitat types and contains several significant habitat features, such as caves. It is also of high significance for SRE species due to the number of microhabitats present. Four potential SRE species were recorded within this habitat type. It is considered to represent Critical habitat for the Northern Quoll, Ghost Bat and Pilbara Olive Python. Northern Quoll and the Ghost Bat were recorded during baseline surveys in this habitat type within the Development Envelope. It is also utilised by the Pilbara Leaf-nosed Bat as the species has been known to forage intermittently and in small numbers within the Development Envelope. Astron (2020d) identified an estimated 298.5 ha of Breakaway habitat type across the Hope Downs Hub area*. As a result of the Proponent's efforts to avoid and minimise its proposed impact to Breakaway habitat, approximately 167 ha (74.6%) will remain within the Development Envelope following full implementation of the proposed clearing limit of 30% of this habitat type. Of the remaining Breakaway habitat in the Development Envelope, 49.3 ha (22.1%) will be protected within MEZ. Astron (2020d) identified an estimated 298.5 ha of Breakaway habitat type across the Hope Downs Hub area*. The fauna habitat type is of high significance, is Critical habitat for several significant fauna, and is relatively scarce in the wider area, the Proposal is **expected to have a significant environmental impact at a local scale**, although this is lessened somewhat by the site's generally low utilisation by significant fauna species and the limited scale and nature of the proposed clearing.
Gorge/Gully	38 (capped)	60	This habitat is relatively restricted in the Pilbara region when compared to the other habitat types and contains several significant habitat features, such as caves. Deep rock incursions occur within the habitat type, which provide microhabitats for SRE species, within which 14 potential SRE and one confirmed SRE species were recorded. It is considered to represent Critical habitat for the Northern Quoll, Ghost Bat and Pilbara Olive Python. Northern Quoll and the Ghost Bat were recorded during baseline surveys in this habitat type within the Development Envelope. It is also utilised by the Pilbara Leaf-nosed Bat as the species has been known to forage intermittently and in small numbers within the Development Envelope. Gane's Blind Snake and the Pilbara Barking Gecko are also likely to occur within this habitat.

Fauna Habitat	Habitat Loss in Development Envelope		Assessment of Impact
	Ha	%	
			Approximately 27 ha (42.7%) of the habitat type will remain within the Development Envelope following full implementation of the proposed clearing limit of 60% of this habitat type. Of the remaining Gorge/Gully habitat in the Development Envelope, 5.7 ha (9%) will be protected within the MEZ. Astron (2020d) identified an estimated 622 ha of Gorge/Gully habitat type across the Hope Downs Hub area*. The Proponent has worked to avoid impacts to this habitat type by reducing the amount of Gorge/Gully habitat within the Development Envelope. As such the area within the Development Envelope represents 10% of that in the Hope Downs Hub area. Because the fauna habitat type is of high significance (including to SRE fauna), is Critical habitat for several significant fauna, and is relatively scarce in the wider area, the proposed clearing of up to 60% of Gorge/Gully habitat within the Development Envelope is **expected to have a significant environmental impact at a local scale**, although this is lessened somewhat by the site's generally low utilisation by significant fauna species, availability within the wider local area, and the retention of 5.7 ha (9%) within a MEZ.
Moderate Value Habitat Types			
Minor Drainage	475 (approx.)	51.8	The habitat has a moderate density of microhabitats, which are recorded as supporting seven potential SRE species. It represents Supporting habitat for the Northern Quoll (within 1 km of a Northern Quoll record), as well as Pilbara Leaf-nosed Bat (within 10 km of Category 2 or 3 roost), Ghost Bat (within 12 km of Category 1 and 2 caves). and the Grey Falcon. It also provides suitable habitat for *Lerista macropisthopus remota*. However, this species also has the potential to occur in the Alluvial Plain and Mulga Woodland habitat types. Approximately 442 ha (48.2%) of the habitat type will remain within the Development Envelope after implementation of the Proposal. Astron (2020d) identified an estimated 1,649 ha of Minor Drainage habitat type across the Hope Downs Hub area*, assessing it as moderate significance and of low value to significant fauna owing to lack of significant shelter. Astron (2020d) stated that the habitat type is common and widespread in the wider area and also across the Pilbara Bioregion. Given the above, the proposed clearing is **not considered to be a significant impact** to this habitat type.
Rocky Hill	369 (approx.)	38.2	The habitat is known to be very widespread within the Pilbara bioregion. It contains an abundance of high elevation rock features that provide a high diversity of microhabitats, within which eight potential SRE and one confirmed SRE species were recorded. It is known to be Supporting habitat for the Northern Quoll (within 1 km of Critical habitat), as well as Ghost Bats (5 km from Category 1 and 2 caves), and the Pilbara Leaf-nosed Bat (within 10 km of Category 2 or 3 roosts) and the Grey Falcon. It is utilised by the Pilbara Leaf-nosed Bat as the species has been known to forage intermittently and in small numbers within the Development Envelope. Western Pebble-mound Mice have also been recorded within the habitat type and it has the potential to support Gane's Blind Snake and Pilbara Barking Gecko. Approximately 598 ha (61.8%) of the habitat type will remain within the Development Envelope after implementation of the Proposal.

Fauna Habitat	Habitat Loss in Development Envelope		Assessment of Impact
	Ha	%	
			Astron (2020d) identified an estimated 2,921 ha of Rocky Hill habitat type across the Hope Downs Hub area*, assessing it as having moderate significance due to its utilisation as forage and dispersal habitat for some conservation significant fauna, but for a limited assemblage. Astron (2020a) also stated that Rocky Hill habitat is widespread throughout the Pilbara Bioregion and is not restricted to the Hamersley and Chichester Ranges. Given the above, the proposed clearing is **not considered to be a significant impact** to this habitat type.

** Vegetation/habitat within the Hope Downs 1 operations may be subject to further clearing under Existing Approvals.*

Despite only one of the habitat types presented in Table 7-24 being significantly impacted by the Proposal, the Proponent recognises that any impact on high value habitats is considered to be a significant residual impact to the environment. As such the Proponent proposes for these impacts to be appropriately offset (See Section 12).

Caves

As discussed in Section 7.4.1.1, two of the nine cave structures recorded within the Development Envelope will be directly impacted by the implementation of the Proposal, namely Cave 1 (Category 3) and Cave 8 (Category 4). The Proponent has ensured that for each of these caves there is a cave that will not be impacted within 2 km – Cave 1 is less than 1 km from MEZ1, which contains Caves 5 and 6 (located approximately 1.5 km from Cave 1). Cave 8 is close to Cave 7, additionally the Proponent's change to the Development Envelope means that Cave 9 is now outside the Development Envelope, within 5 km of Cave 8. This means any highly mobile species, such as bats, will have an alternative location in which to roost. Of the seven remaining caves, four will be protected within MEZs.

Significant Fauna

The assessment of the Proposal impact on each significant fauna species either recorded or highly likely to occur within the Development Envelope is discussed below. It is noted that many of the species Critical and Supporting habitat as well as habitat of moderate value overlap with each other. The offset method and calculation to ensure there is no overlap with significant fauna habitat is detailed in Chapter 12.

Northern Quoll

The Northern Quoll population within the Development Envelope is considered a low-density population, due to the low number of records (only 14 across three years of surveying) within the Development Envelope.

The Proposal will result in the clearing of up to a maximum of 105 ha of Critical habitat for the Northern Quoll (Gorge/Gully and Breakaway) within the Development Envelope. The Proposal will also result in the clearing of approximately 297 ha of Supporting habitat (Minor Drainage and Rocky Hill habitat within 1 km of Northern Quoll records). The clearing of both Critical and Supporting habitats is considered to be a significant residual impact and is proposed to be offset (See Chapter 12). The remaining habitat within the Development Envelope does not represent Critical or Supporting habitat for the species and is considered to be low significance.

A minimum of 182 ha of Critical habitat and 630 ha of Supporting habitat will be retained within the Development Envelope, with 55 ha of Critical habitat and 123 ha of Supporting habitat will be protected within MEZ1 and MEZ2. A significant amount of low value habitat will also be retained within the Development Envelope to facilitate the movement and dispersal of individuals.

Due to the low-density population of Northern Quolls in the Development Envelope, the retention of more than 60% of Critical habitat and 47.2% of Supporting habitat within the Development Envelope (of which a portion is protected through the implementation of MEZs) and more of both habitats being present in the wider area (Astron 2020a), the Proposal is **not expected to result in significant residual impacts to the local or regional population or conservation status of the species.**

Grey Falcon

There have been no Grey Falcon records inside the Development Envelope. The next closest record is approximately 45 km south-east of the survey area. The Proposed Action will not disturb this area; therefore, the Grey Falcon nest site will not be impacted.

Potential suitable breeding and nesting habitat for this species is vegetation associated with Major Drainage Line habitat with established tall trees. However, no Major Drainage Line habitat (preferred breeding habitat) is present within the Development Envelope (Astron 2023f). Minor Drainage Line habitat is not considered suitable breeding habitat due to the lack of mature trees within this habitat. The closest potential breeding habitat for the Grey Falcon is the sections of Weeli Wolli Creek near Weeli Wolli Spring, which contains discharge points that support riparian vegetation with larger trees, approximately 5 km north-east of the Development Envelope, since it provides tall, established trees for breeding (Astron 2023f).

The-habitat types Minor Drainage and Rocky Hill are identified as suitable for foraging and dispersal are widespread within the Pilbara, including the Development Envelope. The total area of Minor Drainage is 475 ha and Rocky Hills is 369 ha within the Development Envelope.

Due to the highly intermittent presence of the species within the local area, the retention of over 60% of Supporting habitat in the Development Area, and the abundance of suitable habitat in the wider area (Astron 2023f) the Proposal is **not expected to result in significant residual impacts to the regional population or conservation status of the species.**

Ghost Bat

The presence of a Category 2 and some scattered Category 3 roosts within the Development Envelope indicates that there is a low to moderate density population of Ghost Bats within the Development Envelope.

The Proposal will result in the clearing of a maximum of 105 ha of Critical habitat for Ghost Bats (Gorge/Gully and Breakaway). The Proposal will also result in the clearing of 2,659 ha of Supporting habitat (all habitat types within 12 km of Category 1 or 2 Ghost Bat roosts within the Development Envelope). Additionally, one Category 3 (Cave 1) and one Category 4 (Cave 8) roosts will be impacted by the Proposal, neither of which are considered critical to the survival of the species. The clearing of both Critical and Supporting habitat is considered to be a significant residual impact and is proposed to be offset (See Chapter 12).

A minimum of 182 ha (63.4%) of Critical habitat, 3,803 ha (58.2%) of Supporting habitat and seven of the nine Ghost Bat roosts (one Category 2, one Category 3 and five Category 4) will be retained within the Development Envelope. Approximately 55 ha of Critical habitat, 233 ha of Supporting habitat and four Ghost Bat roosts (Cave 3, 5, and 6) will be protected in MEZ1 and (Cave 10) MEZ2.

Due to the low to moderate density population of Ghost Bats in the Development Envelope, the retention of Critical and Supporting habitat and seven Ghost Bats caves within the Development Envelope, of which a portion is protected through the implementation of MEZ1 and MEZ2, the Proposal is **not expected to result in significant residual impacts to the regional population or conservation status of the species.**

Pilbara Leaf-nosed Bat

Despite the recorded evidence of Pilbara Leaf-nosed Bats foraging within the Development Envelope, all roosts within the Development Envelope have been categorised as Category 4 roosts which are considered Supporting habitat for the Pilbara Leaf-nosed Bat.

Other than the Category 4 roosts, all the habitat types within the Development Envelope have been classified as having a moderate habitat rating. The presence of the species indicates that they do utilise the habitat but is likely to only be of limited value for the survival of the species. As such, habitat within the Development Envelope is considered moderate value habitat for the species.

Approximately 7,510 ha (60.5%) of moderate value habitat including seven Category 4 roosts will be retained within the Development Envelope. This is likely to be more than sufficient to continue to support the needs of the limited number of Pilbara Leaf-nosed Bats which currently utilise the Development Envelope. As such the Proposal is **not expected to result in significant residual impacts to the regional population or conservation status of the species.**

Pilbara Olive Python

No Pilbara Olive Pythons have been recorded within the Development Envelope, however, they are known to reside in the local area, as attested by records of the species being present within the Development Envelope. However, if the species is present within the Development Envelope the population is likely to have a low density.

The Proposal will result in the clearing of up to a maximum of 105 ha of Critical habitat for the Pilbara Olive Python (Gorge/Gully and Breakaway). The clearing of Critical habitat is considered to be a significant residual impact and is proposed to be offset (See Chapter 12). The remaining habitat within the Development Envelope does not represent Critical or Supporting habitat for the species and are considered to be low significance.

A minimum of 182 ha (63.4%) of Critical habitat will be retained within the Development Envelope, with 55 ha of Critical habitat being protected within MEZ1. A significant amount of low value habitat will also be retained within the Development Envelope to facilitate the movement and dispersal of individuals.

Due to the low density of the Pilbara Olive Python, which is likely to occur within the Development Envelope, and the retention of over 60% of Critical habitat, of which 6% is protected within MEZ1, the Proposal is **not expected to result in significant residual impacts to the regional population or conservation status of the species.**

Priority Fauna Species

Table 7-25 presents the assessment on the significance of residual impacts on the Priority fauna species recorded and highly likely to occur within the Development Envelope.

Table 7-25: Assessment and Significance of Residual Impacts to Priority Fauna in the Development Envelope

Priority Fauna Species	Assessment and Significance of Residual Impacts
Species Known to Occur within the Development Envelope	
Lerista macropisthopus remota	The *Lerista macropisthopus remota* has been recorded within the Mulga Woodland habitat within the Development Envelope, however, this was recorded outside of the proposed Conceptual Footprint and is unlikely to be directly impacted. The Alluvial Plain and Minor Drainage habitat types also provide suitable habitat for the species within the Development Envelope. The Proposal will result in the clearing of approximately 1,333 ha of suitable habitat within the Development Envelope, leaving approximately 1,756 ha (56.8%) within the Development Envelope. Astron (2020d) identified an estimated 8,800 ha of suitable habitat across the Hope Downs Hub area*. Due to the retention of suitable habitat in the Development Envelope and good availability in the surrounding area, the Proposal is **not expected to result in significant residual impacts to the regional population or conservation status of the species.**
Letter-winged Kite	The Letter-winged Kite has been recorded within the Minor Drainage habitat within the Development Envelope. The Alluvial Plain, Mulga Woodland and Stony Plain habitat types within the Development Envelop also provide suitable habitat. Despite the presence of suitable habitat and a record of the species within the Development Envelope, the species is generally sparsely distributed across the species range and are generally rarely encountered (Astron 2019b). Additionally, the habitat presents within the Development Envelope, even though suitable, is not critical to the survival of the species and the species is able to forage in the habitat outside of the Development Envelope. The Proposal will result in the clearing of approximately 2,213 ha of suitable habitat within the Development Envelope, leaving approximately 2,395 ha (52%) within the Development Envelope. Additionally, Astron (2020d) identified an estimated 11,494 ha of suitable habitat across the Hope Downs Hub area*. Due to the retention of a significant amount of suitable habitat, the sparse distribution of the species and the low reliance of the species on any of the habitat present, the Proposal is **not expected to result in significant residual impacts to the regional population or the conservation significance of the species.**
Western Pebble-mound Mouse	The Western Pebble-mound Mouse is a common species that has been recorded throughout the Hamersley and Chichester subregion in the Pilbara. The Western Pebble-mound Mouse was recorded nine times during the Astron surveys (Astron 2019b), comprising of six pebble mounds (three active), one active mound was recorded in the pit area at BHT and will be impacted. The other five mounds are located outside the conceptual footprint. The Proposal will result in the clearing of approximately 2,030 ha of suitable habitat (Mulga Woodland, Rocky Hills and Stony Plain habitat) within the Development Envelope, leaving approximately 2,286 ha (53.0%) of suitable habitat within Development Envelope. Additionally, Astron (2020d) identified an estimated 11,434 ha of suitable habitat across the Hope Downs Hub area*. Due to the common nature of the species and the wide variety of suitable habitat types the Proposal **is not expected to result in residual impacts that affect the regional population or conservation status of the species.**

Priority Fauna Species	Assessment and Significance of Residual Impacts
Species Likely to Occur Within the Development Envelope	
Gane's Blind Snake	The Gane's Blind Snake is distributed throughout the Pilbara region but due to its elusive nature it is poorly collected. The records to date suggest the species is likely to occur within moist gorges and gullies but may occur over a wide range of other Stony habitats such as Mulga Woodlands and Rocky Slopes (Wilson and Swan as referenced in Astron 2019b). Despite the presence of suitable habitat, the species has not been recorded within or in close proximity to the Development Envelope in over 18 years and thus is unlikely to be present within the Development Envelope (Astron 2019b). The Proposal will result in the clearing of approximately 405.7 ha of suitable habitat (Gorge/Gully and Rocky Hills habitat) within the Development Envelope, leaving approximately 625 ha (60.6%) of suitable habitat in the Development Envelope. Additionally, Astron (2020d) identified an estimated 3,543 ha of suitable habitat across the Hope Downs Hub area*. Due to the retention of significant amounts of suitable habitat in both the Development Envelope and surrounding area as well as the absence of any recent records of the species, the Proposal is **not expected to result in significant residual impacts to the regional population or the conservation status of the species.**
Pilbara Barking Gecko	The Pilbara Barking Gecko has been recorded within 40 km of the Development Envelope. The species is confined in the Pilbara to the Hamersley Ranges and prefers rocky habitats with spinifex and low tree cover (Astron 2019b). Within the Development Envelope this aligns with the Gorge/Gully and Rocky Hill habitat types. The Proposal will result in the clearing of approximately 405 ha of suitable habitat (Gorge/Gully and Rocky Hills habitat) within the Development Envelope, leaving approximately 625 ha (60.6%) of suitable habitat in the Development Envelope. Additionally, Astron (2020d) identified an estimated 3,543 ha of suitable habitat across the Hope Downs Hub area*. Due to the retention of significant amounts of suitable habitat in both the Development Envelope and the surrounding area, the Proposal is **not expected to result in significant residual impacts to the regional population or the conservation status of the species.**

** Vegetation/habitat within the Hope Downs 1 operations may be subject to further clearing under Existing Approvals.*

Short-Range Endemics

***Aurecocrypta* `HD1`**

The Preliminary SRE Risk Assessment (Biologic 2022) identified this taxon as being at high risk (Biologic 2022) given this taxon is represented by a single female specimen from site SRE17. While DNA sequences were obtained from this specimen, no matches could be found. This singleton record was collected in a deep gorge at the edge of a central ridgeline which is within the footprint of the Development Envelope.

The gorge in which *Aurecocrypta* `HD1`, a Brush-footed trapdoor spider, was recorded is only partially within the proposed Conceptual Footprint of the Proposal, as such habitat for this taxa is expected to persist following the implementation of the Proposal.

***Pseudodiploexochus* `C75046`**

The Preliminary SRE Risk Assessment (Biologic 2022) identified *Pseudodiploexochus* `C75046`, a slater, as being at high risk (Biologic 2022). This unusual specimen was collected in a Gorge/Gully site (SRE17) from within the proposed Conceptual Footprint of the Development Envelope. Biologic (2022) provides the following description of the specimen (pers comm with Dr Simon Judd):

This epigean Pseudodiploexochus is one of three Armadillidae genera in the Pilbara that are known only from a single specimen at a single location. There are undoubtedly more species there, but they are very difficult to collect. C75046 is almost certainly an SRE and probably only occurs in the gorge where it was collected (Biologic 2022).

The gorge in which this species was recorded is partially within the proposed Conceptual Footprint of the Proposal, as such habitat for this taxa is expected to persist following the implementation of the Proposal.

7.6.1.2. Loss or Injury of Fauna Individuals as a Result of Clearing and Interactions with Vehicles

Significant fauna species present within the Development Envelope may be vulnerable to injury or mortality from vehicle and machinery movements, mainly when foraging nocturnally or basking.

While vehicle movements will increase temporarily during the construction period, overall vehicle movements during the operational phase will reduce to a constant. Vehicle movements at night are much less than during the day and are generally limited to in-pit operations and a haul road between the Proposal and the existing Hope Downs 1 operations.

The Proponent will implement management measures, as outlined in Table 7-23 to mitigate the loss of fauna individuals including speed limits. As such vehicle and machinery movements are not expected to have a significant impact on any of the Northern Quoll, Grey Falcon, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python populations.

In addition to vehicle strike, the Pilbara Leaf-nosed Bat and Ghost Bat are at risk of entanglement in barbed wire fencing, causing injury or mortality. Where the use of barbed wire fencing is legislated, reflectors will be installed to deter bat interaction.

Through the implementation of these measures during both the construction and operation phase of the Proposal the impact is **not expected to be significant.**

7.6.2. Assessment of Indirect Impacts

7.6.2.1. Habitat Degradation Associated with Construction and Other Activities

Dust

An air quality assessment was undertaken for the Proposal modelling against National Environment Protection Measures for Ambient Air Quality (Air NEPM) and other human health criteria. There is limited published research on the impacts of dust on fauna and the dust (particulate) concentrations at which fauna may experience a negative impact (ETA 2022). As such in the absence of criteria specific to animal health, the human health criteria for PM_{10} and Total Suspended Particles (TSP) are useful for considering potential effects on fauna (ETA 2022).

The study found that dust parameters will be elevated within the Development Envelope throughout the life of the mine (Further discussion in Section 11.5.4.3). The predicted ground-level concentrations of PM_{10} and TSP dust parameters at bat cave receptors within the Development Envelope varied dependent on the proximity to the mining operations. However, these concentrations do not represent the concentrations within the caves themselves (which may be significantly lower) (ETA 2022). MEZ2 has been created to protect the Category 2 cave, resulting in a 150 m distance to active mining, which will reduce the risk of high dust concentrations at the cave entrance.

The impacts of dust are typically indirect and generally take the form of behaviour changes, resulting in avoidance of an area in very dusty conditions. The amount of natural habitat surrounding the Proposal means that impacts are likely to be minimal and confined to the immediate area of the Proposal. Susceptible affected fauna is likely to move away from these sources. Furthermore, the dust generation and deposition are not expected to result in significant or permanent changes to fauna habitats given the Proposal timeframes and the effect of periodic rainfall. The Proponent will implement well-established dust management measures to minimise dust emissions. As such, **no significant impacts on fauna individuals or habitats are expected due to dust emissions** from the Proposal.

Altered Fire Regimes

Changes to fire regimes can have a significant impact on vegetation structure. Too-frequent fires reduce vegetation cover, potentially exposing fauna species to a higher risk of predation and may reduce the abundance of food or increase the prevalence of weed species, resulting in disturbance to fauna habitat.

Fauna mortality from fires is generally low because most animals can move out of the affected areas. Fires will often not affect fauna populations as native fauna from the local area will recolonise a burnt area after the fire has gone through. However, when the distribution of the species is listed as vulnerable or endangered, a significant fire event can impact these populations (DPIE 2021).

The highest risk of bushfire ignition occurs during construction while undertaking hot work activities. Effective management of construction activities can prevent the incidence of bushfires. The increased road network resulting from the Proposal and maintenance of firebreaks would also help control the size and extent of potential bushfires. Appropriate work procedures would be employed to reduce the risk of fires starting from activities associated with the Proposal. By implementing mitigation and management measures (see Table 7-23), the potential impacts of fire **are not expected to significantly impact significant fauna species.**

7.6.2.2. Disturbance from Light, Noise and/or Vibration, Resulting in the Displacement of Fauna

Light

The increased amount of ambient light can result in significant behavioural changes to various species within the Development Envelope. This includes changes to invertebrate behaviours, with increased concentrations around heat sources, and thus changes to the behaviour of species that predate on

them, such as the Ghost Bat and Pilbara Leaf-nosed Bat. To limit the impacts of ambient light will have on the surrounding environment the Proponent is committed the mitigation measures presented in Table 7-23 which align with the *National Light Pollution Guidelines for Wildlife* (DotEE 2020). Through the implementation of these mitigation measures the **Proposal is unlikely to have a significant residual impact.**

Noise/Vibrations

The generation of noise and vibration are both unavoidable in the construction and operation of mine sites. Within the Development Envelope vibrations and noise will generally be associated with blasting, which has the potential to damage caves and other significant microhabitat structures present within the Development Envelope.

Caves within MEZ 1 are considered to be adequately buffered from noise and vibration impacts, given the distance from active mining is at least 650m.

In MEZ 2 the Proponent will ensure the following are achieved:

- A vibration upper limit of 10 mm/s peak particle velocity (PPV) during breeding months (1 October to 31 December) for Category 2 caves; and 25 mm/s PPV in non-breeding months
-

These are the recognised disturbance thresholds for Ghost Bat and Pilbara Leaf-nosed Bat roosts, which will not cause individuals to abandon the roosts. Through the implementation of these mitigation measures, along with the buffers provided by MEZs, are expected to ensure the integrity of these roosts are maintained, and seasonal variations in noise and vibration limits will reduce the risk of disturbance to the breeding activities of these species.

7.6.2.3. Disturbance Resulting from an Increase in Abundance and Diversity of Weeds and Feral Species

Weeds

The Development Envelope has been described as having a moderate diversity of weeds and are generally associated with the Minor Drainage, Mulga Woodlands and Low Hills and Slopes habitat types. The clearing of native vegetation has the inherent risk of spreading weeds to non-disturbed areas within the Development Envelope.

The Proponent is committed to the implementation of the weed hygiene procedures and management strategies (as presented in Table 7-23) within the Development Envelope. These are currently used at other operation sites throughout the Pilbara region. The implemented measures include but are not limited to periodic spraying of weed populations, particularly around areas of higher risk (e.g. to sensitive receptors) and the maintenance of equipment hygiene. Any potential impacts of the introduction or spread of weeds on fauna species and habitat are predicted to be localised to areas of disturbance and will not impact the vegetation in the wider area. As such this is **not expected to result in significant residual impacts** to fauna habitats.

Introduced Fauna

The clearing of fauna habitat does not directly result in an increase in introduced fauna species populations; however, it does facilitate the movement of many of these species. The presence of putrefiable waste can also result in attracting many such species to the Development Envelope. Thus, the construction and the operation of the Proposal can indirectly result in an increase in feral animal populations. This will then place increased pressure on the surrounding populations of native fauna species.

Due to the high amount of feral cat activity and the higher concentration of conservation significant species within the area surrounding the BHT deposit, the Proponent is committed to a feral cat control

program in this area (Astron 2020a) and the opportunistic recording of any introduced fauna species sighted in the Development Envelope. The Proponent is also committed to the correct storage and disposal of putrefiable waste to reduce the attractiveness of the Proposal to introduced fauna species.

Whilst there is a possibility the Proposal could still result in an increased number of introduced pest fauna species, the implementation of mitigation measures (as outlined in Table 7-23 and in the EMP (Appendix A7) in the Development Envelope is likely to reduce the impact of any introduced fauna species. Therefore, the Proposal is **not expected to have a significant impact** on the terrestrial fauna as a result of introduced / feral fauna within the Development Envelope.

7.6.3. Assessment of Cumulative Residual Impacts

All significant fauna species that occur or are likely to occur within the Development Envelope may be affected by cumulative impacts from existing or foreseeable projects. However, these species occur widely in the Hamersley sub-region (Table 7-18) and can move throughout the local landscapes. The retention of high value habitat will help maintain the significant fauna species within the sub-region.

The estimated cumulative impacts from this Proposal and reasonably foreseeable projects within the Hamersley subregion are anticipated to be 205,938 ha (5.7%; Table 7-19). The cumulative impacts on land systems are small (the highest loss is 12.6%) within the Pindering land system with 3,307 ha. Therefore, the full range of habitat types associated with these land systems will remain within the Hamersley subregion. Given that the habitat types will remain throughout the sub-region and that the species associated with the Proposal are known to occur throughout the region, the cumulative residual impact of these species **are not expected to be significant**.

7.6.4. Assessment of Significance of Residual Impacts

7.6.4.1. Non-significant residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Terrestrial Fauna values:

- Direct impact to significant fauna species consisting of:
    - Northern Quoll: Due to the low-density population of Northern Quolls in the Development Envelope, the retention of more than 60% of Critical habitat and 47% of Supporting habitat within the Development Envelope, the protection of Critical and Supporting habitat extent through the implementation of MEZs, and more of both Critical and Supporting habitats present in the wider area (Astron 2020a), the Proposal is not expected to result in significant residual impacts to the local or regional population or conservation status of the species.
    - Ghost Bat: Due to the low to moderate density population of Ghost Bats in the Development Envelope, the retention of Critical and Supporting habitat and seven Ghost Bats caves within the Development Envelope, of which a portion is protected through the implementation of MEZ1 and MEZ2, the Proposal is not expected to result in significant residual impacts to the regional population or conservation status of the species.
    - Grey Falcon: The species is highly nomadic and was not recorded within the Development Envelope. No potential critical habitat was recorded within the Development Envelope. The retention of over 60% of potential Supporting habitat in the Development Area, and the abundance of suitable habitat in the wider area (Astron 2023f) the Proposal is not expected to result in significant residual impacts to the regional population or conservation status of the species.
    - Pilbara Leaf Nosed Bat: None of the habitat types within the Development Envelope meet the definition of Critical habitat for the Pilbara Leaf-nosed Bat. This is mainly due to the absence of any permanent or semi-permanent roosts within the Development Envelope, distance from a known permanent roost (Category 1-3) and the very low activity level recorded within the Development Envelope. Proposed impact to Supporting habitat comprises two Category 4 Pilbara Leaf-nosed Bat roosts, with seven of the nine Pilbara Leaf-

nosed Bat roosts (all Category 4) recorded within the Development Envelope will be retained. As such the Proposal is not expected to result in significant residual impacts to the regional population or conservation status of the species.Pilbara Olive Python: The low density of the Pilbara Olive Python, which is a mobile species that is likely to occur within the Development Envelope and the retention of 182 ha (63%) of Critical habitat within the Development Envelope, means that the Proposal is not expected to result in significant residual impacts to the regional population or conservation status of the species. Additionally, the Proposal has minimised impacts to Weeli Wolli Creek, the location of the majority of the Pilbara Olive Python historical records, with consolidated mapping of habitat showing an additional 634 ha of Gorge/Gully and Breakaway habitats mapped within the consolidated mapping area.

- Direct impact to two confirmed SRE taxa: *Aurecocrypta* `HD1` and *Pseudodiploexochus* `C75046`, both are singleton records that were collected from site SRE17, a gorge partially within the proposed Conceptual Footprint of the Proposal. Given the habitat for these taxa is expected to persist following the implementation of the Proposal, there is not expected to be significant residual impacts.
- Indirect impacts to significant fauna species during the construction and operation phase of the Proposal are not expected to result in significant residual impacts.
- Cumulative impacts: All significant fauna species that occur or are likely to occur within the Development Envelope occur widely in habitat types that remain throughout the Hamersley sub-region and can move throughout the local landscapes, as such the cumulative impact to these species are not expected to be significant.

7.6.4.2. Significant Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are significant to Terrestrial Fauna values:

- Clearing of up to 4,900 ha of terrestrial fauna habitat. This is considered a significant residual impact for the Proposal as per the EPAs cumulative environmental impacts of development in the Pilbara region (EPA 2014). This clearing is proposed to be offset as per Chapter 12
- Clearing of up to 105 ha of high value habitat (note this occurs within the 4,205 ha of native vegetation in good to excellent condition discussed above), comprising of:
    - 67 ha of Breakaway habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python
    - 38 ha of Gorge/Gully habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python.
    - These fauna habitat types are of high significance, are Critical habitat for several significant fauna, and is relatively scarce in the wider area. The Proposal is expected to have a significant environmental impact at a local scale, although this is lessened somewhat by the site's generally low utilisation by significant fauna species, the implementation of MEZs, and the limited scale and nature of the proposed clearing
- Clearing of up to 2,659 ha is of moderate value habitat (note this occurs within the 4,205 ha of native vegetation in good to excellent condition discussed above), comprising of:
    - 369 ha of Rocky Hill habitat – considered to be Supporting for Northern Quoll, Grey Falcon and Ghost Bat
    - 269 ha of Minor Drainage habitat – considered to be Supporting for Northern Quoll, Ghost Bat, and Grey Falcon
    - 70 ha of Alluvial Plain habitat – considered to be Supporting for Ghost Bat
    - 917 ha of Low Hills and Slopes habitat – considered to be Supporting for Ghost Bat
    - 601 ha of Mulga Woodland habitat – considered to be Supporting for Ghost Bat

- 433 ha of Stoney Plain habitat – considered to be Supporting for Ghost Bat

7.7. Environmental Outcome

7.7.1. Summary of Significant Residual Impacts and Proposed Conditions

A summary of the significant residual Terrestrial Fauna assessment and the proposed conditions is provided in Table 7-26.

Table 7-26: Assessment Findings and Proposed Conditions for Terrestrial Fauna

Residual Impact to Environmental Value	Assessment Finding	Recommended conditions
Direct Impacts		
Clearing of up to 4,900 ha of terrestrial fauna habitat.	• Clearing vegetation in 'Good' to 'Excellent' condition is considered a significant residual impact. • Habitat types of similar conditions are also well represented outside of the Development Envelope • The environmental outcome is likely to be consistent with the EPA's objective for this factor with the implementation of Proposal extent condition (recommended condition 1) and counterbalanced by the provision of offsets as outlined in Chapter 12.	Regulated through recommended conditions: • Condition 1 – Proposal extents limited to the Development Envelope (12,409.5 ha) and clearing extent of up to 4,900 ha • Condition 2 – Offset Pilbara Environmental Offsets Fund: Payment of $890 AUD (excluding GST) per hectare of 'Good' to 'Excellent' vegetation, cleared as a result of the Proposal within the Hamersley IBRA subregion
Clearing of high significance and moderate significance habitat types	• Design changes to the Development Envelope and Conceptual Footprint have reduced the high and moderate significance habitat types being impacts • MEZ will be implemented to further reduce the risk of impacts • The clearing associated with the Proposal will impact 105 ha of high value habitat and 2,659 ha of moderate value habitat within the Development Envelope • High and moderate value habitat is considered a significant residual impact that is expected to be counterbalanced by the provision of offsets as outlined in Chapter 12.	Proposed to be regulated through implementation of: • Ministerial conditions limiting the extent of clearing of high and moderate value habitat types for Northern Quoll, Ghost Bat and Pilbara Olive Python, within the Development Envelope to: ○ 105 ha of high value habitat ○ 2,659 ha of moderate value habitat ○ Two caves (Cave 1 and Cave 8) suitable for roosting for Ghost Bat and Pilbara leaf-nosed bat • Ministerial condition on implementation of the Proposal as defined in the Proposal Content Document, which includes the Mining Exclusion Zones • Ministerial condition protecting the structural integrity and microclimate of Ghost Bat caves retained in the Mining Exclusion Zones. Specifically Caves 10 (as depicted in Figure 7 5) • Ministerial condition requiring implementation of the EMP • Ministerial condition requiring the payment of offsets for clearing of critical and

Residual Impact to Environmental Value	Assessment Finding	Recommended conditions
		supporting MNES habitat (Chapter 12 and Section 13.10.2)

7.7.2. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit; and
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

In consideration of the proposed management measures and likely residual impacts, the Proponent will manage the implementation of the Proposal to achieve the following anticipated environmental outcomes for Environmental Factor - Terrestrial Fauna:

- Direct disturbance to terrestrial fauna habitat limited to 4,900 ha
- Direct disturbance of 105 ha is of high value habitat limited to:
    - 67 ha of Breakaway habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python
    - 38 ha of Gorge/Gully habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python.
- Direct disturbance of 2,659 ha is of moderate value habitat limited to:
    - 369 ha of Rocky Hill habitat – considered to be Supporting for Northern Quoll, Grey Falcon and Ghost Bat
    - 269 ha of Minor Drainage habitat – considered to be Supporting for Northern Quoll, Ghost Bat, and Grey Falcon
    - 70 ha of Alluvial Plain habitat – considered to be Supporting for Ghost Bat
    - 917 ha of Low Hills and Slopes habitat – considered to be Supporting for Ghost Bat
    - 601 ha of Mulga Woodland habitat – considered to be Supporting for Ghost Bat
    - 433 ha of Stoney Plain habitat – considered to be Supporting for Ghost Bat
- Direct disturbance limited to two caves within the Development Envelope, one Category 3 (Cave 1) and one Category 4 (Cave 8) Ghost Bat roosts, both caves are also Category 4 Pilbara Leaf-nosed Bat caves (Figure 7-6).
- No direct disturbance of high value habitat types and no impact to Ghost Bat caves within the MEZs.

Based on significant survey work and advice from Pilbara subject matter experts, the avoidance, mitigation, MEZ and offsets proposed are specific to the Proposal. Mechanisms to achieve these environmental outcomes are outlined in Table 7-26**Error! Reference source not found.**. Offsets associated with the implementation of the Proposal are discussed in Chapter 12.

In accordance with EPA guidance (EPA 2021e), Table 7-26 outlines the anticipated mechanisms to ensure the proposed environmental outcomes can be achieved. MEZs are established in the Proposal Content Document (Appendix A3).

The environmental outcomes of the Proposal are consistent with the EPA objective to protect terrestrial fauna so that biological diversity and ecological integrity are maintained. The proposed implementation conditions and regulation through other DMA processes will ensure these outcomes are achieved.

8. SUBTERRANEAN FAUNA

8.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021c) lists the following as their objective for Subterranean Fauna:

To protect Subterranean Fauna so that biological diversity and ecological integrity are maintained

For the purpose of this assessment, Subterranean Fauna are defined as fauna which live their entire lives below the surface of the earth. They are divided into two main groups:

- Stygofauna – aquatic and living in groundwater
- Troglofauna – air breathing and living in caves and voids (above the water table).

Subterranean fauna often display evolutionary adaptations to underground life, particularly reduced pigment and reduced, poorly functioning or non-existent eyes. Other morphological and physiological adaptations, such as vermiform bodies, elongate sensory structures, loss of wings, increased lifespan, a shift towards longer-term breeding strategies with fewer offspring (K-selected) and decreased metabolism, reflect the habitats occupied by subterranean species (Gilbert and Deharveng 2002).

The Pilbara and Yilgarn regions are recognised as globally significant 'hot-spots' for subterranean fauna biodiversity and endemism (EPA 2016h). Estimates of species richness for the subterranean fauna of Western Australia range from nearly 3,000 in the Pilbara (Halse 2018) to over 4,000 in Western Australia (Guzik et al. 2010). Except for three fish species and a blind snake, all known species of subterranean fauna in Western Australia are invertebrates such as arachnids (e.g., spiders, scorpions), crustacea (e.g., crabs, woodlice, shrimp), insects and myriapods (e.g., centipedes, millipedes) (Aplin 1998; Larson et al. 2013; Moore 2019).

The presence of subterranean fauna is strongly linked to geology and hydrogeology and the availability of suitable micro-habitats, e.g., air-filled voids, or caves above the water table for troglofauna, and aquifers with the right physio-chemical ranges suitable for stygofauna. This assessment recognises these inherent links.

8.2. Relevant Policy and Guidance

Table 8-1 presents the relevant policy and guidance for Subterranean Fauna and demonstrates how this has been considered for the Proposal.

Table 8-1: Relevant Policy and Guidance for Subterranean Fauna

Relevant EPA and other State or Commonwealth policy or guidance	Explain how the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for Subterranean Fauna forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.

Relevant EPA and other State or Commonwealth policy or guidance	Explain how the Policy and Guidance has been Considered
Environmental Factor Guideline: Subterranean Fauna (EPA 2016h) EPA Technical guidance – Subterranean fauna surveys for environmental impact assessment (EPA 2021l)	Considered in the design (methods and approach) of Subterranean Fauna surveys (previous guidelines were used where surveys were undertaken before current guidelines).
Instructions on how to prepare an Environmental Review Document (EPA 2020e)	Utilised as the basis for the structure and content of this document
Other State or Commonwealth	
Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	Considered in the development of this document and for the Mine Closure Plan (Appendix A4)
Statutory Guidelines for Mine Closure Plans (DMIRS 2020b)	

8.3. Receiving Environment

8.3.1. Studies and Survey Effort

Table 8-2 summarises the Proposal-specific and other relevant surveys and studies undertaken for Subterranean Fauna. Key studies and survey reports are provided in Appendix D1 and D2. The spatial extent and location of stygofauna and troglofauna sampling are shown in Figure 8-1 and Figure 8-2.

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Table 8-2: Summary of Technical Studies for Subterranean Fauna Environmental Factor

Studies/Survey	Study area, Type and Timing	Consistency with Guidance
Proposal-specific Studies		
Stantec (2019) Hope Downs 2 Proposal Level 2 Troglofauna Survey Appendix D1	Survey area: BHT, HD2 **Type:** Desktop review and Level 2 troglofauna Survey **Timing:** First phase Oct 2018 – Jan 2019, second phase Apr/May 2019	Undertaken in accordance with previous EPA technical guidance (EPA 2016i; 2016j). Mostly complies with current guidance (EPA 2021l) and is the equivalent to a Detailed survey. Level 2 troglofauna survey undertaken, with three survey events (2015, 2018 and 2019) incorporating both wet and dry seasons. Limitations of the study included taxonomic limitations (common to all subterranean fauna surveys) and lack of suitable sampling sites in non-resource areas which caused a disproportionate sampling effort between proposed impact areas and reference areas.
Stantec (2020) Hope Downs 2 Proposal Level 2 Stygofauna Survey Appendix D2	**Survey area**: BHT, HD2, HD1 (Baby Hope Proposal) **Type:** Desktop review and Level 2 stygofauna Survey **Timing:** First phase Oct-Nov 2018, second phase Mar-Apr 2019	Undertaken in accordance with previous EPA technical guidance (EPA 2016i; 2016j). Mostly complies with current guidance (EPA 2021l) and is the equivalent to a Detailed survey. The Level 2 stygofauna surveys were undertaken over two seasons, a wet and dry season. Current guidance recommends three phases in areas where there is prospective habitat and a reasonable expectation of encountering stygofauna (EPA 2021l). Given that the desktop and current survey shows that stygofauna are relatively depauperate within the Development Envelope, a third phase of survey is not considered applicable. Limitations of the study included taxonomic limitations (which are common to all subterranean fauna surveys) and a lack of suitable sampling sites in non-resource areas which caused a disproportionate sampling effort between proposed impact areas and reference areas.
Other Relevant Studies		
Biota (2011) Hope Downs Project Life of Mine Targeted Fauna Survey	**Survey area:** HD1 **Type:** A single phase troglofauna survey **Timing**: Jun – Aug 2010	The survey was designed in accordance with the EPA guidance available at the time (EPA 2007b and EPA 2013) Limitations of the study included the spatial extent of sampling, which was limited by availability and accessibility of drillholes, as well as general taxonomic limitations which are common to all subterranean fauna studies.

Studies/Survey	Study area, Type and Timing	Consistency with Guidance
Biota (2015a) Baby Hope Downs Deposit Targeted Fauna Survey	**Survey area:** HD1 (Baby Hope Proposal), BHT **Type:** A single phase troglofauna survey **Timing:** September to October 2013	The survey was designed in accordance with the EPA guidance available at the time (i.e. Pre-2016 guidance); however, only one phase of sampling was undertaken (two phases were previously recommended). Limitations of the study included taxonomic limitations which is common to all subterranean fauna surveys, as well as limitations in mapping hydrated geological units which was not available at the time, however preliminary cross section and selected drill log data assisted offsetting these limitations.

8.3.1.1. Overview

Stantec Australia Pty Ltd (Stantec) completed baseline (Level 2) subterranean fauna surveys for the Proposal in 2018 and 2019, with dual phase troglofauna and stygofauna sampling throughout the HD2 and BHT deposit areas. The stygofauna sampling program was focussed across the AWT deposits and also on areas for the proposed borefield. Stygofauna were also assessed from the adjacent Baby Hope (BH) deposit, and the Weeli Wolli Creek calcrete area to the northeast of the Development Envelope.

Assessment of impacts to subterranean fauna habitat was undertaken within the extent of Development Envelope using a 2D approach validated by preliminary 3D habitat modelling. The 2D habitat units are inferred from 250K surface geology mapping (GSWA 1:250,000). Preliminary 3D modelling was undertaken by Rio Tinto (unpublished), which utilises drill-hole logging information data in the program Leapfrog Geo v4.3.1.

8.3.1.2. Troglofauna Survey

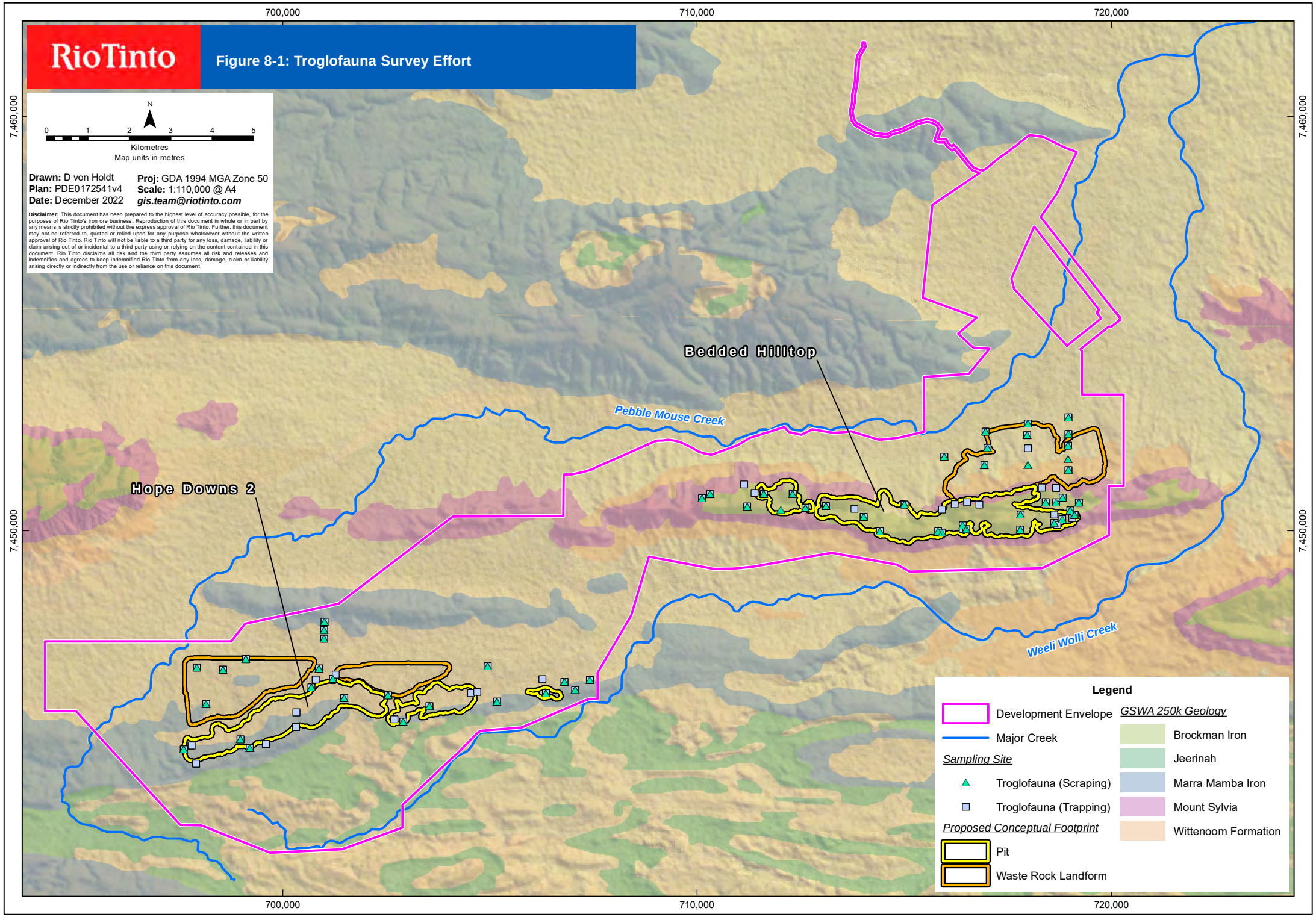
A detailed (Level 2) troglofauna survey was undertaken within the Development Envelope (Stantec 2019; Table 8-2). During this survey, a total of 97 litter trap samples and 675 scrape samples were collected from 58 sites at BHT, and a total of 75 litter trap samples and 50 scrape samples were collected from 38 sites at HD2, over two phases/seasons (i.e., a wet season and a dry season). Sampling was undertaken both inside and outside the deposit areas and satisfies the requirements for a detailed subterranean fauna survey as set by the current EPA (EPA 2021l).

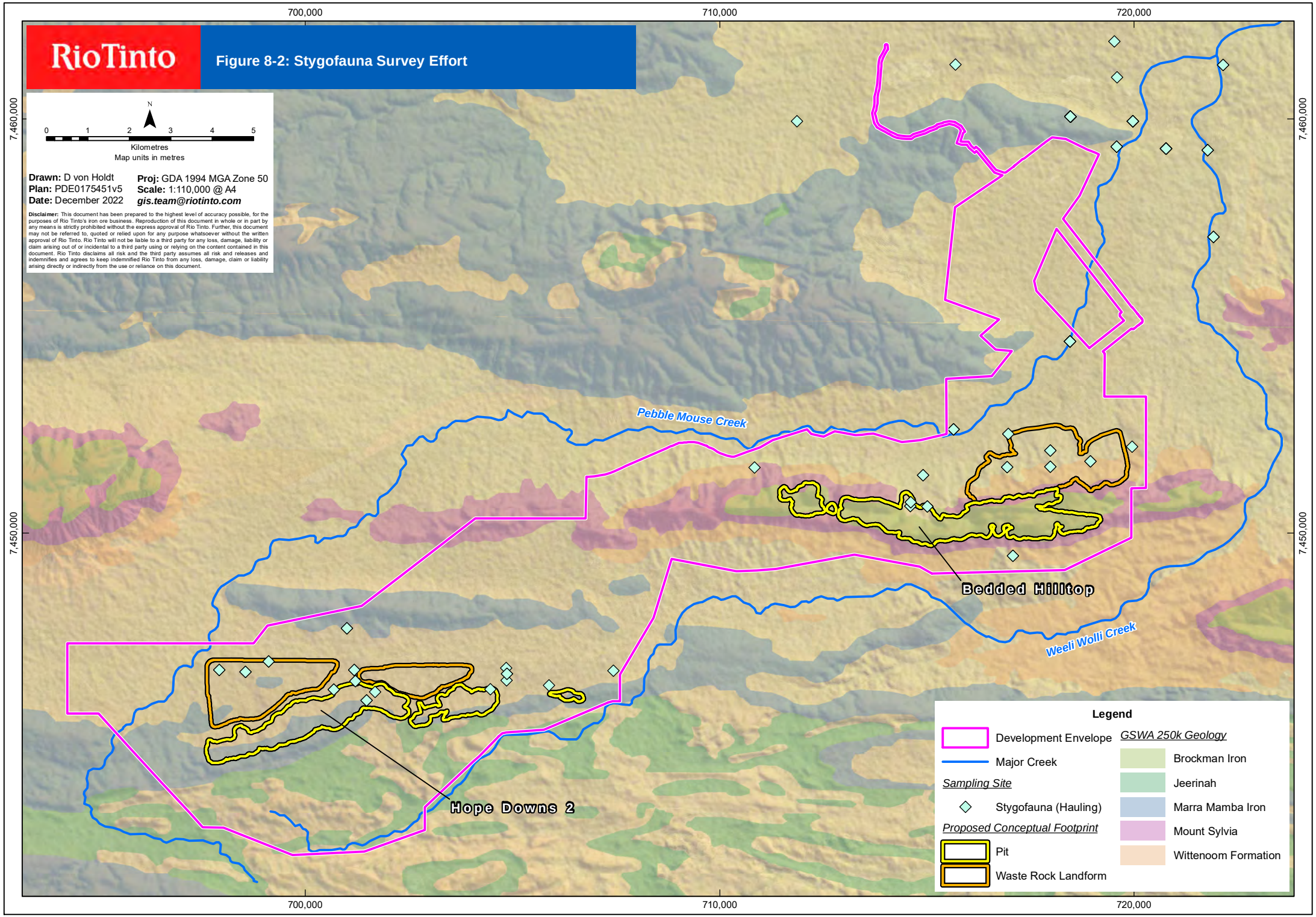
One earlier survey phase of BHT was completed in 2015 by Biota (Biota 2015a). The 2015 survey included 38 trap samples and three scrape samples from 13 sites. This survey is relevant to the current Proposal as the study area abuts/overlaps portions of the Development Envelope (Figure 8-1). This survey was undertaken in accordance with the EPA Technical Guidance available at the time of survey.

In total, troglofauna surveys undertaken for the Proposal have collected a total of 324 samples, which includes 199 from BHT and 125 samples from HD2 from 71 and 38 sites respectively, exceeding the applicable guideline requirements of 60 impact samples for a Level 2 troglofauna survey (EPA 2016 j). The surveys have been undertaken across two seasons: the wet and the dry season, and there is a similar number of impact sites compared to reference sites as is recommended under current EPA guidance (EPA 2021l).

8.3.1.3. Stygofauna Survey

A detailed (Level 2) stygofauna survey was undertaken over two phases in 2018- 2019 (Stantec 2020; Table 8-2). This survey covered both deposits as well as suitable habitat outside the deposits including the BH deposit (Figure 8-2). During the survey, a total of 88 stygofauna net haul samples were collected from 57 sites. This incorporated sites from within the BH (29 samples from 23 sites) BHT (21 samples from 11 sites) and HD2 (25 samples from 16 sites) deposits and regional references sites in the Weeli Wolli Creek calcrete and riparian zone (13 samples from seven sites) (Figure 8-2).


RioTinto
Figure 8-1: Troglofauna Survey Effort
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172541v4
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
gis.team@riotinto.com
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700,000
710,000
720,000
7,460,000
7,450,000
Bedded Hilltop
Hope Downs 2
Pebble Mouse Creek
Weeli Wolli Creek
Legend
Development Envelope
Major Creek
Sampling Site
Troglofauna (Scraping)
Troglofauna (Trapping)
Proposed Conceptual Footprint
Pit
Waste Rock Landform
GSWA 250k Geology
Brockman Iron
Jeerinah
Marra Mamba Iron
Mount Sylvia
Wittenoom Formation


RioTinto
Figure 8-2: Stygofauna Survey Effort
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0175451v5
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
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700,000
710,000
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7,460,000
7,450,000
Pebble Mouse Creek
Bedded Hilltop
Weeli Wolli Creek
Hope Downs 2
Legend
Development Envelope
Major Creek
Sampling Site
Stygofauna (Hauling)
Proposed Conceptual Footprint
Pit
Waste Rock Landform
GSWA 250k Geology
Brockman Iron
Jeerinah
Marra Mamba Iron
Mount Sylvia
Wittenoom Formation

8.3.2. Conservation Status and Short-Range Endemic Classification

Subterranean fauna species and ecological communities may be considered significant through formal listing under the EPBC Act or the BC Act; however, there are many potential SRE subterranean fauna species that are not formally listed, primarily due to incomplete regional sampling and low taxonomic certainty, which hinders formal recognition of species distribution ranges (EPA 2021l; Stantec 2019).

In the absence of formal listings, subterranean fauna taxon can be assigned an SRE status category: Confirmed SRE, Potential SRE or widespread (i.e., not an SRE; Table 8-3). This categorisation indicates the potential for short-range endemism and thus informal conservation significance. These groupings are based on the Western Australian Museum's (WAM) categorisation for SRE invertebrates, which is based on the 10,000 km^2 range criterion for SREs proposed by Harvey (2002; Table 8-3). As most subterranean fauna are taxonomically poorly known, the majority of morphospecies are assigned as 'Potential SREs'.

Table 8-3: SRE Categorisation Used by WAM

Distribution Range	Taxonomic Certainty	Taxonomic Uncertainty
<10,000 km^2	Confirmed SRE • A known distribution of <10,000 km^2 • Taxonomy well known • Group is well represented in collections and/or via comprehensive sampling	Potential SRE • Patchy sampling resulting in incomplete knowledge of geographic distribution • Incomplete taxonomic knowledge • Group not well represented in collections • Category applies where there are significant knowledge gaps **Potential SRE sub-categories** may apply depending on taxonomic certainty: • Data deficient • Habitat indicators • Morphology indicators • Molecular evidence • Research and expertise
>10,000 km^2	Widespread (not an SRE) • A Known distribution of >10,000 km^2 • Taxonomy is well known • Group is well represented in collections and/or via comprehensive sampling	

8.4. Troglofauna

8.4.1. Habitat Suitability

The extent of troglofauna habitat generally is dependent on the interconnection of sub-surface crevices, fractures and voids within suitable geological units. In addition to allowing for the movement of subterranean fauna, adequate interconnected spaces and associated high permeability can provide pathways for infiltration (vertical or lateral) of resources such as oxygen and nutrients, which are key factors influencing subterranean fauna persistence and distribution (Humphreys 2008; Strayer 1994).

Geological units associated with the Proposal (Figure 8-3) that are known to provide prospective habitat for troglofauna include iron ore formations, of which, the Brockman Iron Formation and Marra Mamba Iron Formation have been known to host records of troglofauna and occur extensively at BHT and HD2 deposits. Other highly prospective geologies occur in the area including the surrounding detrital deposits (alluvium and colluvium), and the karstic dolomite of the underlying Wittenoom Formation.

8.4.2. Habitat Model

An assessment of the prospective suitability of habitat to support troglofauna has been undertaken within, and in proximity to, the Development Envelope (Stantec 2022). The extent, thickness, and connectivity of local geological habitats above water table was mapped by Rio Tinto based upon 3D geological models.

Of the 11 geological units mapped within the Development Envelope, five have been identified as suitable habitat for troglofauna, comprising colluvium (4,449 ha), Mt McRae Shale / Mt Sylvia Formation (862 ha), Wittenoom Formation (1,018 ha), Brockman Iron Formation (704 ha) and Marra Mamba Iron Formation (1,577 ha) (Figure 8-3).

Initial habitat modelling for the Development Envelope indicated that high confidence modelled habitat (medium and high suitability troglofauna habitat) was well connected within the HD2 area, with varying thicknesses (Figure 8-3). The modelled habitat primarily coincided with 2D-mapped Marra Mamba Iron Formation and colluvium, with other units including alluvium and Jeerinah Formation contributing to a lesser extent. The medium and high suitability modelled troglofauna habitat in the proposed BHT pits was largely connected, corresponding with Brockman Iron Formation and a low percentage of Mt McRae Shale / Mt Sylvia Formation in the proposed pit areas.

8.4.2.1. Bedded Hilltop Deposit

Prospective troglofauna habitat has been found in secondarily weathered and fractured zones of Brockman Iron Formation atop the BHT deposit (Figure 8-3). The topography of the BHT deposit is highly undulating and exposed, resulting in a high degree of weathering in the hilltop surface strata. The BHT deposit is also ringed by a highly fractured outcropping of Mt Sylvia formation that is likely to provide further habitat. (Stantec 2019).

The BHT deposit is surrounded by colluvium and alluvial sheet wash (detritals). This geology provides connectivity of suitable habitat through the valley to nearby known habitat at the BH deposit (part of the Hope Downs 1 operations) as well as laterally along Pebble Mouse Creek. Extensive adjoining troglofauna habitat is known to connect and extend through to the adjacent Marra Mamba Formation within the BH Development Envelope. (Biota (2015a).

Habitat modelling shows troglofauna habitat is connected throughout the modelled area of the BHT deposit, of varying thickness. The thickest sections of high and medium suitability troglofauna habitat (~107 m) occurs in the eastern section of the BHT deposit, in the Brockman Iron Formation (Stantec 2019; Figure 8-3).

Geological information (based on surface and inferred underlying geology mapping) indicates that further suitable connected habitat is highly likely to occur outside of the area of high confidence habitat modelling. The most prospective areas and geologies include the Mt Sylvia formation, the colluvial and alluvial sheetwash units surrounding the landform, and the far western and eastern parts of the BHT deposit, which are outside of the Proposal footprint. (Stantec 2019).

8.4.2.2. Hope Downs 2 Deposit

The HD2 deposit has a low rolling hill landform. A small amount of outcropping Marra Mamba rock exists, dissected by upstream tributaries of Pebble Mouse Creek in the northwest, and Weeli Wolli Creek in the southeast (Figure 8-3). Troglofauna habitat in the area is predominately within the Marra Mamba Formation, overlain by detrital deposits in the southwest and northeast (Stantec 2019). Colluvium and alluvial sheet wash, which is also suitable habitat for troglofauna, surround these small outcrops and extend beyond the habitat model (Figure 8-3).

Habitat modelling shows troglofauna habitat is connected throughout the modelled area of the HD2 deposit although some areas of habitat are greater in thickness than others (Figure 8-3). The thickest sections of high and medium suitability troglofauna habitat (~112 m) (depth from the surface) occurs in

the western section of the deposit, in the deepest area of detritals overlying and including a portion of Marra Mamba Formation (Stantec 2019).

8.4.3. Troglofauna Records

A total of 108 potential troglofauna specimens, representing at 22 taxa from 10 higher level taxonomic groups; Araneae, Blattodea, Diplura, Hemiptera, Palpigradi, Polyxenida, Pseudoscorpiones, Scolopendromorpha, Schizomida, and Zygentoma have been recorded from the Development Envelope (Stantec 2022). Within the Development Envelope, the BHT area appears to host a more diverse troglofauna assemblage with 12 taxa recorded, compared to eight taxa from HD2 (Table 8-4, Figure 8-3).

Three taxa; Lophoproctidae `sp. Biologic-POLX001`, Nocticola `sp. Biologic-BLAT003` and Pauropoda sp. indet., were found to occur in both areas (i.e., BHT and HD2). The troglobitic species, Draculoides `sp. SCH068`, recorded from BHT, had previously been collected from the adjacent BH deposit.

Of the taxa considered to represent discrete species, nine (cf. *Prethopalpus* 'sp. Biologic-ARAN014', *Dodecastyla* `sp. Biologic-ZYGE001`, *Eukoenenia* `sp. OES2`, *Indjapx* `sp. Biologic-DIPL001`, *Lagynochthonius* `sp. WAMPSE096`, *Nocticola* `sp. Biologic-BLAT001`, *Scolopendromorpha* `sp. Biologic-CHIL001`, *Trinemura* `sp. OES11`, and *Tyrannochthonius* `sp. Biologic-PSEU001`), were recorded as singletons or were recorded from a single site (Table 8-4).

Genetic analysis indicated that four taxa; the singleton *Dodecastyla* `sp. Biologic-ZYGE001`, *Lophoproctidae* `sp. Biologic-POLX001`, the singleton *Indjapx* `sp. Biologic-DIPL001` and *Nisia* `sp. Biologic-HEMI001` belonged to relatively widespread taxa. With linear distributions extending for over 140 km, 300 km, 175 km and 50 km respectively, these taxa are likely to be troglophilic; carrying out most of their lifecycle underground but able to survive in epigean habitats (Thurgate et al. 2001). There is also the possibility that the singleton *Nocticola* `sp. Biologic-BLAT001, could be represented in indeterminate *Blattodea* sp. and *Nocticolidae* sp. material collected as part of the previous HD1 and BH troglofauna assessments (Stantec 2022).

The majority of the species recorded from the Development Envelope were considered likely to be troglophiles; while five species were classified as troglobitic (obligate subterranean inhabitants); cf. *Prethopalpus* `sp. Biologic-ARAN014`, *Eukoenenia* `sp. OES2`, *Tyrannochthonius* `sp. Biologic-PSE001`, *Lagynochthonius* `sp. WAMPSE096` and *Draculoides* `sp. SCH068`. Four of these troglobitic taxa were recorded from BHT while HD2 yielded only one troglobitic taxa; cf. *Prethopalpus* `sp. Biologic-ARAN014` (Table 8-4).

Table 8-4: Troglofauna Taxa Recorded from the Surveys (Stantec 2022)

Orange highlight indicates species only known from

Taxon	Study	ID Method	Abundance	Deposit Area	Number of Sites	SRE Status, Distribution and Ecology
Arachnida - Araneae: Oonopidae						
cf. *Prethopalpus* `sp. Biologic -ARAN014`	Stantec 2019	DNA	1	HD2 (indirect impact site)	1	Potential SRE. Singleton; distribution unable to be empirically determined. Troglobite
Arachnida – Palpigradi: Eukoeneniidae						
Eukoenenia `sp. OES2`	Stantec 2019	Morphology	1	BHT (direct impact site)	1	Potential SRE. Singleton; distribution unable to be empirically determined. Troglobite
Arachnida - Pseudoscorpiones: Chthoniidae						
Tyrannochthonius `sp. Biologic-PSEU001`	Stantec 2019	DNA	1	BHT (direct impact site)	1	**Confirmed SRE**. Singleton; distribution unable to be empirically determined. Troglobite
Lagynochthonius `sp. WAM-PSE096`	Biota 2015b	Morphology	1	BHT (direct impact site)	1	**Confirmed SRE.** Singleton; distribution unable to be empirically determined. Troglobite
Arachnida- Schizomida: Hubbardiidae						
Draculoides `sp. SCH068`	Stantec 2019	DNA	8	BHT (direct impact sites and non-impact site)	4	**Confirmed SRE.** Also recorded from the nearby Baby Hope deposit (linear range 7.5 km)[1,2]. Troglobite
	Biota 2015b	DNA	2		2	
Chilopoda - Scolopendromorpha						
Scolopendromorpha `sp. Biologic-CHIL001`	Stantec 2019	DNA	1	HD2 (direct impact site)	1	Potential SRE. Singleton from the HD2 deposit area; distribution unable to be empirically determined. Likely troglophile.
Diplopoda - Polyxenida: Lophoproctidae						
Lophoproctidae `sp. Biologic-POLX001`	Stantec 2019	DNA	2	BHT, HD2 (indirect impact sites)	2	Potential SRE. Molecular analysis determined it to be a widespread species[3] (linear range of >300 km). Troglophile

Taxon	Study	ID Method	Abundance	Deposit Area	Number of Sites	SRE Status, Distribution and Ecology
Diplopoda - Polyxenida						
Polyxenida sp.	Biota 2011	Morphology	1[#]	None (Development Envelope)	1	Indeterminate specimens. Potential SRE.
Diplopoda – Polyxenida: Polyxenidae						
Polyxenidae sp.	Biota 2011	Morphology	1[#]	None (Development Envelope)	1	Indeterminate specimens. Potential SRE.
Entognatha - Diplura: Japygidae						
Indjapx `sp. Biologic-DIPL001`	Stantec 2019	DNA	1	HD2 (indirect impact site)	1	Potential SRE. Single record from the HD2 deposit area. Also known from locality approximately 50 km away[4]. Likely troglophile
Japygidae sp.	Biota 2015b	Morphology	1	BHT (direct impact site)	1	Indeterminate specimen; may represent *Indiapx* 'sp. Biologic-DIPL001' recorded from the Development Envelope. Potential SRE. Other records of Japygidae sp. in adjacent area (BH and HD1)
Insecta – Blattodea: Nocticolidae						
Nocticola `sp. Biologic-BLAT001`	Stantec 2019	DNA	1	HD2 (indirect impact site)	1	Potential SRE. Singleton; distribution unable to be empirically determined. Troglophile
Nocticola `sp. Biologic-BLAT002`	Stantec 2019	DNA	18	BHT (direct impact and non-impact sites)	9	Potential SRE. (linear range 8.5 km. Troglophile
Nocticola `sp. Biologic-BLAT003`	Stantec 2019	DNA	47	BHT, HD2 (direct impact and non-impact sites)	14	Potential SRE. linear range 22.5 km. Troglophile
Nocticola `sp. Biologic-BLAT004`	Stantec 2019	DNA	7	BHT (direct impact and non-impact sites)	6	Potential SRE. linear range 2.5 km. Troglophile
Blattodea sp.	Biota 2015b	Morphology	10	BHT (direct impact sites)	3	Indeterminate specimens; may represent one of the four *Nocticola* species recorded from Development Envelope. Potential SRE. Also recorded from BH[2]. Likely troglophile

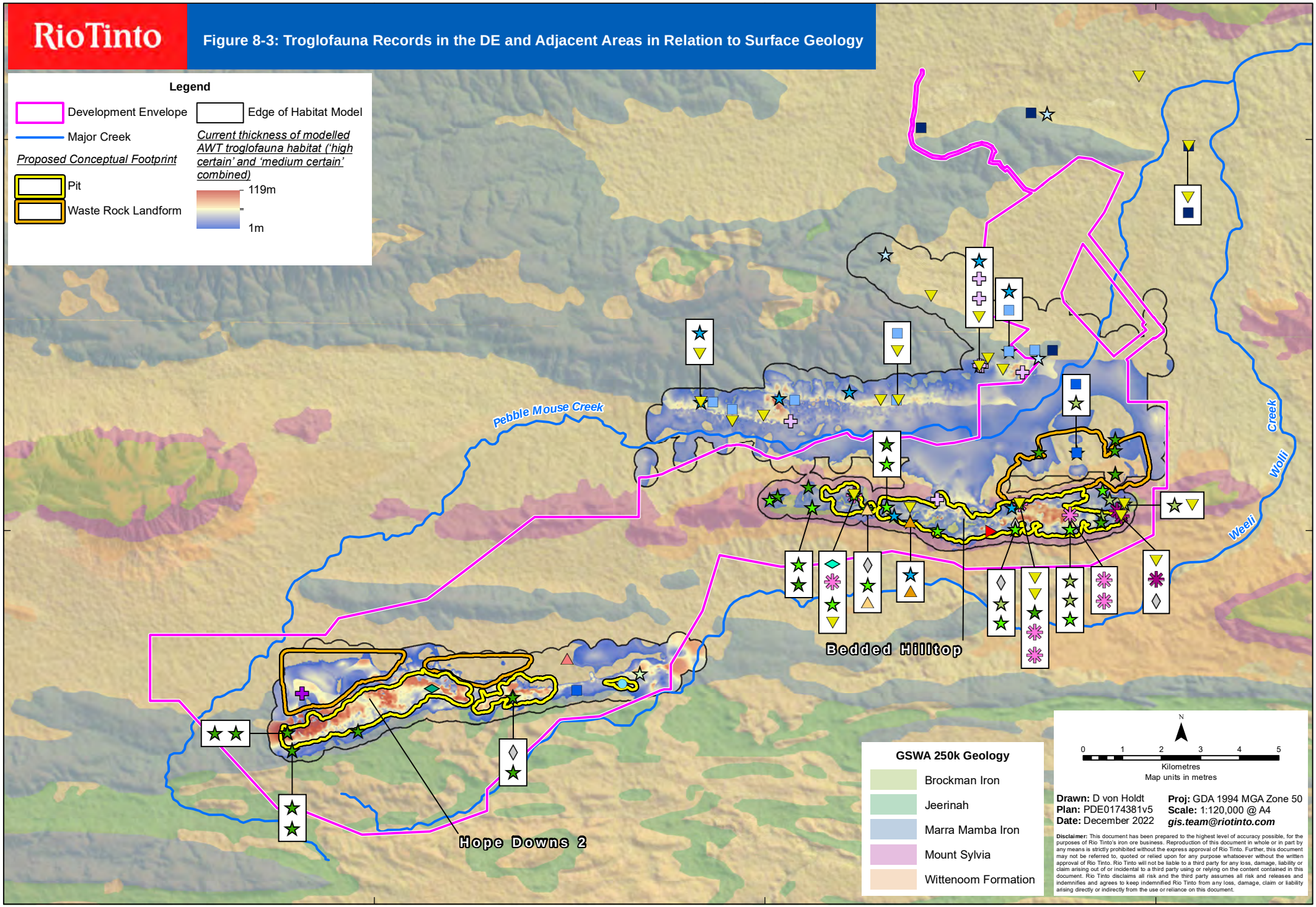
Taxon	Study	ID Method	Abundance	Deposit Area	Number of Sites	SRE Status, Distribution and Ecology
Nocticolidae sp.	Biota 2011	Morphology	1[#]	None (Development Envelope)	1	Indeterminate specimens; may represent one of the four *Nocticola* species recorded from the Development Envelope. Potential SRE. Likely troglophile
Insecta - Hemiptera: Meenoplidae						
Nisia `sp. Biologic-HEMI001`	Stantec 2019	DNA	11	BHT (direct impact sites)	3	Potential SRE. Molecular analysis determined it to be a widespread species with a linear range of over 175 km^3 . Troglophile
Phaconeura `sp. Biologic-HEMI002`	Stantec 2019	DNA	2	BHT (direct impact and non-impact sites)	2	Potential SRE. Recorded from two sites within the BHT deposit area (linear range 0.1 km). Troglophile
Insecta - Zygentoma: Nicoletiidae						
Dodecastyla `sp. Biologic-ZYGE001`	Stantec 2019	DNA	2	BHT (direct impact site)	1	Potential SRE. Molecular analysis determined this taxon to be a widespread species with a linear range of over 140 km^3. Troglophile
Trinemura `sp. OES11`	Stantec 2019	Morphology	1	HD2 (direct impact site)	1	Potential SRE. Singleton from the HD2 deposit area; distribution unable to be empirically determined. Uncertain dependence on subterranean habitat
Pauropoda						
Pauropoda sp. indet.	Stantec 2019	Morphology	4	BHT, HD2 (direct impact and non-impact sites)	4	Potential SRE. Recorded from 4 sites across the HD2 and BHT deposit areas. Likely troglophile

[#] *Specific abundance not provided (Biota 2011)*

[1] *(Biota 2015a),* [2] *(Biota 2015b),* [3] *(Biologic 2019),* [4] *(Stantec unpublished data)*

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Figure 8-3: Troglofauna Records in the DE and Adjacent Areas in Relation to Surface Geology



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Figure 8-3: Troglofauna Records in the DE and Adjacent Areas in Relation to Surface Geology - Legend

Legend - Troglofauna

Araneae
- cf. Prethopalpus `sp. Biologic -ARAN014`

Palpigradi
- Eukoenenia `sp. OES2`

Pseudoscorpiones
- Tyrannochthonius `sp. Biologic-PSEU001`
- Lagynochthonius `PSE96`

Schizomida
- Draculoides `sp. SCH068`

Scolopendromorpha
- Scolopendromorpha `sp. BiologicCHIL001`

Polyxenida: Lophoproctidae
- Lophoproctidae `sp. Biologic-POLX001`

Polyxenida
- Polyxenida sp.

Polyxenida: Polyxenidae
- Polyxenidae sp.

Diplura
- Indjapx `sp. Biologic-DIPL001`
- Japygidae sp.

Blattodea
- Nocticola `sp. Biologic-BLAT001`
- Nocticola `sp. Biologic-BLAT002`
- Nocticola `sp. Biologic-BLAT003`
- Nocticola `sp. Biologic-BLAT004`
- Blattodea sp.
- Nocticolidae sp.

Hemiptera
- Nisia `sp. Biologic-HEMI001`
- Phaconeura `sp. Biologic-HEMI002`

Zygentoma
- Dodecastyla `sp. Biologic-ZYGE001`
- Trinemura `sp. OES11`

Pauropoda
- Pauropoda sp. indet.

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8.4.4. Species Richness Estimates and Survey Adequacy

Based on the 2018 and 2019 survey data only, the various species richness estimators indicated the total species richness within the Development Envelope to range from 17.7 to 24 species, with the 15 taxa collected in 2018 and 2019 representing an estimated 63% to 85% of the total species predicted to occur in the Development Envelope (Stantec 2019). The extrapolation of the observed species accumulation curve indicates that increasing the survey effort by more than 100% (i.e. from 283 to 566 samples) will likely only record an additional four troglofauna species.

8.4.5. Troglofauna Abundance and Distribution

Within BHT, troglofauna were recorded from 27 (50%) of the 54 sites sampled, and 36 (23%) of the 158 samples collected in 2018 and 2019. Within HD2, troglofauna were not collected as commonly as at BHT, with material recorded from 10 (29%) of the 38 sites sampled, and 13 (10%) of the 124 samples collected.

The nocticolid cockroaches were the most abundant and species rich group, with genetic analysis revealing four *Nocticola* species to occur (Table 8-4). *Nocticola* `sp. Biologic-BLAT003` was the most abundant and widespread species, with 47 specimens collected from BHT and HD2. The 14 sites from which *Nocticola* `sp. Biologic-BLAT003` was recorded occurred within mapped Brockman BIF, colluvial, and Mount McRae Shale surface geologies across a range of depths. All nocticolids were considered likely troglophiles.

The troglobitic schizomid, *Draculoides* `sp. SCH068`, was also relatively abundant with 10 specimens collected in total from the BH and BHT deposits from within mapped Brockman and Marra Mamba BIF, and Mount McRae Shale surface geological units also from a range of depths.

8.4.6. Potential Impacts to Troglofauna

Implementation of the Proposal will potentially result in the following direct impacts to troglofauna:

- Removal of habitat (excavation) for potentially restricted troglofauna taxa.

Potential indirect impacts to troglofauna include the degradation of habitat due to mining-related activities and include:

- Clearing of vegetation and subsequent placement of mineral waste potentially leading to a reduction in organic inputs into the subterranean environment
- Vibration and compaction from blasting and heavy traffic may cause voids to collapse
- Contamination associated with accidental hydrocarbon spills and siltation of voids from waste rock dumps or stockpiles storage may result in a reduction in the quality of troglofauna habitat.

8.4.6.1. Direct Impacts

Removal of Habitat

Five geological units have been identified as prospective troglofauna habitat (colluvium, Mt McRae Shale / Mt Sylvia Formation, Wittenoom Formation, Brockman Iron Formation and Marra Mamba Iron Formation). Of these units colluvium, Mt McRae Shale/Mt Sylvia Formation and Wittenoom Formation, will have greater than 95% of the surface mapped extent remaining in the Development Envelope following proposed pit excavation, and the Marra Mamba Iron Formation, one of the prevalent geological units in the proposed HD2 pits, will have over 84% of the surface mapped extent of the unit within the Development Envelope retained. The percentage is comparatively lower for the Brockman Iron Formation, the predominant unit in the proposed BHT pits, with 35% of the surface mapped extent of the unit within the Development Envelope remaining after implementation of the Proposal (Stantec 2022), however noting that the geological formations are connected and that species are not specifically constrained to individual geological formations.

Potentially Restricted Troglofauna

Seventeen of the 22 taxa recorded during the baseline surveys are considered unlikely to be impacted by the Proposal on the basis that their recorded distribution is outside of, or extends beyond, the proposed pits. For the remaining five taxa, all are singletons and have so far only been recorded from within the proposed pit shells. The five taxa are:

- *Eukoenia* `sp. OES2` (Troglobite)
- Lagynochthonius `sp. WAM-PSE096` (Troglobite)
- *Tyrannochthonius* `sp. Biologic-PSEU001` (Troglobite)
- *Scolopendromorpha* `sp. Biologic-CHIL001` (Troglophile)
- *Trinemura* `sp. OES11` (uncertain dependence on subterranean habitats).

8.4.6.2. Indirect Impacts

Potential indirect impacts to troglofauna include temporary reduction or degradation of habitat due to mining-related activities other than pit excavation, such as:

- Clearing of vegetation and subsequent placement of mineral waste or other infrastructure potentially leading to a reduction in infiltration and organic inputs into the subterranean environment
- Groundwater drawdown, resulting in decreased soil humidity
- Contamination associated with accidental hydrocarbon spills and siltation of voids from waste rock dumps or stockpiles storage may result in a reduction in the quality of troglofauna habitat.

Little is known about the origin of energy (i.e., organic carbon), key taxa or connectivity within the food web of subterranean systems (OEPA 2012). If energy in the subterranean system originates from the surface, clearing of vegetation and placement of mineral waste material may lead to a reduction in organic inputs and potentially a localised reduction of surface water infiltration into the subterranean environment (Gibson et al. 2019). However, little evidence is available examining the effects these impacts have on subterranean fauna communities (Gibson et al. 2019). Results from recent troglofauna sampling at other Rio Tinto developments (Mesa A and Mesa K) indicate that troglofauna utilise habitat in or below mineral waste dumps (Rio Tinto 2018a, 2018b). Based on the available data, troglofauna are therefore expected to continue to utilise habitat in or below the proposed waste dumps to some extent. Based on this, and given the relatively minor scale, this potential indirect impact will not be considered further in this assessment.

Abstraction of groundwater for water supply at HD2 is expected to lower the groundwater levels by approximately 18 m, mostly in the Marra Mamba and Wittenoom formations (Chapter 9). This may potentially affect habitat occupied by Scolopendromorpha `sp. Biologic-CHIL001`. The Wittenoom Formation is not expected to host troglofauna, and the Marra Mamba formation at HD2 is widely distributed across and beyond the Development Envelope. Based on this, no significant indirect residual impacts to troglofauna from dewatering are expected, and no further assessment is considered required.

The potential for the Proposal to result in subsurface contamination or siltation of suitable troglofauna habitat at a scale sufficiently large across all three dimensions to significantly impact that habitat or troglofauna populations it may support, is considered as very low. Any impacts are expected to be highly localised only. Accordingly, this aspect is not considered further.

8.4.6.3. Cumulative Impacts

Consideration of cumulative impacts on troglofauna habitats within the modelled extent has included the proposed operations within the Development Envelope and the nearby existing operations at Baby Hope (also an AWT project), West Angelas, and BHP's Mining Area C Southern Flank. Cumulative impacts

will only impact troglofauna species whose distribution extends across two or more projects, although the cumulative impact is difficult to quantify. However, any impacts will be moderated by the retention of troglofauna habitat in the Development Envelope following pit excavation (Stantec 2022).

8.4.7. Mitigation

During Proposal design, the mitigation hierarchy (avoid, minimise and rehabilitate) has been applied to avoid and minimise potential impacts of the Proposal to troglofauna, with key measures and outcomes of the process described in detail below and summarised in Table 8-5.

8.4.7.1. Avoidance

The Proponent has established several MEZs across the Development Envelope to protect areas of significant environmental and/or heritage value (Chapter 2). The largest MEZ1 will cover 233 ha to the immediate west of the BHT deposits and along the same BHT ridgetop (Figure 2-2). As a result, a sizeable portion of BHT troglofauna habitat will be protected from direct and indirect mining impacts.

The Proponent has iteratively revised the Proposal design and corresponding Development Envelope to ensure the Proposal is clearly removed from core environmental and heritage areas, such as Weeli Wolli Creek (Section 2.2). An outcome of this process is that large areas of contiguous troglofauna habitat at both BHT and HD2 deposits are now outside of the Development Envelope.

8.4.7.2. Minimisation

The Proponent will implement the following key controls to minimise indirect impacts to troglofauna:

- Ensure the disturbance of vegetation across the Proposal is minimised at all times and that areas no longer required for use are rehabilitated as soon as practicable (see below)
- Manage groundwater abstraction to ensure groundwater drawdown is not greater than the predicted volumes.
- Ensure hydrocarbons and other potentially polluting substances are properly managed and spills/leaks are fully remediated as soon as practicable.

8.4.7.3. Rehabilitation

The MCP (Appendix A4) includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use, and final landforms are stable and consider hydrological factors. A summary of the approach to closure relevant to troglofauna, is provided below.

Closure objectives relevant to troglofauna include:

- The final landform is stable and considers ecological and hydrological factors
- Contamination risks have been appropriately managed
- Vegetation of rehabilitated land is self-sustaining and compatible with the final land use.

Measures to achieve these objectives will include but are not necessarily limited to:

- Rehabilitation of waste dumps and other disturbed areas
- Deep ripping/scarification of compacted areas to improve infiltration
- Opportunistic backfilling into pit voids during operations as they become available or post closure
- Removal of stockpiles
- Hydrocarbon management.

For troglofauna, rehabilitation of waste landforms at closure is expected to provide an opportunity for infiltration and nutrient input pathways to be re-established.

Table 8-5: Application of Mitigation Hierarchy for Troglofauna

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Removal of potential troglofauna habitat.	**Measures to Avoid**			
	Establish MEZ1 at BHT to protect 233 ha from direct disturbance.	Project specific.	No	Project optimisation and reduction of the Development Envelope and preserving in-situ habitat is the most effective control to ensure impacts are ALARP.
	Reduction in Development Envelope extents.			
	Measures to Minimise			
	Ensure the disturbance of vegetation across the Proposal is minimised at all times and that areas no longer required for use are rehabilitated as soon as possible	Project specific.	No	The proposed measures are additional to the large amounts of contiguous, similar habitats that will remain undisturbed from the Proposal, so there is a very high confidence that the existing troglofauna communities will remain viable.
	Measures to Rehabilitate			
	Pits and other excavations will be stabilised and rehabilitated to stakeholder expectations, as per the MCP.	Project specific MCP has been developed, based on Rio Tinto's standard approach to closure planning.	Yes – DMIRS for implementation of the MCP (see Appendix A4)	The rehabilitation measures for the pits are not expected to alter the outcomes of the operational phase of the Proposal
Indirect Impacts				
Temporary reduction or degradation of habitat due to mining-	**Measures to Avoid**			
	Establish MEZ1 at BHT to protect 233 ha from direct disturbance.	Project specific.	No	Project optimisation and reduction of the Development Envelope and preserving in-situ habitat is the most effective control to ensure impacts are ALARP.
	Reduction in Development Envelope extents.			
	Measures to Minimise			

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
related activities.	Ensure the disturbance of vegetation across the Proposal is minimised at all times and that areas no longer required for use are rehabilitated as soon as possible	Project specific.	No	The proposed measures are additional to the large amounts of contiguous, similar habitats that will remain undisturbed from the Proposal, so there is a very high confidence that the existing troglofauna communities will remain viable.
	Manage groundwater abstraction to ensure groundwater drawdown is not greater than the predicted volume.	Project specific	Yes – Groundwater Licence limiting the total abstraction volume per annum and associated Groundwater Licence Operating Strategy	Minimisation of impacts to species and/or habitats is considered the most effective control and will be done through limits set in Groundwater Licences.
	Ensure hydrocarbons and other potentially polluting substances are properly managed and spills/leaks are fully remediated as soon as practicable.	Standard business practice	No	These measures are standard business practice and are considered effective controls in minimising indirect impacts on subterranean fauna
	Measures to Rehabilitate			
	Areas that are no longer in use will be rehabilitated as soon as practicable. The MCP includes a closure objective to ensure that the final landform is stable and considers ecological and hydrological factors. Contamination risks will have been appropriately managed throughout the lifetime of the Proposal and will not present a risk at closure.	Standard business practice	Yes – DMIRS for implementation of the MCP (see Appendix A4)	The rehabilitation measures will assist in restoring nutrient cycles and other functions that support the integrity of troglofauna ecosystems at the conclusion of mining.

8.4.8. Assessment and Significance of Residual Impacts – Troglofauna

8.4.8.1. Assessment of Direct Impacts

Large areas of BHT and HD2 troglofauna habitat will remain in their in situ natural state after the development of the Proposal. As per Section 8.4.6.1, only the Brockman Iron Formation (BHT only) will be significantly reduced in volume within the Development Envelope, leaving approximately 35% of the surface extent intact, based on mapped surface geology. Suitable troglofauna habitat extends beyond areas of proposed impact into the surrounding areas and at depth (including within MEZ1), in the form of the Brockman Iron Formation, Jeerinah, Mount McRae Shale, Mount Sylvia and Wittenoom formations.

Section 8.4.6 identifies five troglofauna species that are currently only known from the proposed pits (*Eukoenia* 'sp. OES2', Lagynochthonius PSE96, *Tyrannochthonius* 'sp. Biologic-PSEU001', *Scolopendromorpha* 'sp. Biologic-CHIL001', *Trinemura* 'sp. OES11'). all five species are singletons it is important to preface that, singletons are by their nature information poor yet common in biodiversity surveys and often never recovered in subsequent surveys.

The reduction in volume may impact on the distribution of two of the five restricted troglofauna taxa that have only been recorded within the proposed pit outlines:

- *Eukoenenia* `sp. OES2` (a palpigrade)
- *Lagynochthonius* `sp. WAM-PSE096`(a pseudoscorpion).

Both *Eukoenenia* `sp. OES2` and *Lagynochthonius* `sp. WAM-PSE096` are considered to represent troglobitic SREs, aligning with the localised distributions noted for a number of palpigrades and *Lagynochthonius* pseudoscorpions in the Pilbara region (Halse and Pearson 2014; Harrison et al. 2014; Phoenix 2014). There is however currently little confidence in the taxonomic assessment due to the lack of a taxonomic framework for palpigrads and attempts to sequence the pseudoscorpion were unsuccessful. As a result,, it is unlikely that the current records provide an accurate representation of their range, with the associated geology (Brockman Iron Formation), continuous along the BHT ridge landform, both within and outside the Development Envelope.

The extent and connectivity of habitat for troglofauna is supported by a comparable species, the schizomid *Draculoides* `sp. SCH068`. The distribution of this species provides evidence that suitable habitat for true troglobites, for which *Lagynochthonius* `sp. WAM-PSE096` and *Eukoenenia* `sp. OES2` may also be, extends throughout the same area. *Draculoides* `sp. SCH068`, also characterised as a troglobitic SRE, was represented by multiple records, with a documented distribution spanning from the BHT landform (within and outside the proposed pit) northward to the adjacent Baby Hope area, generally correlating with the high confidence modelled extent of likely troglofauna habitat (Stantec 2022).

Accordingly, it is expected that both taxa would occur more broadly along the BHT landform.

The reduction in volume is considered unlikely to impact on the distribution of following three of the five restricted troglofauna taxa:

- Scolopendromorpha `sp. Biologic-CHI001` is a likely troglophile that has been recorded from a location subject to proposed direct (pit) and indirect (groundwater drawdown ~18m) impacts. The species was recorded within the Marra Mamba surface geology, of which 15% of the lateral extent within the DE is proposed to be removed.
- *Tyrannochthonius* `sp. Biologic-PSEU001` is regarded as a troglobite and was collected from a location subject to direct (pit) impacts. The species was recorded within the Mt McRae Shale/Mt Silvia Formation surface geology, of which 4% of the lateral extent within the DE is proposed to be removed.
- *Trinemura* `sp. OES11` has an unknown dependence on living underground and was collected from a location subject to direct (pit) impacts. The species was recorded within the Marra

Mamba surface geology, of which 15% of the lateral extent within the DE is proposed to be removed.

No significant residual impacts to troglofauna associated with direct impacts attributable to the Proposal are expected.

8.4.8.2. Assessment of Indirect Impacts

Information presented in Section 8.4.6.2 concludes that the Proposal is highly unlikely to result in indirect impacts to troglofauna. The mitigation measures described in Section 8.4.7 will further ensure that any impacts that do arise are kept as low as reasonably practicable and well below ecological thresholds.

8.4.8.3. Assessment of Cumulative Impacts

Although difficult to predict, the likelihood of the Proposal causing or contributing to cumulative regional impacts to troglofauna values is considered to be very low (Section 8.4.6.3).

8.4.8.4. Assessment of Significance of Residual Impacts

Non-significant Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant:

- The Brockman Iron Formation (BHT only) will be reduced in surface mapped extent within the Development Envelope (approximately 35% will remain, based on mapped surface geology) for troglofauna, however it has been shown that this formation is continuous outside of the Development Envelope and is in contact with other geological formations which provide connected habitat for troglofauna.
- The reduction in surface mapped extent may impact on the distribution of two of the five restricted troglofauna taxa that have only been recorded in the Brockman Iron Formation and within the proposed pit outlines: (*Eukoenenia* `sp. OES2` and *Lagynochthonius* `sp. WAM-PSE096`). However, as outlined in Section 8.4.8.1, the Proposal will not result in significant irreversible impacts to the troglofaunal assemblage and populations of individual taxa.

Significant Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal demonstrate there are no significant residual impact to subterranean fauna – troglofauna values.

8.5. Stygofauna

8.5.1. Habitat Suitability Assessment

A review of geological and hydrogeological information was undertaken to characterise potential stygofauna habitat in the Development Envelope and assess its suitability for stygofauna (Stantec 2020, 2022). Information reviewed included bore logs, hydrogeological cross section diagrams and mapping of interpreted aquifer extents, as well as publicly available maps of surface and bedrock geological units.

Three surface geological units were found to host stygofauna within the Development Envelope, indicating suitable habitat structure and groundwater quality. These were alluvium and colluvium, which are both known to be at least partially saturated along the drainage lines such as Pebble Mouse Creek, and the Wittenoom Formation, which represents the dominant aquifer in the area (Figure 8-4). Alluvium supported the highest number of taxa. Samples collected from within the orebodies themselves (Marra Mamba and Brockman Iron formations) returning no stygofauna specimens.

8.5.2. Habitat Model

8.5.2.1. Bedded Hilltop Deposit

Three mapped geological units were found to host stygofauna within the Development Envelope, indicating suitable habitat structure and groundwater quality. These included, alluvium (1,991 ha) and colluvium (4,449 ha), which are known to be partially saturated along the drainage lines, and Wittenoom Formation (1,018 ha), which represents a dominant aquifer in the area (Figure 8-4). Alluvium supported the highest number of taxa, which were predominantly recorded from a single site. This unit is well distributed along the drainage lines within the Development Envelope and adjacent areas (Pebble Mouse and Weeli Wolli Creeks). Colluvium also occurs extensively through the Development Envelope and surrounds. The remaining unit associated with stygofauna, the Wittenoom Formation, will not be impacted by proposed pit excavation.

The majority of stygofauna records occurred outside the buffer for the high confidence modelled habitat. However, where available, modelling indicated that alluvium and colluvium along sections of Pebble Mouse Creek represented medium to high suitability stygofauna habitat. Based on the lateral extent of these units along the drainage lines, indicated by 2D mapping, the medium to high suitability habitat associated with these units would be expected to continue outside the modelled extent.

8.5.3. Stygofauna Records

Stygofauna taxa recorded from within the Development Envelope (Table 8-6) were from bores to the north and northeast of the BHT landform in association with alluvial and colluvial detritals along the drainage lines of Pebble Mouse and Weeli Wolli Creeks (Figure 8-4).

No taxa were recorded from within the proposed BHT pits or any section of HD2, highlighting the low prospectivity of BIF for stygofauna. There were also no occurrences within the modelled extent of groundwater drawdown (Figure 8-4), with dykes and low permeability areas forming a barrier to groundwater movement between the aquifers (Section 9.3.5).

The majority of the stygofauna taxa are known to occur more broadly outside the Development Envelope. While several taxa including *Amphipoda indet*., Paramelitidae sp., Cyprididae indet. Enchytraeidae sp. and Oribatida group 1 were identified to a coarse taxonomic level and their distribution cannot be confirmed, it is likely that at least some belong to existing taxa known from the Development Envelope or adjacent areas. For the amphipods in particular, at least five identified taxa are known from the vicinity (Stantec 2022).

An exception was the paramelitid amphipod *Pilbarus* `sp. Biologic-AMPH001`. This taxon is currently only known from a single site in the Development Envelope, located outside of the proposed BHT pit, along the alluvial channel associated with Pebble Mouse Creek (Figure 8-4). However, the single result is likely an artefact of limited site accessibility during sampling (Stantec 2020). Based on the wide distribution of mapped and saturated alluvial and colluvial units, the distribution of *Pilbarus* `sp. Biologic-AMPH001` is likely to extend further along the Pebble Mouse and Weeli Wolli drainage lines.

8.5.4. Potential Impacts to Stygofauna

Implementation of the Proposal has the potential to result in the following direct impacts to stygofauna:

- Temporary reduction in availability of suitable stygofauna habitat as a result of groundwater drawdown (from abstraction for water supply).

Potential indirect impacts to stygofauna include the degradation of habitat due to mining-related activities and include:

- Clearing of vegetation and subsequent placement of mineral waste potentially leading to a reduction in organic inputs into the subterranean environment
- Contamination associated with accidental hydrocarbon spills or acid mine drainage.

8.5.4.1. Direct Impacts

The Proposal does not involve mining below the water table (BWT) but will lower the groundwater table in the vicinity of the HD2 deposit by approximately 18 m as a result of groundwater abstraction undertaken to supply water for the Proposal. No stygofauna were recorded at HD2 or within the predicted modelled extent of groundwater drawdown (Figure 8-4). Based on the above, the Proposal will not result in direct impacts to stygofauna values.

8.5.4.2. Indirect Impacts

Mining activities other than mine pit excavation may indirectly impact stygofauna through degradation of habitat associated with clearing vegetation, changes in surface hydrology and contamination. While some of the stygofauna records were located within the Conceptual Footprint, none were associated with pits or waste rock landforms. Due to the reduced scale of clearing and low potential for significant contamination of groundwater, it is considered unlikely that the Proposal will result in significant indirect impacts to stygofauna values.

8.5.4.3. Cumulative Impacts

The negligible potential for the Proposal to impact on local stygofauna species and habitats renders it improbable that the Proposal would then cause or contribute to significant cumulative impacts to other stygofauna communities, including those at Weeli Wolli Spring.

Table 8-6: Summary of Stygofauna Taxa Recorded from the Development Envelope

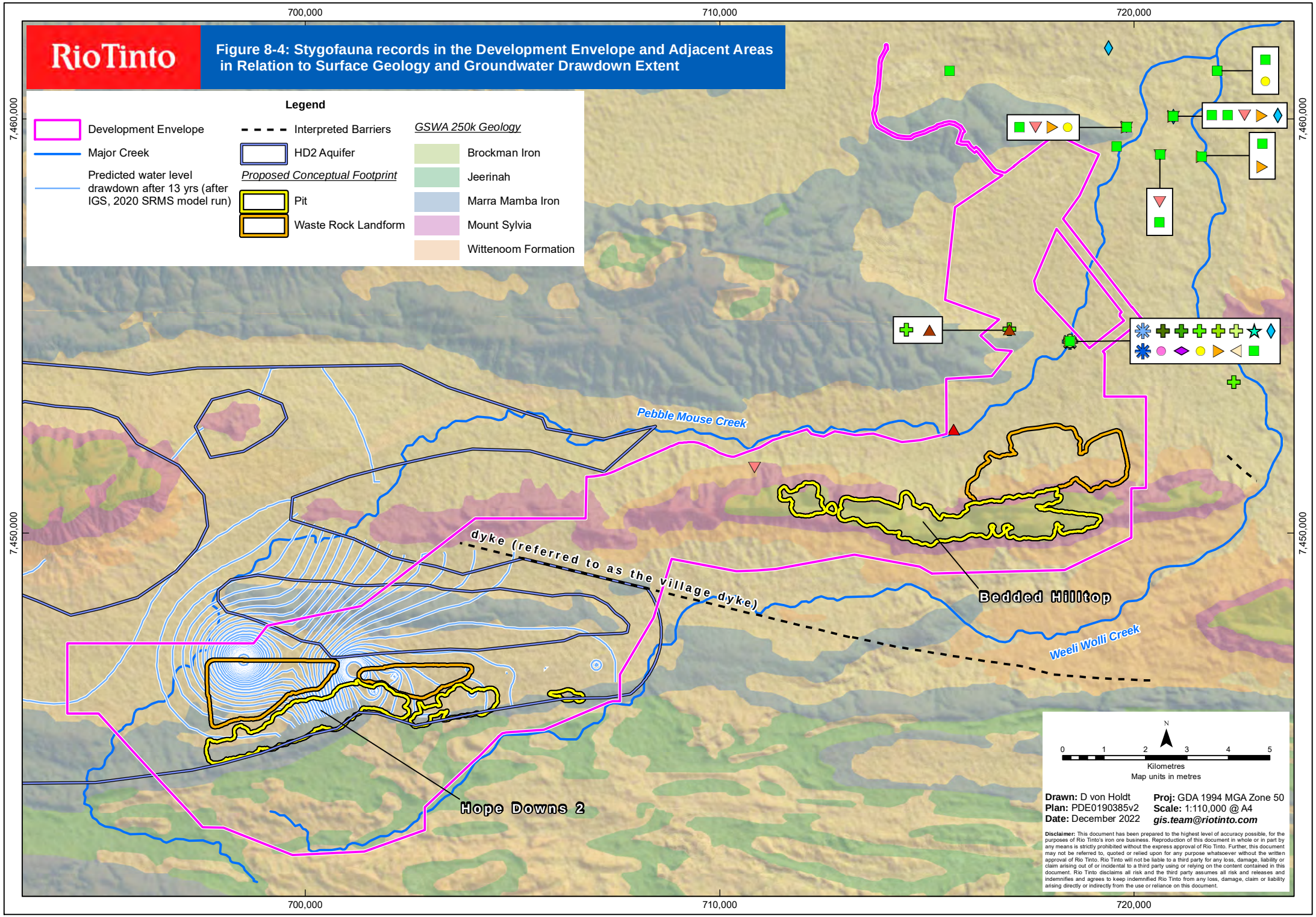
Taxon	Study	ID Method	Abundance	Deposit	Number of Sites	Distribution and Ecology
Crustacea – Malacostraca: Amphipoda						
Amphipoda indet.[9]	Halse et al. 2014	Morphology	4	None (Development Envelope)	1	Recorded from one site in Development Envelope. Likely belongs to amphipod taxa identified from the Development Envelope or adjacent areas. Stygobite
Malacostraca -Amphipoda: Paramelitidae						
Pilbarus `sp. Biologic-AMPH001`	Stantec 2020	Morphology, DNA	4	BHT (non-impact site)	1	Only recorded from one site in the BHT deposit area (outside proposed pits); likely represents a new operational taxonomic unit (OTU) or taxon. Likely habitat (alluvium) extensive Stygobite
Paramelitidae sp. 2	Biota 2006	Morphology	2	BHT (non-impact site)	1	Broadly distributed throughout the Weeli Wolli Creek catchment[1]. Stygobite
Paramelitidae sp. [9]	Halse et al. 2014	Morphology	5	None (Development Envelope)	1	Uncertain due to taxonomic resolution. Stygobite
Chydaekata sp.	Halse et al. 2014	Morphology	2	None (Development Envelope)	1	Distributed throughout the Weeli Wolli Creek catchment[2]. Stygobite
Maarrka weeliwolli	Western Australian Museum 2018	Morphology	1	None (Development Envelope)	1	Distributed throughout the Weeli Wolli and Marillana Creek catchments[2]. Stygobite
Malacostraca - Isopoda: Tainisopidae						
Pygolabis weeliwolli	Halse et al. 2014	Morphology	7	None (Development Envelope)	1	Broadly distributed throughout the Weeli Wolli Creek catchment and Marillana Creek catchments[3] . Stygobite

Taxon	Study	ID Method	Abundance	Deposit	Number of Sites	Distribution and Ecology
Crustacea - Ostracoda: Candonidae						
Deminutiocandona stomachosa	Halse et al. 2014	Morphology	4	None (Development Envelope)	1	Distributed outside of the DE[4]. Stygobite
Notocandona modesta	Halse et al. 2014	Morphology	1	None (Development Envelope)	1	Distributed outside of the DE[5]. Stygobite
Meridiescandona facies	Halse et al. 2014; Western Australian Museum 2018	Morphology	14[#]	None (Development Envelope)	2	Distributed throughout the Weeli Wolli and Marillana Creek catchments, as well as the central/eastern Fortescue River catchment. Stygobite
Meridiescandona ?lucerna	Halse et al. 2014	Morphology	1	None (Development Envelope)	1	Considered likely to be *Meridiescandona ?lucerna,* originally described from the Fortescue River Valley in the Pilbara region[6]. Stygobite
nr *Areacandona ?rosa*	Halse et al. 2014	Morphology	1	None (Development Envelope)	1	Potential error with taxon name. May be similar to Pilbaracandona rosa. Likely stygobite
Crustacea - Ostracoda: Cyprididae						
Cyprididae sp. indet [9]	Halse et al. 2014	Morphology	1	None (Development Envelope)	1	Likely to be more broadly distributed outside the Development Envelope. Likely stygophile
Crustacea - Copepoda: Cyclopoida						
Diacyclops humphreysi humphreysi	Halse et al. 2014	Morphology	39	None (Development Envelope)	1	Pilbara wide distribution[7]. Stygobite
Crustacea - Copepoda: Harpacticoida						
Inermipes sp. 1	Halse et al. 2014	Morphology	4	None (Development Envelope)	1	Distributed throughout the Weeli Wolli and Marillana Creek catchments. Potential stygobite

Taxon	Study	ID Method	Abundance	Deposit	Number of Sites	Distribution and Ecology
Gordanitocrella trajani	Halse et al. 2014	Morphology	1	None (Development Envelope)	1	Recorded from several localities in the Pilbara region[8] . Potential stygobite
Annelida – Enchytraeidae						
Enchytraeidae sp. [9]	Halse et al. 2014	Morphology	5	None (Development Envelope)	1	Uncertain due to taxonomic resolution. Unlikely to be stygobite or display short range endemism. Affinity to groundwater uncertain
Acarina – Oribatida						
Oribatida group 1 [9]	Halse et al. 2014	Morphology	10	None (Development Envelope)	1	Likely to be more broadly distributed outside the Development Envelope. Affinity to groundwater uncertain

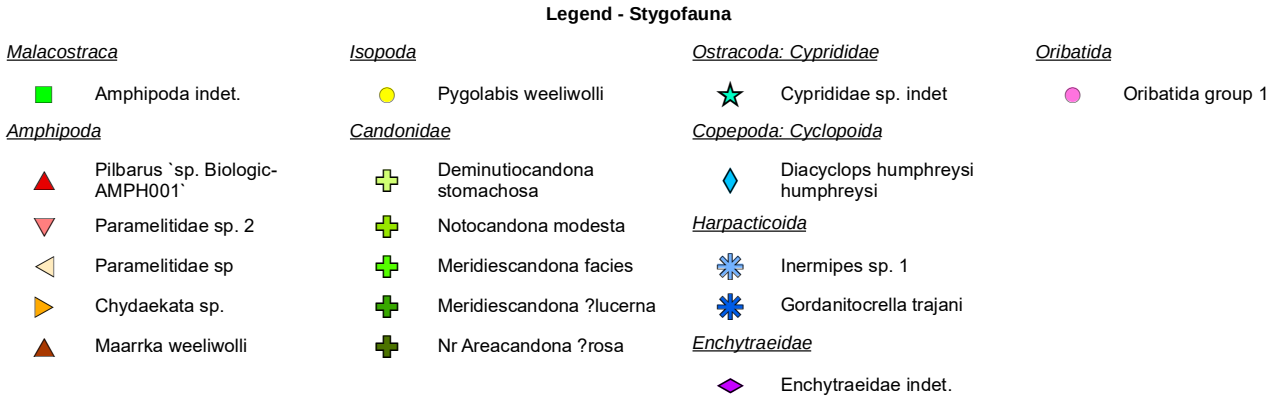
[#] *Estimated number where abundances are not available from all sources.*

[1] (Biota 2015c) [2] (Finston et al. 2011) [3] (Finston et al. 2009) [4] (Karanovic 2007) [5] (Halse et al. 2014) [6] (Karanovic 2005) [7] (Karanovic 2006) [8] (Karanovic and Hancock 2009) [9] denotes coarse taxonomic level, where wider distribution cannot be confirmed likely represent taxa from the Development Envelope or adjacent areas.


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Figure 8-4: Stygofauna records in the Development Envelope and Adjacent Areas in Relation to Surface Geology and Groundwater Drawdown Extent
Legend
Development Envelope
Major Creek
Predicted water level drawdown after 13 yrs (after IGS, 2020 SRMS model run)
Interpreted Barriers
HD2 Aquifer
Proposed Conceptual Footprint
Pit
Waste Rock Landform
GSWA 250k Geology
Brockman Iron
Jeerinah
Marra Mamba Iron
Mount Sylvia
Wittenoom Formation
700,000
710,000
720,000
7,460,000
7,450,000
Pebble Mouse Creek
dyke (referred to as the village dyke)
Bedded Hilltop
Weeli Wolli Creek
Hope Downs 2
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0190385v2
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
gis.team@riotinto.com
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Figure 8-4: Stygofauna records in the Development Envelope and Adjacent Areas in Relation to Surface Geology and Groundwater Drawdown Extent - Legend



Drawn: D von Holdt
Plan: PDE0190385v2
Date: December 2022 ***gis.team@riotinto.com***

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8.5.5. Mitigation

During Proposal design, the mitigation hierarchy (avoid, minimise and rehabilitate) has been applied to avoid and minimise potential impacts of the Proposal to stygofauna and associated environmental values as far as practicable. Table 8-7 demonstrates how the mitigation hierarchy has been applied during Proposal design and in the development of appropriate mitigation and management strategies to address the key potential impacts on troglofauna.

8.5.5.1. Avoidance

The Proposal comprises AWT mining and therefore avoids significant direct impacts to stygofauna as a result of mine dewatering and associated groundwater drawdown and/or discharge.

8.5.5.2. Minimisation

Management measures to minimise direct and indirect impacts to stygofauna associated with groundwater drawdown and habitat degradation include managing borefield location and operation, limiting vegetation clearing to that which is necessary for construction, limiting disturbance to major creeklines and ensuring flow pathways are retained (and associated alluvial / colluvial habitat); and managing hydrocarbons, chemicals, and waste in accordance with legal requirements and industry standards.

8.5.5.3. Rehabilitation

Groundwater abstraction for water supply will cease at closure. Given the compartmentalisation of the local aquifers (Wittenoom Aquifer and Mineralised Brockman Aquifer) used for water supply (vicinity HD2 deposit), there is very low recharge and groundwater recovery will be slow. However, it is noted that the alluvial aquifer will still maintain its hydrological function as a creekline during both the operational phase and through to closure and is expected to recharge following significant rainfall events, thus providing stygofauna habitat and connectivity.

Table 8-7: Mitigation Measures for Stygofauna Values

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Removal of potential stygofauna habitat	**Measures to Avoid**			
	No BWT mining to occur.	Project specific.	No	Proposal content document limits mining to AWT. High certainty of retention of suitable stygofauna habitat.
	Measures to Minimise			
	Groundwater abstraction will be limited to that which is necessary for construction and operation. Groundwater abstraction will be undertaken in accordance with a licence managed under the RiWI Act. Limiting clearing around major creeklines and ensuring flow pathways are retained (and associated alluvial / colluvial habitat)	Project specific.	Yes – Groundwater Licence limiting the total abstraction volume per annum and associated Groundwater Licence Operating Strategy	These measures are best practice High-certainty as retention of important habitats is one of the key recommendations for species conservation.
	Measures to Rehabilitate			
	At conclusion of active use, the groundwater production bores will be decommissioned, and groundwater levels will gradually return to pre-mining conditions.	Project specific.	Yes – Groundwater Licence limiting the total abstraction volume per annum and associated Groundwater Licence Operating Strategy	The rate of groundwater recovery post-abstraction is dependent on the frequency and magnitude of recharge events.
Indirect Impacts				
Temporary reduction or degradation of stygofauna	**Measures to Avoid**			
	No avoidance measures are applicable for indirect impacts.	Project specific.	No	Not applicable.

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
habitat due to mining related activities.	**Measures to Minimise**			
	Borefields will be located and operated to ensure drawdown is minimised and not greater than predicted.	Standard business practice	Yes – Groundwater Licence limiting the total abstraction volume per annum and associated Groundwater Licence Operating Strategy	The proposed controls are standard practice at Rio Tinto and other operations and are recognised as having a high level of effectiveness.
	Vegetation clearing will be limited to that which is necessary for implementation of the Proposal.	Project specific.	No	Proposal content document provides upper clearing limits. Project optimisation and reduction of the Development Envelope is the most effective control to ensure impacts are ALARP.
	Hydrocarbons, chemicals and waste will be managed in accordance with legal requirements and industry standards.	Standard business practice	Yes – Licence to Operate conditions	These measures are standard business practice and are considered effective controls in minimising indirect impacts on subterranean fauna
	Measures to Rehabilitate			
	The MCP includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms will be stable and consider ecological and hydrological factors. Progressive rehabilitation will be undertaken where possible; however, the majority of rehabilitation will occur at closure. In addition, waste dumps will be rehabilitated at closure to ensure they are stable and revegetated, and some catchments flows will be reinstated.	Standard business practice	No	A Ministerial Statement condition requiring the implementation of the HD2 MCP is expected. The proposed measures will assist in re-establishing nutrient flows into the subterranean environment and enhancing the integrity of the subterranean ecosystems.

8.5.6. Assessment and Significance of Residual Impacts – Stygofauna

The Proponent's decision to restrict mining to AWT has greatly reduced the potential for impacts to stygofauna overall. A single taxon has been recorded within Pebble Mouse Creek colluvium within an area that will experience temporary drawdown from nearby production wells but not to the extent that habitat will be significantly impacted. Changes to the Proposal design has reduced around major creeklines and mitigation measures, outlined in Section 2.2.2, will ensure surface water flow pathways are retained (and retain associated alluvial / colluvial habitat).

Risk of contamination is expected to be effectively managed with hydrocarbon management measures.

The Proponent considers that potential impacts are minor, and the residual impact will not be significant.

8.6. Environmental Outcome

8.6.1. Summary of Significant Residual Impacts and Proposed Conditions

Non-significant Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant:

- The Brockman Iron Formation (BHT only) will be reduced in surface mapped extent within the Development Envelope (approximately 35% will remain, based on mapped surface geology) for troglofauna, however it has been shown that this formation is continuous outside of the Development Envelope and is in contact with other geological formations which provide connected habitat for troglofauna.
- The reduction in surface mapped extent may impact on the distribution of two of the five restricted troglofauna taxa that have only been recorded in the Brockman Iron Formation and within the proposed pit outlines: (*Eukoenenia* `sp. OES2` and *Lagynochthonius* `sp. WAM-PSE096`). However, as outlined in Section 8.4.8.1, the Proposal will not result in significant irreversible impacts to the troglofaunal assemblage and populations of individual taxa.
- The Proponent's decision to restrict mining to AWT has greatly reduced the potential for impacts to stygofauna overall. A single taxon has been recorded within Pebble Mouse Creek colluvium within an area that will experience temporary drawdown from nearby production wells but not to the extent that habitat will be significantly impacted. Changes to the Proposal design has reduced potential impact around major creeklines and mitigation measures, such as culvert design, will ensure surface water flow pathways are retained (and retain associated alluvial / colluvial habitat).

Significant Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal demonstrate there are no significant residual impact to subterranean fauna.

Given there are no expected significant residual impacts to subterranean fauna value, no environmental conditions have been proposed.

8.6.2. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states

- Have a clear boundary, size, extent, or limit
- Are associated with achievement of one or more of the EPA's objectives for the environmental factor.

After implementation of the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to subterranean fauna values. All species recorded from the Development Envelope are expected to persist following implementation of the Proposal. As such the assessment has concluded that subterranean fauna is not a key environmental factor for the Proposal. Accordingly, the Proponent considers the Proposal can be implemented to meet the EPA's objective to protect subterranean fauna so that biological diversity and ecological integrity are maintained.

9. INLAND WATERS

9.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021c) lists the following as their objective for Inland Waters:

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected

For assessment by the EPA, Inland Waters include groundwater, such as superficial and confined aquifers, and surface water, such as waterways, wetlands and estuaries (EPA 2018a). A 'waterway' is any river, creek, stream, or brook, including its floodplain, estuary, or inlet. This includes systems that flow permanently, for part of the year or occasionally, and waterways that have been artificially modified.

9.2. Policy and Guidance

Table 9-1 lists the policy and guidance for Inland Waters that have been considered in this section, and the manner in which they have been addressed.

Table 9-1: Relevant Policy and Guidance for Inland Waters

Policy and Guidance	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for Inland Waters forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Inland Waters (EPA 2018a)	The information required for impact assessment has been considered in the scope of this chapter.
Instructions on how to prepare an Environmental Review Document (EPA 2021e)	This document forms the basis of the headings and content provided in this ERD.
Other State or Commonwealth	
Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes. (DER 2015a)	Section 9.3.5.8 summarises the efforts and findings of investigations into acid metalliferous drainage risk for the Proposal, and sets out the risk profile, based on mine lithologies.
Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (DER 2015b)	Section 9.5 describes the management controls that will be applied to ensure acid metalliferous drainage risk is as low as reasonably practicable.
Use of Mine Dewatering Surplus (DWER 2020)	The water management strategy has been developed with consideration of this guidance, and surplus water will be preferentially discharged to mine pit voids once operational and environmental needs have been met.
Western Australian Water in Mining Guidelines (DoW 2013)	Discharge of surplus water is subject to the DWER Water in Mining guideline (DoW 2013) and licence requirements. It is noted that the Proponents undertaking of dewatering will not be permitted to discharge to the environment where there is a likelihood that it will cause impacts on other land users (including inundation of land) or significant

Policy and Guidance	Explain How the Policy and Guidance has been Considered
	environmental damage (including water quality, acidification, erosion, damage to riverbed and/or banks and altered water levels at sites with ecological and cultural assets) (DoW 2013).
Pilbara Water in Mining Guidelines (DoW 2009)	The water management strategy has been prepared with consideration of this guidance.
Water Quality Protection Notes (DOW, various)	Several of the Water Quality Protection Notes (WQPN) published by the WA Govt are very relevant to the Proposal and have been used to inform the impact assessment and well as mitigation approaches.
Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG 2018)	Australia's National Water Quality Management Strategy (WQMS) provides guidance on the management of water quality in Australia and New Zealand. This guidance has been used in consideration of surface water management and setting appropriate water quality targets.
National Water Quality Management Strategy (ANZECC and ARMCANZ 1994)	

9.3. Receiving Environment

9.3.1. Studies and Survey Effort

The receiving hydrological environment relevant to the Proposal and its surrounding area has been informed though long-term studies undertaken for the existing Hope Downs 1 operations, as well as recent studies to support the Proposal.

A summary of these studies is provided in Table 9-2.

Table 9-2: Summary of Studies

Survey	Survey Area, Type and Timing	Consistency with Guidance
Surface Water		
Baby Hope Hydrology and Hydraulic Assessment (Rio Tinto 2014; Appendix E3)	**Study/Survey area:** Weeli Wolli Creek catchment, including Pebble Mouse Creek **Type:** Assessment of potential impacts on surface water quantity and quality at Pebble Mouse Creek **Timing:** Desktop study, issued 2014.	The Assessment is consistent with the Water in Mining Guidelines (DOW 2013).
Hope Downs 2 and Bedded Hilltop: Assessment of surface water impacts on sensitive receptors in the Weeli Wolli Creek catchment (Rio Tinto 2022a; Appendix E1)	**Study/Survey area:** Weeli Wolli Creek catchment, including Pebble Mouse Creek **Type:** assessment of the potential impacts on surface water quantity and quality at Weeli Wolli Spring and Ben's Oasis from mining infrastructure proposed for the HD2 Proposal which includes deposits at BHT and HD2. **Timing**: 2022	The Assessment is consistent with the Water in Mining Guidelines (DOW 2013) and provides information necessary to describe and assess the impacts of the Proposal on water-dependent ecosystems and environmental values, as required by the EPA Guideline (EPA 2018a).
Groundwater		
Hydrogeological Assessment of the Hope Downs 2 and BHT (Rio Tinto 2022b; Appendix E2)	**Study/Survey area:** HD2 and BHT deposits **Type:** Hydrogeological assessment and groundwater modelling to quantify available groundwater at each deposit, and	The assessment is consistent with the EPA Guideline for Inland Waters (EPA 2018a) and the Water in Mining Guidelines (DOW 2013). The hydrogeological conceptual model includes Weeli Willi Spring and Ben's Oasis.

	groundwater impacts associated with abstraction. **Timing**: 2022	
Geochemistry		
Hope Downs (Sustaining Deposits) – Geochemical Characterisation of Waste Rock Samples (SRK 2019; Appendix 10 of the Mine Closure Plan (Appendix A4)) Prepared for Rio Tinto	**Study/Survey area:** HD2 and BHT deposits **Type:** Geochemical characterisation of waste rock samples to provide guidance for waste rock management with respect to managing and limiting acid generation and metalliferous drainage. **Timing**: 2019	The scope, approach and effort of the characterisation study, when considered in the context of the extensive geochemical and mineralogical knowledge held by the Proponent, is consistent with guidelines issued by DWER and EPA (2018a)

9.3.2. Climate

The Hope Downs Hub area is a semi-arid to arid environment, characterised by hot summers and warm winters. The region experiences climate extremes, where severe droughts and major floods can follow in close succession.

The long-term annual rainfall for the Newman region is approximately 324 mm, and at the Hope Downs 1 Weather Station the average annual rainfall received since 2008 is 313 mm (Table 9-3). Rainfall is highly variable both temporally, and spatially, predominantly occurring over a summer wet season dominated by tropical cyclones, low pressure systems and convective thunderstorms.

Table 9-3: Rainfall – Hope Downs 1 Weather Station and Newman Averages (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Hope Downs 1 Weather Station Average (2008-2021)	106	45	44	14	19	49	14	6	6	4	47	27	313
Newman* Average (1971 to 2021)	68	72	41	22	18	16	14	6	4	6	12	35	324

Rainfall events of more than 60 mm in 24 hours are estimated to occur on average once each year. Analysis of gridded rainfall and streamflow data from the Tarina streamflow gauge located on Weeli Wolli Creek and operated by the Department of Water and Regulation (DWER) indicates the Hope Downs Hub area experiences on average two rainfall events 35 mm per day or greater per year. This analysis suggests that the minimum amount of rainfall required to generate flow in the catchment is approximately 35 mm per day.

The average annual evaporation rate for the region is 1,900 mm (sheltered free water surface) and the average annual pan evaporation is approximately 3,400 mm, an order of magnitude larger than mean annual rainfall.

9.3.3. Surface Water

9.3.3.1. Catchments

Natural watercourses within the Pilbara region are ephemeral and exhibit high temporal variability, with flows occurring in response to high rainfall events. The primary mechanism for runoff occurs when the rate of rainfall exceeds the infiltration capacity of the soil (CSIRO 2015). This mechanism is commonly associated with high-intensity cyclonic rainfall and impervious catchments.

Regionally, the Proposal is located within the upper reaches of the Weeli Wolli Creek catchment that forms part of the Fortescue River Region (EPA 2018b). The total catchment area of Weeli Wolli Creek is approximately 4,770 km^2 and drains northwards into the Fortescue Marsh. The Weeli Wolli Creek catchment up to the Tarina gauging station is approximately 1,530 km^2 , the location used for hydrologic and hydraulic model development.

Pebble Mouse Creek, a major tributary of Weeli Wolli Creek, has a catchment area of 340 km^2 and is located within the upper reaches of the Weeli Wolli catchment.

The Proposal bisects the catchment divide between Pebble Mouse Creek and Weeli Wolli Creek catchments as shown in Figure 9-1.

9.3.3.2. Creeks and Pools

The local topography consists of a series of plateaus, hills, ridges and valleys. As a result, numerous ephemeral drainage lines are found across the Development Envelope. Two main waterways of significance occur within the Development Envelope and its immediate surrounds:

- Weeli Wolli Creek
- Pebble Mouse Creek.

These waterways support two pools which are considered to be of high ecological and cultural significance:

- Weeli Wolli Spring – located downstream of the confluence of Weeli Wolli Creek and Pebble Mouse Creek
- Ben’s Oasis – Significant feature of Weeli Wolli Creek.

Both Weeli Wolli Spring and Ben’s Oasis are permanent water features supported by groundwater. Currently, Weeli Wolli spring is maintained by discharge of surplus water from dewatering at the Hope Downs 1 operations, which has occurred since 2007 and has substituted the spring’s groundwater flow. Weeli Wolli Spring and Ben’s Oasis occur outside of the Development Envelope.

In addition, two other minor pools have been identified during social surroundings surveys:

- HD214_04
- GHD19-17-WS.

These isolated pools were located within separate minor ephemeral creek systems.

The features are presented in Figure 9-1 and summarised in Table 9-4.

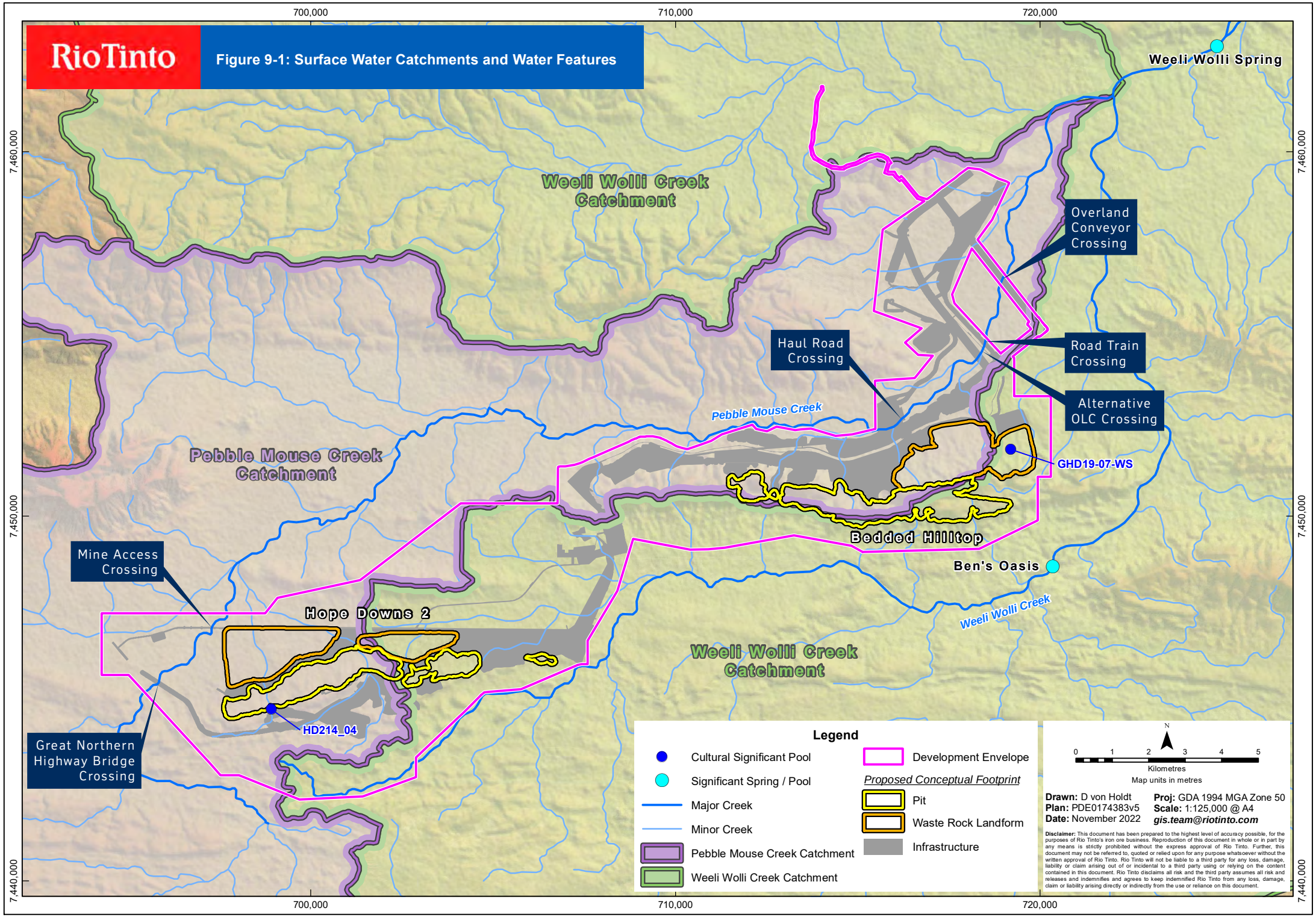

RioTinto
Figure 9-1: Surface Water Catchments and Water Features
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Weeli Wolli Spring
Weeli Wolli Creek Catchment
Overland Conveyor Crossing
Haul Road Crossing
Road Train Crossing
Alternative OLC Crossing
Pebble Mouse Creek
Pebble Mouse Creek Catchment
GHD19-07-WS
Bedded Hilltop
Ben's Oasis
Mine Access Crossing
Hope Downs 2
Weeli Wolli Creek
Weeli Wolli Creek Catchment
HD214_04
Great Northern Highway Bridge Crossing
Legend
Cultural Significant Pool
Significant Spring / Pool
Major Creek
Minor Creek
Pebble Mouse Creek Catchment
Weeli Wolli Creek Catchment
Development Envelope
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Infrastructure
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0174383v5
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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Table 9-4: Significant Surface Water Features

Feature	Description	Value	Representative Photograph
Weeli Wolli Creek	Weeli Wolli Creek represents one of the largest waterways within the Hamersley subregion (97.8 km in length) and has a wide and well-defined channel with a gravel bed. Weeli Wolli Creek is formed through the confluence of numerous smaller tributaries, including Pebble Mouse Creek and tributaries that flow through Wonna Munna Gorge to the south. Naturally, Weeli Wolli Creek is ephemeral and dynamic (EPA 2018c). Prior to mining most of the creek would only flow following large rainfall events (typically two flow events a year), interspersed with extended periods of no flow. Since mining operations commenced, sections of Weeli Wolli Creek, downstream of the Gabion discharge point associated with Hope Downs 1 operations, experience perennial flows due to discharge of mine dewatering. The water of Weeli Wolli Creek is fresh (<1,000 µS/cm), and generally dominated by sodium and bicarbonate, and water quality is circumneutral to slightly basic (RPS 2015). The dynamic nature of the creek is reflected in its high turbidity and sediment loads.	Weeli Wolli Creek represents high ecological and cultural significance in the local area. The Weeli Wolli Creek system includes a spring and pools, namely Weeli Wolli Spring and Ben's Oasis, these two receptors are permanent or semi-persistent. Weeli Wolli Creek supports a number of Priority Ecological Communities, including those found at Ben's Oasis and Weeli Wolli Springs and is a major surface tributary into Fortescue Marsh.	
Pebble Mouse Creek	Pebble Mouse Creek is a generally well defined, meandering creek with minor braiding. The average width of the Pebble Mouse Creek low flow channel is 10 m with a depth of 1.5 m. This drainage line floods the alluvial plain during overbank flow events after significant rainfall (Rio Tinto 2014; Appendix E3). The morphology of Pebble Mouse Creek (Figure 9-1) varies along its reaches, with the following characteristics of note: • The upper reaches of Pebble Mouse Creek are intersected/crossed by the Rio Tinto rail line and service road that runs along its southern bank, and also the Great Northern Highway. • Downstream of the Proposal, Pebble Mouse Creek is much narrower and flows northwards, in this area a section of the creek has been diverted around the existing Hope Downs 1 operations and directly into Weeli Wolli Creek; the diversion levee has been designed to the 1:100 AEP flood levels. The channel and floodplain of Pebble Mouse Creek are made up of alluvial/colluvial detritals of varying depth. These materials constitute the bed armouring, which is generally resistant to mobilisation in all but the largest of flow events (Rio Tinto 2022a). When flowing, Pebble Mouse Creek water quality tends to be relatively fresh but with high suspended sediment loads particularly in higher flow events when bed velocities are sufficient to mobilise rocks and sediments within the main channel as well as within larger tributaries.	Pebble Mouse Creek has cultural significance, both in its own right and as a tributary feeding into Weeli Wolli Creek.	

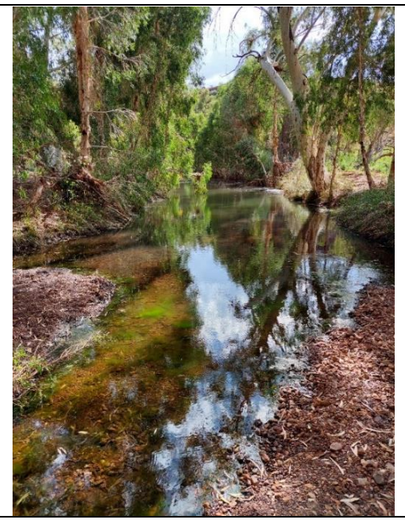
Weeli Wolli Springs	Weeli Wolli Spring, a significant environmental receptor of Weeli Wolli Creek, is located 9.7 km northeast of the Proposal, outside the Development Envelope (Figure 9-1). Weeli Wolli Spring is located approximately 7 km downstream of the confluence of Pebble Mouse Creek and Weeli Wolli Creek. The estimated area of the Weeli Wolli Creek catchment contributing surface water flows to Weeli Wolli Spring is approximately 1,340 km². A number of permanent and semi-permanent pools scattered over a distance of 2 km are fed by the Spring and sustained by the shallow groundwater system (DEC 2009). This series of pools associated with Weeli Wolli Spring are considered an arid zone wetland that maintains a unique community of flora and fauna and is listed as a Priority 1 Ecological Community (PEC) (DEC 2009). Weeli Wolli Spring is currently maintained by discharge of surplus water from dewatering at HD1, which has occurred since 2007 and has substituted the Spring's groundwater flow and enhanced surface water flows. The discharge of excess water from HD1 is authorised under MS 893 and managed through Condition 7. The discharge has restricted groundwater drawdown immediately upstream of the Spring to 1 to 2 m below pre-mining levels, and areas closer to the Spring exhibit pre-mining groundwater levels (RPS 2015). The groundwater of Weeli Wolli Spring is typical of water in carbonate rich terrain in that it is fresh and contains bicarbonate and calcium/magnesium (RPS 2015). The salinity of groundwater increases as it flows towards the Spring.	Weeli Wolli Spring has considerable spiritual and cultural significance to traditional owners and is protected as a Registered Aboriginal Site (ID 11287; see Chapter 1). The Spring is located at the base of a large, banded ironstone ridge that intersects the Weeli Wolli Creek providing an impermeable barrier to the subsurface downstream flow of water (DEC 2009). Weeli Wolli Spring and the riparian vegetation supported by the spring is categorised as a Priority 1 Ecological Community, as discussed in Chapter 6.	
Ben's Oasis	Ben's Oasis is a significant environmental feature within Weeli Wolli Creek, located approximately 20 km upstream of Weeli Wolli Spring (Figure 9-1). Ben's Oasis is located approximately 1.8 km southeast of the BHT deposit and 15 km east of the HD2 deposit, outside of the Development Envelope. Ben's Oasis is a perennial pool that is a natural surface expression of groundwater (Rio Tinto 2022b), however, also receives surface flows following rainfall as it is within the main channel of Weeli Wolli Creek. The estimated area of the Weeli Wolli Creek catchment contributing surface water flows to Ben's Oasis is approximately 420 km². Ben's Oasis is located in an area where dolomite of the Wittenoom Formation outcrops, causing groundwater to naturally discharge at the surface due to low to no permeability of the dolomite in this area (Rio Tinto 2022b). Groundwater in the BHT groundwater system is hydraulically isolated from Ben's Oasis due to the separation of the Brockman Iron Formation from the Wittenoom Formation by low permeability strata that encapsulates the Brockman Formation and hinders groundwater flow. Groundwater flow within the Wittenoom Formation is impeded between the HD2 deposit and Ben's Oasis by the low permeability of the dolomite in this area and by a southwest trending dyke near the HD1 village. A 13 m hydraulic head either side of the dyke has been observed, indicating a restricted flow boundary.	Ben's Oasis was added to the Weeli Wolli Spring PEC in 2014. This pool and other less permanent pools in the vicinity are associated with approximately 3.5 km of riparian vegetation possessing varying degrees of obligate groundwater dependent vegetation (including various stretches of vegetation supporting *Melaleuca argentea*) which is associated with the shallow groundwater expression occurring in this area.	

Table 9-5: Pools of Cultural Significance

Feature	Description	Value	Representative Photograph
HD214_04	Located within the HD2 pit disturbance footprint, HD214_04, is within a within a minor ephemeral creek which flows north from Great Northern Highway, through the HD2 pit area, towards Pebble Mouse Creek. This particular section of the creek sits within a minor gully location, as shown in the representative photograph. Water appears to pool in a weathered section of the creekline which is shaded by both vegetation and surrounding rock faces. When located the HD2 pool was a single standing shallow water body roughly 1 m by 1.5 m. When full the HD2 pool is estimated to be 12 m x 17m and up to 1 m deep. Given depth to groundwater in the area it is assumed that the pool is a surface water fed pool only. Storage will be depleted via both evaporation and infiltration. Hydrological function is currently unclear, but conceptually the pool is expected to the semi-permanent or ephemeral. The site was identified during the November 2021 Nyiyaparli Social Surroundings site visit. Two of the five waterholes were observed to be holding small amounts of water as shown in the representative photograph. This creekline is ephemeral and not supported by groundwater flow.	Persistent freshwater pools in the Pilbara are considered to have high conservation value and are considered to be significant in accordance with the Inland Waters guideline. Identified by the Nyiyaparli Traditional Owners as potentially providing valuable drinking source for native fauna. No specific heritage values (e.g. meeting place) were raised during the Social Surroundings site visit in November. Please refer to Chapter 11 (Social Surrounds) for further discussion.	 

Feature	Description	Value	Representative Photograph
GHD19-17-WS	Located within the current disturbance footprint, GHD19-17-WS is a series of five waterholes within a minor creek and measures 11 m by 17 m, covering an area of 187 m^2. The site was identified during the November 2021 Nyiyaparli Social Surroundings site visit. Two of the five waterholes were observed to be holding small amounts of water as shown in the representative photograph. This creekline is ephemeral and not supported by groundwater flow.	No significant values identified in the context of the Inlands Water factor and its objective, as the pool is not considered to be a permanent or semi-permanent pool. Identified by Nyiyaparli Traditional Owners as potentially providing valuable drinking source for native fauna. No specific heritage values (e.g. meeting place) were raised during the Social Surroundings site visit in November. Please refer to Chapter 11 (Social Surrounds) for further discussion.	

9.3.4. Hydrological Modelling

9.3.4.1. Flows in Weeli Wolli Creek and Pebble Mouse Creek to Sensitive Receptors

To characterise the surface water flow regimes during mining operations a two-dimensional model was developed. The model extent is presented in Figure 9-2. Details of the methodology and results of this assessment are contained in Rio Tinto 2022a.

To inform the model, historic rainfall patterns were derived from streamflow gauging stations, the nearest of which is 708014 Tarina (located on Weeli Wolli Creek, approximately 13 km downstream its confluence with Pebble Mouse Creek), and experiences on average two flow events per year. This frequency of events compared to the rainfall record indicates that the catchment requires at least 35 mm of rainfall to generate flows; however, flows in the region are estimated to be four times more variable than rainfall, so this value is a best estimate.

Examination of the annual maximum flow time series at the nearest streamflow gauging station also indicates that large flow events can be expected to occur on average once every five years. Recent large flows recorded at the Tarina gauge have occurred in 1999 (Tropical Cyclone John), 2003 (rainfall associated with an un-named tropical low) and in 2009 (un-named tropical low), supporting the expected frequency of large events (Rio Tinto 2014).

These large events (and others) have also been used to calibrate the original 1D hydrological model (RORB), allowing peak flow estimates to be derived for Pebble Mouse Creek (Table 9-6) (Rio Tinto 2014; Appendix E3). These estimates are critical to ensure crossing designs and erosion protection planning are aligned to the design objectives and ensure that environmental impacts are minimised from upstream impoundment / ponding or impediment of flow.

The modelled results for pre-mining peak flow and total volumes for Weeli Wolli Spring and Ben's Oasis were derived from the information discussed above and are presented in Table 9-7 and Table 9-8.

Table 9-6: Peak Flow and Critical Duration Estimates for Pebble Mouse Creek

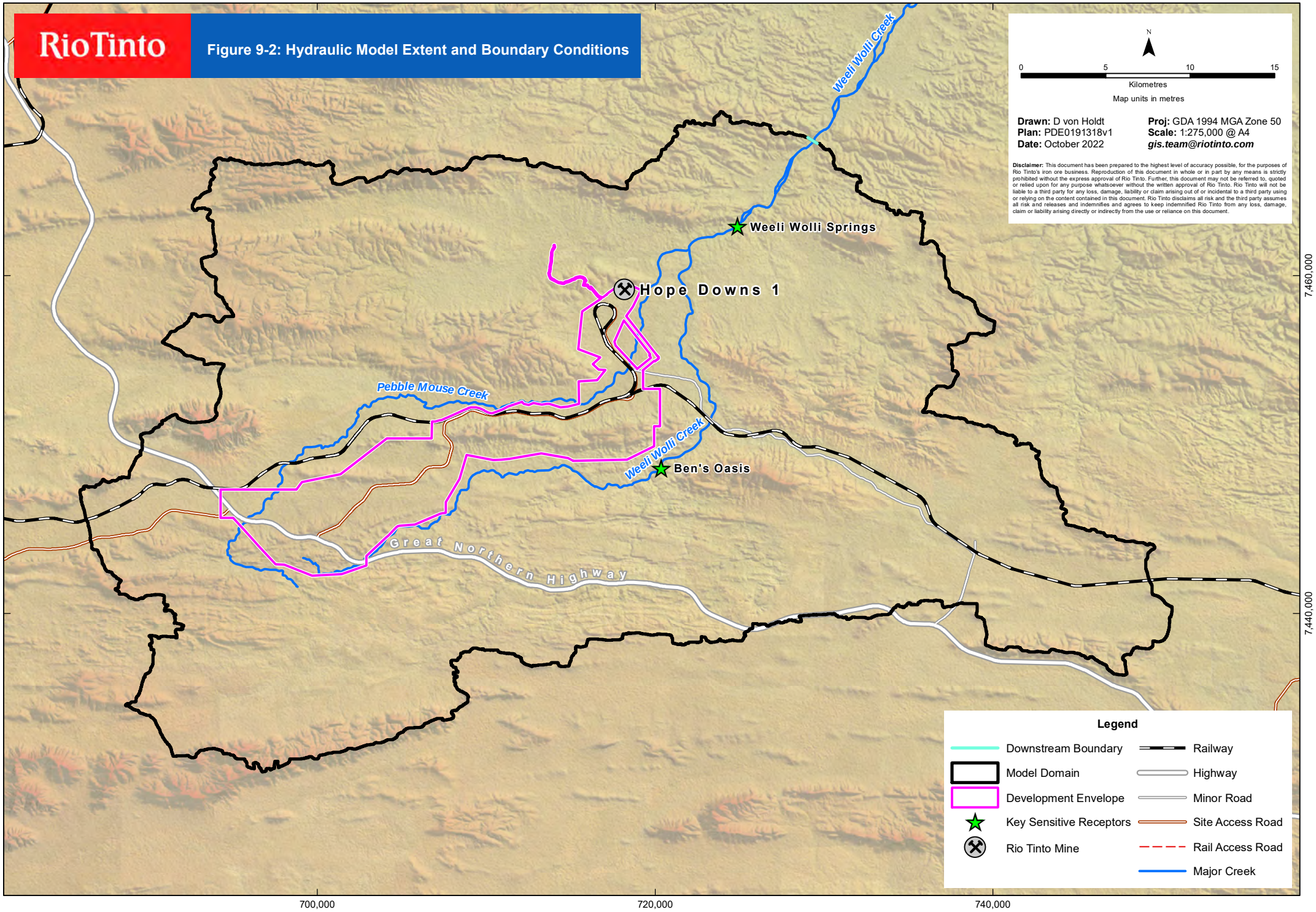
AEP (%)	Peak Flow west of BHT (m^3/s)	Critical Duration (hrs)	Peak Flow east of BHT (m3/s)	Critical Duration (Hrs)
1	970	6	890	6
2	510	9	480	12
5	280	24	240	24
10	160	24	140	24
20	80	24	70	24

Table 9-7: Modelled Peak Flows at Sensitive Receptors

Sensitive Receptor	Event	Pre-mining (m^3/s)
Weeli Wolli Spring	1:100 AEP 24 hr	2,474
	1:5 AEP 12 hr	148
Ben's Oasis	1:100 AEP 24 hr	921
	1:5 AEP 12 hr	55

Table 9-8: Total Modelled Volumes at Sensitive Receptors

Sensitive Receptor	Event	Pre-mining (GL)
Weeli Wolli Spring	1:100 AEP 24 hr	25.2
	1:5 AEP 12 hr	0.8
Ben's Oasis	1:100 AEP 24 hr	7.1
	1:5 AEP 12 hr	0.33


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Figure 9-2: Hydraulic Model Extent and Boundary Conditions
700,000
720,000
740,000
7,460,000
7,440,000
Weeli Wolli Creek
Weeli Wolli Springs
Hope Downs 1
Pebble Mouse Creek
Weeli Wolli Creek
Ben's Oasis
Great Northern Highway
N
0
5
10
15
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191318v1
Date: October 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:275,000 @ A4
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Legend
Downstream Boundary
Model Domain
Development Envelope
Key Sensitive Receptors
Rio Tinto Mine
Railway
Highway
Minor Road
Site Access Road
Rail Access Road
Major Creek

9.3.5. Groundwater

9.3.5.1. Regional Aquifer Systems

Groundwater in the Pilbara region is replenished through direct infiltration from rainfall and from surface water flows. Regionally, groundwater flow reflects topography, flowing in a northerly direction towards the coast. There are a range of aquifer types in the Pilbara, with the majority of aquifers in the central and eastern Pilbara comprising complex fractured rock aquifers with irregular structures and various recharge mechanisms.

Within the regional groundwater system, the dominant aquifer is the Paraburdoo Member of the Wittenoom Formation which occurs in the strike orientated valley floors between ridges of the Brockman and Marra Mamba Iron formations. The dolomite of the Paraburdoo Member can show extensive karstification.

Secondary permeability is commonly formed within ore bodies as a part of the mineralisation process leading to areas of higher permeability. These zones are often hydraulically connected to the overlying tertiary detritals and the underlying upper Marra Mamba Iron Formation (that being the Mt Newman Member where mineralised).

Overlying the regional aquifer are Mt Sylvia and Mt McRae Shale formations which comprise low permeability shale and can usually be considered as aquitards. The lower, low permeability members of the Marra Mamba Formation (the MacLeod and Nammuldi members) form the base of the aquifer. Local and/or regional dolerite intrusive and faulting act to bound, or compartmentalise, the groundwater system.

9.3.5.2. Conceptual Hydrogeological Model

In order to identify and assess potential impacts associated with the proposed abstraction of groundwater to facilitate the Proposal, a hydrogeological model was developed for both HD2 and BHT mining areas, incorporating results from hydrogeological investigations (Rio Tinto 2022b; Appendix E2).

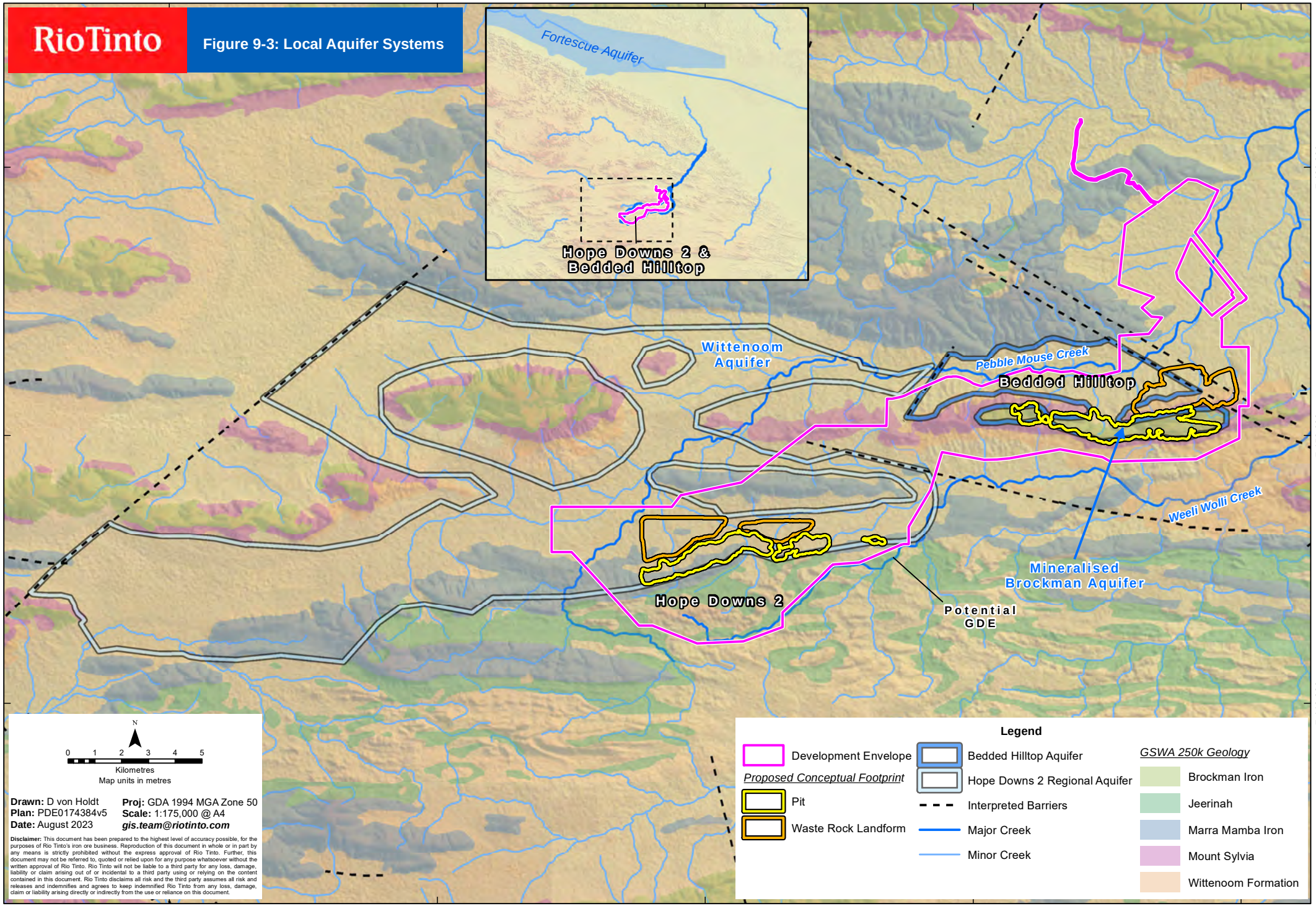
It should be noted that all mining will be restricted to AWT, even though mineralisation continues BWT. Naturally, the model focusses on those geological units below the depth of mining.

9.3.5.3. Local Aquifer Systems

The local hydrogeology for HD2 and BHT is described separately as there is negligible hydraulic connection between the two deposit areas, with each area containing its own individual hydrogeological flow environment as shown in Figure 9-3 (Rio Tinto 2022b).

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Figure 9-3: Local Aquifer Systems



Drawn: D von Holdt
Plan: PDE0174384v5
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:175,000 @ A4
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HD2 Deposit Hydrogeology

In the HD2 deposit area, the Marra Mamba Iron Formation abuts the regionally extensive Wittenoom Formation and is underlain by the Fortescue Group, as shown in the cross section represented in Figure 9-4 (Rio Tinto 2022b). The groundwater aquifer in the HD2 deposit area is located within both the Marra Mamba Iron Formation and Wittenoom Formation and the water table is generally below the base of the detrital deposits. Pre-mining groundwater levels within the area of the HD2 deposit and its surrounds range from 613-691 m Australian Height Datum (AHD) (Figure 9-5). Groundwater levels are described further in Section 9.3.5.4. The key characteristics of the hydrogeology at the HD2 deposit are summarised in Table 9-9.

Table 9-9: HD2 Deposit Groundwater Summary

Deposit	Aquifer	Hydro-Stratigraphic Unit	Lithology	Typical Characteristics	Distribution, Local Characteristics

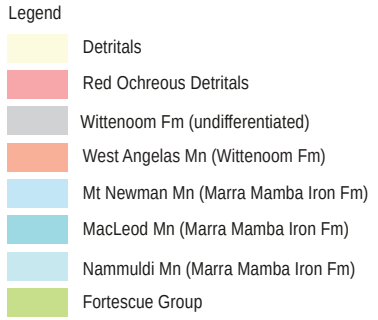
HD2	HD2 Wittenoom Aquifer	Wittenoom Formation	Weathered/altered dolomite, shale with minor Banded Ironstone Formations (BIF) and chert bands.	Often associated with drainage valleys and saturated Tertiary cover. Major yields where dolomite is karstic (Paraburdoo Member) and from mineralised Mount Newman Member (yields from 40 to 100 L/s), high hydraulic conductivity.
				Groundwater in the upper Marra Mamba Iron Formation is in hydraulic connection with the overlying Wittenoom Formation, effectively forming a single groundwater system (Rio Tinto 2020b).
				It is a fractured rock aquifer, channel-like in geometry and extends east-west along strike for approximately 30 km. Although the Wittenoom aquifer is a known regional and extensive aquifer, at HD2 it is bounded making it a local, compartmentalised aquifer.
				The lateral extent of the Wittenoom aquifer at HD2 is shown in Figure 9-4; the boundaries are:
				• Outcropping unmineralised Marra Mamba Iron Formation to the north
				• The Fortescue Group to the south
				• A regionally extensive south-west to north-east trending dyke to the west
				• Separate structures and low permeability zones forming the eastern extent of the aquifer
				  ○ A folded zone of low permeability silica which forms the north-eastern boundary (effectively separating HD2 from BHT)
				  ○ Reduced permeability displayed by fresh, massive dolomite of the Wittenoom Formation east of HD2 and southeast of the HD1 Village
					• Main aquifer at HD2; average thickness of 85 m
					• Compartmentalised by cross-cutting dykes and abutting low permeability lithologies (i.e. fresh/massive dolomite), channel like geometry
					• Yields of 5 to 15 L/s
					• Electrical Conductivity (EC) ~1000 uS/cm.
					• Predominantly unsaturated detritals present along drainage lines
					• Known connection to the aquifer at Deposit B at West Angelas (evident from abstraction at Deposit B drawing down water levels at HD2)

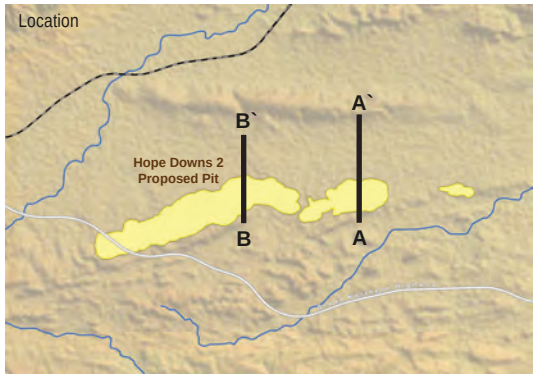
		Marra Mamba Iron Formation – upper member	BIF with thin shale bands.		

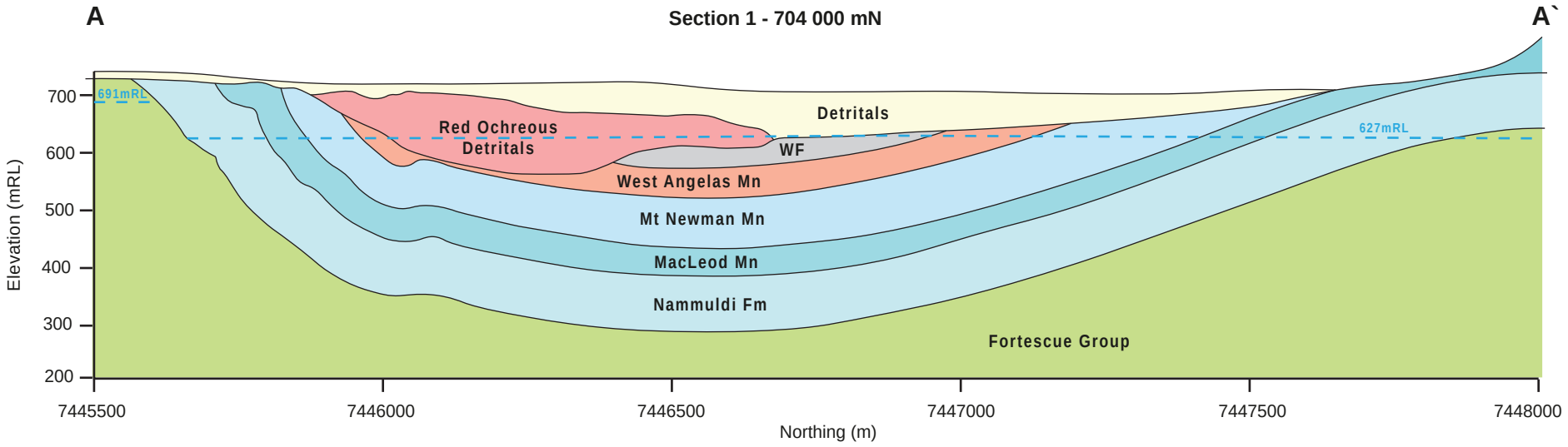
Deposit	Aquifer	Hydro-Stratigraphic Unit	Lithology	Typical Characteristics	Distribution, Local Characteristics
				○ A dyke forming the south-eastern boundary immediately west of the HD1 Village	
	Aquitard	Marra Mamba Iron Formation – lower members	BIF, chert with extensive interbedded and/or extensive bands of shales with 'podded' BIF horizons.	Comprises low permeability, lower members of the Marra Mamba Iron Formation (MacLeod and Nammuldi) and the upper Fortescue Group. Generally poor yielding and forms no flow boundaries to Marra Mamba ore bodies (unless mineralised). Yields of ~10L/s can be encountered if fractured or weathered.	• Underlies or abuts Wittenoom aquifer at HD2 • Low to negligible yields • EC ~3000 uS/cm
		Jeerinah Formation	Shale, sandstone, siltstone, mudstone, dolomite, local micro banded chert, jaspilite, thin basalt/dolerite and andesitic basalt flows.		

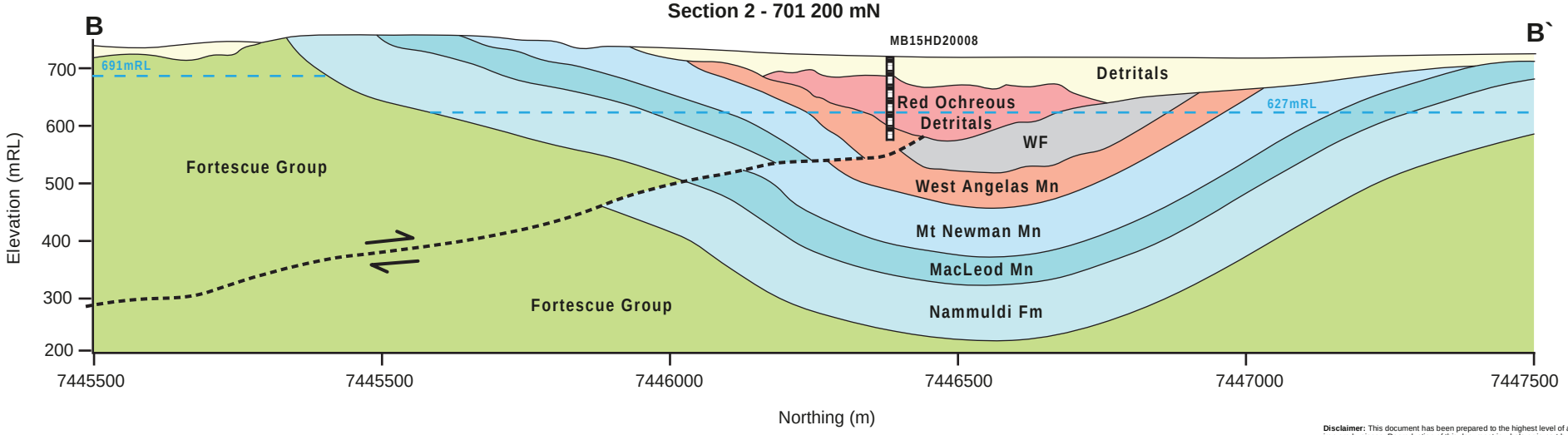
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Figure 9-4: Hydrogeological Cross Section of the HD2 Deposit



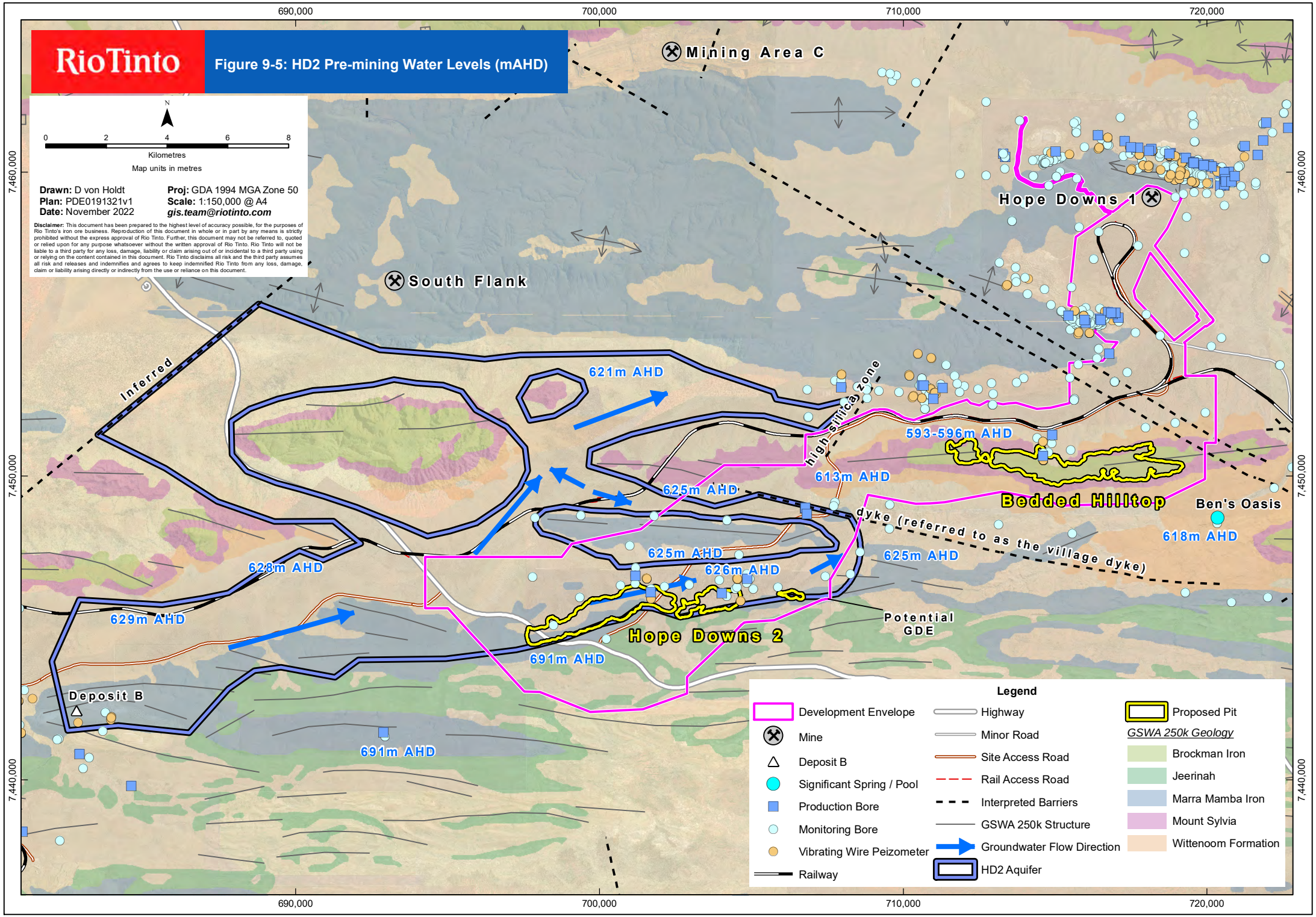






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Plan: PDE0178942v4 **Date:** Nov 2023


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Figure 9-5: HD2 Pre-mining Water Levels (mAHD)
N
0 2 4 6 8
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191321v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
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690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Mining Area C
Hope Downs 1
South Flank
Inferred
621m AHD
high silica zone
593-596m AHD
613m AHD
625m AHD
Bedded Hilltop
Ben's Oasis
618m AHD
dyke (referred to as the village dyke)
625m AHD
625m AHD
626m AHD
628m AHD
629m AHD
Potential GDE
Hope Downs 2
691m AHD
691m AHD
Deposit B
Legend
Development Envelope
Mine
Deposit B
Significant Spring / Pool
Production Bore
Monitoring Bore
Vibrating Wire Peizometer
Railway
Highway
Minor Road
Site Access Road
Rail Access Road
Interpreted Barriers
GSWA 250k Structure
Groundwater Flow Direction
HD2 Aquifer
Proposed Pit
GSWA 250k Geology
Brockman Iron
Jeerinah
Marra Mamba Iron
Mount Sylvia
Wittenoom Formation

BHT Deposit Hydrogeology

The BHT iron ore deposit is located within the mineralised Dales Gorge Member of the Brockman Iron Formation. A localised and predominantly isolated groundwater system is present within the Brockman Iron Formation with limited connection to regional aquifers. The Mount McRae Shale forms an aquitard around the majority of the Brockman Iron Formation, isolating the groundwater held in the base of the BHT deposit from the regional Wittenoom aquifer with the exception of a small area in the north of the deposit (Figure 9-6, Rio Tinto 2022b).

To the north of the BHT deposit, the groundwater table is considered analogous to, and a geological continuation of, the Wittenoom aquifer of the HD2 deposit, with the groundwater table located within both Marra Mamba Iron Formation and Wittenoom Formation. However, up gradient groundwater flow from the HD2 aquifer is interrupted by the zone of low permeability silica referred to in Table 9-9.

A sequence of detritals (comprised of alluvium/colluvium, clay, pisolite and calcrete) overlies the Brockman Iron Formation at BHT and extends north across Pebble Mouse Creek where it is underlain and bounded by the Wittenoom Formation. The detritals typically range in thickness from <10 m up to 90 m and extend along the length of Pebble Mouse Creek (Figure 9-4 and Figure 9-6). Saturation within the detritals is varied according to topography. Pre-mining groundwater levels are presented in Figure 9-7 and groundwater levels are described further in Section 9.3.5.4.

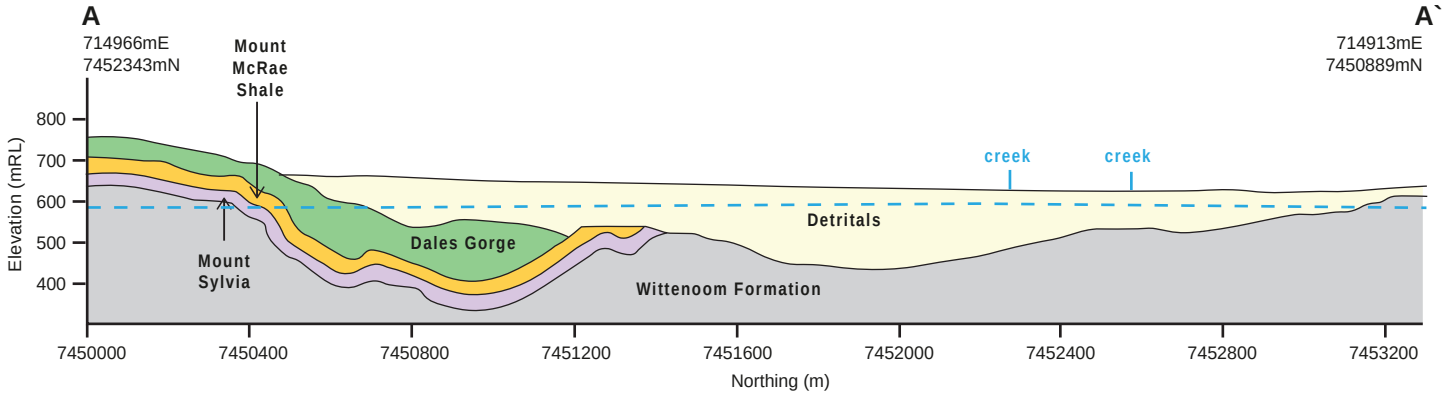
The key characteristics of the hydrogeology at BHT deposit are summarised in Table 9-10.

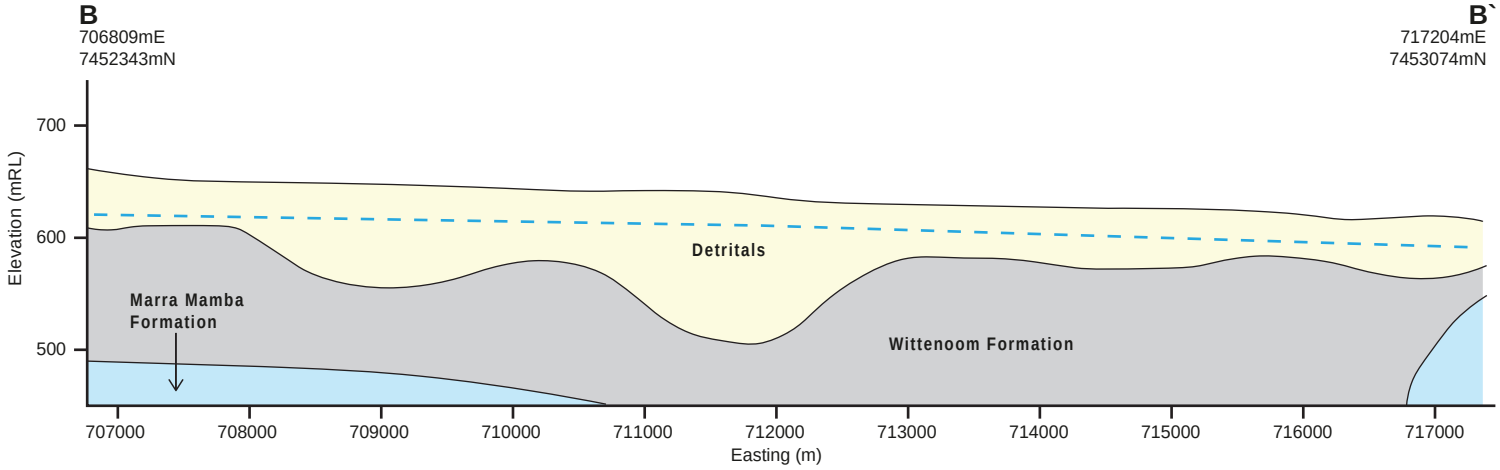
Table 9-10: BHT Deposit Groundwater Summary

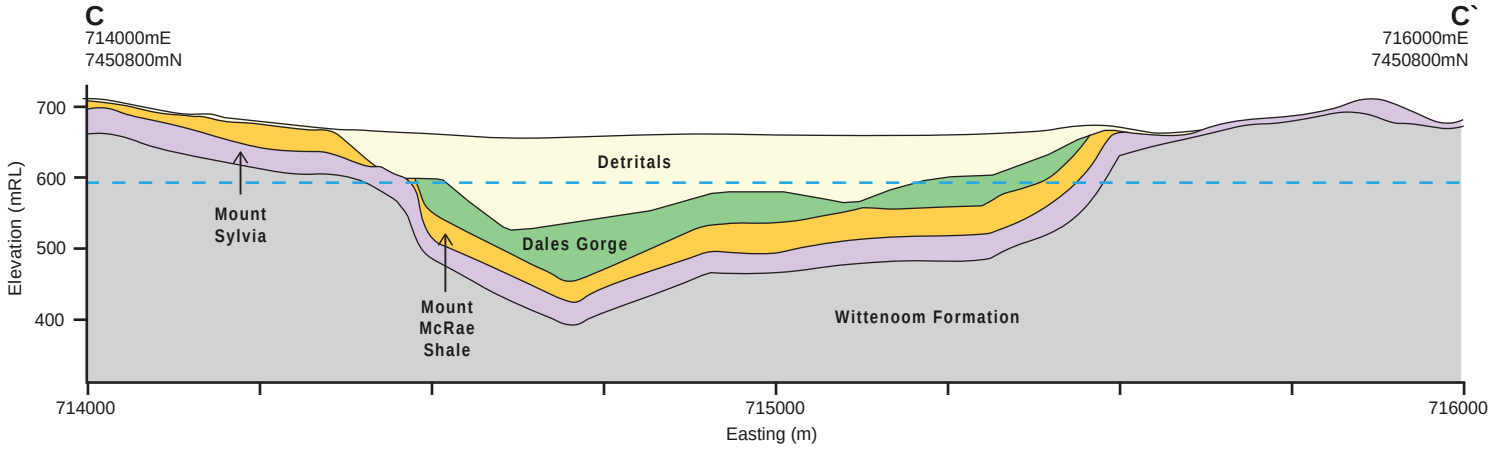
Deposit	Aquifer	Hydro Stratigraphic Unit	Lithology	Typical Characteristics	Distribution, Local Characteristics
BHT	BHT Brockman aquifer	Surficial sediments (detritals)	Surficial sediments (gravelly clays, thick clays, chemical sediments-calcrete/silcrete, high Fe detritals).	Heterogeneous and varying in thickness, can be perched or in hydraulic connection with underlying units. Variable permeability, high storage, recharged by rainfall and surface flows.	• Associated with topographic lows and drainage lines • Extends from water table and ranges from <10 up to 90m in thickness • Negligible to no water yield is often encountered during drilling; bore yields vary up to ~30 L/s • EC <1000 uS/cm
		Brockman Iron Formation	BIF with shale and chert.	• Where BIF is mineralised forms a significant, moderate to high yielding aquifer, high conductivity and storage • Where BIF is unmineralised permeability, storage (and yields) are low	• Main aquifer at BHT (not present at HD2) • Bounded aquifer • Typical yield 10 to 20 L/s • EC <1500 uS/cm
		Wittenoom Formation	Weathered/altered dolomite, shale with minor BIF and chert bands.	Major yields where dolomite is karstic (Paraburdoo Member) and from mineralised Mount Newman Member (yields from 40 to 100 L/s), high hydraulic conductivity.	Hydraulically connected with Brockman Iron Formation over a small area; evident from the equal groundwater level elevations within both the Brockman deposit and adjacent Wittenoom Fm.
	Aquitard	Mount McRae Shale / Mount Sylvia Formation	Thin bedded shale and chert with some dolomite and BIF.	Minor groundwater resource, permeability is typically low and the unit acts as a barrier to flow and confines underlying aquifer. Individual beds may be permeable and yield low to moderate flows and fracturing can produce hydraulic connections.	Underlies and bounds the Brockman aquifer at BHT.

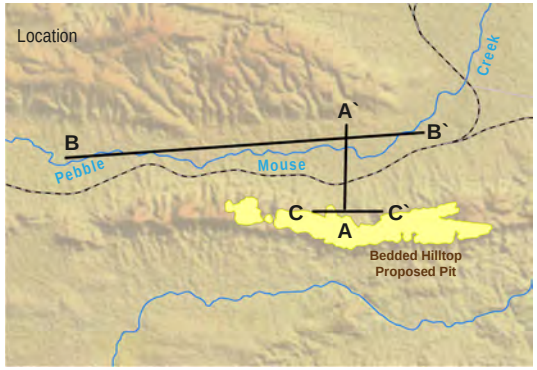
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Figure 9-6: Hydrogeological Cross Section of the BHT Deposit







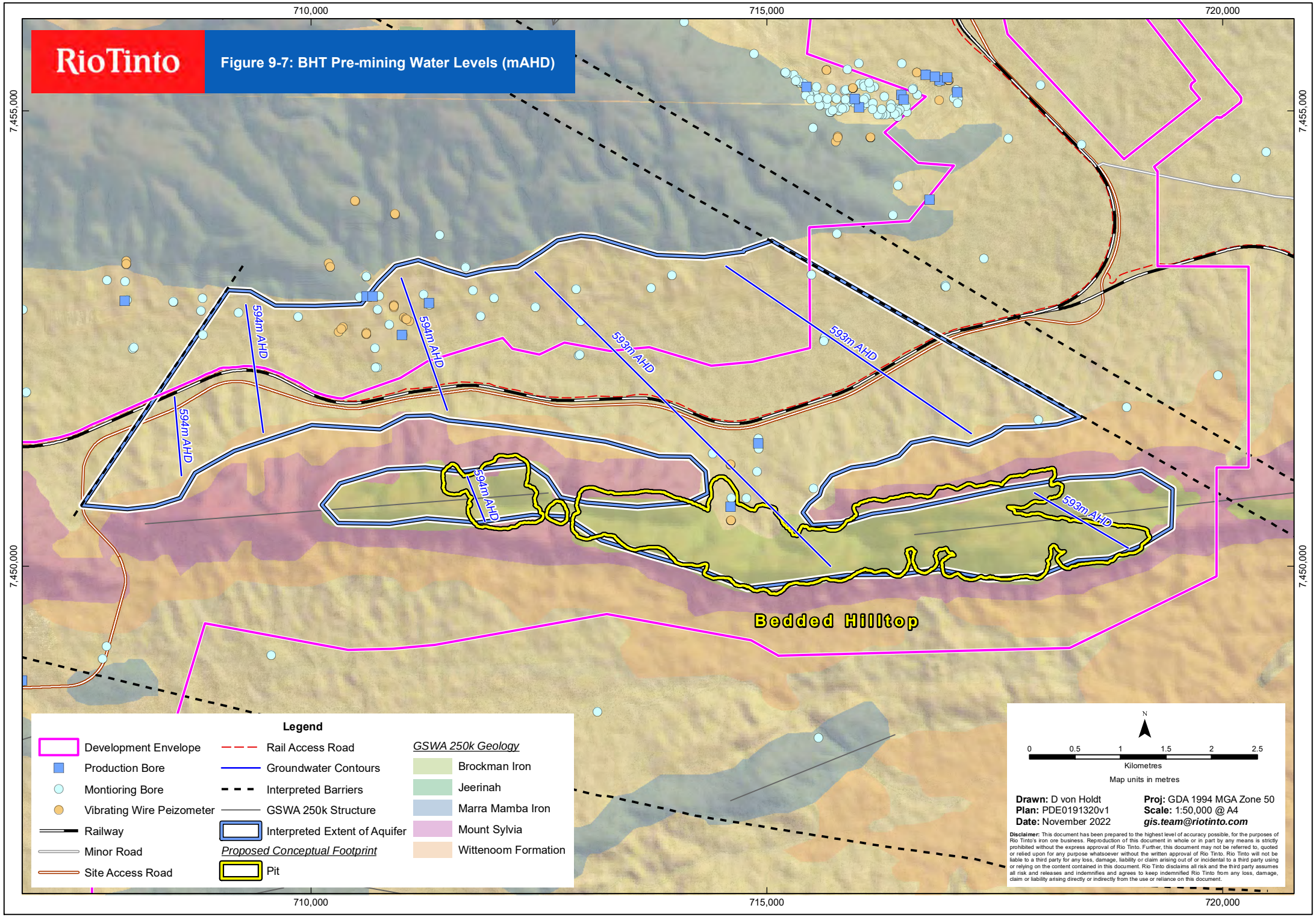


Legend

- DETRITALS (alluvium, clay, pisolite, calcrete)
- DALES GORGE (Brockman Fm)
- Mount McRae Shale
- Mount Sylvia Fm
- Wittenoom Fm (undifferentiated)
- Marra Mamba Fm (undifferentiated)

Plan: PDE0178942v4 **Date:** Nov 2023

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Figure 9-7: BHT Pre-mining Water Levels (mAHD)
710,000
715,000
720,000
7,455,000
7,450,000
594m AHD
593m AHD
Bedded Hilltop
Legend
Development Envelope
Production Bore
Montioring Bore
Vibrating Wire Peizometer
Railway
Minor Road
Site Access Road
Rail Access Road
Groundwater Contours
Interpreted Barriers
GSWA 250k Structure
Interpreted Extent of Aquifer
Proposed Conceptual Footprint
Pit
GSWA 250k Geology
Brockman Iron
Jeerinah
Marra Mamba Iron
Mount Sylvia
Wittenoom Formation
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191320v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:50,000 @ A4
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9.3.5.4. Groundwater Levels

Groundwater depth (the pre-mining water table) ranges between 25 to 100 mbgl throughout the Development Envelope (Figure 9-5 and Figure 9-7). The range in groundwater depths is a reflection of the large variation in surface (topographic) elevations and not the local groundwater gradient i.e. the groundwater depth as measured by mbgl is a measurement relative to the surface level and provides information about the likelihood of supporting environmental values such as riparian vegetation, based on likely access to groundwater.

Groundwater depths in the area of the HD2 Wittenoom Aquifer range between approximately 40 and 90 mbgl, depending on surface topography. The alluvial detrital deposits are predominantly unsaturated in the HD2 area.

The groundwater depth at the BHT deposit ranges from 25 to 100 m bgl. To the north of BHT, groundwater depth at Pebble Mouse Creek is typically 25 to 30 mbgl within the Development Envelope, with the shallower occurrences of groundwater occurring within alluvial detrital deposits.

9.3.5.5. Groundwater Quality

In general groundwater at HD2 is fresh; with a salinity of generally less than 1000 µS/cm, recorded as EC, and is near neutral with the following characteristics:

- Salinity (as EC) ranges from approximately 650 to 1,250 µS/cm
- pH ranges from 6.6 to 7.6; with some exceptions (i.e. pH of 8.8 and a low pH (<6)
- Total nitrogen concentration ranges from 0.8 to 3.8 mg/L
- Iron concertation ranges from <0.05 to 1.5 mg/L
- A notably different composition of groundwater to the south of the HD2 deposit (within the Fortescue Formation and outside of the HD2 groundwater system) which included elevated salinity, upwards of 2,500 µS/cm, low pH and elevated metals (iron, manganese, nickel and zinc).

At BHT groundwater is fresh; with salinity typically about 1000 µS/cm EC, and is slightly alkaline with the following characteristics:

- Salinity (as EC) ranges from approximately 650 to 1,250 µS/cm
- pH ranges from 7.4 to 8.2
- Total nitrogen was recorded at concentrations of less than 0.4 mg/L
- Iron concentration ranges from 0.4 to 4.2 mg/L
- Arsenic concentrations of 0.011 and 0.017 mg/L
- Manganese concentrations of up to 0.7 mg/L.

9.3.5.6. Existing Groundwater Use

There is no groundwater abstraction directly from the HD2 area. Rio Tinto abstracts groundwater from approved operations located near to the Proposal (namely HD1 to the east and West Angelas to the west). Groundwater is currently abstracted from the Wittenoom aquifer to supply water to the HD1 Village. Production bores for the HD1 Village (HDVP1 and HDVP2) are located approximately 2.5 km north of the closest part of the HD2 deposit and abstract water from the HD2 groundwater system. Abstraction from these bores commenced in 2006, the total annual abstraction is generally close to the annual licence allocation.

The relevant licences that Rio Tinto hold to abstract groundwater are:

- GWL 161141 (dewatering of the HD1 mine, limit of 40.15 GL/a)
- GWL 161143 (abstraction of up to 500,000 kL/a at the HD1 Village for potable supply)
- GWL 98740 (dewatering of the West Angelas mine, limit of 14 GL/a which includes Deposit B and other deposits)
- Several small volume 5C licenses held for ad hoc abstraction along the rail corridor.

9.3.5.7. Groundwater Level Response to Existing Abstraction

Groundwater levels and groundwater flow across the HD2 area have responded to nearby groundwater abstraction at the HD1 Village, where groundwater levels recorded approximately 200 m south of the HD1 Village abstraction bores, have declined by around 2 m over the 12-year period of abstraction, and abstraction has induced groundwater flow towards the HD1 Village in the eastern part of the HD2 groundwater system. (Rio Tinto 2022b).

Water levels observed in the western part of the HD2 system show a very minor change (drop of 0.5 m over a 6-year period) attributed to groundwater abstraction at Rio Tinto's West Angelas (Deposit B) operation. Groundwater levels at BHT have not responded to abstraction at HD1 and show that a distinct and significant hydraulic divide exists between the Hope Downs 1 operations and the Proposal as shown in Figure 9-7.

9.3.5.8. Geochemistry

The Proponent has undertaken extensive geochemical testing to understand the risks associated with the exposure of various waste units common to mining operations in the Pilbara (Rio Tinto 2008), including low sulfur materials that have traditionally been considered to present a low AMD risk but may pose a Neutral Metalliferous Drainage (NMD) risk.

To date, 151,258 waste samples have been analysed for sulphur content; with 89,006 samples (including 29,978 in pit samples) analysed at the HD2 deposit, and 62,252 samples (including 21,786 in pit samples) analysed at the BHT deposit. Of these samples taken, the majority were located at depth, below the approved pit shells (i.e., below water table). These samples contained sulfur with concentrations >0.3%.

As the Proposal involves AWT mining activities only, the Proposal will not expose or disturb these PAF materials and therefore there is limited to no AMD/NMD risks from these materials. While noting this, there is always a risk of unintended exposure of PAF material.

Materials characterisation of waste has been detailed within the MCP (Appendix A4) and considered post-closure. No long-term impacts associated with waste landforms are anticipated.

9.3.6. Water Management Strategy

To enable an assessment of environmental impacts in relation to the Inland Waters factor, a more detailed description and rationale for how water will be managed for the Proposal is required. This water management information is presented in this section as it is relevant to defining the potential environmental impacts.

9.3.6.1. Water Demand and Supply

The Proposal involves AWT mining only and will not require abstraction of groundwater to safely access ore deposits. The Proposal will require a water supply 3 GL/a of for construction and operational water supply purposes.

- Water supply demands for the Proposal are proposed to be met via:
    - The use of water currently abstracted and discharged from the adjacent operations, such as HD1 mine dewatering. Use of the HD1 surplus water volumes will minimise

volume of water released to the environment from this operation and minimise the requirement to develop additional groundwater resources

- A borefield local to HD2 to meet any potential shortfalls in the supply of water from HD1
- Construction and small potable supply (<0.5GL/a) for a crib room may be abstracted from BHT.

The supply of water from HD1 will result in a reduction in surplus water discharge from HD1 to Weeli Wolli Creek. However, surplus water supply required for the maintenance of Weeli Wolli Spring will continue to be met, as required under Ministerial Statement 893.

Rio Tinto holds several groundwater abstraction licences to support its current operations in the area, including:

- GWL 161141 which permits the dewatering of the HD1 deposit,
- GWL 161143 which permits abstraction from the HD1 Village for potable supply,
- GWL 98740 which permits abstraction from Deposit B at Rio Tinto's West Angelas Mine, and several small volume 5C licences held for ad hoc abstraction along the rail corridor.

Table 9-11 provides the details of the current small volume 5C licences held by Rio Tinto, on behalf of the relevant Proponents.

Table 9-11: Current Small Volume 5C Licences

Instrument no.	Annual Allocation (kl)	Location of water source	Authorised activities
161814	95000	M282SA - Hope Downs	Dust Suppression for earthworks and construction purposes Earthwork and construction purposes Exploratory Drilling Operations General Campsite purposes Geotechnical investigation purposes Mineral exploration activities Potable water supply purposes
174257	45000	L5SA	Dust Suppression for mining purposes Earthwork and construction purposes Exploratory Drilling Operations Geotechnical investigation purposes Potable water supply purposes Railway construction and maintenance Road maintenance purposes
172873	45000	L5SA	Dust Suppression for mining purposes Earthwork and construction purposes Geotechnical investigation purposes Potable water supply purposes Railway construction and maintenance Road maintenance purposes
180082	95000	G47/1236, AML70/248, E52/2043, E52/1459, E47/754, E47/2086	Dust Suppression for earthworks and construction purposes Earthwork and construction purposes Exploratory Drilling Operations General Campsite purposes Geotechnical investigation purposes Mineral exploration activities

Instrument no.	Annual Allocation (kl)	Location of water source	Authorised activities
			Potable water supply purposes
180086	95000	AM70/248	Dust Suppression for earthworks and construction purposes Earthwork and construction purposes Exploratory Drilling Operations General Campsite purposes Geotechnical investigation purposes Potable water supply purposes Mineral exploration activities

9.3.6.2. Surface Water Management

As outlined in Chapter 2, the Proposal includes infrastructure for the management of surface water, including up to four crossings of Pebble Mouse Creek, diversion drains, levees and culverts.

Multiple diversion drains have been proposed at HD2 to manage the surface water flow around the HD2 pit to protect the pit from flooding and allow for safe operation; and to avoid creek capture by enabling surface water flows to be directed back into major creeklines. The diversion infrastructure configuration, consisting of a levee and two drains, will divert northward flow from a tributary of Pebble Mouse Creek around the southern side of HD2 pit and convey flows into Weeli Wolli Creek in the southeast (noting the Pebble Mouse Creek is a tributary of Weeli Wolli Creek). Diverted water discharged into Weeli Wolli Creek will occur approximately 20 km upstream from Ben's Oasis. The levee and drains have been designed to convey a 1:100 AEP event.

9.3.7. Summary of Key Inland Waters Values

The key environmental values associated with Inland Waters include:

- Weeli Wolli Creek
- Pebble Mouse Creek
- Weeli Wolli Springs
- Ben’s Oasis

9.4. Potential Environmental Impacts

The following section presents the potential environmental impacts as a result of the Proposal in absolute and relative (%) terms, consistent with the requirements of EPA (2021e), including consideration of:

- Known extent of the existing environmental values in both a local and regional context
- Direct impact of the Proposal on the existing environmental values
- Indirect impact of the Proposal on the environmental values, and
- Cumulative environmental effects.

For the purposes of this assessment, the key environmental values comprise of:

- Weeli Wolli Creek
- Pebble Mouse Creek
- Weeli Wolli Springs
- Ben's Oasis.

9.4.1. Direct Impacts

Potential direct impacts from the implementation of the Proposal to Inland Waters include:

- Alteration of hydrological regimes of surface water systems resulting from the construction and operation of open mine pits and associated infrastructure, including:
    - Reduction in catchment area of Weeli Wolli Creek and Pebble Mouse Creek
    - Reduction in surface water flows to significant environmental values of Weeli Wolli Spring and Ben's Oasis
    - Alteration to surface water flow levels and volume within Pebble Mouse Creek due to linear infrastructure crossings
    - Diversion of 3 minor drainage lines at HD2 deposit
    - Reduction in surface water flows or direct impacts to minor pools, HD214_04 and GHD19-17-WS
- Alteration to groundwater levels through:
    - Operation of a HD2 borefield to provide water supply requirements.

9.4.1.1. Catchment Area

The implementation of the Proposal has the potential to impact the regional hydrology surrounding the Development Envelope. The construction of open cut mine pits and associated infrastructure will have the effect of reducing total catchment area supporting key inland water environmental values.

The following sections quantify this potential impact and present the modelling outcomes for the relative reduction in peak flows and volumes expected at the identified receptors of Weeli Wolli Spring and Ben's Oasis.

Weeli Wolli Creek

Following implementation of the Proposal, the Weeli Wolli Creek catchment area will be reduced by 46 km^2 (Table 9-12), representing a reduction in total catchment area by 1%, which is considered negligible.

Table 9-12: Catchment Area Loss – Weeli Wolli Creek

Total Catchment Area (km^2)	Mining Catchment Area (km^2)	Area Reduction by Proposal (km^2)	Difference (%)
4,770	1,530	-46	-3% of operating mining catchment area -1% of total catchment area

Weeli Wolli Springs

Following implementation of the Proposal, the regional catchment area supporting the Weeli Wolli Spring will be reduced by 45 km^2, representing a reduction in total catchment area by 3.5% as summarised in Table 9-13.

Table 9-13: Catchment Area Loss – Weeli Wolli Springs

Total Catchment Area (km^2)	Mining Catchment Area (km^2)	Area Reduction (km^2)	Difference (%)
1,340	1,295	-45	-3.5

A reduction in catchment area of 3.5% is considered negligible and unlikely to result in impacts to the hydrological regime of Weeli Wolli Spring, given the small change in the catchment area and that the Spring is a groundwater dependant ecosystem. The outcomes of the two-dimensional modelling on peak flows and volumes support this position and are discussed in Section 9.4.1.2.

Pebble Mouse Creek

As discussed in Section 9.3.3, Pebble Mouse Creek holds ecological and cultural significance as a water source for people, fauna and native vegetation. Mining of both HD2 and BHT will directly impact the catchment area supplying Pebble Mouse Creek by <8% as summarised in Table 9-14.

Table 9-14: Catchment Area Loss – Pebble Mouse Creek

Current Total Catchment Area (km^2)	Operational Mining Catchment Area (km^2)	Area Reduction (km^2)	Difference (%)
340	314	-26	-7.6

9.4.1.2. Peak Flows and Total Volumes

As discussed in Section 9.3.3, flow regimes through Weeli Wolli Creek and Pebble Mouse Creek to the sensitive receptors of Weeli Wolli Spring and Ben's Oasis, were characterised through two-dimensional hydraulic models.

Potential impacts to existing peak flow and total volumes following the implementation of the Proposal are presented in Table 9-15 and Table 9-16.

The modelled difference in peak volumes following the implementation of the Proposal for 1:100 AEP and 1:5 AEP are presented in Figure 9-8 and Figure 9-9.

Table 9-15: Modelled Peak Flows at Sensitive Receptors Following Proposal Implementation

Location	Event	Pre-mining (m^3/s)	Operational Mining (m^3/s)	Difference (m^3/s)	Difference (%)
Weeli Wolli Spring	1:100 AEP 24 hr	2,474	2,438	-36	-1.4
	1:5 AEP 12 hr	148	135	-12	-8.1

Ben's Oasis	1:100 AEP 24 hr	921	911	-10	-1.1
	1:5 AEP 12 hr	55	53	-2	-3.6

Table 9-16: Total Modelled Volumes at Sensitive Receptors Following Proposal Implementation

Location	Event	Pre-mining (GL)	Operational Mining (GL)	Difference (GL)	Difference (%)
Weeli Wolli Spring	1:100 AEP 24 hr	25.2	24.7	-0.5	-2
	1:5 AEP 12 hr	0.8	0.6	-0.2	-25*
Ben's Oasis	1:100 AEP 24 hr	7.1	7.0	-0.1	-2
	1:5 AEP 12 hr	0.33	0.31	-0.02	-7

**Combined HD1 and HD2 reduction*

As outlined in Table 9-16, volume modelling for 1:5 AEP events to Weeli Wolli Spring show 25% reduction as a result of HD1 and HD2 combined. Water levels (and therefore volumes) at Weeli Wolli Spring are supplemented by dewatering discharge from the main HD1 discharge pipe to Weeli Wolli Creek.

In addition, it is a requirement, under Ministerial Statement 893, that the aquifer supporting Weeli Wolli Spring is replenished and Weeli Wolli Spring is returned to self-sustaining system. There are several monitoring locations in this area used to ensure water levels at the Spring are maintained. This discharge to the creek and the spur lines will continue for the operating life of the Proposal.

The model does not consider these existing management measures, and therefore the modelled reduction to flows at the Spring are unlikely to be observed.

9.4.1.3. Pools

Two waterholes, HD214_04 and GHD19-17-WS, were identified by Nyiyaparli Traditional Owners as being significant to their cultural and environmental values. The Proponent has therefore undertaken an assessment of the potential impacts to these locations:

HD214_04 is in very close proximity to the HD2 deposit and has been described as a water source of ethnographic interest. The waterhole is 12m by 17m and is at least 1 m deep. The site was visited as part of the November 2021 Nyiyaparli Social Surroundings site visit, this is discussed further in Chapter 11 and Appendix E1.

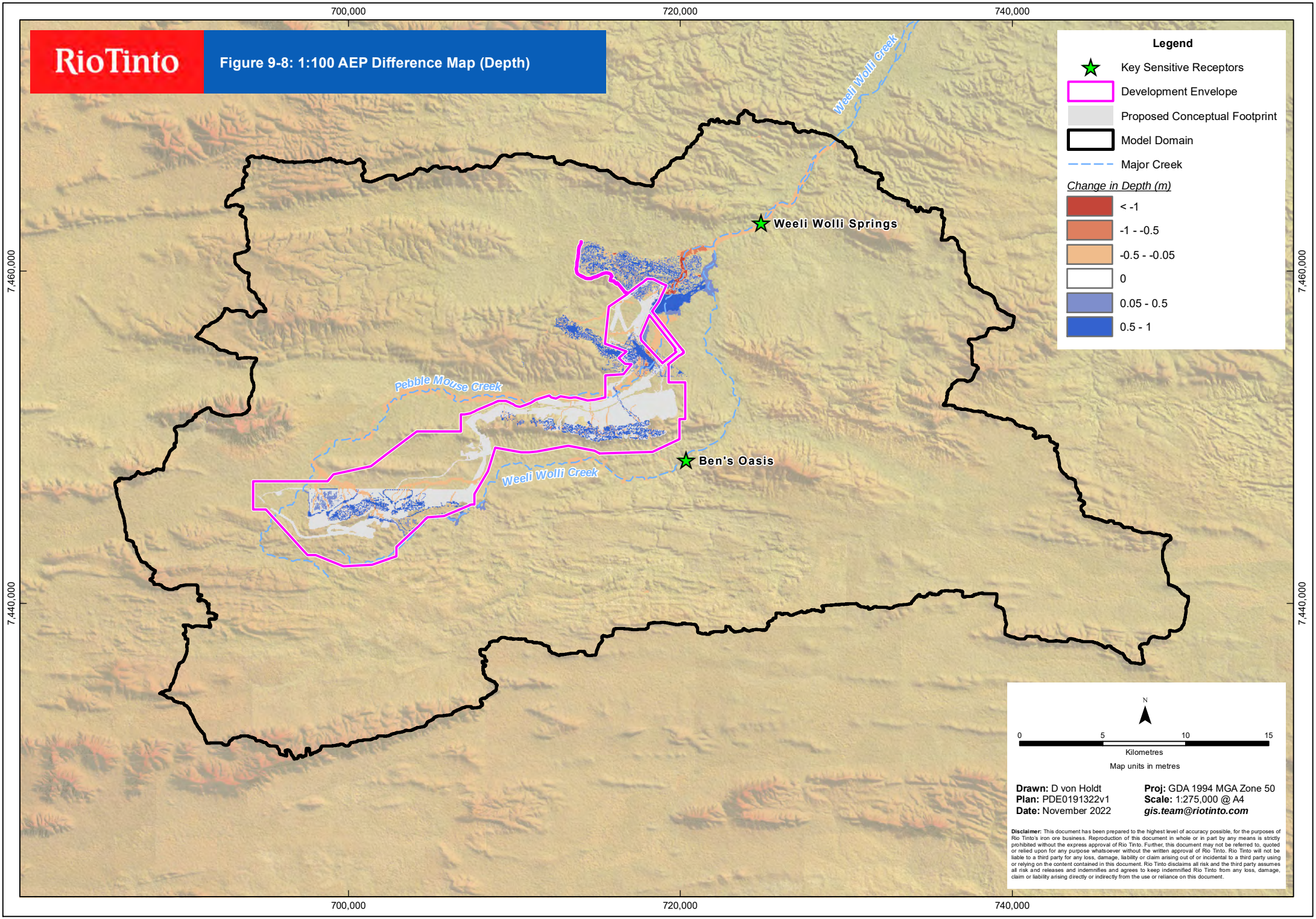
Although the physical location of the HD2 waterhole (HD214_04) will remain during the operational mining period, flows to this location will be impacted. The HD2 diversion levee is directly upstream of HD214_04 and will reduce flow rates and volumes experienced at the waterhole. Modelling results indicate that during a 1:5 AEP rainfall event, maximum flows at the waterhole are reduced by 28%. During a 1:100 AEP event, maximum flows are reduced by 59%.

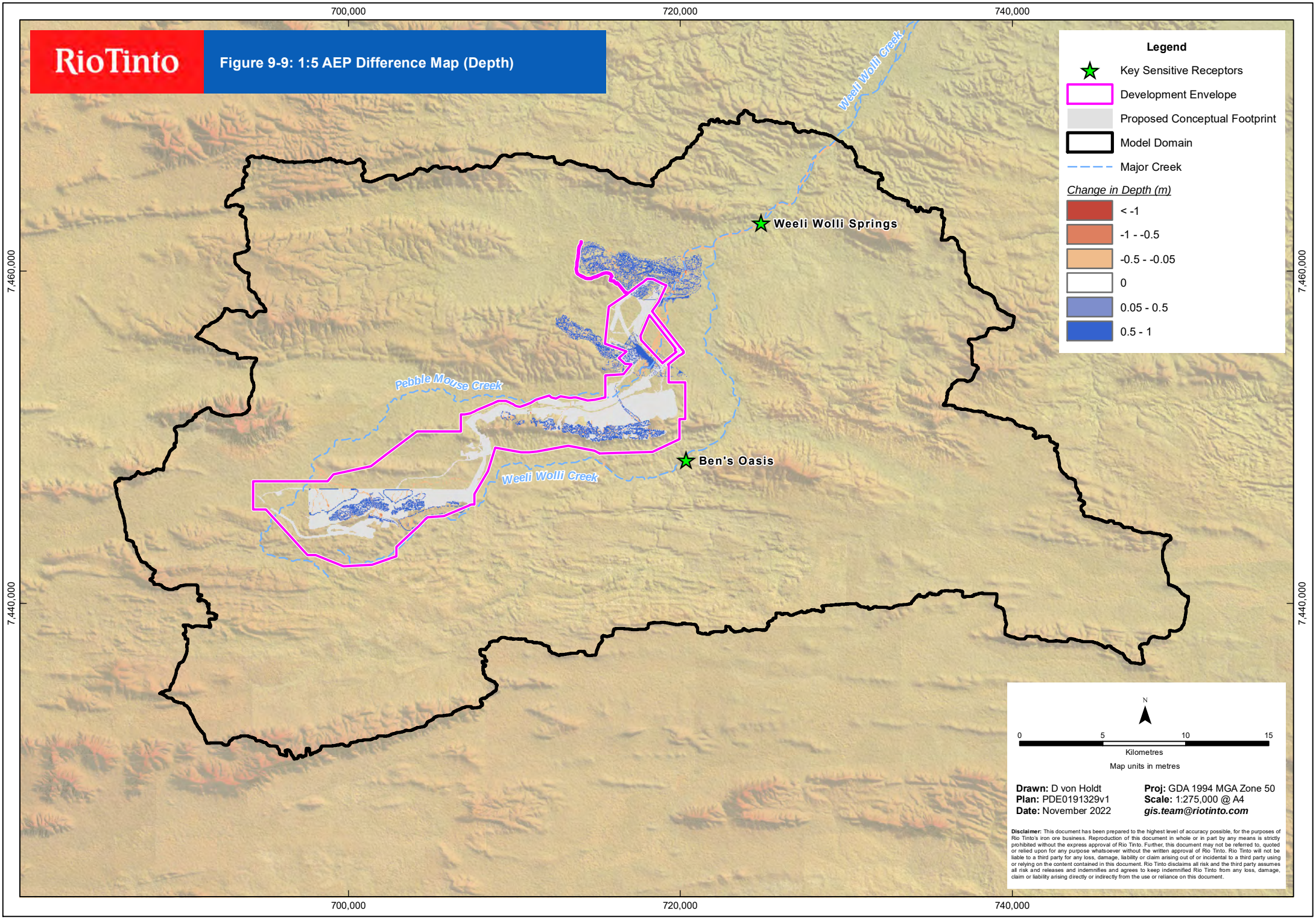
The BHT waterhole (GHD19-17-WS) will be directly impacted by proposed mining activities. The site is in the middle of a proposed waste dump; therefore, the waterhole will no longer exist.

It is noted that the pools are not significant Inland Waters features.

Persistent freshwater pools in the Pilbara are considered to have high conservation value and are considered to be significant in accordance with the Inland Waters guideline. The BHT waterhole (GHD19-17-WS) is ephemeral and therefore impacts to this feature are not considered significant. The

HD2 waterhole (HD214_04HD2) is conceptually expected to the semi-permanent or ephemeral, therefore impacts to this waterhole are considered significant.


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Figure 9-8: 1:100 AEP Difference Map (Depth)
700,000
720,000
740,000
7,460,000
7,440,000
Weeli Wolli Creek
Weeli Wolli Springs
Pebble Mouse Creek
Ben's Oasis
Weeli Wolli Creek
Legend
Key Sensitive Receptors
Development Envelope
Proposed Conceptual Footprint
Model Domain
Major Creek
Change in Depth (m)
< -1
-1 - -0.5
-0.5 - -0.05
0
0.05 - 0.5
0.5 - 1
N
0
5
10
15
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191322v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:275,000 @ A4
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Figure 9-9: 1:5 AEP Difference Map (Depth)
700,000
720,000
740,000
7,460,000
7,440,000
Weeli Wolli Creek
Weeli Wolli Springs
Pebble Mouse Creek
Ben's Oasis
Weeli Wolli Creek
Legend
Key Sensitive Receptors
Development Envelope
Proposed Conceptual Footprint
Model Domain
Major Creek
Change in Depth (m)
< -1
-1 - -0.5
-0.5 - -0.05
0
0.05 - 0.5
0.5 - 1
N
0
5
10
15
Kilometres
Map units in metres
Drawn: D von Holdt
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9.4.1.4. Changes to the Hydrological Regime through alteration of surface water flows

Diversion of minor drainage lines at HD2 deposit

The Proposal will require the construction of 2 diversions and a levee, which will re-direct minor drainage lines that currently flow into Pebble Mouse Creek towards Weeli Wolli Creek (Figure 9-16). Without the diversion the minor drainage lines would flow into the HD2 pit. The small tributaries of Pebble Mouse Creek have a 5km^2 catchment. Section 9.4.1.1 and Appendix E1 discuss that 92.4% of the Pebble Mouse Creek catchment remains post-mining.

The proposed diversion has been designed with a 1% AEP design flood. The diversion is to be operational diversion throughout the life of mine to avoid the tributary flowing into the HD2 pit during mining. Decisions on whether the diversion will remain post closure will be made in consultation with Traditional Owners. Should the diversion remain post-closure, the design will be upgraded in accordance with closure standards and a risk-based approach. Depending on the outcome, the design may require upgrade to allow for more extreme events such as the 1:1000 AEP flood or more extreme, if required.

While the surface water flows that contribute to the Pebble Mouse Creek will be diverted to the adjacent Weeli Wolli Creek, it is important to note that all runoff from the Pebble Mouse Creek catchment eventually end up in the Weeli Wolli Creek as the Pebble Mouse Creek is a tributary of the Weeli Wolli Creek and the actual confluence is located at HD1 (Pebble Mouse Creek diversion levee).

Mine Road/Infrastructure Crossing over Pebble Mouse Creek

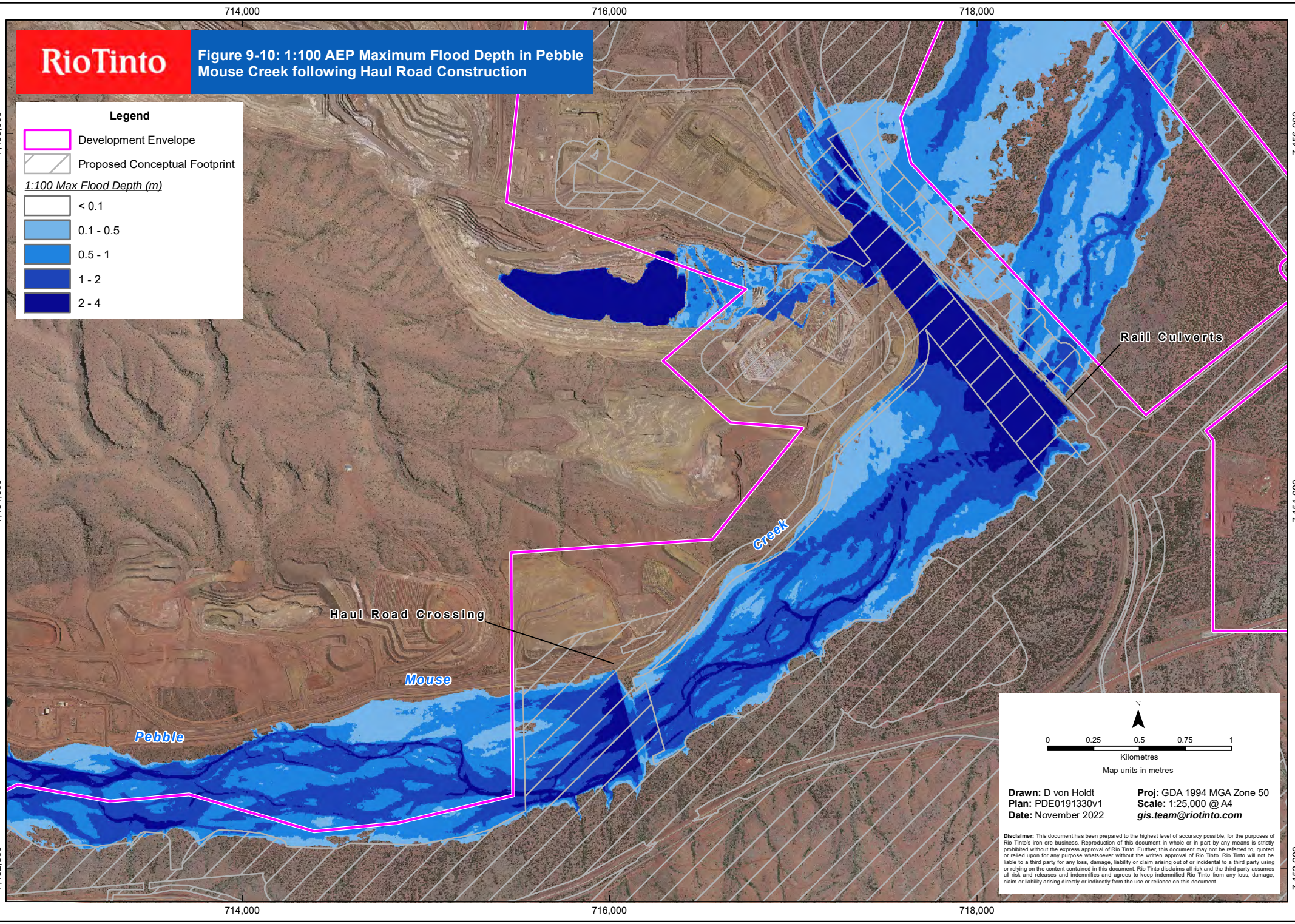
The Proposal will require the construction of up to four linear infrastructure crossings over Pebble Mouse Creek (Figure 9-17). The construction of these crossings can directly impact on existing water flows and volumes within Pebble Mouse Creek.

The proposed haul road, connecting the BHT deposit to the Hope Downs 1 operations processing infrastructure and facilities, has been designed as a floodway with culverts to ensure low flows are not impeded. The width of Pebble Mouse Creek bed at the proposed crossing location is approximately 350 m. The culvert crossing has been designed for a 1:20 AEP flow rate, which will allow all creekline ephemeral flow up to the 1:20 AEP event to pass through the culverts. More extreme events will result in the planned overtopping of the crossing.

The attenuation of surface water upstream of the Pebble Mouse Creek haul road crossing may result in a localised increase in flood depths in this area of up to 1 m (Rio Tinto 2022a). Model results indicate that depths downstream of the crossing are expected to only change slightly, with difference mapping (Figure 9-10) indicating a maximum decrease of 0.1 m for the 1:100 AEP.

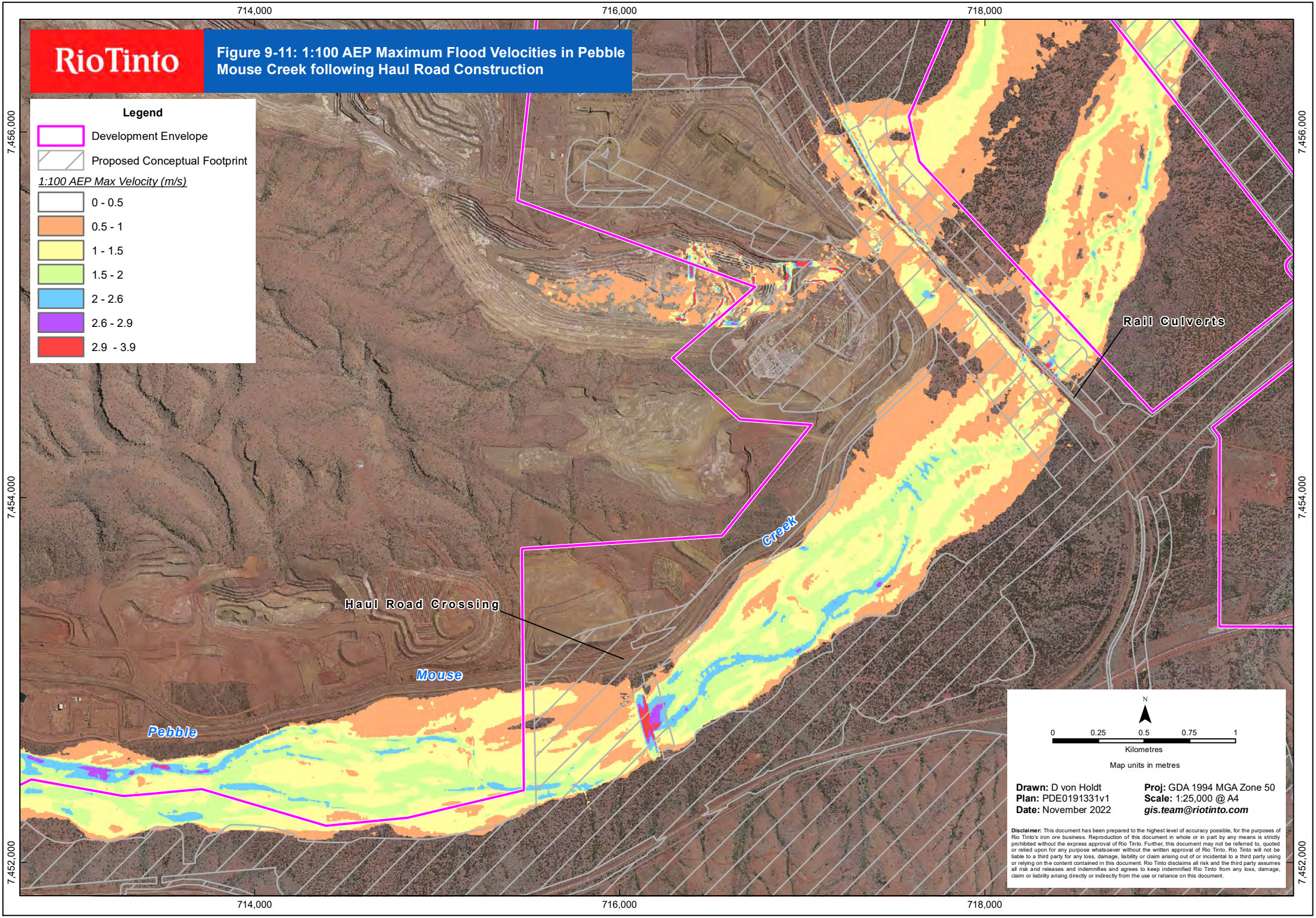
The alteration to surface water depth and velocity is unlikely to result in a significant impact to Pebble Mouse Creek.

In addition, the Proposal will require the construction of a smaller road train crossing, approximately 2 km downstream of the haul road. Combined, it is expected that during significant rainfall events (1:100 AEP) there will be no significant increase in flooding or erosion of Pebble Mouse Creek between these crossings.


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Figure 9-10: 1:100 AEP Maximum Flood Depth in Pebble Mouse Creek following Haul Road Construction
Legend
Development Envelope
Proposed Conceptual Footprint
1:100 Max Flood Depth (m)
< 0.1
0.1 - 0.5
0.5 - 1
1 - 2
2 - 4
714,000
716,000
718,000
7,456,000
7,454,000
7,452,000
Rail Culverts
Haul Road Crossing
Mouse
Creek
Pebble
N
0
0.25
0.5
0.75
1
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191330v1
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:25,000 @ A4
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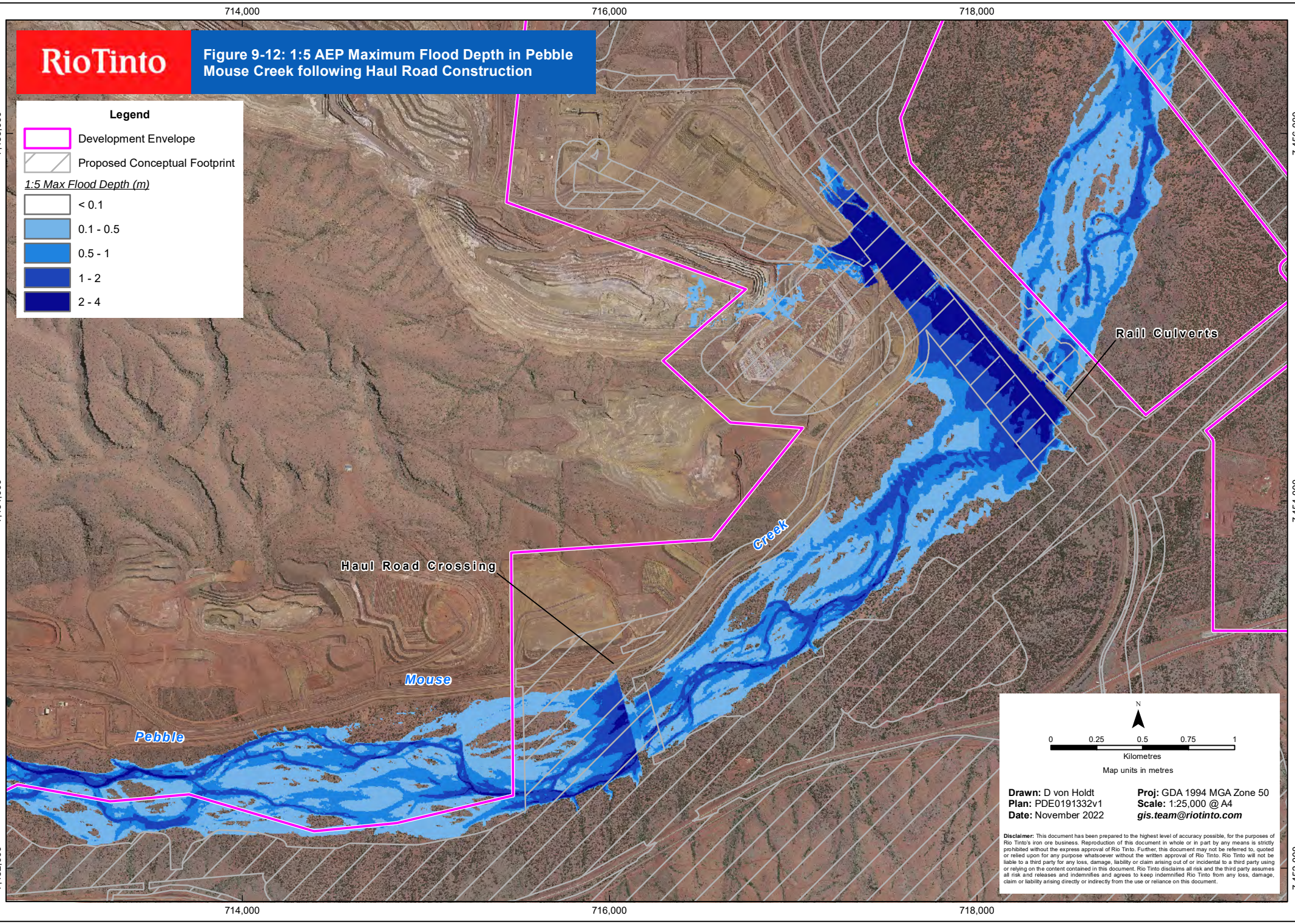
Figure 9-11: 1:100 AEP Maximum Flood Velocities in Pebble Mouse Creek following Haul Road Construction



Drawn: D von Holdt
Plan: PDE0191331v1
Date: November 2022

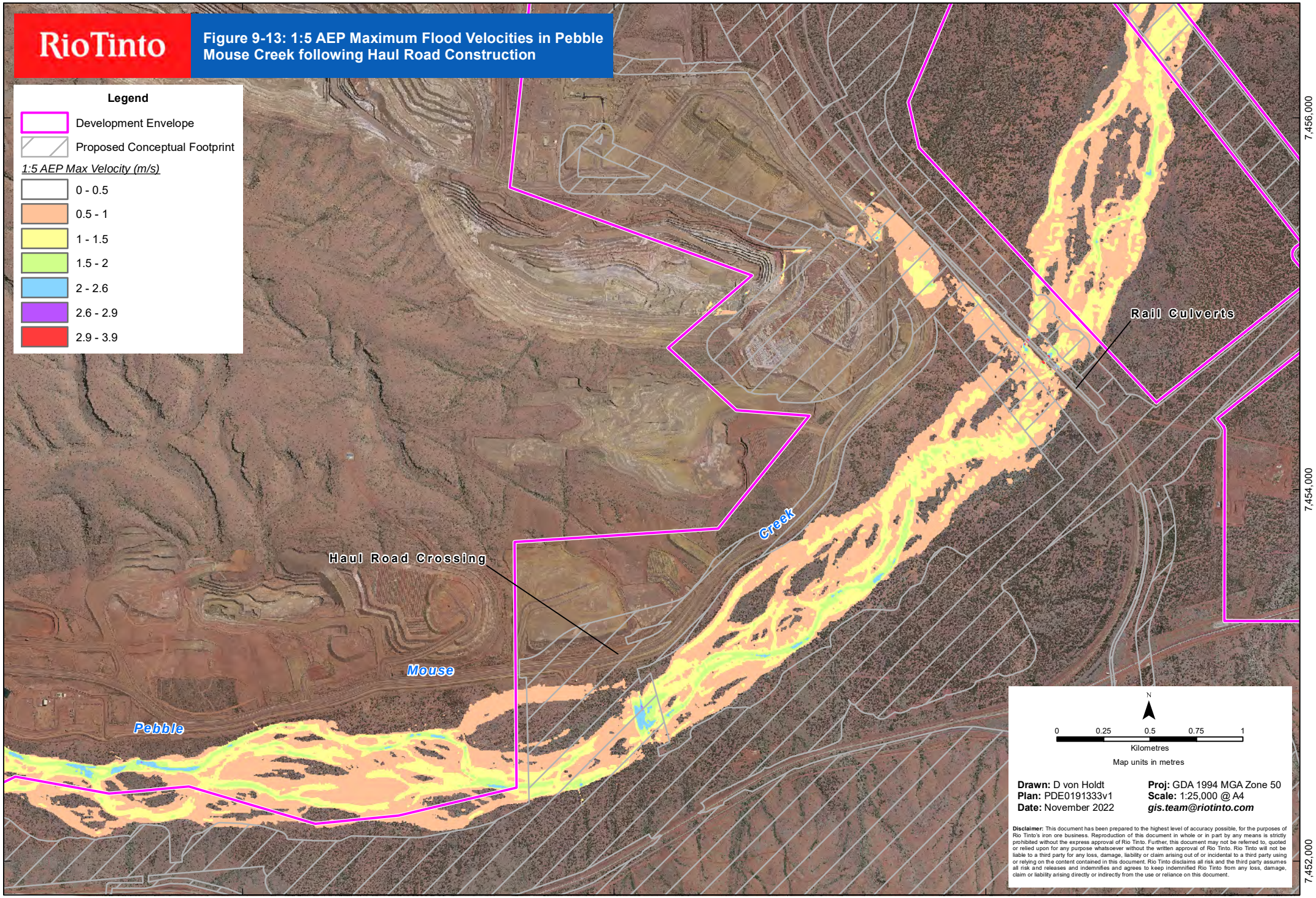
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Figure 9-12: 1:5 AEP Maximum Flood Depth in Pebble Mouse Creek following Haul Road Construction
Legend
Development Envelope
Proposed Conceptual Footprint
1:5 Max Flood Depth (m)
< 0.1
0.1 - 0.5
0.5 - 1
1 - 2
2 - 4
714,000
716,000
718,000
7,456,000
7,454,000
7,452,000
Rail Culverts
Haul Road Crossing
Mouse
Creek
Pebble
N
0
0.25
0.5
0.75
1
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191332v1
Date: November 2022
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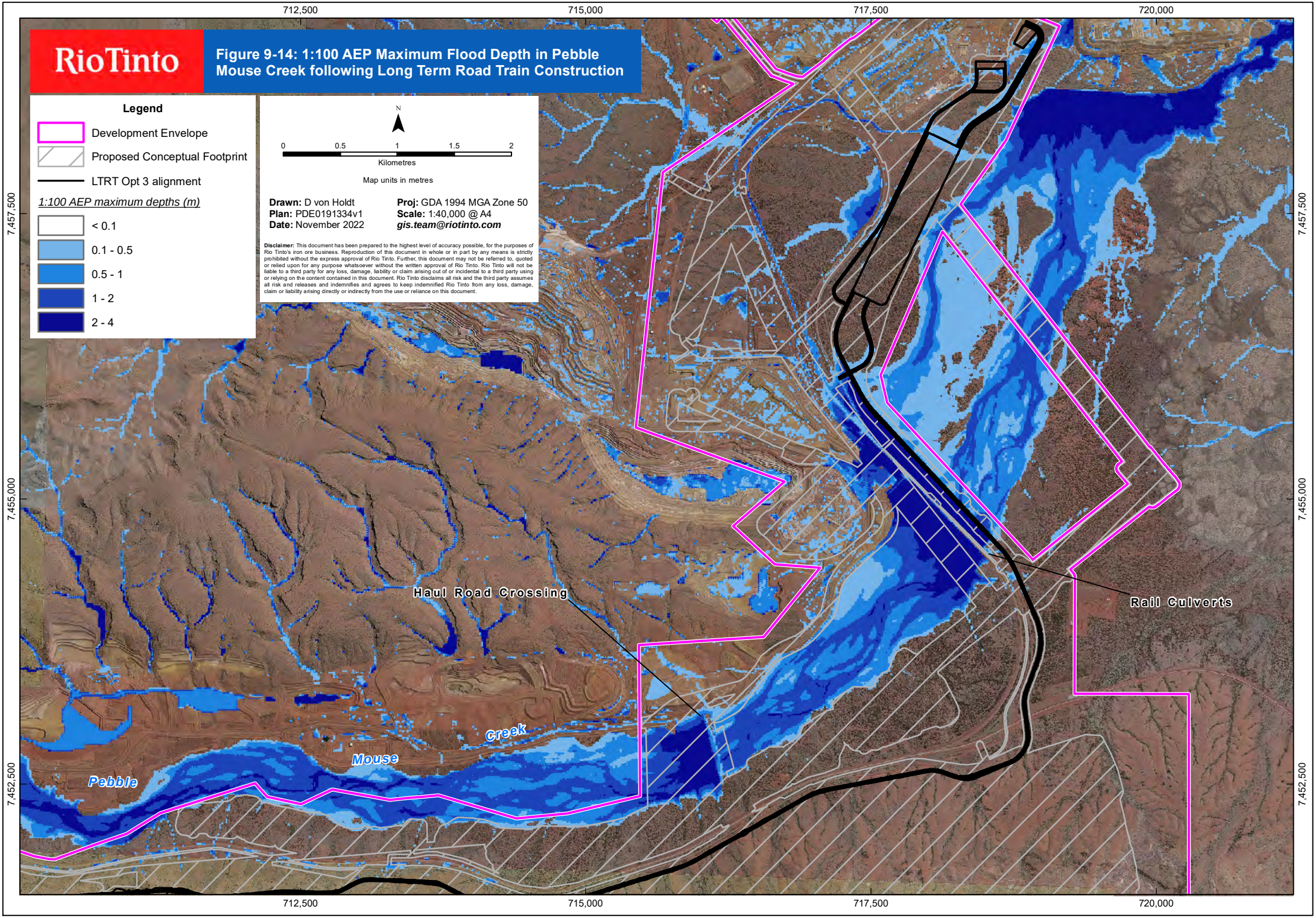
Figure 9-13: 1:5 AEP Maximum Flood Velocities in Pebble Mouse Creek following Haul Road Construction



Drawn: D von Holdt
Plan: PDE0191333v1
Date: November 2022

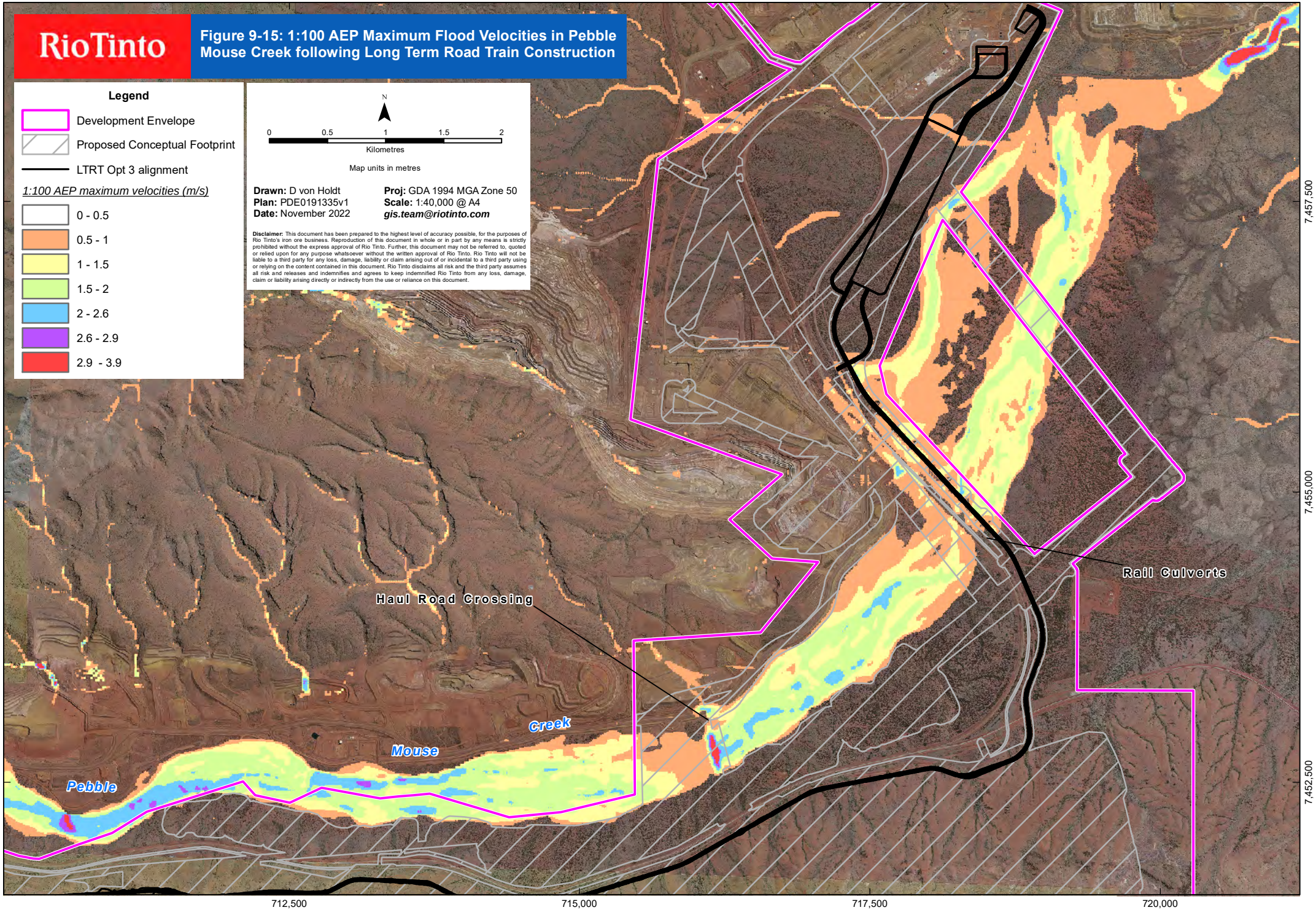
Proj: GDA 1994 MGA Zone 50
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Figure 9-14: 1:100 AEP Maximum Flood Depth in Pebble Mouse Creek following Long Term Road Train Construction
Legend
Development Envelope
Proposed Conceptual Footprint
LTRT Opt 3 alignment
1:100 AEP maximum depths (m)
< 0.1
0.1 - 0.5
0.5 - 1
1 - 2
2 - 4
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191334v1
Date: November 2022
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712,500
715,000
717,500
720,000
7,457,500
7,455,000
7,452,500
Haul Road Crossing
Rail Culverts
Pebble
Mouse
Creek

RioTinto

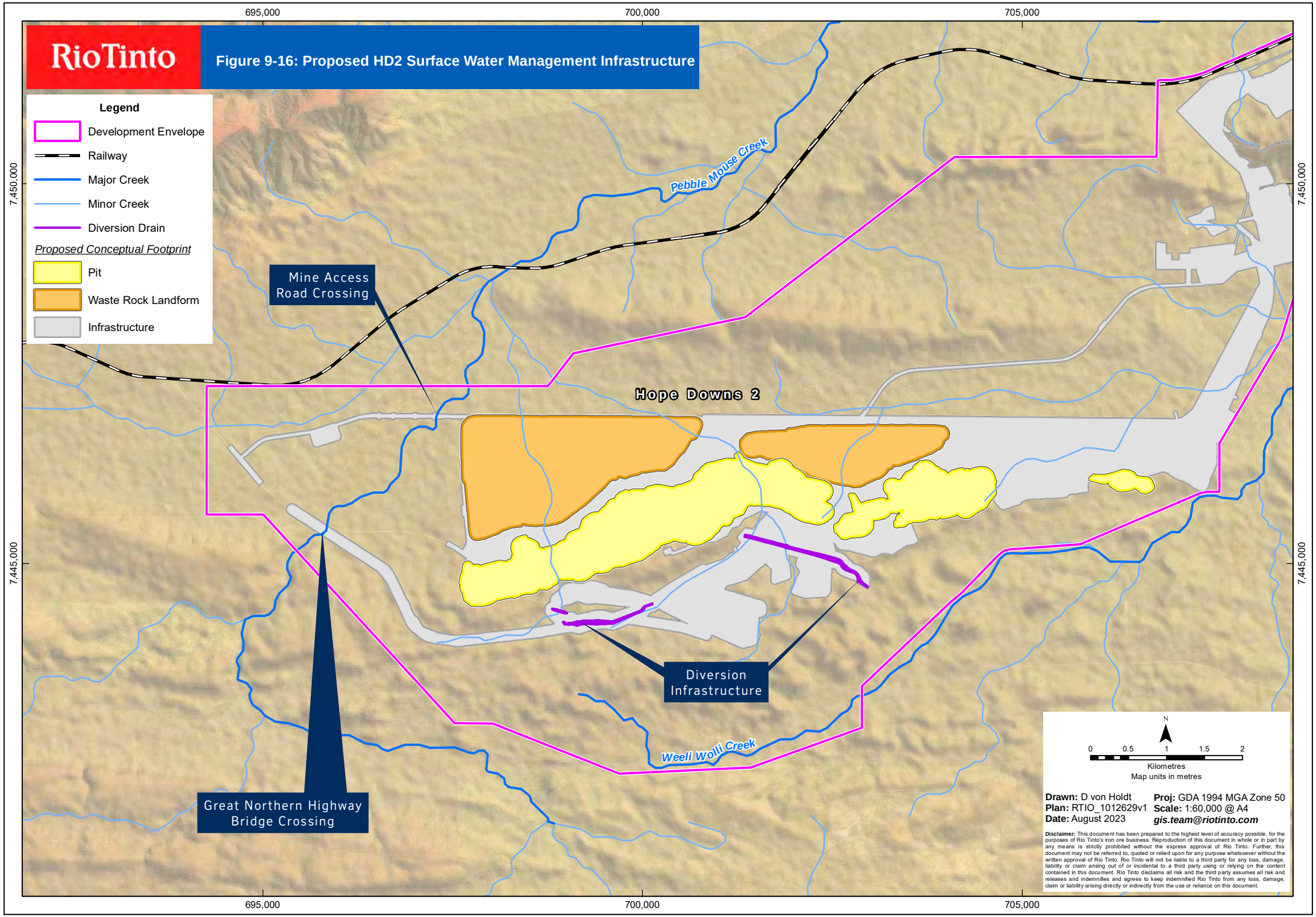
Figure 9-15: 1:100 AEP Maximum Flood Velocities in Pebble Mouse Creek following Long Term Road Train Construction

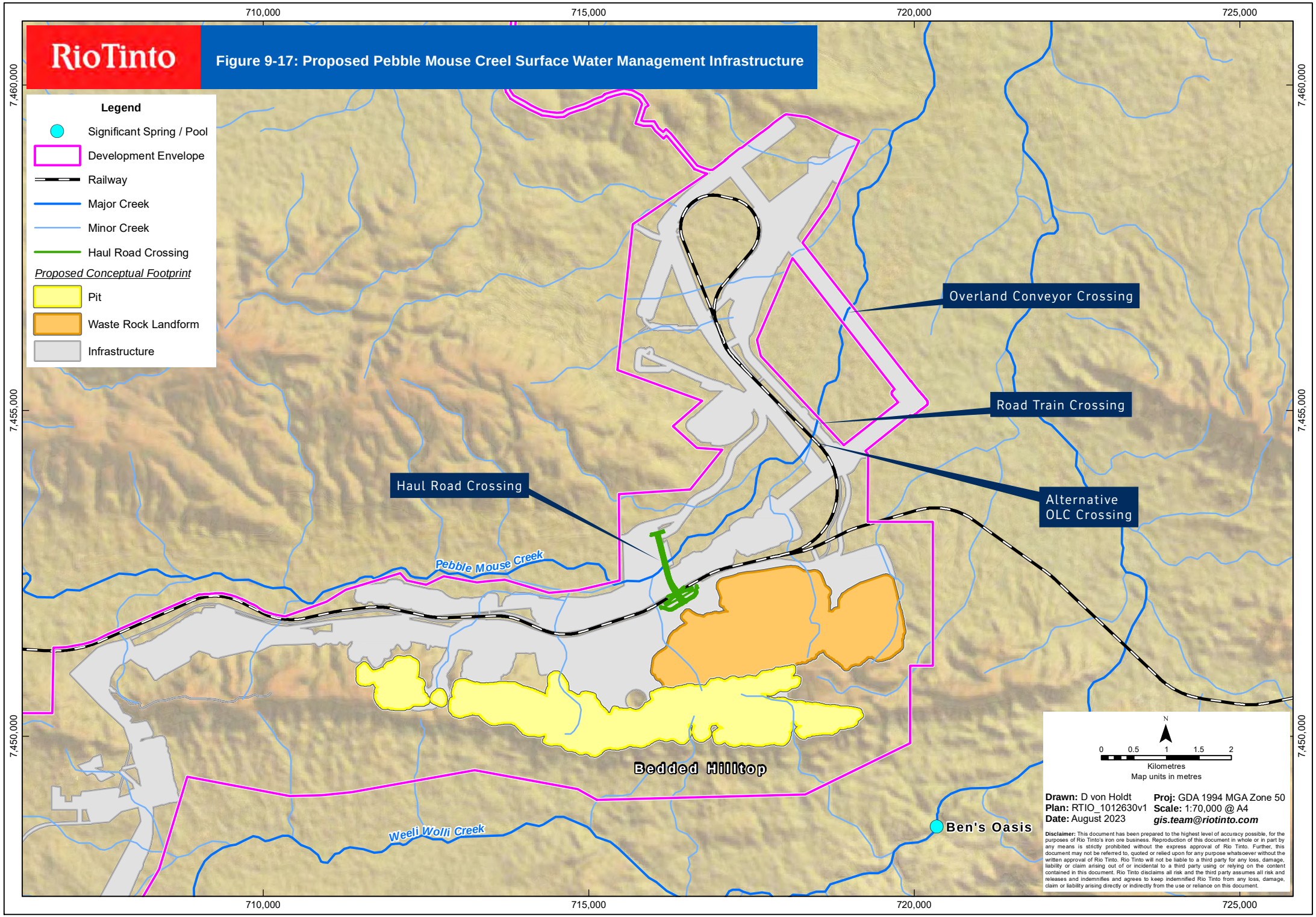


Drawn: D von Holdt
Plan: PDE0191335v1
Date: November 2022

Proj: GDA 1994 MGA Zone 50
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RioTinto
Figure 9-16: Proposed HD2 Surface Water Management Infrastructure
Legend
Development Envelope
Railway
Major Creek
Minor Creek
Diversion Drain
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Infrastructure
695,000
700,000
705,000
7,450,000
7,445,000
Pebble Mouse Creek
Mine Access Road Crossing
Hope Downs 2
Diversion Infrastructure
Weeli Wolli Creek
Great Northern Highway Bridge Crossing
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO_1012629v1
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:60,000 @ A4
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Figure 9-17: Proposed Pebble Mouse Creel Surface Water Management Infrastructure
Legend
Significant Spring / Pool
Development Envelope
Railway
Major Creek
Minor Creek
Haul Road Crossing
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Infrastructure
Overland Conveyor Crossing
Road Train Crossing
Alternative OLC Crossing
Haul Road Crossing
Pebble Mouse Creek
Bedded Hilltop
Weeli Wolli Creek
Ben's Oasis
710,000
715,000
720,000
725,000
7,460,000
7,455,000
7,450,000
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO_1012630v1
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9.4.1.5. Groundwater Drawdown

Hydrogeological investigations have been carried out within the Development Envelope and its surrounding area between 2006 and 2022 (Rio Tinto 2022b). These investigations show that:

- The use of HD1 surplus mine dewatering to meet operational water demand will be sufficient for initial periods of mining at the Proposal however, an additional source of water may be required during the commissioning phase and when water availability at HD1 is limited post 2033 as abstraction volumes decrease
- A borefield at HD2 (Figure 9-18) is expected to provide a sustainable supply sufficient to meet demand (estimated at 3 GL/a) for the combined HD2/BHT deposits mine life. Available supply, based on test pumping of existing bores and modelling is approximately 9.3 ML/day (~3.4 GL/a). Modelling has demonstrated that drawdown from abstraction at HD2 is not expected to propagate towards any existing users or environmental receptors (namely, Ben's Oasis or Weeli Wolli Spring).

Rio Tinto (2022b) simulated groundwater abstraction over a period of 13 years. A total combined volume of 38 GL was abstracted (3 GL/a), with combined daily abstraction ranging from 3.7 to 9.5 ML/d which allows demand to be met with contingency for larger demands, plus an additional 4.9 ML/d was abstracted from the HD1 Village, each year, to simulate meeting the Village's potable water demand.

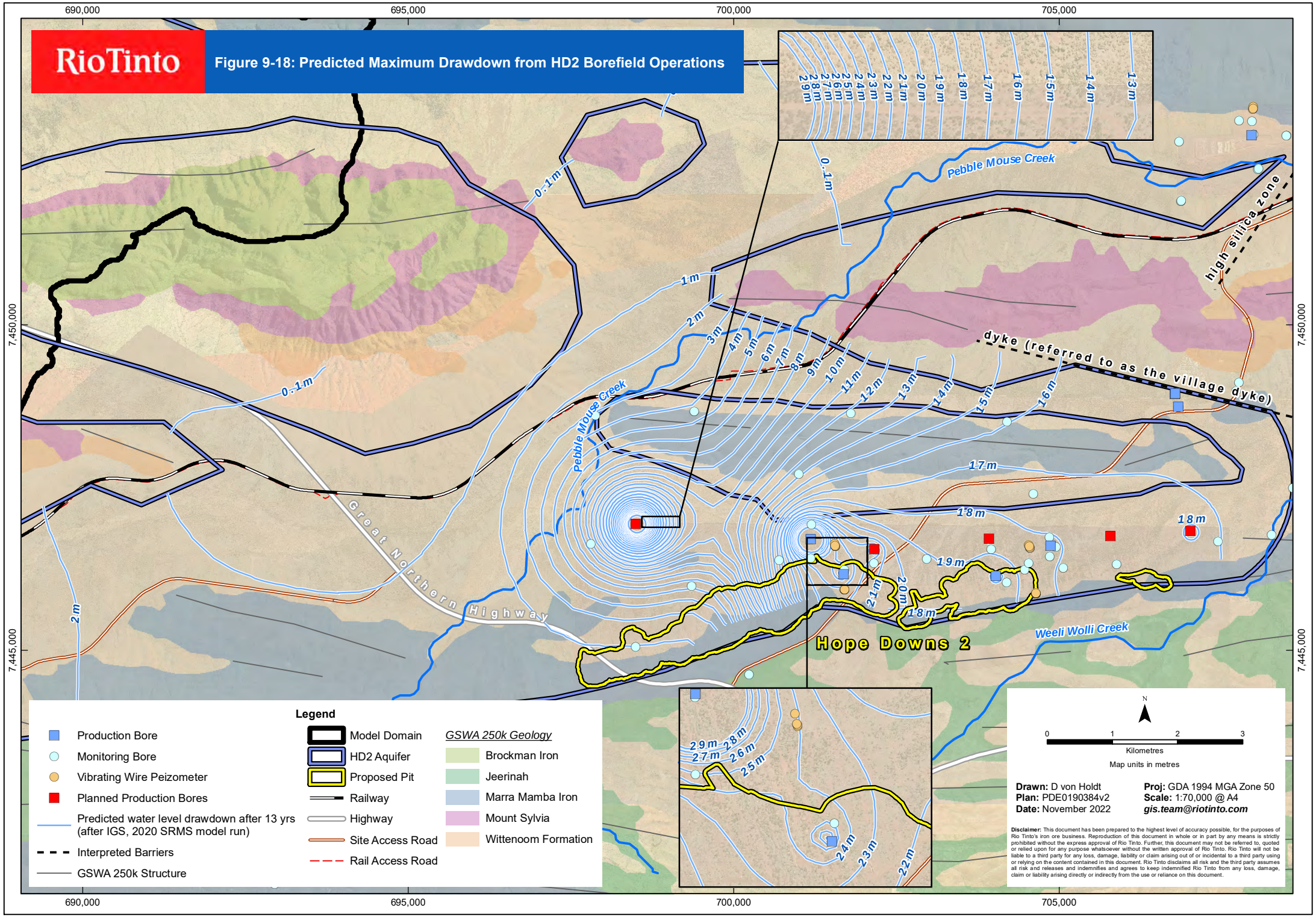
Results of the modelled abstraction (Rio Tinto 2022b) at the end of 13 years show a predicted drawdown of 29 m in the immediate area of the proposed HD2 borefield. The extent of groundwater drawdown will be localised and mostly remain within the proposed borefield area, as shown in Figure 9-18. Drawdown of about 2 m was predicted at a distance of 10 km to the west of the centre of the HD2 deposit and borefield area, and drawdowns of about 18 m were produced at a distance of 6 km to the east.

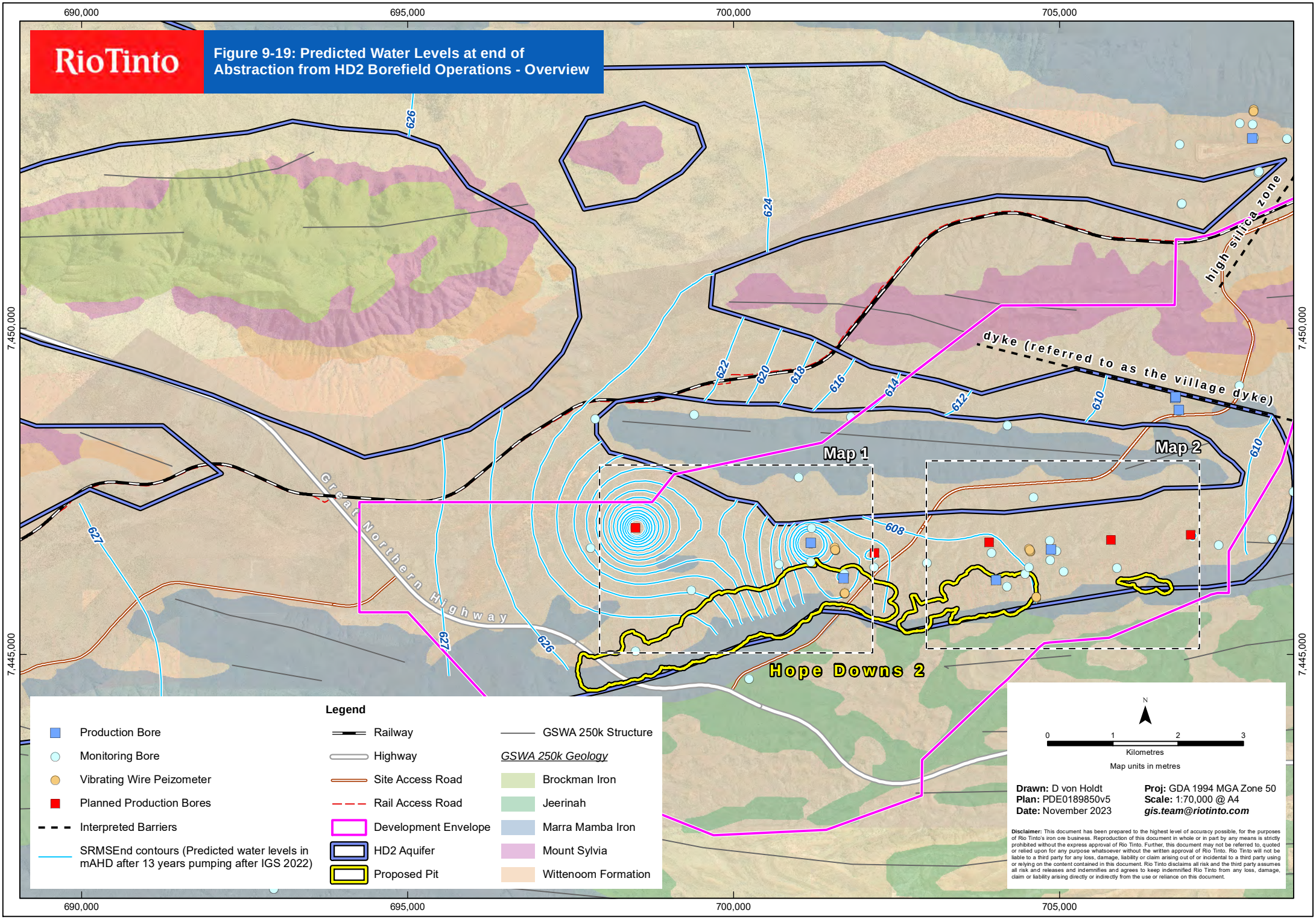
Importantly, predicted drawdown did not extend beyond aquifer boundaries, most notably, no drawdown propagation was evident in the Fortescue Group, nor at Ben's Oasis. Groundwater drawdown is therefore not expected to impact any surrounding potential GDE's or extend beyond the extent of the aquifer.

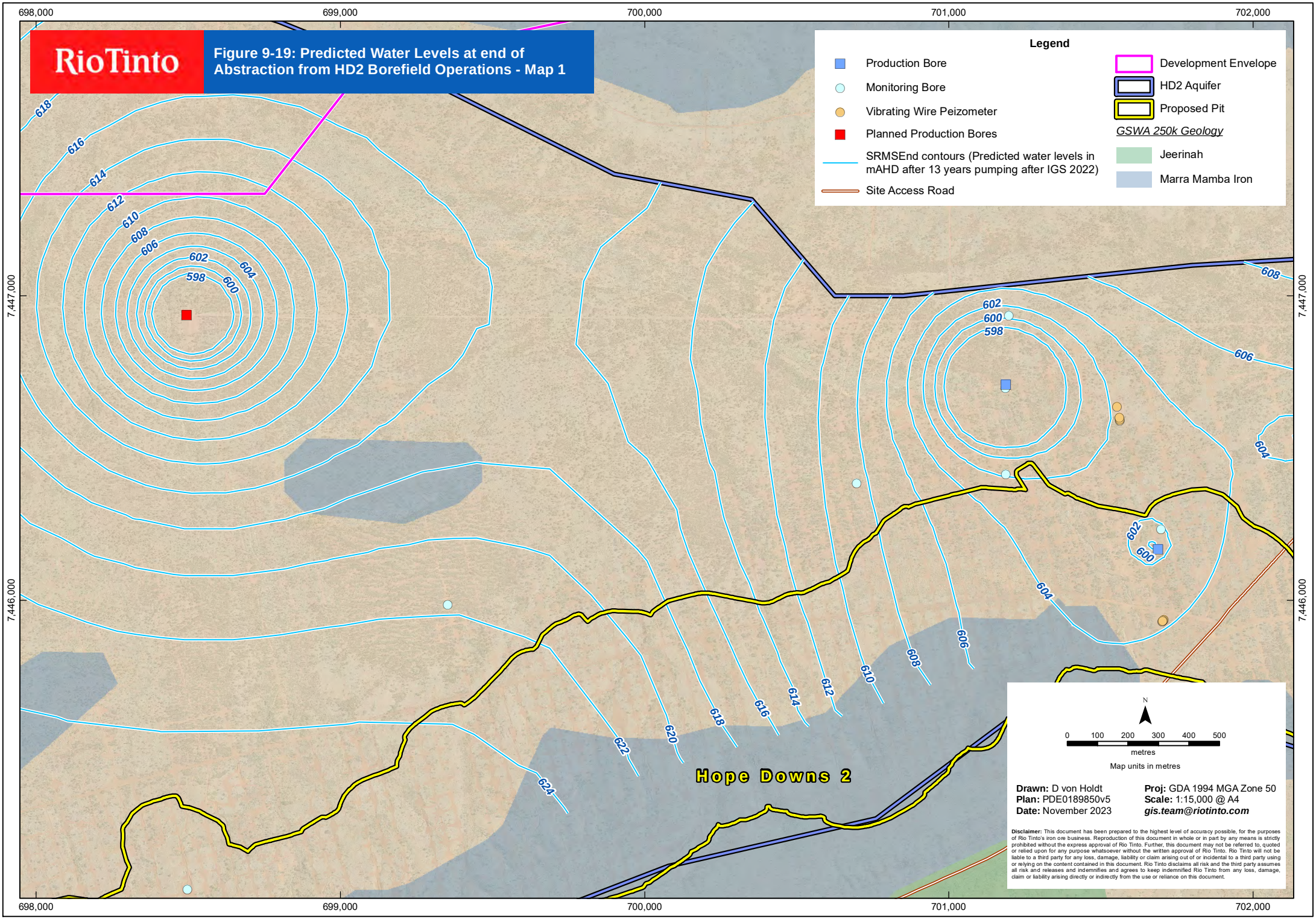
The Weeli Wolli Spring is not considered to be connected to the groundwater systems that coincide with the Proposal due to the presence of a southeast trending dyke (Village Dyke; Figure 9-18) located to the east of the BHT (Rio Tinto 2022b). As such it is considered that abstraction poses no risk to the Weeli Wolli Spring pools, located downstream from the Hope Downs 1 operations and outside of the HD2 groundwater system.

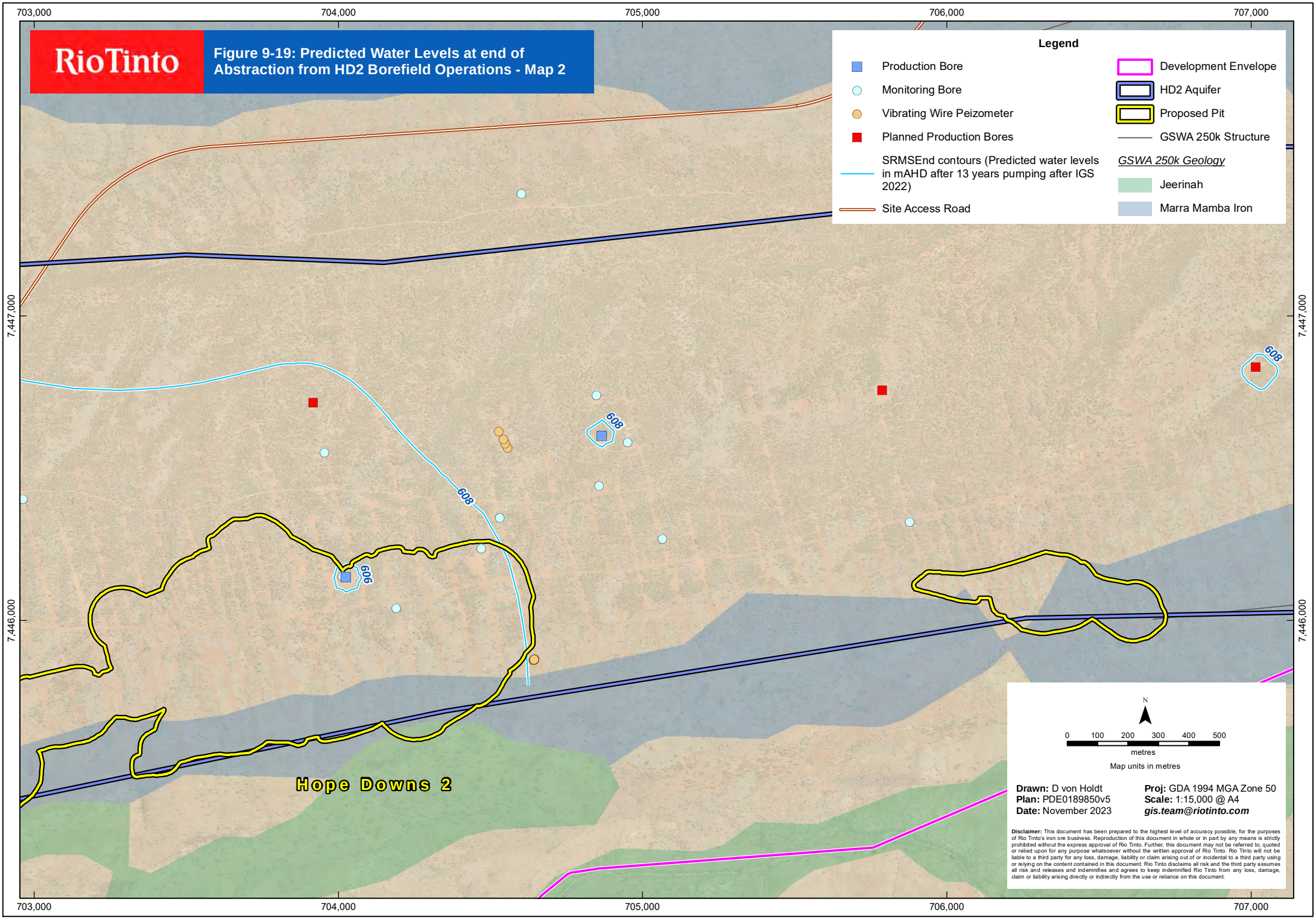
The predicted outcomes of the abstraction at HD2 based on the model simulations are shown in Figure 9-18. with water levels at end of abstraction period shown in Figure 9-19.

No groundwater abstraction at proposed BHT for production water supply. A bore at BHT currently exists and will be utilised for limited construction and potable water supply, which is in the order of 0.2GL/annum, with a single year peak during construction in the order of 1GL. The drawdown associated with these volumes is limited due to the small aquifer extent and no significant environmental impacts are associated with the abstraction of this volume. Licensing of potable water abstraction will be sought under the RIWI Act.


RioTinto
Figure 9-18: Predicted Maximum Drawdown from HD2 Borefield Operations
690,000
695,000
700,000
705,000
7,450,000
7,445,000
Pebble Mouse Creek
high silica zone
dyke (referred to as the village dyke)
Great Northern Highway
Weeli Wolli Creek
Hope Downs 2
0.1m
1m
2m
3m
4m
5m
6m
7m
8m
9m
10m
11m
12m
13m
14m
15m
16m
17m
18m
19m
21m
20m
22m
23m
24m
25m
26m
27m
28m
29m
Legend
Production Bore
Monitoring Bore
Vibrating Wire Peizometer
Planned Production Bores
Predicted water level drawdown after 13 yrs (after IGS, 2020 SRMS model run)
Interpreted Barriers
GSWA 250k Structure
Model Domain
HD2 Aquifer
Proposed Pit
Railway
Highway
Site Access Road
Rail Access Road
GSWA 250k Geology
Brockman Iron
Jeerinah
Marra Mamba Iron
Mount Sylvia
Wittenoom Formation
N
0
1
2
3
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0190384v2
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:70,000 @ A4
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RioTinto
Figure 9-19: Predicted Water Levels at end of Abstraction from HD2 Borefield Operations - Overview
690,000
695,000
700,000
705,000
7,450,000
7,445,000
626
624
622
620
618
616
614
612
610
608
627
high silica zone
dyke (referred to as the village dyke)
Map 1
Map 2
Great Northern Highway
Hope Downs 2
Legend
Production Bore
Monitoring Bore
Vibrating Wire Peizometer
Planned Production Bores
Interpreted Barriers
SRMSEnd contours (Predicted water levels in mAHD after 13 years pumping after IGS 2022)
Railway
Highway
Site Access Road
Rail Access Road
Development Envelope
HD2 Aquifer
Proposed Pit
GSWA 250k Structure
GSWA 250k Geology
Brockman Iron
Jeerinah
Marra Mamba Iron
Mount Sylvia
Wittenoom Formation
N
0
1
2
3
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0189850v5
Date: November 2023
Proj: GDA 1994 MGA Zone 50
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Figure 9-19: Predicted Water Levels at end of Abstraction from HD2 Borefield Operations - Map 1
Legend
Production Bore
Monitoring Bore
Vibrating Wire Peizometer
Planned Production Bores
SRMSEnd contours (Predicted water levels in mAHD after 13 years pumping after IGS 2022)
Site Access Road
Development Envelope
HD2 Aquifer
Proposed Pit
GSWA 250k Geology
Jeerinah
Marra Mamba Iron
Hope Downs 2
698,000
699,000
700,000
701,000
702,000
7,447,000
7,446,000
N
0 100 200 300 400 500
metres
Map units in metres
Drawn: D von Holdt
Plan: PDE0189850v5
Date: November 2023
Proj: GDA 1994 MGA Zone 50
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RioTinto
Figure 9-19: Predicted Water Levels at end of Abstraction from HD2 Borefield Operations - Map 2
Legend
Production Bore
Monitoring Bore
Vibrating Wire Peizometer
Planned Production Bores
SRMSEnd contours (Predicted water levels in mAHD after 13 years pumping after IGS 2022)
Site Access Road
Development Envelope
HD2 Aquifer
Proposed Pit
GSWA 250k Structure
GSWA 250k Geology
Jeerinah
Marra Mamba Iron
703,000
704,000
705,000
706,000
707,000
7,447,000
7,446,000
606
608
Hope Downs 2
N
0 100 200 300 400 500
metres
Map units in metres
Drawn: D von Holdt
Plan: PDE0189850v5
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9.4.2. Indirect Impacts

Implementation of the Proposal has the potential to result in the following indirect impacts on Inland Waters:

- Increases in sediment load of Pebble Mouse Creek as a result of clearing and soil disturbance, including the construction of crossings and the placement and management of stockpiles.
- Impacts to ground and/or surface water due to AMD seepage from PAF exposures in pit walls or Waste Rock Landforms.
- Reduction in surface water and groundwater quality due to accidental spills of hydrocarbons, hazardous materials and waste.

9.4.2.1. Increases in Sediment Load of Pebble Mouse Creek

The primary source of potential water quality impact to Weeli Wolli Spring is the liberation of additional sediment load to the watercourse. In the context of the Proposal, the biggest risk is associated with the proposed haul road crossing of Pebble Mouse Creek.

Owing to the climate, vegetation and pastoral land use of the Pilbara, the water quality of ephemeral watercourses in the region is often highly turbid (coloured) and flows can naturally carry large volumes of suspended sediments (van Vreeswyk et al 2004); however, there is potential for the increased turbidity or sediment load to have local impacts.

Liberation of sediment could occur in the unlikely event that a haul road crossing is washed out during a heavy rainfall event. The pathway from this source to the key receptors is a significant distance of ephemeral creek line – the proposed Pebble Mouse Creek haul road crossing is 14 km upstream of the Weeli Wolli Spring; the proposed road train crossing is 11 km upstream and the proposed transfer pad. Additionally there is an existing diversion of Pebble Mouse Creek associated with the HD1 operations, the diversion levee is located 7 km upstream from Weeli Wolli Spring. As such, the impacts associated with the Proposal are not expected to be greater than or different to those associated with existing operations.

9.4.2.2. Contamination of Surface Water and/or Groundwater from AMD Seepage

The Proposal involves AWT mining activities only. As a result, the Proposal is not expected to disturb PAF materials, which have been identified BWT only and therefore presents little to no AMD/NMD risks from these materials. No significant residual impacts are expected.

However, it is acknowledged that there is potential for unexpected PAF materials to be exposed during mining operations. The exposure of these materials and their subsequent storage within waste rock landforms could potentially expose the receiving environment to potential AMD seepage. Further information is provided in Appendix 9 of the MCP.

9.4.2.3. Contamination of Surface Water and Groundwater from Spills of Hydrocarbons, Hazardous Materials and Waste

Construction and operation activities has the potential to contaminate surface water and groundwater due to storage and handling of hazardous materials, hydrocarbons, and waste. Site drainage infrastructure will be designed to minimise or eliminate surface water runoff into areas where hydrocarbon contamination may occur.

Hydrocarbon storage facilities will be appropriately constructed and bunded in accordance with Australian Standards. Site inspection, maintenance and spill management procedures are expected to effectively mitigate the risk of contamination.

Accordingly, the residual potential impact to water resources from spills and leaks is expected to be minimal and reversible.

9.4.3. Cumulative Impacts

The following section outlines the potential cumulative impacts to Inland Water environmental values as a result of the Proposal and other surrounding mining activities either approved or currently under assessment. Cumulative impacts have been considered against the following inland water aspects:

- Surface water catchment area
- Groundwater drawdown.

In undertaking a cumulative impact assessment, a number of assumptions need to be made. For this assessment it has been assumed that:

- Cumulative impacts have been considered against the following projects
  - Rio Tinto (Hamersley Iron) managed – Hope Downs 1, Baby Hope, and West Angelas Operations
  - BHP – Mining Area C (North and South Flank)
- Cumulative impacts to inland waters resulting from third-party operations have been quantified based on information obtained from the public domain and does not encapsulate impacts for all third-party operations in the East Pilbara
- Cumulative impact calculations do not take into consideration areas outside of those assessed under Part IV of the EP Act for each relevant proposal
- The accuracy of data from external sources has not been verified and it is assumed that data publicly available is accurate and collected in accordance with standard industry guidelines
- Cumulative impact calculations do not take into consideration areas outside of those assessed by each relevant proposal
- Cumulative impacts to catchment areas resulting from third-party operations are conservative and based on information available in the public domain and may not represent the most accurate levels of disturbance.

9.4.3.1. Surface Water – Catchment Area

In the context of surface water, a review of potential cumulative impacts centred on catchment area reduction. The Proposal, Rio Tinto's existing Hope Downs 1 operations and BHP's South Flank and North Flank (Mining Area C) all occur within the Weeli Wolli catchment area.

Table 9-17 summarises the cumulative impact to the Weeli Wolli Creek.

Table 9-17: Cumulative Impacts – Catchment Area (Weeli Wolli Creek)

Catchment	Total Catchment Area (km^2)	Area Reduction by Proposal (km^2)	Area Reduction by Other Project (km^2)				Cumulative Impact	Total Reduction (%)
			Hope Downs 1	Baby Hope	South Flank	North Flank	Total Cumulative Disturbance (km^2)	
Weeli Wolli Creek	4,770 km^2	46	27.9	15.1	145.0	111.4	345.4	7.2

The total cumulative area of the Weeli Wolli Creek catchment impacted by the Proposal and surrounding operations is 7.2%, representing approximately 2% of the Fortescue Marsh catchment. Of this the

Proposal contributes 46 km^2 reduction, representing 1% of the impact to the Weeli Wolli Creek catchment.

It is important to note that a reduction catchment area is not a direct link to reduced surface water flow or volume. In considering the impact of this reduction, current modelling results (Section 9.4.1), show no significant reductions in surface water flow and volume modelling during mining operations.

At the sensitive receptors of Ben's Oasis and Weeli Wolli Springs, the cumulative loss of catchment area will not significantly impact these sites as:

- The local catchment area supporting Ben's Oasis is only impacted by the Proposal, which will reduce the catchment area by 0.2%. Additionally, Ben's Oasis is groundwater dependent and not reliant on surface water flow.
- Weeli Wolli Springs will be supported by the continued supplementation of water in accordance with MS 893, effectively offsetting the cumulative reduction in surface water flow to this receptor to maintain the values of the spring.

With regards to Pebble Mouse Creek, the catchment supporting this drainage line extends west of the Great Northern Highway and will continue to experience typical flows following significant rainfall events. No mining activities directly impact (e.g. divert) the natural flow path of the Pebble Mouse Creek and all linear infrastructure crossings have and will be designed to maintain the existing flow regime.

Considering the above, the Proposal does not substantially contribute to cumulative reduction of the Weeli Wolli Creek catchment, and no significant residual impacts to the environmental values of Weeli Wolli Creek, including Ben's Oasis and Weeli Wolli Spring, are expected as a result of implementation of the Proposal.

The requirements of Hope Downs 1 Ministerial Statement (MS 893) ensure that supplementation of Weeli Wolli Spring protects dependent environmental values from existing HD1 operations. In addition, following closure, there is a requirement for the aquifer supporting the Weeli Wolli Spring to be replenished and re-establish a self-sustaining environment. Monitoring and compliance measures required under MS 893 will ensure that the environmental and cultural values of Weeli Wolli Spring are maintained.

9.4.3.2. Groundwater Drawdown

The regional Wittenoom aquifer which underlays the HD2 deposit is also subject to dewatering from Rio Tinto's West Angelas operations and BHP's Mining Area C (South Flank). Drawdown contours from these operations are expected to extend into the Development Envelope. It is therefore likely that the abstraction for the Proposal will interact with, and further extend this drawdown.

When considered in the context of sensitive environmental receptors (Ben's Oasis and Weeli Wolli Spring), the cumulative effect of the drawdown is not expected to result in significant residual impacts as:

- Ben's Oasis is a groundwater dependent surface water feature, work undertaken to date demonstrates that it is sustained by groundwater flow from the south (Rio Tinto 2022b). Current conceptualisation suggests that Ben's Oasis is isolated from HD2 by a combination of lithological hydraulic barriers and groundwater compartmentalisation (Rio Tinto 2022b)
- Weeli Wolli Spring is not considered to be connected to the groundwater systems that coincide with the Proposal due to the presence of a southeast trending dyke located to the east of BHT (Rio Tinto 2022b). As such it is considered that abstraction poses no risk to the Weeli Wolli Spring pools, located downstream from the HD1 mine and outside of the HD2 groundwater system.

The existing Hope Downs 1 operations involve BWT mining with surplus water managed via discharge to Weeli Wolli Creek. As concluded in the EPA's assessment of Weeli Wolli Creek (2018c), there

appears to be enough distance between the dewatering bores at the mining developments so that there are no obvious spatial or temporal cumulative effects to the groundwater of the catchment and its values.

Given that the Proposal involves AWT mining only, and that no significant groundwater abstraction will be occurring, the Proposal will not contribute to the existing groundwater drawdown related effects on the Weeli Wolli Creek catchment and its values.

9.5. Mitigation

During the planning process, the mitigation hierarchy (avoid, minimise and rehabilitate) was applied to avoid and minimise potential impacts to environmental values related to inland waters as far as practicable. The Proponent proposes to minimise impacts through the following measures.

9.5.1. Avoid

9.5.1.1. Proposal Design Refinements

As part of the mine planning process the Proponent has implemented the following avoidance measures:

- Reduction in Development Envelope, including the exclusions of approximately 6 km of Weeli Wolli Creek from the Development Envelope
- The area of Weeli Wolli Creek that is within the Development Envelope, is not adjacent to any area of the conceptual footprint, therefore is not expected to be impacted by direct or indirect impacts
- Relocation of the waste rock landform from the Ben's Oasis catchment area
- No BWT mining.

The Development Envelope has been reduced by 2,672 ha representing a 17.7% reduction since the Proposal was referred. The most significant aspect of this reduction has been the excision of almost 6 km of Weeli Wolli Creek from within the Development Envelope. This reduction will avoid the potential for disturbance within or adjacent to long stretches of the Weeli Wolli Creek.

The relocation of the HD2 waste rock landform from its original location (southeast of the HD2 pit) to northwest of the HD2 pit (Figure 2-3), has further avoided potential impacts to Weeli Wolli Creek, specifically:

- Increase loss in catchment area supporting Ben's Oasis
- Potential water quality impacts arising from the waste landform being located in close proximity Weeli Wolli Creek.

These measures will ensure that the water quality of Weeli Wolli Creek and Ben's Oasis is not reduced as a result of the Proposal.

Ongoing work is being undertaken, in consultation with the Nyiyaparli Traditional Owners, in order to avoid or minimise impacts to the minor surface water pools identified (HD214_04 and GHD19-17-WS), as outlined in the SCHMP (Appendix F).

9.5.1.2. Groundwater Abstraction

To avoid potential significant impacts on nearby sensitive receptors due to groundwater drawdown, the Proponent will implement AWT mining only. AWT mining avoids the need to abstraction large volumes of groundwater in order to safely access ore deposits.

With regards to production bores, all bores will be located in a geologically isolated aquifer system. This will ensure that all drawdown is localised and will not extend outside of the Development Envelope. As a result, there will be no impacts on groundwater dependent values, specifically Ben's Oasis.

9.5.2. Minimise

9.5.2.1. Water Management Strategy

The proposed water management strategy will involve several measures that will mitigate the effects of the Proposal on inland water environmental values, including:

- Implementation of appropriate surface water diversion infrastructure to maintain surface water flow to Ben's Oasis and Weeli Wolli Creek
- Utilisation of excess water from the Hope Downs 1 operations, minimising abstraction requirements
- Limited dewatering from the HD2 deposit aquifer (3GL/a) resulting in localised drawdown only that is contained within the Development Envelope.

Implementation of these measures will result in reduced potential impacts to local sensitive receptors.

9.5.2.2. Water Quality

Potential impacts from the linear infrastructure corridors include the increased risk of sediment deposition due to the alteration of the flow regime at the location of the crossing. To mitigate this potential impact, crossings will be constructed in accordance with best industry practice and will include the use of rock armour to minimise erosion risk and impacts to water quality during significant flow events (1:100 AEP).

To reduce the risk of sediment-laden stormwater runoff from disturbed areas impacting local surface water resources the Proponent will ensure drainage from at-risk areas includes appropriate erosion and sediment controls, such as armouring and settling ponds.

The Proponent will continue to store its bulk hydrocarbons and manage its solid and liquid wastes in accordance with its legal obligations and industry best practice. This includes storing potentially contaminating materials, including wastes, within appropriately contained areas and ensuring incident response equipment and signage/training is up to date and appropriate to the range and scale of potential incidents (e.g. spills, leaks and fires).

Implementation of Rio Tinto hydrocarbon management procedures and hydrocarbon and spill management procedures. No fluorinated fire-fighting foam will be introduced as a result of the Proposal.

9.5.3. Rehabilitation

The MCP addresses closure requirements for the Proposal (Appendix A4). The MCP includes closure objectives relevant to the restoration and/or maintenance of values associated with Inland Waters, including:

- All disturbed areas that are no longer required will be stabilised and, if appropriate, rehabilitated
- All contamination risks are appropriately managed
- All remaining mineral waste landforms and other structures remaining within floodplains have additional erosion protection as appropriate to their risk potential
- All infrastructure within creeklines, such as crossings and culverts, that are no longer required will be removed
- All surface water diversions remaining after closure are designed and engineered to minimise impacts on local hydrological regimes, ensure long term stability across the realistic range of expected flow events, and do not significantly cause or contribute to water quality impacts
- Production bores will be decommissioned in accordance with relevant guidelines.

The MCP will be reviewed and updated as necessary, including consideration of inputs from stakeholders, including Traditional Owner groups, every three years at a minimum throughout the life of operations.

Table 9-18 further outlined the proposed mitigation measures listed above and their expected effectiveness.

Table 9-18: Application of the Mitigation Hierarchy for the Inland Waters

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Groundwater drawdown	**Measures to Avoid**			
	The Proposal, as described, involves AWT table mining and will not require significant groundwater abstraction.	Proposal Specific	No	High No significant impacts associated with abstraction will occur.
	Construction, Potable and Production bores will be placed in aquifers that are isolated from groundwater-dependent environmental values including Ben's Oasis.	Proposal Specific	Yes – DWER – Groundwater Licence (5C)	High Impacts to the environmental and social values of Weeli Wolli Spring and Ben's Oasis are not expected to occur.
	No proposed abstraction for production water within the BHT deposit area	Proposal Specific	N/A	High The avoidance of abstraction from the BHT aquifer for production water supply will eliminate any potential impacts to environmental and cultural values linked to groundwater.
	Measures to Minimise			
	Groundwater abstraction requirements will be minimised by maximising the use of surplus mine dewater from HD1.	Proposal Specific in line with standard business approach to groundwater management	No – the use of HD1 surplus water does not need approval for production use	High Impact minimised by use of existing water resource from HD1
	Proposed abstraction volumes to be within the sustainable yield of the HD2 groundwater resources.	Standard business practice with Proposal Specific limits	Yes – DWER – Groundwater Abstraction Licence (5C)	High Abstraction from HD2 groundwater resources and associated limits will be subject to assessment from the DWER.
	Measures to Rehabilitate			
	Groundwater bores will be decommissioned in accordance with relevant guidelines, once no longer required.	Standard business practice, in accordance with DWER bore decommissioning guidelines and licence conditions	Yes – DWER – Groundwater Bore Licence (26D)	N/A

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Reduction in Total Catchment Area	**Measures to Avoid**			
	• Relocation of waste rock landforms to outside of the Weeli Wolli Creek/Ben's Oasis primary catchment • Reduction in Development Envelope by 17.7%.	Proposal Specific	No	High • The relocation of the waste rock landform will avoid the potential for a significant reduction in surface water flow into Ben's Oasis. This relocation will also avoid any potential risk from the waste rock landform impacting on the water quality of the Weeli Wolli Creek and Ben's Oasis • The 17.7% reduction in Development Envelope will excise almost 6 km of Weeli Wolli Creek. This reduction will prevent any Proposal related disturbance from occurring in close proximity to Weeli Wolli Creek and Ben's Oasis
	Measures to Minimise			
	Diversion infrastructure will be implemented at HD2 deposit through the implementation of a levee and two drains. The drain configuration will divert flow a tributary of Pebble Mouse Creek towards Weeli Wolli Creek.	Standard Business Practice	No	High Implementation of diversion infrastructure reduces the net reduction in catchment area supporting Ben's Oasis from 6 km^2 to 1 km^2, representing 0.2% of pre-mining value.
	Measures to Rehabilitate			
	• All disturbed areas that are no longer required will be stabilised and, if appropriate, rehabilitated • All surface water diversions remaining after closure are designed and engineered to minimise impacts on local hydrological regimes, ensure long term stability across the realistic range of expected flow events, and	Standard Business Practice	No	High Implementation of diversion infrastructure reduces the net reduction in catchment area supporting Ben's Oasis from 6 km^2 to 1 km^2, representing 0.2% of pre-mining value.

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	do not significantly cause or contribute to water quality impacts			
Changes to the hydrological regime through Construction of mine road/ infrastructure crossing over Pebble Mouse Creek	**Measures to Avoid**			
	Impacts to downstream water quality will be avoided by constructing the crossings during the dry (no-flow) season.	Standard Business Practice	No	High Impact avoided due to construction during dry season
	Measures to Minimise			
	• Linear infrastructure will be designed to convey high frequency flood events (up to 1 in 100 AEP) through culverts or similar. Infrastructure may be designed to allow overtopping in lower frequency events • Crossings will be constructed in accordance with best industry practice and will include the use of rock armour to limit potential scouring effects, to minimise erosion risk and impacts to water quality during significant flow events (1:100 AEP)	Standard business practice	No	Moderate Engineering controls will limit potential impacts are far as reasonably practicable.
	Measures to Rehabilitate			
	The crossings will be completely removed during closure. Removal will be completed during the dry (no-flow) season and the creek bed and banks appropriately stabilised to reduce erosion and ensure natural values are re-established.	Proposal specific	Yes DMIRS for development of the Mine Closure Plan (Appendix A4)	High Standard practice for mining proposals. Will reinstate uninterrupted flows in the areas of linear infrastructure.
Water quality impacts arising from erosion and sedimentation, and the improper storage and handling of potentially	**Measures to Avoid**			
	Impacts to water quality from PFAS will be avoided by implementation of regulator requirement to use fluorine-free fire-fighting foams.	Standard Business Practice	No	High Impact avoided as no introduction of potential PFAS fire-fighting foams.
	Impacts to water quality from potentially acid forming materials will be avoided by limiting proposed mining to above water table.	Project specific	No	High Impact avoided as potentially acid forming materials are located below water table.

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
contaminating materials including solid and liquid wastes.				
	Measures to Minimise			
	• Where possible, surface water diversions will be constructed to avoid natural flows from entering disturbed areas, including mining voids. The flow diversions will be designed, constructed and maintained so as to minimise flow velocities and scour potential	Standard business practice with Proposal specific measures.	No	Moderate Engineering controls will limit potential impacts are far as reasonably practicable.
	• Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements and industry guidelines, including within secondary containment. These substances will not be stored within or near creeklines, or within floodplains • All personnel involved in the storage and handling of potentially contaminating materials will be appropriately trained and supported by adequate resources including signage, spill kits and PPE	Standard business practice	Yes Part V – Works Approval and Licence conditions	Moderate Engineering controls will limit potential impacts are far as reasonably practicable. Proper implementation of standard management actions and Part V conditions will minimise risk of potential impacts.
	Measures to Rehabilitate			
	• Modelling will be used to ensure the integrity of legacy structures, such as waste rock landforms, is retained over the long term • All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure	Standard business practice	Yes – DMIRS for development of Mine Close Plan	Moderate Engineering controls will limit potential impacts are far as reasonably practicable. Proper implementation of Mine Closure Plan will minimise risk of potential impacts.

9.6. Assessment and Significance of Residual Impacts

9.6.1. Assessment of Direct Impacts

9.6.1.1. Catchment Area

Weeli Wolli Creek and Spring

Following implementation of the Proposal, the Weeli Wolli Creek catchment area will be reduced by approximately 46 km^2, representing a reduction in total catchment area by 1%, which is considered negligible.

Likewise, potential impacts to downstream sensitive receptors are considered to be negligible. As impacts to Weeli Wolli Spring have the potential to reduce the total catchment supporting Weeli Wolli Spring by approximately 45 km^2, representing a 3.5% reduction in catchment area.

However, water levels (and therefore volumes) at Weeli Wolli Spring are currently supplemented by HD1 operations from a series of spur lines running off the main discharge pipe to Weeli Wolli Creek. Given these management measures, it is unlikely that the modelled reduction associated with the Proposal will actually be observed.

Considering this, the implementation of the Proposal will not result in a significant residual impact to either Weeli Wolli Creek catchment or Weeli Wolli Spring.

Ben's Oasis

Mining operations at HD2 and BHT (including proposed waste rock landforms) will result in the following potential impacts to Ben's Oasis reduction in the total catchment supporting Ben's Oasis by approximately 6 km^2, representing a 1.5% reduction in catchment area. The resulting in reduction to the peak flow by approximately 10 m3/s or 1.1% during a 1:100 AEP and 3.6% reduction for the 1:5 AEP event.

This limited loss of runoff is not expected to impact the environmental value of Ben's Oasis as the main source of water at this location is sustained by the groundwater aquifer. In addition, the implementation of mitigation measures, including diversion structures, will reduce the relative catchment area loss from 6 km^2 to 1 km^2, equivalent to 0.2% of pre-mining conditions.

Pebble Mouse Creek

The Proposal will reduce the total Pebble Mouse Creek catchment area approximately 26 km^2, which represents less than 8% of the total catchment. Modelling show water depths in Pebble Mouse Creek directly downstream of the HD2 pits could be reduced by approximately 0.1 m. However, given the sporadic flow of the creek and the management measures to be implemented, this reduction is not considered significant and will not result in downstream residual impacts on the Weeli Wolli Spring.

No significant residual impacts from the loss of catchment area attributable to the Proposal are expected.

Waterholes

Social, cultural and environmental values of waterholes Pool HD214_04 and GHD19-17-WS have been identified by Traditional Owners and quantified by Rio Tinto hydrologists. Persistent freshwater pools in the Pilbara are considered to have high conservation value and are considered to be significant in accordance with the Inland Waters guideline. The BHT waterhole (GHD19-17-WS) is ephemeral and therefore impacts to this feature are not considered significant. The HD2 waterhole (HD214_04HD2) is conceptually expected to the semi-permanent or ephemeral, therefore impacts to this waterhole are considered significant.

The pools are significant to Traditional Owners and are therefore discussed further in the Social Surroundings section (Chapter 11).

9.6.1.2. Alteration to Surface Water Flow and Volume within Pebble Mouse Creek

The Proposal will require the construction of up to four new crossings over Pebble Mouse Creek. Design of the Proposal, in particular culvert design, has been undertaken to ensure no significant impacts are expected.

There will be minor changes around the new crossings, to in water flow patterns upstream of crossings due to reduced flow path and sediment deposition downstream. Crossings will be constructed in accordance with best industry practice and will include the use of rock armour to limit potential scouring effects, to minimise erosion risk and impacts to water quality during significant flow events (1:100 AEP).

The Proposal will require the construction of 2 diversions and a levee, which will re-direct minor drainage lines that currently flow into Pebble Mouse Creek towards Weeli Wolli Creek. Without the diversion the minor drainage lines would flow into the HD2 pit.

The proposed diversion, with a 1% AEP design flood, is to be an operational diversion throughout the life of mine to avoid the tributary flowing into the HD2 pit during mining. Decisions on whether the diversion will remain post closure will be made in consultation with Traditional Owners. Should the diversion remain post-closure, the design will be upgraded in accordance with closure standards and a risk-based approach. Depending on the outcome, the design may require upgrade to allow for more extreme events such as the 1:1000 AEP flood or more extreme, if required.

While the surface water flows that contribute to the Pebble Mouse Creek will be diverted to the adjacent Weeli Wolli Creek, it is important to note that all runoff from the Pebble Mouse Creek catchment eventually end up in the Weeli Wolli Creek as the Pebble Mouse Creek is a tributary of the Weeli Wolli Creek and the actual confluence is located at HD1 (Pebble Mouse Creek diversion levee).

Impacts as a result of the proposed diversions at HD2 and crossing options at Pebble Mouse Creek would result in minor impacts to the surface water flow paths, as discussed in Section 9.4.1.2.

In consideration of the information provided in Section 9.4 and the proposed mitigation measures, no significant residual impacts are expected as natural flow of Pebble Mouse Creek will be retained.

9.6.1.3. Groundwater Drawdown

The numerical groundwater model developed for the Proposal was used to predict the groundwater drawdown associated with dewatering and the potential for impacts to environmental values and other users (Appendix E2).

As the HD2 aquifer is restricted to the HD2 groundwater system by geological barriers. Modelling has demonstrated that drawdown from abstraction at HD2 is not expected to propagate towards any existing users or environmental receptors (namely, Ben's Oasis or Weeli Wolli Spring).

No groundwater abstraction at proposed BHT for production water supply. A bore at BHT currently exists and will be utilised for limited construction and potable water supply, which is in the order of 0.2GL/annum, with a single year peak during construction in the order of 1GL. The drawdown associated with these volumes is limited due to the small aquifer extent and no significant environmental impacts are associated with the abstraction of this volume. Both Ben's Oasis and Weeli Wolli Spring are located outside of the BHT aquifer and are interpreted to be hydraulically disconnected (Figure 9-7). Licensing of potable water abstraction will be sought under the RIWI Act.

There are no wetlands or other groundwater dependent wetlands of State, national or international importance within the Development Envelope or surrounding the Proposal.

The only third-party water user in the vicinity of the Development Envelope is BHP.

9.6.2. Assessment of Indirect Impacts

Implementation of the Proposal has the potential to result in the following indirect impacts on Inland Waters:

- Increases in sediment load of Pebble Mouse Creek as a result of clearing and soil disturbance, including the construction of crossings and the placement and management of stockpiles
- Impacts to ground and/or surface water due to AMD seepage from PAF exposures in pit walls and WRLs
- Reduction in surface water and groundwater quality due to accidental spills of hydrocarbons, hazardous materials and waste.

9.6.2.1. Increase in Sediment Load of Pebble Mouse Creek

Liberation of sediment could occur in the unlikely event that a haul road crossing is washed out during a heavy rainfall event. The pathway from this source to the key receptors is a significant distance of ephemeral creek line – the proposed Pebble Mouse Creek haul road crossing is 14 km upstream of the Weeli Wolli Spring; the proposed road train crossing is 11 km upstream and the proposed transfer pad. Additionally there is an existing diversion of Pebble Mouse Creek associated with the HD1 operations, the diversion levee is located 7 km upstream from Weeli Wolli Spring. As such, the impacts associated with the Proposal are not expected to be significant or different to those associated with existing operations. The introduction of crossing associated with the Proposal will not significantly impact the downstream environmental values associated with the Weeli Wolli Spring.

9.6.2.2. Contamination of Surface Water and/or Groundwater from AMD Seepage

The Proposal involves AWT mining activities only. As a result, the Proposal is not expected to disturb PAF materials, which have been identified within saturated zones (BWT) and therefore is little to no AMD/NMD risks from these materials.

However, there is always potential for unexpected PAF occurrences to be disturbed during mining operations. In the event of these unexpected finds, the risk of surface water and groundwater contamination from the potential seepage of AMD will be minimised by implementing management, monitoring and contingency measures. Standard business practices include constructing bunding to reduce surface runoff flowing over exposed PAF material and storing waste material in appropriately designed WRLs.

The waste fines solids are likely to be NAF with concentrations of As, Fe, Mn and Sn that may exceed selected Contaminated Site Guidelines values; however, this is only of concern if these elements are leachable, which is a low risk given the neutral pH of the supernatant and NAF solids (SRK 2019).

The Proposal is not expected to result in significant residual impacts to the environment as a result of contamination of surface water and/or groundwater from AMD seepage.

9.6.2.3. Contamination of Surface Water and Groundwater from Spills of Hydrocarbons, Hazardous Materials and Waste

Construction and operation activities has the potential to contaminate surface water and groundwater due to storage and handling of hazardous materials, hydrocarbons, and waste. Site drainage infrastructure will be designed to minimise or eliminate surface water runoff into areas where hydrocarbon contamination may occur.

Hydrocarbon storage facilities will be appropriately constructed and bunded in accordance with Australian Standards. Site inspection, maintenance and spill management procedures are expected to effectively mitigate the risk of contamination. Accordingly, the Proposal is not expected to result in significant residual potential impacts to water resources from spills and leaks, as these are expected to be minimal and reversible.

9.6.3. Assessment of Cumulative Impacts

The total cumulative area of the Weeli Wolli Creek catchment impacted by the Proposal and surrounding operations is 7.2%, representing approximately 2% of the Fortescue Marsh catchment. Of this

approximately 1% is attributable to the Proposal. In considering the impact of this reduction, current modelling results (Section 9.4.1), show no significant reductions in surface water flow and volume modelling during the Proposal's mining operations.

At the sensitive receptors of Ben's Oasis and Weeli Wolli Springs, the cumulative loss of catchment area will not result in a significant residual impact at these sites as a resulting of implementing the Proposal:

- The local catchment area supporting Ben's Oasis is only impacted by the Proposal, which will reduce the catchment area by 0.2%. Additionally, Ben's Oasis is a groundwater feed system and not reliant on surface water flow.
- Weeli Wolli Springs will be supported by the continued supplementation of water in accordance with MS 893, effectively offsetting the cumulative reduction in surface water flow to this receptor to maintain the values of the spring.

The Proposal does not substantially contribute to cumulative reduction of the Weeli Wolli Creek catchment, as such the Proposal does not contribute substantially to significant residual impacts to the environmental values of Weeli Wolli Creek, including Ben's Oasis and Weeli Wolli Spring.

9.6.4. Assessment of significance of residual impacts

9.6.4.1. Non-significant Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Inland Waters – surface water values:

- Weeli Wolli Creek catchment: the Weeli Wolli Creek catchment area has the potential to be reduced by approximately 46 km^2, representing a reduction in total catchment area by 1%, which is considered negligible and not a significant residual impact.
- Ben's Oasis: Is located outside the Development Envelope and the environmental value of Ben's Oasis is not expected to be impacted by the Proposal given that it is sustained by the groundwater aquifer. The implementation of mitigation measures, including diversion structures, will reduce the relative catchment area loss from 6 km^2 to 1 km^2, equivalent to 0.2% of pre-mining conditions, which will not result in significant residual impacts.
- Weeli Wolli Spring: Is located outside the Development Envelope, to the north of existing HD1 operations. Weeli Wolli Spring is impacted by HD1 operations, which are BWT, and the water levels (and therefore volumes) at Weeli Wolli Spring are supplemented by a series of spur lines running off the main discharge pipe to Weeli Wolli Creek. While the Proposal is expected to result in a reduction in the total catchment supporting Weeli Wolli Spring by approximately 45 km^2, representing a 3.5% reduction in catchment area, this is considered relatively negligible and there not a significant residual impact. In addition, the existing management measures in place for the HD1 operations, it is unlikely that the modelled reduction will actually be observed. The implementation of the Proposal will not result in a significant residual impact.
- Pebble Mouse Creek: The Proposal will reduce the total Pebble Mouse Creek catchment area approximately 26 km^2, which represents less than 8% of the total catchment. Modelling show water depths in Pebble Mouse Creek directly downstream of the HD2 pits could be reduced by approximately 0.1 m. However, given the sporadic flow of the creek and the management measures to be implemented, this reduction is not considered significant and will not result in downstream residual impacts on the Weeli Wolli Spring. No significant residual impacts from the loss of catchment area attributable to the Proposal are expected.
- No significant indirect residual impacts to surface water flow or water quality to Ben's Oasis, Weeli Wolli Creek or Weeli Wolli Spring are predicted to as a result of the Proposal.

- The BHT waterhole (GHD19-17-WS) is ephemeral and therefore impacts to this feature are not considered significant.

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to Inland Waters – groundwater values:

- Mining: There is no groundwater drawdown associated within the mining, as the Proposal deposits are AWT only and will not require dewatering of the HD2 or BHT aquifers to access ore deposits
- Groundwater drawdown abstraction of groundwater is for production needs only and is limited to the relatively small volume of 3GL/a from production bores located at HD2; drawdown is restricted to the HD2 groundwater system by geological barriers and will not affect the sensitive receptors of Ben's Oasis or Weeli Wolli Spring.
- Cumulatively, drawdown from HD2 production bores is not expected to extend into or interact with the HD1 aquifer due to location of geological barriers. As a result, there will be negligible additional effects, as a result of the Proposal, on either HD1 or BHP's Mining Area C existing drawdown.

Considering the above points, the implementation of the Proposal will not result in any significant residual impacts on environmental values from abstraction and subsequent groundwater drawdown.

9.6.4.2. Significant Residual Impacts

The assessment of residual impacts, after application of mitigation measures, concluded following residual impacts are considered to be significant to Inland Waters values:

- Impact to pool HD2-(HD214_04): The pool is conceptually expected to the semi-permanent or ephemeral, therefore impacts to this waterhole are considered significant.

9.7. Environmental Outcomes

9.7.1. Summary of Significant Residual Impacts and Proposed Conditions

A summary of the significant residual Inland Waters assessment and the proposed conditions is provided in Table 9-19.

Table 9-19: Assessment Findings and Proposed Conditions for Inland Waters

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions
Direct Impacts		
Alteration of hydrological regimes of surface water systems	• Minimal reduction in catchment area of Weeli Wolli Creek and Pebble Mouse Creek • Minimal reduction in surface water flows to significant environmental values of Weeli Wolli Spring and Ben's Oasis attributable to the Proposal.	Proposed to be regulated through implementation of: • Ministerial conditions requiring the implementation of the agreed Nyiyaparli SCHMP, which reflect the Proponent's commitment develop options to minimise impacts to BHT and HD2 pools, in

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions
	• No change to flow path and minor alteration to surface water flow levels and volume within Pebble Mouse Creek due to linear infrastructure crossings. • Diversion of 3 minor drainage lines at HD2 deposit. • Reduction in surface water flows or direct impacts to minor pools, HD214_04 and GHD19-17-WS. • The environmental outcome is likely to be consistent with the EPA's objective for this factor with the implementation of Proposal extent condition (recommended condition 1) and counterbalanced by the mitigation measures as outlined in Section 9.5.	consultation with the Nyiyaparli Traditional Owners.
Alteration to groundwater levels through operation of a HD2 borefield to provide water supply requirements	• No BWT mining is proposed • Abstraction is only for provision of construction, potable and operational water supply • Local sources of water will be used preferentially to abstraction • The environmental outcome is likely to be consistent with the EPA's objective for this factor.	• Proposal content document sets upper abstraction limit at 3GL/year.

9.7.2. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

The referred design of the Proposal included potential impacts to Weeli Wolli Creek water quality. Following feedback from Nyiyaparli Traditional Owners and their representatives, the design was altered and a s43A subsequently approved by the EPA.

The current design of the HD2 deposit mine pit includes potential impacts to the location where the HD2 pool was identified. Identification of the pool occurred during social surroundings survey work, during 2022. During subsequent ongoing consultation with Nyiyaparli Traditional Owners and their representatives, the importance of the HD2 pool and associated creekline was raised (Stevens, 2022, Appendix F5). In response to this feedback, the Proponent has committed to design changes to avoiding impacts to this pool and is continuing to work with the Nyiyaparli Traditional Owners and their representatives, as outlined in the SCHMP. Implementation of the SCHMP is a recommended condition.

The Proponent has undertaken a full assessment of surface and groundwater values and potential impacts associated with the implementation the Proposal. As outlined in Section 9.6.4, the assessment has concluded that after implementation of the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to inland waters values. This is also due to the scale and nature of the activities included in the Proposal, including AWT mining. Noting that the cultural values associated with Inland Waters values are addressed in the Social Surroundings factor. Accordingly, the environmental outcomes of the Proposal are consistent with the EPA objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

10. GREENHOUSE GAS EMISSIONS

10.1. EPA Environmental Factor and Objective

The EPA's Environmental Factor Guideline – Greenhouse Gas (2023) lists the following objective for Greenhouse Gas (GHG) Emissions:

To minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as far as practicable

GHG emissions are a key contributor to climate change, which has already had a significant effect on Western Australia's environment (EPA 2023).

Annual Scope 1 GHG emissions associated with the Proposal will be above the EPA assessment threshold of 100 kilotonnes (kt) of carbon dioxide equivalent (CO_2-e) per year. Therefore, the GHG emissions associated with the Proposal are a key environmental factor and are included in the EIA for the Proposal, consistent with the EPA Chair's determination.

10.2. Relevant Policy and Guidance

10.2.1. Commonwealth Policy and Guidance

In 2015 the Paris Agreement was ratified by parties to the United Nations Framework Convention on Climate Change. The Paris Agreement establishes a series of targets, including:

- Keeping global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit temperature increase to 1.5°C
- Reach global peaking of GHG emissions as soon as possible to achieve a balance between anthropogenic emissions by sources and removals by sinks in the second half of this century.

The Paris Agreement acknowledged that the Nationally Determined Contributions (NDCs) made by countries as commitments were insufficient to meet the goals of the Paris Agreement. To manage this, the Paris Agreement includes a process to update or 'ramp-up' NDCs every five years.

Australia is a signatory to the agreement, and to assist in meeting the agreement's aims, on 16 June 2022, Australia communicated its updated NDC to the United Nations which included confirmation of Australia's commitment to achieve net zero emissions by 2050, and a new, increased, 2030 target of 43% below 2005 levels by 2030. To achieve this target, the government set targets in legislation via the *Climate Change Bill 2022*.

The primary policy mechanisms to implement national targets, and therefore Australia's current commitments under the Paris Agreement, are the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* (Cth) (Safeguard Mechanism) made under the *National Greenhouse and Energy Reporting Act 2007* (Cth) (NGER Act) and are administered by the Clean Energy Regulator (CER). The Safeguard Mechanism applies to facilities with Scope 1 emissions (covered emissions) of more than 100,000 t CO_2-e per year (Clean Energy Regulator 2023). The recently reformed (passed Parliament) Safeguard Mechanism applies baselines (including a year on year decline rate commencing July 1st 2023) to large GHG-emitting facilities to ensure that net emissions are kept below a defined baseline. If the baseline is exceeded, or is likely to, emitters can manage excess emissions by;

- Pursuing activities that reduce emissions of the facility
- Purchase and surrender carbon units (Australian Carbon Credit Units (ACCUs) are the sole currently prescribed units)

- Apply for a multi-year monitoring period
- Apply for an exemption due to exceptional circumstances

10.2.2. Western Australia Policy and Guidelines

On 28 August 2019, the WA Government released its State Government's (GoWA 2019) *Greenhouse Gas Emissions Policy for Major Projects* (State GHG Policy) for major projects assessed by the EPA. The EPA published the original Environmental Factor Guideline – Greenhouse Gas Emissions (GHG Guideline) in April 2020 and in April 2023 published its revised GHG Guideline (EPA 2023).

The GHG Guideline outlines how and when the Greenhouse Gas Emissions factor is considered by the EPA in the environmental impact assessment (EIA) process. The GHG Guideline aims to facilitate flexible approaches to GHG reduction that promote innovation, emerging best practice technologies and potential new industries and opportunities for WA. It supports the development of Greenhouse Gas Environment Management Plans (GHG EMPs) for proponents) which details:

- interim and long-term emissions reductions targets the proposal aims to achieve throughout the project
- best practice design, technology, management and reasonable practicable alternatives and measures appropriate to avoid, reduce or offset scope 1 and 2 emissions from this proposal
- partnerships and arrangements with third parties considered to reduce scope 3 emissions
- how the proposal is consistent with achieving corporate emissions reduction targets
- other legal and policy instruments that require GHG emissions reductions from the proposal to meet the EPA's objectives

Table 10-1 presents GHG's relevant policy and guidance and demonstrates how this has been considered for the Proposal.

Table 10-1: Relevant Policy and Guidance for Greenhouse Gas Emissions

Relevant Policy and Guidance	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for GHG Emissions forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Greenhouse Gas Emissions (EPA 2023)	Considerations for EIA as outlined in the guideline has been considered in this chapter, including: • The application of the mitigation hierarchy to avoid, reduce and offset emissions as outlined in Section 10.5 • The interim and long-term emissions reduction targets the Proponent proposes to achieve net zero emissions by 2050 (Table 10-6) • The best practice design, technology and management measures to mitigate GHG emissions and relevant benchmarking are described in Greenhouse Gas Environmental Management Plan (GHG EMP; Appendix A6 • The Rio Tinto corporate emissions reduction targets and how the proposal is consistent with achieving those targets as outlined in Section 10.5.5

Relevant Policy and Guidance	Explain How the Policy and Guidance has been Considered
	• Other legal and policy instruments that require reductions in GHG emissions from the proposal that also meet the EPA's objectives (e.g. Safeguard Mechanism)
Instructions on how to prepare an Environmental Review Document (EPA 2021e)	This document forms the basis of the headings and content provided in this ERD.
Instructions on how to prepare EP Act Part IV Environmental Management Plans (EPA 2021h)	Considered during the development of this document and the GHG EMP.
Other State or Commonwealth	
Greenhouse Gas Emissions Policy for Major Projects (State GHG Policy; GoWA 2019)	The Proponent is committed to contributing towards the State's aspiration of net zero by 2050. In line with this policy, a GHG EMP has been prepared with the following commitments associated with emissions reduction targets: • Management based five-yearly interim reduction targets from 2025 to 2040 • If the target is not met, commitment to offset via purchase of eligible offset units • Annual reporting and five yearly progress reporting • Five yearly formal re-submission or if significant change is triggered.
Western Australia Climate Policy (GoWA 2020)	The Proposal includes interim and long-term emission reduction targets consistent with the State's net zero aspiration by 2050.
National Greenhouse and Energy Reporting Act 2007 (NGER Act) (DISER 2007)	Emissions from the Proposal operations will be reported annually through NGER scheme, in accordance with the NGER Act.
National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Measurement Determination) (DISER 2008)	The GHG emissions inventory for the Proposal have been estimated using the methods and criteria from the Measurement Determination.
Safeguard Mechanism (Crediting) Amendment Act 2023	Emissions from the Proposal are attributed to the Hope Downs 1 facility under the Safeguard Mechanism. The Hope Downs 1 facility will endeavour to keep its emissions at or below its baseline by: • Avoiding emissions through the electrification of fleet (as this technology becomes available) and the use of biofuels • Reducing emissions in the interim (for example through energy efficiency initiatives), and • Managing remaining excess emissions through the purchase and surrendering of Australia Carbon Credit Units (ACCU's)
Renewable Energy (Electricity) Act 2000	As a liable entity under the Renewable Energy Target (RET) the Proponent annually purchases and surrenders the appropriate amount of large-scale generation certificates (LGCs) and small-scale technology certificates (STCs).

10.3. Receiving Environment

10.3.1. Assessment Context

There has been a steady increase in GHG emissions from WA since the 1990s, and emissions growth is generally expected to continue in the short and medium term (EPA 2020b).

In 2020, WA emitted an estimated 81.7 million tonnes (Mt) of CO_2-e and has offset approximately 8.6 Mt of CO_2-e (DISER 2021a). Approximately 35% of WA's emissions are associated with the mining sector (DISER 2021b).

Consistent with the EPA Guideline (EPA 2020b), the geographic scope for the assessment of GHG emissions for Scope 1 and 2 associated with the Proposal is the state of Western Australia.

10.4. Potential Environmental Impacts

Potential GHG emissions from the Proposal have been identified as:

- Direct emissions from the burning of fossil fuels for mobile and stationary energy demands and changes in land use (clearing of vegetation) (Scope 1 emissions)
- Indirect emissions from the consumption of electricity. The Proponent draws its power from the integrated Rio Tinto power network (Pilbara Power Generation Network) (Scope 2 emissions)
- Indirect emissions (other than Scope 2 emissions) as a consequence of the activities of the Proponent's customers, from sources not owned or controlled by the Proponent's business. In this case, largely in the manufacturing of steel[5] (Scope 3 emissions).

The Proponent is part of the Rio Tinto integrated power network which has an established Climate Action Plan that seeks to reduce emissions impact on the physical climate. The Proponent is exploring a range of options to achieve emissions reductions, via abatement projects at the Pilbara system level and through specific site-based energy efficiency improvements.

10.4.1. Greenhouse Gas Emissions Estimates

A GHG emissions inventory has been calculated for the Proposal using the methods and criteria from the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (DISER 2008) (NGER Determination). The major emission types of GHG emissions from the Proposal are carbon dioxide (CO_2), nitrogen oxide (N_2O) and methane (CH_4). The principal sources of GHG emissions include:

- Stationary, mobile and transport diesel combustion (Scope 1 emissions)
- Land clearing (Scope 1 emissions)
- Consumption of electricity from the Pilbara Power Generation Network (Scope 2 emissions).

It should be noted that no fugitive emissions are expected from the Proposal.

The Proponent sells an iron ore blend and calculates its Scope 3 emissions based on a portfolio of sales. Estimated Proposal Scope 3 emissions are 25.8 Mt CO_2-e (annual average) and 361 Mt CO_2-e through the 15-year life of the Proposal (Appendix A6).

A summary of estimated annual average and total GHG emissions over the operational life of the Proposal by source and scope is presented in Table 10-2. The Proposal peak emissions represent

[5] Scope 3 emissions sit outside of the geographic scope for assessment and are included for context purposes only.

0.26% of WA emissions (using the 2020-21 WA GHG inventory from the Australia's National Greenhouse Accounts, which is the latest available data).

Table 10-2: Estimated GHG Emissions from the Proposal (Rio Tinto 2022b)[6]

Activity	Annual Average Emission (t CO_2-e/ annum)	Total Emission over Life of Proposal (~15 years) (t CO_2-e/ annum)
Scope 1 Emissions		
Land clearing	2,899	40,587
Diesel fuel	144,989	2,029,850
Scope 2 Emissions		
Electricity	28,396	397,548
Total (Scope 1 & 2 emissions)	176,285	2,467,984
Scope 3 Emissions		
Scope 3 Emissions	25.8 Mt	361 Mt

[6] Emissions relate to the operational phase only, noting closure studies are currently in progress with an emissions estimate being developed. The GHG EMP will be updated to reflect closure emissions once data is available.

10.4.2. Operational Phase GHG Emissions Intensity

The operational phase GHG emission intensity varies over the life of the Proposal with the volume of Saleable Ore Product (SOP) produced, as well as a result of other factors, such as the distance of the ore from the processing facility. Peak annual production occurs in 2032, however peak emission intensity (Scope 1 emissions not including land clearing) occurs in 2026. Emissions intensity of the product increases towards the end of production as diesel consumption to shift ore does not reduce linearly with the reduction in volume. These details are outlined in Table 10-3.

Table 10-3: Proposal GHG Emissions Intensity

Year Peak Annual Production	SOP (kt)	Emissions ($t CO_2$-e pa)	Emissions Intensity ($t CO_2$-e/tSOP)
Peak Intensity (2026)	4,054	60,656	0.0150
Average Intensity	19,241	144,989	0.0075

10.4.3. Cumulative GHG Emissions

Ore production included in the Proposal will sustain rather than increase annual throughput associated with the Hope Downs 1 operations. The Proposal will increase the total operational life within Hope Downs Hub as the approved deposits (HD1N, HD1S and Baby Hope) reach the end of their productive life.

As a result, the Hope Downs Hub (including the Proposal) is expected to contribute approximately 207,372 t CO_2-e per annum (average), as follows:

- Scope 1 emissions: 171,328 t CO_2-e
- Scope 1 emissions (land clearing): 2,899 t CO_2-e
- Scope 2 emissions (consumption of electricity): 33,145 t CO_2-e.

10.4.4. GHG Benchmarking Assessment

A GHG benchmarking assessment was undertaken to compare the GHG emissions performance of the Proposal against comparable mining operations, such as existing or planned open-cut iron ore mining projects in the Pilbara, based on publicly available information (Table 10-4; Rio Tinto 2022b).

The operations considered for benchmarking are similar iron mines, but also include above and below-water table mining using conventional open pit methods.

Comparable benchmarking of emissions from individual mining operations is challenging, as it does not consider the site-specific circumstances which impact on GHG intensity. Waste to ore ratios, grade characteristics and topography have a significant influence on GHG intensity. Given this, the benchmarking results indicate that the performance of the Proposal is comparable to other recent iron ore developments in the Pilbara. Noting this intensity is prior to any abatement initiatives being applied.

Table 10-4: Benchmarking Against Comparable Open Cut Iron Ore Mines in the Pilbara

Facility	Forecast Emissions Intensity ($t CO_2$-e/t SOP)
Proposal	**0.0075**
Default Emission Intensity Iron Ore Mining Safeguard Mechanism	0.0048
FMG – Eliwana Iron Ore Mine	0.0070
BHP – Western Ridge	0.0073
Roy Hill – Roy Hill Revised Proposal	0.0076

10.5. Mitigation

The Proponent is committed to achieving net-zero GHG emissions by 2050, consistent with the State GHG Policy and Guidelines. The Proponent is exploring a range of options to achieve emissions reductions, including via abatement projects at the Pilbara system level and through specific site-based energy efficiency improvements.

10.5.1. Mitigation Hierarchy

In recognition of the State GHG Policy (GoWA 2020), the Proposal has implemented the EPA's mitigation hierarchy (avoid, reduce, offset), and internal processes are in place to integrate GHG considerations into the design and planning of the Proposal. Strategic decisions are made throughout the development of the Proposal to ensure energy-efficient lower-emission solutions are prioritised where practicable and are discussed below and summarised in Table 10-5.

10.5.2. Measures to Avoid and Reduce GHG Emissions

Options being explored to achieve emissions reductions include leveraging abatement projects at both a RTIO Pilbara system level and through site-based energy efficiency improvements. The Proposal is connected to the Rio Tinto integrated Pilbara-wide power generation network, and the Proponent is exploring leveraging abatement projects such as solar and wind renewable energy. RTIO's climate action plan includes connecting renewable generation facilities such as these to the power network at any location, providing 'green' power to the system, reducing reliance on gas across all operating mines and port operations.

Internal guidelines are in place to integrate GHG considerations into the design and planning of development projects.

Strategic decisions have been made throughout the development of the Proposal to ensure energy-efficient lower-emission solutions are prioritised where practicable. The Proposal, in conjunction with the internal Rio Tinto Study Definition Guidelines and aligned with the State GHG Policy and Guideline, considers energy efficiency throughout design, construction and operational phases:

- Application of a mitigation hierarchy to avoid, reduce and offset emissions
- Contribution to emissions reduction targets
- Adoption of best practice design, technology and management appropriate to the mitigation measures implemented
- Continuous improvement to reduce emissions over the life of the Proposal in a measured and consistent manner.

Specific measures implemented to avoid or reduce GHG emissions from the Proposal are identified in the Proponent's GHG EMP (Appendix A6) and summarised in Table 10-5.

10.5.3. Offsets

If and where abatement is insufficient, the Proponent will offset GHG Emissions against the interim and long-term targets by retiring credible offset units in 2025, 2030, 2035 and 2040. Diversity in credible offset units is an important means of managing risks to source sufficient volumes. It is also important to ensure the quality, integrity and credibility of offset units used (Rio Tinto 2022b).

Where offsets are required, the Proponent proposes to use Australian Carbon Credit Units (ACCUs), that may have also been retired to meet any Safeguard Mechanism obligations, to meet any EPA commitments. Integrity standards, as set out in the Commonwealth *Carbon Credits (Carbon Farming Initiative) Act 2011,* will be adhered to for any ACCUs that may be retired for the purpose of meeting any Safeguard Mechanism obligations as well as interim targets for the Proposal.

Table 10-5: Mitigation Measures for the Greenhouse Gas Emissions Environmental Factor

Potential Impact Event	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Predicted Outcome
Generation of GHG through combustion of fossil fuels and land clearing (Scope 1 Emissions) and consumption of power (Scope 2 Emissions)	**Measures to Avoid**			
	The Proposal incorporates the following best practice designs to avoid GHG emissions: • The Proponent has study and development processes that identify, assess and where practicable develop existing, innovative and new technology developments • Progress on the basis of Road Train instead of Haul Trucks to improve fuel efficiency; ore transport via overland conveyors has been considered • Emission abatement projects may be implemented as part of the Proposal or at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld, as part of the RTIO climate action plan • Investigation into the use of biofuels for Heavy Mining Equipment	Project specific	No	• Residual impacts and risks associated with contribution of the Proposal to global GHG emissions are considered as low as reasonably possible (ALARP) and acceptable • A GHG EMP has been prepared which outlines the Proponents commitments to avoid where possible and minimise GHG emissions as far as reasonably practicable (Rio Tinto 2023; Appendix A6) in line with WA and Commonwealth's Legislation and Guidance • Performance against the Proposal target will be reported in the Ministerial Statement Annual Compliance Assessment Report every five years • Emissions from the entire Hope Downs Hub (including the Proposal) will also be reported annually through NGER, in accordance with the NGER Act

Potential Impact Event	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Predicted Outcome
				The Proponent considers the Proposal can be managed to meet the EPA's objective for GHG emissions.
	Measures to Reduce			

	The Proposal incorporates the following best practice designs to reduce GHG emissions:
	• Procurement of fuel-efficient haul trucks and dig units
	• Mine Design: The ongoing design and mine plan optimisation process assesses the following opportunities:
	  ○ The location of crusher, mining area, pit exit locations and waste dumps are optimised to reduce haul distances
	  ○ Road train and haul road layout design – designed to smooth the truck speeds to minimise stop/start and hence improve diesel use efficiency
	• Design and construct non-process infrastructure buildings with 6-star Greenstar rating in accordance with the National Construction Code
	• Minimise haulage distance and diesel use by utilising HD1 South Crusher for the majority of the HD2 ores
	• Minimise stop/start through the design of haul roads
	• Optimise haulage distances between the pit exits and waste dumps
	• Optimise the design of Pebble Mouse Creek haul road crossing to reduce the haulage distance to the HD1 South Crusher
		Project specific	No	As per avoidance.

Potential Impact Event	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Predicted Outcome
	• Utilise existing HD1 north and south crushing plants to avoid building and operational emissions			
	Measures to Offset			
	The Proponent will offset emissions where abatement is insufficient against the interim and long-term targets outlined in Section 10.5.5.2 and Section 3.2.1 of the GHG EMP. Offsets will be delivered by retiring credible offset units in 2025, 2030, 2035 and 2040, as follows: • calculate Safeguard Mechanism obligations purchased within the relevant five-year cumulative period to determine if any offsets purchased met the EPA requirements in these time periods ○	Standard Business Practice	Yes	Where required, ACCUs will be sourced and retired to meet any annual (financial year) Safeguard Mechanism obligations which will also meet interim emissions reduction targets for the Proposal. This strategy will allow the Proponent to be confident in meeting the interim and long-term targets effectively. Therefore, this is consistent with the State's aspiration of net zero by 2050 stated in the *Western Australian Climate Policy* (GoWA 2020) and *Greenhouse Gas Emissions Policy for Major Projects* (GoWA 2019).

10.5.4. RTIO Climate Action Plan

In Western Australia, the RTIO climate action plan forms a part of the Rio Tinto corporate decarbonisation strategy. It includes a suite of renewable energy and electrification of diesel fleet projects. This is due to RTIO's fossil fuel use which is derived from ~30% gas consumption for power generation, the electricity used in plant, port and office facilities, with the remaining ~70% diesel, predominantly powering mobile equipment, for example haul trucks and rail. The solutions to transition mobile fleet from diesel to low emission energy are not yet commercially and technically viable at scale. Therefore, the short to medium term low-carbon transition strategy initiatives are focussed on displacement of gas in electricity generation with renewable energy sources. In some cases, developments may be sought, with emissions abatement projects implemented at alternative locations to the Proposals. Managing the technical constraints of the network in a system wide fashion, ensures security, reliability and stability is upheld. Emissions abatement projects are treated holistically in their application across Rio Tinto's integrated Pilbara operations providing net emissions reduction regardless of their physical location.

While extensive work across executed projects is being undertaken to meet Rio Tinto's 2030 targets, Rio Tinto is also setting up the foundations for the next phase of abatements required to achieve net zero emission across all operations by 2050.

Existing open cycle gas turbines provide firming of intermittent renewable energy and Rio Tinto's existing Pilbara Power Generation network provides pathways for future fleet electrification. A number of alternative power solutions are being investigated and delivered as part of the planning for future potential opportunities to lower our carbon emissions in the Pilbara. The opportunities in delivery and under assessment include:

- A Battery Energy Storage System (BESS), that has the potential to provide back-up power capacity, known as spinning reserve
- A solar PV (34MW) facility. Solar PV reduces emissions through the displacement of gas in electricity generation with renewable energy sources
- Renewable energy studies focused on solar PV and wind energy are assessing deep renewable energy penetration (1GW) to support the transition of mobile fleet away from diesel
- Rio Tinto has successfully completed the full transition of its heavy machinery from fossil diesel to renewable diesel at its Boron, California operation and continues to investigate biofuels as an interim step
- Rio Tinto is investigating the development of a viable trolley assist option for existing haul fleet to enable substantial reduction in diesel use while on trolley
- Rio Tinto has partnered an industry wide partnership initiative collaborating to identify and develop innovative mobile fleet charging solutions
- Additional partnerships have been established to develop and implement battery electric haul solutions including haul trucks

For further detail on these opportunities, please refer to the GHG EMP (Appendix A6).

10.5.5. Targets

10.5.5.1. Rio Tinto Group Level Targets

The Rio Tinto climate action plan is based upon the Rio Tinto Group announcement regarding its ambition to reach net zero emissions by 2050 across all operations. To support this ambition, interim global targets have been introduced for Scope 1 and 2 emissions, effective from 2021, to:

- Reduce absolute emissions by 15% by 2025 (approximately 4.9 Mt CO_2-e equity basis)

- Reduce absolute emissions by 50% by 2030 (approximately 16.3 Mt CO_2-e equity basis)

The target is measured against a 2018 global equity baseline, currently 32.6 Mt CO_2-e, which will be adjusted for divestments and acquisitions.

To support the reduction of Rio Tinto's Scope 3 emissions, a number of separate partnerships have been established to develop and implement new methods to reduce carbon emissions and improve environmental performance across the value chain.

10.5.5.2. Proponent Interim and Long-term Emissions Reduction Targets

The Proponent is committed to contributing towards the State's aspiration of net zero by 2050 through the achievement of interim and long-term emissions reduction targets for its operations. The emissions associated with this Proposal are included in emissions accounting for abatement within the long-term RTIO climate action plan, which is currently under investigation, and which will naturally see significant emissions reductions over the longer timeframe as technologies develop and alternatives to power generation and mobile diesel fleet become available.

To support the State's net zero aspiration, the Proponent's interim and long-term Scope 1 emissions reduction targets for the Proposal are to:

- Reduce or abate emissions by 15% between by 2025 (approximately 5,608 t CO_2-e)
- Reduce or abate emissions by 50% between 2026-2030 (approximately 523,778 t CO_2-e)
- Reduce or abate emissions by 66% between 2031-2035 (approximately 759,076 t CO_2-e)

Where reduction or abatement is insufficient, the retirement of Credible Offset Units in relation to the Proposal for 2025, 2030, 2035 and 2040will occur to meet Scope 1 and 2 interim and long-term emissions reduction targets.

The Proponent is committed to delivering emissions reductions in a linear trajectory (based on five-yearly targets) to net zero GHG emissions by 2050, through the mitigation hierarchy. The estimated emission reductions resulting from the interim and long-term targets are shown in Figure 10-1 and Table 10-6. The actual emissions will be managed via the GHG EMP.

Table 10-6: Interim and Long-term Emissions Reduction Targets (Rio Tinto 2022b)

Target Year	by 2025	2026-30	2031- 35	2036-40
Total Scope 1and 2 Emissions (t CO_2-e)	37,387	1,047,556	1,151,910	231,131
Emission Reduction Target (t CO_2-e)	5,608	523,778	759,076	-
Percentage Reduction Emissions (%)	15	50	66	-

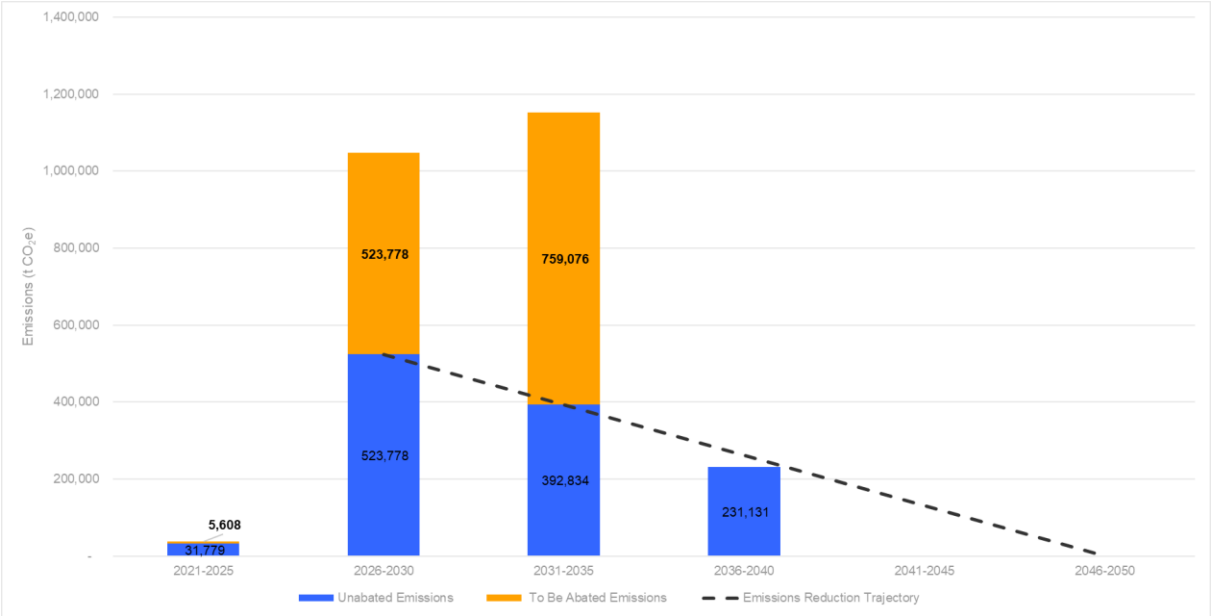


Figure 10-1: Proposed Scope 1 Emissions and Reduction Targets at Five Year Intervals (Rio Tinto 2023)

10.5.6. Greenhouse Gas Management Plan

The Proponent, in consultation with WA EPA and EPA Services has developed a Greenhouse Gas Environmental Management Plan (Rio Tinto 2023; Appendix A6) in accordance with the Environmental Factor Guideline: Greenhouse Gas Emissions (EPA 2023) and in line with the State GHG Policy.

The GHG EMP has been prepared with the following commitments associated with emissions reduction targets:

- Management based on five yearly interim reduction targets from 2025 to 2040 as outlined in Section 3.2.1 of the GHG EMP
- If the target is not met, commitment to offset via the purchase of eligible offset units (Section 3.2.1 and 3.8 of the GHG EMP)
- Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 and 2 emissions (Table 3-8 and Table 3-11 of the GHG EMP)
- Five yearly formal re-submission or if a significant change is triggered as outlined in Section 4 of the GHG EMP
- Annual (summary) and five yearly (consolidated report against Proposal targets) progress reporting as described in Section 5 of the GHG EMP.
-

10.6. Assessment of Significance of Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures, associated with the Proposal concluded that the following residual impacts are not significant to GHG values:

- Cumulative impacts, when considered in combination with the adjacent Hope Downs 1 operations, will, overall result in a cumulative reduction in net emissions.
- The Proposal peak emissions represent 0.26% of WA emissions (2020-21 WA GHG inventory from the Australia's National Greenhouse Accounts)

After application of the mitigation hierarchy, including avoidance, reduction and offset measures, the Proposal is predicted to result in the following significant residual impacts to Greenhouse Gas Emissions:

- is expected to contribute net GHG emissions (Scope 1 and 2 emissions) of approximately 1,179,522 t CO_2-e through the life of the project (Figure 10-1).

The GHG EMP outlines how the overall net emissions from the Proposal will be abated from the implementation of emissions reduction measures or offset.

10.7. Environmental Outcomes

10.7.1. Summary of Significant Residual Impacts and Proposed Conditions

A summary of the GHG emissions assessment and the proposed conditions, and GHG EMP requirement is provided in Table 10-7.

Table 10-7: Assessment Findings and Proposed Regulatory Mechanisms for Greenhouse Gas Emissions

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
The Proposal is expected to contribute net GHG emissions (Scope 1and 2 emissions) of approximately 1,179,522 t CO_2-e through the life of the project.	• After the avoidance, reduction and offset measures, the Proposal is expected to contribute net GHG emissions (Scope 1 and 2 emissions) of approximately 1,179,522 t CO_2-e through the life of the project (Figure 10 1). • The GHG EMP outlines how the overall net emissions from the Proposal will be abated from the implementation of emissions reduction measures or offset. • Cumulative impacts, when considered in combination with the adjacent Hope Downs 1 operations, will, overall result in a cumulative reduction in net emissions	Proposed to be regulated through implementation of Ministerial conditions requiring: • the Proponent to take measures to ensure that net GHG emissions are: ○ Reduced or abated by 15% by 2025 ○ Reduced or abated by 50% between 2026 and 2030 ○ Reduced or abated by 66% between 2030 and 2035 • the retirement of Credible Offset Units in relation to the Proposal for 2025, 2030, 2035 and 2040 will occur where the measures to avoid or reduce emissions are insufficient to meet Scope 1 and 2 interim and long-term emissions reduction targets. • the Proponent to implement the GHG EMP.

10.7.2. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

In consideration of the proposed management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to GHG include:

- Five yearly interim reduction of emissions from 2025 to 2040 based on targets outlined in Table 10-6 and in Section 3.2.1 of the GHG EMP, including but not limited to:
    - Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 and 2 emissions
    - Commitment to offset if the targets are not met
    - Annual and five yearly progress reporting
    - Five yearly formal re-submission or if a significant change is triggered
- Abatement of Scope 1 and 2 emissions in accordance with targets as set out in the GHG EMP (currently estimated at 1,288,462 t CO_2-e).

The proponent has prepared a GHG EMP (Appendix A6) that outlines how emissions from the Proposal are monitored and managed to minimise the contribution to global emissions.

The environmental outcomes of the Proposal are consistent with the EPA objective to minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as far as practicable so that environmental values are protected. The proposed implementation conditions will ensure these outcomes are achieved.

11. SOCIAL SURROUNDINGS

11.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021c) lists the following as their objective for Social Surroundings:

To protect social surroundings from significant harm

Social surroundings under the EP Act refers to "the social surroundings of a person are their aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by a person's physical or biological surroundings".

As such, there is a specific focus on a clear linkage between the Proposal's potential impact on the physical and biological surroundings and the subsequent impact on a person's aesthetic, cultural, economic or social surroundings. In addition, an impact must be significant in terms of its effect on the physical or biological environment.

11.2. Relevant Legislation, Policy and Guidance

Table 11-1 lists the policy and guidance for Social Surroundings that have been considered in this section, and the manner in which they have been addressed.

Table 11-1: Relevant Policy and Guidance for Social Surroundings

EPA, other State or Commonwealth and industry or Proponent Policy or Guidance, if Relevant	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for Social Surroundings forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Social Surroundings (EPA 2016g)	Considered in: • Planning and design of relevant surveys, consultation and investigations undertaken to date • Consultation with Traditional Owners • Consultation with pastoral and community stakeholders • Preliminary assessment of potential impacts • Project design and refinement • Development of mitigation measures
Instructions on how to prepare an Environmental Review Document (EPA 2021e)	Considered during the development of this document.
Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans (EPA 2021h)	This document forms the basis of the headings and content provided in this ERD.
EPA Guidance Statement Number 41: Assessment of Aboriginal Heritage (EPA 2004)	Considers Aboriginal heritage in the environmental approvals process when heritage values are linked to the environment. The guidance focuses on sites and objects

EPA, other State or Commonwealth and industry or Proponent Policy or Guidance, if Relevant	Explain How the Policy and Guidance has been Considered
	not broader facets of Aboriginal cultural or living heritage (e.g., hunting places, holding rituals or resource collection).
Other State or Commonwealth	
Statutory Guidelines for Mine Closure Plans (MCP) (DMIRS 2020b)	The MCP has been prepared in accordance with the guidance and recognises the importance of Social Surroundings and related consultation in informing closure strategies (Appendix A4).
Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	
Department of Planning, Lands and Heritage and Department of Premier and Cabinet Due Diligence Guidelines, Version 3.0 (DAA and DPC 2013)	Considered with respect to guidance on raising awareness of how proposed activities could adversely impact Aboriginal heritage sites.
Engage Early Guidance for proponents on best practice Indigenous engagement for environmental assessments under the EPBC Act (DoE 2016b)	Used as guidance during engagement.
Other Industry or Proponent	
ESG: Change for the Better (MCA 2021)	Considered with respect to industry-standard policies, strategies and partnerships that support and improve the mining industry in its environmental, social and governance (ESG) performance, including Indigenous partnerships.
Integrated Mine Closure Good Practice Guide (ICMM 2019)	Considered with respect to engagement and participation of stakeholders most affected by the Proposal, through the LOM including closure.
Communities and Social Performance Standard (Rio Tinto 2022c)	The Standard the Proponent expects of itself in regard to its performance in relation to, and management of, Health, Safety, Environment and Communities (HSEC) and Human Rights risks and opportunities associated with the proposed activities which could adversely impact the social surroundings of Traditional Owners and local communities.
Communities and Social Performance Commitments Disclosure Interim Report (Rio Tinto 2021b)	Considered with respect to commitments the Proponent has made regarding partnerships and engagement with Traditional Owner groups within the Pilbara.
The Burra Charter the Australia International Council on Monuments and Sites (ICOMOS) Charter for Places of Cultural Significance, (ICOMOS 2013)	Used as Guidance for Heritage Surveys Considered with respect to the practice of cultural heritage management and guidance on the Burra Charter and its application.

11.2.1. Applicable Legislation

Relevant Legislation is described in Table 11-2, with more detail on the interaction of Western Australian legislation provided below.

Table 11-2: Relevant Legislation for Social Surroundings

Document	Description
Environmental Protection Act 1986 (WA) (EP Act)	An Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement, and management of the environment and for matters incidental to or connected with the foregoing.

Document	Description
Environmental Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act)	An Act for protecting the environment, including MNES - which can include cultural heritage; providing for, protecting and conserving cultural heritage; and promoting a co-operative approach to management of the environment, involving governments, the community, landholders and Aboriginal (and Torres Strait Islander [TSI]) peoples; to recognise the role of Aboriginal (and TSI) peoples in conservation and ecologically sustainable use of biodiversity; and to promote the use of Aboriginal (and TSI) peoples knowledge of biodiversity, with knowledge-owners involvement and cooperation.
Native Title Act 1993 (Cth) (NT Act)	An Act to recognise and protect native title. It recognises the rights and interests of Aboriginal and Torres Strait Islander people in land and waters according to their traditional laws and customs. Native Title includes areas where native title holders have exclusive rights and interests as well as areas where non-exclusive rights and interests exist.
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth) (ATSIHP Act)	An Act to preserve and protect places, areas and objects of significance to Indigenous people, and for related purposes.
Aboriginal Cultural Heritage Act 2021 (WA) (ACH Act) Came into force in mid-2023.	An Act to recognise the fundamental importance to Aboriginal people of Aboriginal cultural heritage and the central role of Aboriginal cultural heritage in Aboriginal communities past, present and future; recognise that Aboriginal people have custodianship over Aboriginal cultural heritage; recognise the value of Aboriginal cultural heritage to Aboriginal people and the wider Western Australian community; recognise the living, historical and traditional nature of Aboriginal cultural heritage; recognise, protect, conserve and preserve Aboriginal cultural heritage; manage activities that may harm Aboriginal cultural heritage and promote an appreciation of Aboriginal cultural heritage. Potential direct impacts to heritage values will be appropriately managed via Aboriginal heritage legislation. Any disturbance will be in accordance with approvals under s.16 and/or s.18 of the AH Act or ACH Permit and/or ACHMP under the ACH Act, and as agreed with Traditional Owners through consultation, based on the principle of free, prior and informed consent.
Aboriginal Heritage Act 1972 (WA) (AH Act)	An Act to make provision for preservation on behalf of the community of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants. The Act protects all Aboriginal heritage sites in WA, whether or not they are registered with the Department of Planning Lands and Heritage (WA). Consent was required from the Minister for Aboriginal Affairs under s. 18 of the AH Act for any activity which will adversely impact Aboriginal heritage sites. Authorisation could also be granted under s. 16 to enter, excavate, examine, or remove anything on an Aboriginal heritage site (e.g., for archaeological purposes).
Heritage Act 2018 (WA)	An Act concerned with the understanding, appreciation, importance, identification, documentation and conservation, use, development, and reuse of historic cultural heritage (for both settler society and Aboriginal people, focussed on the built environment and historic elements of Western Australian heritage).

11.3. Consultation and Social Surroundings Study Effort

Key parties consulted to date, from 2019 include:

- Nyiyaparli, Banjima and Ngarlawangga Traditional Owners
- other key community stakeholders, including the Shire of East Pilbara, Marillana Pastoral Station and relevant State Government agencies.

A Stakeholder Consultation Register can be found in Appendix F2.

11.3.1. Traditional Owner Consultation

Since 2019, the Proponent has undertaken, and continues to undertake consultation with each Traditional Owner group to inform the EIA for this Proposal. These dedicated Social Surroundings consultation forums have included both in-field consultations as well as meetings and workshops to inform the development of the Proposal and approvals documents, including this ERD and, where required, SCHMPs.

An agreed facilitator is used to guide the process and each Traditional Owner group is represented by individuals from the group, including elders with cultural authority and others who are community-recognised spokespeople, along with representatives from the relevant Registered Native Title Body Corporate (RNTBC) and supporting independent experts engaged by the RNTBC such as anthropologists or environmental approval specialists. Proponent representatives include technical specialists to support discussion topics (e.g., hydrological or closure specialists), and senior representatives may also be present (e.g., the mine General Manager).

At each stage of consultation, the Proponent has aimed to transparently present to the Traditional Owner groups the most up to date information on relevant Proposal aspects, such as Proposal design options and study findings, and provide updates and further information in response to issues or queries raised during or following previous consultation.

Recognising that Traditional Owners have been asked to consider a large volume of often new and complex information, the Proponent has, at each stage, attempted to build on the last consultation forum, be targeted, reflect and address Traditional Owners recommendations from the previous consultations and responses on key concerns, or acknowledge and incorporate cultural information provided, and to present information in ways to support lay people's understanding without minimising key detail. To achieve this, information is sometimes shared using a variety of mediums such as the use of graphics, photos, 3D modelling and actual operating examples wherever possible. Specific important sites or features (for example, Weeli Wolli Creek [*Wirlawarli*]) were given extra attention within presentations as appropriate. At times, Traditional Owners led on-country visits to special places to capture and convey important areas of cultural value to be protected.

Where relevant, in addition to dedicated Social Surroundings consultation, other related consultation such as ethnobotanical, land management or traditional ecological knowledge consultation has also been undertaken to inform the EIA for the Proposal.

11.3.2. Social Surroundings Studies and Consultations

Social Surroundings studies undertaken for the assessment of this Proposal, the related area studied, consultation type and timing are listed in below in Table 11-3. For more details, key study/survey reports (which are subject to confidentiality restrictions) are provided in Appendix F1. Further, Social Surroundings consultation and assessment has not relied solely on the studies listed below. Various other studies undertaken for other key environmental factors have also been utilised where there is a relevant link between Social Surroundings and the other factor/s. For more information on 'other factors' that are referred to in this section; the reader should refer to the corresponding tables in the relevant factor chapters.

Table 11-3: Summary of Technical Studies for the Social Surroundings Factor

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Short Report Regarding Social Surroundings Consultation in Relation to Rio Tinto Iron Ore's HD2 Proposal: Mine Expansion Project at Hope Downs 2 and Bedded Hilltop in the East Pilbara Region of Western Australia (Stevens 2020) Prepared for Karlka Nyiyaparli Aboriginal Corporation (KNAC) and Rio Tinto	**Area:** Nyiyaparli Country within and near the Development Envelope **Type:** On-Country and offsite consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings **Timing:** October 2020	No specific guidance is available for Social Surroundings consultation; however, the consultation process has been consistent with best practices such as DPLH and DPC 2013.
Short Report Regarding Social Surroundings Consultations in Relation to Rio Tinto Iron Ore's HD2 Proposal in the East Pilbara Region of Western Australia, July-August 2021 (Stevens 2021a) Prepared for KNAC and Rio Tinto	**Area:** Nyiyaparli Country within and near the Development Envelope **Type:** On-Country and offsite consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings **Timing:** August 2021	
Short Report of a Social Surroundings Nyiyaparli - Rio Tinto Iron Ore Field Consultation Regarding the Hope Downs 2 Proposal, November 2021 (Stevens 2021b) Prepared for KNAC and Rio Tinto	**Area:** Nyiyaparli Country within and near the Development Envelope **Type:** On-Country consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings **Timing:** November 2021	
Report of Nyiyaparli – Rio Tinto Iron Ore Social Surroundings Consultations regarding the Hope Downs 2 Proposal, May 2022 (Stevens 2022a) Prepared for KNAC and Rio Tinto	**Area:** Nyiyaparli Country within and near the Development Envelope **Type:** On-Country and offsite consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings **Timing:** July 2022	

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Interim Report of Ngarlawangga Aboriginal Corporation Social Surroundings Phase 1 Scoping Consultation (Herrmann and Millett 2021) Prepared for NAC and Rio Tinto	**Area:** Ngarlawangga Country within and near the Development Envelope **Type:** On-Country and offsite consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings **Timing**: July 2021	
Draft Report of Ngarlawangga – Rio Tinto Iron Ore Social Surroundings Consultations regarding the Hope Downs 2 Proposal, July 2022 (Stevens 2022b) Prepared for NAC and Rio Tinto	**Area:** Ngarlawangga Country within and near the Development Envelope **Type:** On-Country consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings **Timing:** July 2022	
Preliminary Advice Report of Banjima Cultural Values for the Hope Downs 2 Proposal, Banjima Country, Western Australia (Banjima People and Archae-aus 2022) Prepared for BNTAC and Rio Tinto	**Area:** Banjima Country within and near the Development Envelope **Type:** On-Country consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings **Timing:** January 2022	
Nyiyaparli Ethnobotanical / Land Management / Traditional Ecological Knowledge surveys / in-field consultations (report due December 2022) Prepared for KNAC and Rio Tinto	**Area:** Nyiyaparli Country within and near the Development Envelope **Type:** Field study and consultation with Traditional Owners regarding the classification, use and management of plants and other aspects of ecology and land management **Timing:** April 2022 and September 2022, additional consultation as agreed	No guidance available to this date, report due in December 2022.
Hope Downs 2 Proposal Visual Impact Assessment (Rio Tinto 2020c) Prepared for Rio Tinto	**Area:** Observer locations surrounding the Development Envelope **Type:** Viewshed analysis and analysis of photomontages Timing: 2020	No guidance is available with respect to visual impact assessment in Australia. Study based on qualitative analysis of rendered images of proposed pits and waste rock landforms on photomontages created through GIS and design software applications.

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Hope Downs 2 Proposal Visual Impact Assessment (Truescape 2022) Prepared for Rio Tinto	**Area:** Observer locations surrounding the Development Envelope **Type:** Digital view analysis tool Timing: 2022	No guidance is available with respect to visual impact assessment in Australia. Study based on advanced processing of images of existing landscape, proposed pits and waste rock landforms through design software applications to create accurate visualisations of the pre-mining and end-of-mine landscape from selected vantage points.
Hope Downs 2 Air Quality Assessment (ETA 2022) Prepared for Rio Tinto	**Area:** Receptor locations within and surrounding the Development Envelope (Appendix F1) **Type:** Predictive modelling and assessment. Timing: 2022	No specific guidance is available with respect to air quality assessment in Western Australia; however, modelling was undertaken using the WRF/CALMET/CALPUFF suite, which incorporated site-specific meteorological data, and emissions information estimates for the Proposal based on equipment design specifications specific to the Proposal. Emission rates were estimated using recognised and accepted methods of emissions estimation, which included published emission factors from the NPI Emission Estimation Technique Manual for Mining (EA 2012, cited in ETA 2022).
Hope Downs 1 Phase 2 Environmental Noise and Vibration Impact Assessment (Wood 2022) Prepared for Rio Tinto	**Area:** Receptor locations within and surrounding the Development Envelope. **Type:** Predictive noise modelling and assessment at a range of receptors against criteria derived from the *Environmental Protection (Noise) Regulations 1997 (WA)* (Noise Regulations) and other guidance. Timing: 2022	No specific guidance is available with respect to noise assessment in Western Australia; however, the algorithm (CONCAWE) for industrial noise simulation used to predict the sound levels at each of the noise sensitive receivers has been approved for such purpose by DWER. The noise predictive model utilised SoundPlan software, which is internationally recognised, including in Australia.
Heritage site investigations (various)	See Appendix F1	All archaeological and ethnographic heritage surveys undertaken have been in accordance with requirements of the AH Act including (for those undertaken since 2013) the Aboriginal Heritage Due Diligence Guidelines (DAA and DPC 2013).

11.3.3. Heritage Survey Progress

Numerous Aboriginal archaeological and ethnographic heritage surveys have been undertaken within the Development Envelope. These surveys have been undertaken with Traditional Owner participation within their respective Native Title Determination. They were commissioned for various purposes, including to:

- ensure compliance with the AH Act or ACH Act.
- inform the Proponent of the location of heritage places so that these may be avoided through project design and re-design where practicable; and
- assess the cultural values of heritage places with a view to register them with DPLH, and where required to gain consent to investigate or disturb sites that the Proponent cannot practically avoid and are seeking to disturb.

The results of these heritage surveys will be used to ensure that the Proposal avoids heritage sites where possible. Where Aboriginal heritage sites cannot be avoided, potential direct impacts to heritage values will be appropriately managed via Aboriginal heritage legislation and the IHMP. Any disturbance will be in accordance with approvals under s.16 and/or s.18 of the AH Act or ACH Permit and/or ACHMP under the ACH Act, and as agreed with Traditional Owners through consultation, based on the principle of free, prior and informed consent. The results of these heritage surveys will be used to support a section 18 application under the AH Act and/or an Aboriginal Cultural Heritage Management Plan (ACHMP) subject to the requirements ACH Act section 10-10-5.

Table 11-4: Summary of In-field Archaeological and Ethnographic Heritage Surveys within the Development Envelope

Proposal Area	Traditional Owner Group	Area within Native Title Determination	Baseline Archaeological Survey Coverage	Baseline Ethnographic Survey Coverage
Conceptual Footprint	Nyiyaparli	89%	70-80%	50-60%
	Banjima	10%	80-90%	80-90%
	Ngarlawangga	1%	50%	50%
Development Envelope	Nyiyaparli	86%	55-65%	30-40%
	Banjima	9%	80-90%	80-90%
	Ngarlawangga	5%	80%	80%

Note: Percentages are as of November 2022. The Conceptual Footprint includes the proposed Pits, Waste Rock Landforms, Stockpiles, and Infrastructure footprints. Surveys have targeted identifying sites within 350 m of proposed blasting activities, and within 100 m of other activities to ensure direct and indirect impacts can be managed.

Appendix F1 provides further details of in-field archaeological and ethnographic heritage surveys within the Development Envelope.

11.3.3.1. Nyiyaparli Traditional Lands and Heritage

Surveys within the Development Envelope commenced in 2006 over the Hope Downs Hub area, with surveys continuing over multiple survey areas as required since then to develop an improved understanding of the cultural heritage landscape. In total, more than 63 heritage surveys have been completed within the sections of the Development Envelope which overlap the Nyiyaparli Native Title Determination area.

Consultation regarding this Proposal was initiated with Nyiyaparli in 2020 with further consultation occurring in the field and with working groups throughout 2021 and 2022. These consultations have complemented the heritage surveys through capture of additional knowledge regarding the broader landscape, locations of cultural significance, connections between locations and sites, and ethnobotanical knowledge.

11.3.3.2. Ngarlawangga Traditional Lands and Heritage

Results from existing and additional survey work will help to inform ongoing refinement of the options for the potential relocation of part of Great Northern Highway, with the expectation that avoidance of direct impacts to heritage sites will be pursued as the first option.

Consultation regarding the Proposal was initiated with Ngarlawangga in 2021 with consultation occurring in the field and with working groups throughout 2021 and 2022.

11.3.3.3. Banjima Traditional Lands and Heritage

Surveys within the Development Envelope commenced in the 1990s over the Hope Downs Hub area, with surveys continuing over multiple survey areas as required since then to support mining related works. In total, more than 37 heritage surveys have been completed within the sections of the Development Envelope which overlap the Banjima Native Title Determination area.

Consultation regarding the Proposal was held with Banjima through various forums in 2020 and 2021. One in field Social Surroundings consultation has occurred with Banjima in January 2022. Consultation progress paused due to capacity constraints within Banjima. Social Surroundings consultation is currently being planned for 2023 but will be subject to Banjima Traditional Owner capacity.

11.3.3.4. All Groups

Additional archaeological and ethnographic surveys will be completed for any remaining unsurveyed areas proposed for disturbance within the Development Envelope as the proposed Conceptual Footprint is finalised. Heritage information can be sensitive and is treated “in confidence” with each Traditional Owner group. The information provided in this section may therefore be non-specific in some cases to protect the sensitivity of the detailed information.

Appendix F1 summarises the archaeological and ethnographic surveys undertaken within the Development Envelope to date.

11.3.4. Other Social Surroundings Consultation

Consultation with non-Traditional Owner stakeholders regarding all aspects of the Proposal is outlined in Chapter 4. Matters raised during consultation pertinent to Social Surroundings are provided in Table 11-5 below.

Table 11-5: Social Surroundings Consultation (non-Traditional Owners)

Stakeholder	Date	Issues Raised by Stakeholder	Proponent Response
State Government			
Main Roads Western Australia (MRWA)	13 September 2019	MRWA were receptive to a potential realignment of the GNH pending further information and consideration of the views of other key stakeholders such as the Shire, residents and other groups who use the highway frequently. MRWA were not supportive of closing the GNH for blasting due to its importance in the region.	MRWA were provided high level details, copy of map and conceptual layouts, mine access diversions and ability to mine within 350m of highway reserve.
Local Government			
Shire of East Pilbara	28 October 2022	Shire of East Pilbara were receptive to the Proposal. The Shire did not raise any issues regarding the temporary closure (up to 24 months) of the HD2 mine access (private) road to begin construction. This road is occasionally accessed by the public travelling to Weeli Wolli Creek and/or Spring. The Shire was open to the offer by Rio Tinto to grade the initial 45 km of the Shire owned Rhodes Ridge Road for the period that Rio Tinto's HD2 mine access road is closed in order to maintain public access to Weeli Wolli Creek and Spring	The Shire of East Pilbara was provided with a 45-minute presentation on Rio Tinto's current projects within their Shire which included a map and proposed conceptual layouts of the Proposal. The potential diversion of the GNH was briefly introduced as one of three options that Rio Tinto is exploring to allow mining in the Southwest section of the HD2 deposit. Continued access by the public to Weeli Wolli Creek and Weeli Wolli Spring was also a topic raised. Further consults with the Shire are planned for 2023.
Pastoralists			
Marillana Station	23 June 2022	Proposal information provided to the Lessee (and through them to sub-Lessee) for comment and feedback. No issues raised to date.	The Proponent will continue to engage with Marillana Station on the Proposal as required

11.4. Receiving Environment

11.4.1. Overview

The Development Envelope extends across the Nyiyaparli, Ngarlawangga and Banjima Native Title Determination areas (Figure 11-2), and is located in Shire of East Pilbara, a sparsely populated region with approximately 11,000 residents living in an area of around 372 km^2 (ABS 2022, Shire of East Pilbara 2022).

The Development Envelope covers approximately 12,410 ha of land and is located within the upper reaches of the Weeli Wolli Creek catchment, which includes Pebble Mouse Creek, a major tributary of Weeli Wolli Creek. The HD2 and BHT deposits are located between Pebble Mouse Creek to the north and the upper reaches of the main channel of Weeli Wolli Creek to the south.

Key landscape features in proximity to the Development Envelope include Djadjiling Range to the north of the Proposal (Figure 11-3), and Mt Robinson (*Wirrbi Wirrbi*) to the northeast, as well as Weeli Wolli Creek to the south. Karijini National Park is approximately 30 km west of the Development Envelope at its nearest point (Figure 11-1).

The Proposal is located approximately 80 km northwest of Newman (Figure 11-1), which has a population of approximately 7,000 residents. Newman is the administrative centre and largest town in the Shire. Site access to the Proposal from Newman is via the Great Northern Highway.

11.4.2. Community

Newman was established in the 1960's by BHP to service the Mount Whaleback mine. Today, social services and utilities in Newman are provided by the State Government and the Shire of East Pilbara. BHP provides power and water to the town, the latter of which is distributed by the Water Corporation. The mining industry is the dominant employer in Newman.

Newman is close to several of the Proponent's mine sites, including the Hope Downs Hub, Yandicoogina and West Angelas (Figure 11-1). Each of these mine sites operate with 100% Fly in Fly Out staff (see Section 11.4.4 below).

The Proponent's main interaction with Newman is limited to workforce transit through Newman Airport, a facility which is owned and operated by the Shire of East Pilbara. Newman Airport is the primary airport for the Hope Downs 4 mine and acts as a contingency airport for Rio Tinto managed Yandicoogina, West Angelas and Gudai-Darri mines. In 2021, the Proponent does not own or rent any houses in Newman.

Other communities in proximity to the Proposal are shown on Figure 11-1 include:

- Parnpajinya, part of the Newman townsite
- Youngaleena, approximately 90 km northwest
- Innawonga, approximately 100 km west
- Irrungadji (Five Mile) near Nullagine, approximately 140 km northeast
- Jigalong and associated satellite communities, approximately 160 km east.

Given the significant distance between Newman and the above communities from the Proposal, it has been assessed that the residents of those communities are unlikely to be adversely impacted in a significant way.

11.4.3. Pastoral Stations

The Development Envelope does not extend over any current pastoral station leases. The closest existing pastoral station is Marillana Station, the boundary of which is about 1 km to the east of the

northern-most boundary of the Development Envelope. Marillana Station is owned by BHP and was sub-leased to KNAC in April 2022. Today Marillana is a cattle station but has previously operated as a sheep station which is uninhabited but occasionally used for cattle grazing.

Impacts to Marillana Station have been assessed as being limited to temporary interruptions to access to local roads such as the Great Northern Highway and some noise, dust, and light emission impacts in the south-eastern corner of the Station due to its 1 km proximity to the proposed road train facility. Incremental impacts of the Proposal are also considered marginal given the existing Hope Downs 1 operations ore processing facility is located within 1 km of the station boundary.

11.4.4. Other Mining Activities

More recently, the area surrounding the Development Envelope has been targeted for its mineral resources refer to Figure 11-1 below which shows current mining projects in the region, in addition to the Proposal, include:

- Rio Tinto – Hope Downs 1 operations, immediately north
- Rio Tinto – West Angelas Iron Ore Mine, approximately 28 km southwest
- Rio Tinto – Yandicoogina Iron Ore Mine, approximately 29 km northeast
- Rio Tinto – Hope Downs 4 Iron Ore Mine, approximately 42 km southeast
- BHP – Area C Southern Flank Iron Ore Mine, approximately 15 km north-northwest
- BHP – Yandi Iron Ore Mine, approximately 37 km north
- Mineral Resources Limited - Wonmunna Iron Ore Mine, approximately 10 km south.

Figure 11-1: Social Setting and Land Use Within and Around the Development Envelope

RioTinto

600,000 650,000 700,000 750,000

7,500,000

7,450,000

Legend

- Development Envelope
- Town
- Roadhouse
- Aboriginal Community
- Airport
- Rio Tinto Mine
- Third Party Mine
- Rio Tinto Camp
- Third Party Camp
- Significant Spring / Pool
- Rest Area with Toilet
- Highway
- Major Road
- Minor Road
- Site Access Road
- Rio Tinto Railway
- Major Creek

Ministerial Statement

- 1020
- 1025
- 1038
- 1113
- 584
- 854
- 999

Land Administration Act Tenure

- General Lease
- Rio Tinto - Pastoral Lease
- Third Party - Pastoral Lease
- National Park
- Reserve

Youngaleena
Auski Munjina Roadhouse
N050370 Mulga Downs Station
Cowra Camp
Fortescue Dave Forest (Cloudbreak)
N050452 Hillside Station
Cloudbreak Village
Cloudbreak
Graeme Rowley (Christmas Creek)
Kantarma
Christmas Creek Construction Camp
Christmas Creek
FORTESCUE RIVER
Karijini National Park
Tognolini
Gudai-Darri
Gudai-Darri Exploration Camp
Gudai-Darri Village
Koodaideri Spring
Karijini Drive
Great Northern Highway
MARILLANA CREEK
N050622 Roy Hill Station
N050471 Juna Downs Station
Banjima Pool
TUREE CREEK
Minthi Spring
Spinifex Camp
Yandicoogina Barimunya
Yandi Camp (BHPBIO)
Nyidinghu Camp
Yandi
Yandi Village
Yandicoogina
N050368 Marillana Station
Coppin Pool
Packsaddle Camp
Mining Area C
Weeli Wolli Springs
Mulla Mulla Camp
Coondawanna
Hope Downs 1
South Flank
COONDINER CREEK
Coondiner Pools
Innawonga
Karijini National Park
Mount Robinson
Hope Downs 1 Village
Ben's Oasis
Eagle Rock Falls
Eagle Rock Pool
N050372 Rocklea Station
West Angelas Village
West Angelas
Wintamarra Village
West Angelas
Bella Pool
Three Pool
Hope Downs 4
Kalgan Pool
Hope Downs 4 Village
Stuarts Pool
N050676 Turee Creek Station
Angelo River Camp
Eastern Ridge
Parnpajinya
Newman
Mount Whaleback
N050553 Prairie Downs Station
SPEARHOLE CREEK
Central Syncline Seep
N049724 Ethel Creek Station

N
0 5 10 15 20
Kilometres
Map units in metres

Drawn: D von Holdt
Plan: RTIO-095357v1
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:500,000 @ A3
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11.4.5. Existing Tourism and Local Economy

Tourism is an important part of the existing local economy, accounting for 14.3% of jobs in the Shire of East Pilbara (DPIRD 2020).

A lookout and rest area are located at Mt Robinson, approximately 5 km northwest of the Development Envelope along Great Northern Highway. With a variety of facilities, it is described as 'busy' by caravanning and camping websites (ExploreOz 2020; Grumpy Grey Nomads 2020).

Another tourist destination, also frequented regularly by locals and Traditional Owners is Weeli Wolli Spring. The spring is a permanent freshwater spring providing a haven for fish and wildlife (Australia's Northwest 2022) and a place of spiritual and cultural significance to the Banjima and Nyiyaparli People (refer to Section 11.4.9.1). The spring is accessible by vehicles via Marillana Station roads from the north or the HD1 mine access road from the south.

11.4.6. Amenity

Amenity in this section refers to 'amenity values' for the general population from both a 'landscape and visual' amenity and a 'land use and lifestyle/recreational' amenity perspective. Amenity values related to the three Traditional Owner groups with Native Title rights over land within the Development Envelope are discussed in Sections 11.5.4 and 11.5.5.

As the region is sparsely populated and no town sites and communities are in the immediate vicinity of the Proposal, consideration of amenity is largely restricted to:

- The effect on users of the GNH
- Tourists and locals accessing sites such as Karijini National Park and higher nearby viewpoints
- Tourist and locals accessing both Weeli Wolli Creek and Weeli Wolli Spring to swim and camp.

Three prominent high points occur in the vicinity, and with clear views of the Development Envelope area (Rio Tinto 2020c), include:

- Mt Meharry, approximately 32 km west-northwest from the Development Envelope within Karijini National Park and regularly visited by tourists as the highest point in the State
- Mt Robinson (Wirrbi Wirrbi), approximately 3.5 km north of the Development Envelope – the peak is accessible from the Mt Robinson rest area, utilised by travellers along the GNH (actual visitation numbers to the peak is not known but expected to be relatively low given the hike is challenging and the time it takes to complete (AllTrails 2022)
- The Governor, approximately 7 km west of the Development Envelope, is an area of cultural importance for Yinhawangka people.

Views from Mt Meharry take in existing mines, including the BHP Area C Southern Flank and Rio Tinto West Angelas operations (Rio Tinto 2020c). Views for the three high point locations are otherwise generally of surrounding National Park and/or pastoral station landscapes composed of essentially intact native vegetation and surrounding flatlands and ranges, with disturbance from existing mines visible but not prominent.

Great Northern Highway road users have potential views of the Proposal as the current alignment traverses' western parts of the Development Envelope, including through the proposed HD2 deposit pit and waste rock landform areas (Rio Tinto 2020c). The highway is proposed to be realigned to allow the access of iron ore as introduced in Chapter 2.

Limited information on ambient dust levels exists for the eastern Pilbara. However, the Pilbara region is considered naturally dusty due to the effects of bushfires and wind erosion (ETA 2022; EPA 2007a). The Proposal is located near the existing Hope Downs 1 operations and is expected to cause increased dust levels in the vicinity of the Proposal during construction, operations, and closure.

11.4.7. Transport Infrastructure

The Great Northern Highway is a key transit route in the region for tourism, pastoral and mining activities. It forms part of the National Highway Network and provides a strategic freight link between Perth and the state's north as well as Darwin and the Northern Territory. The highway is the region's major road, and most other public roads outside town areas, of which there are few, are unsealed.

The Great Northern Highway also intersects the south-eastern end of the Development Envelope, providing public access between the towns of Newman and Port Hedland and tourist access to Karijini National Park (noting the public entrance to Karijini National Park is approximately 60 km north). Auski Roadhouse and Tourist Village, a key stopping point for travellers in the region, is approximately 100 km north of the Proposal.

11.4.8. Native Title

As noted above in Section 11.4.1, the Development Envelope extends over three Native Title Determination areas being:

- Nyiyaparli People Native Title Determination (WCD2018/008), covering the majority of the Development Envelope (the Nyiyaparli section). Karlka Native Title Aboriginal Corporation (KNAC) holds determined native title rights on behalf of the Nyiyaparli People
- Banjima People Native Title Determination (WCD2014/001), which relates to a portion in the north of the Development Envelope (the Banjima section). BNTAC holds determined native title rights on behalf of the Banjima People
- Ngarlawangga People Native Title Determination (WCD2016/007), which relates to a portion in the southwest of the Development Envelope (the Ngarlawangga section). Ngarlawangga Aboriginal Corporation (NAC) holds determined native title rights on behalf of the Ngarlawangga People.

KNAC, BNTAC and NAC are Registered Native Title Bodies Corporate (RNTBCs) following each native title determination, in accordance with the *Native Title Act 1993*, to manage and protect native title holders' rights and interests.

These three Traditional Owner groups hold non-exclusive native title rights in their respective determination areas, recognised by the Federal Court. Each of the three Traditional Owner groups demonstrated a long history of land use and cultural association within the Proposal area and its near surrounds, which continues into the present.

These Traditional Owner groups share close familial ties that create fluidity in the rights and responsibilities for this area of land. These groups have a shared responsibility to protect and care for this country, and this responsibility applies to the whole of their country, as well as being part of a reciprocal responsibility shared more broadly with neighbouring Traditional Owner groups.

The Development Envelope extends along the western boundary of Nyiyaparli lands, intersecting with the southern boundary of Banjima land and the north-eastern boundary of Ngarlawangga lands (Figure 11-2).

The Nyiyaparli section covers the majority of the Development Envelope (86%) and proposed Conceptual Footprint including the entirety of the HD2 and BHT deposits and associated waste rock landforms. Banjima land (equivalent to 9% of the Development Envelope) lies to the north and intersects proposed infrastructure areas north of Pebble Mouse Creek, adjacent to the existing rail loop and access corridor connecting the Proposal with the Hope Downs 1 operations. A narrow part (5%) of the south-western end of the Development Envelope, including the GNH alignment and realignment option, coincides with Ngarlawangga land, which extends west and south from the Development Envelope boundary. Refer to Table 11-6.

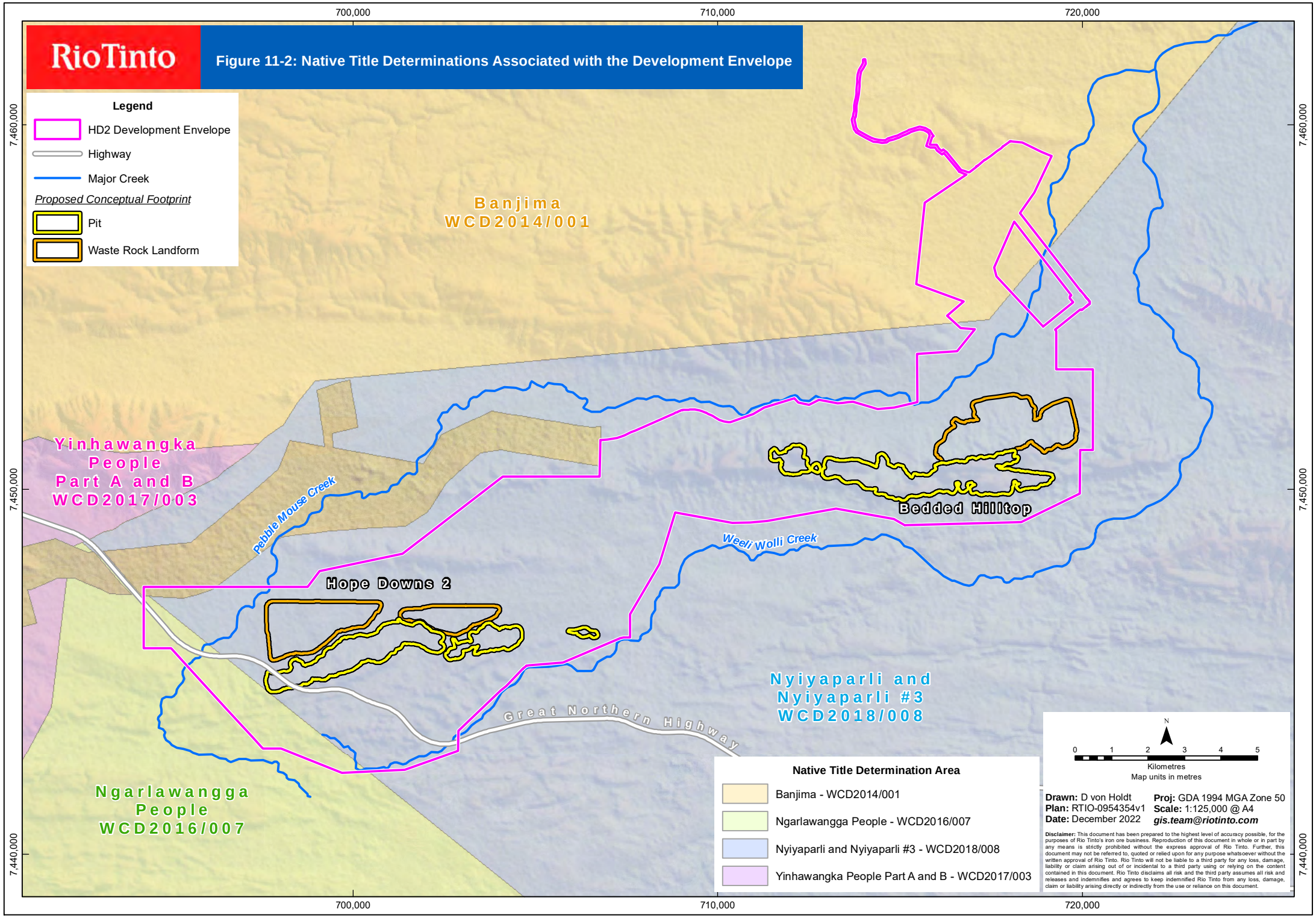
Table 11-6: Potential Impacts for each Traditional Owner groups from the Proposal

Traditional Owner Group	Development Envelope (ha)	Conceptual Footprint Area (ha)	Cleared area (ha) within the Conceptual Footprint	Vegetated area (ha) in Conceptual Footprint
Nyiyaparli	10,650.5	4,334	427	3,908
Banjima	1,080	509	265	244
Ngarlawangga	679	56	4	53
Total	12,409.5	4,900	695	4,205

Neighbouring Native Title areas include:

- Yinhawangka People Native Title Determination (WCD2017/003)
- Nharnuwangga People (WCD2000/001)
- Palyku People (Part A) Native Title Determination (WCD2019/002)
- Birriliburu (Part A) Native Title Determination (WCD2008/002)
- Martu and Ngurrara Native Title Determination (WCD2002/002).

The Proponent has negotiated and executed Native Title Agreements with the Nyiyaparli, Ngarlawangga and Banjima Traditional Owner groups in respect of the broad use of land, which includes the Development Envelope. These agreements provide frameworks through which the Proponent and the Traditional Owner groups work together to manage the social, cultural and heritage values in the areas in which the Proponent operates. Ongoing engagement with the groups is maintained through formal and informal engagement frameworks as discussed in Section 11.4.9. Indigenous Land Use Agreement (ILUAs) between the Proponent and each of the three Traditional Owner groups have also been registered addressing the Future Acts provisions of the *Native Title Act 1993*.


RioTinto
Figure 11-2: Native Title Determinations Associated with the Development Envelope
Legend
HD2 Development Envelope
Highway
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Banjima
WCD2014/001
Yinhawangka
People
Part A and B
WCD2017/003
Ngarlawangga
People
WCD2016/007
Nyiyaparli and
Nyiyaparli #3
WCD2018/008
Pebble Mouse Creek
Weeli Wolli Creek
Great Northern Highway
Hope Downs 2
Bedded Hilltop
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
Native Title Determination Area
Banjima - WCD2014/001
Ngarlawangga People - WCD2016/007
Nyiyaparli and Nyiyaparli #3 - WCD2018/008
Yinhawangka People Part A and B - WCD2017/003
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0954354v1
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:125,000 @ A4
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11.4.9. Aboriginal Land Use and Association

The Development Envelope and its near surrounds is located within a storied landscape rooted in deep antiquity that remains active in Nyiyaparli, Banjima and Ngarlawangga culture (Plate 11-1).

Nyiyaparli Law (*Mangun*) explains how the hills, plains, rivers, and waterholes as well as people, plants and animals were created by the ancestral spirits in the *Kukutpa*, the Dreamtime (Nyiyaparli Community et al. 2015). Archaeological investigations in this area have indicated Aboriginal occupation over tens of thousands of years, with rockshelters in the Djadjiling Range such as Jundaru and to a lesser extent Djadjiling Rockshelter, HS-A1 and HD07-3A-PAD13, found to preserve unusually dense and diverse archaeological assemblages from the period of initial occupation, 50,000–35,000 years ago (Cropper and Law 2018). For example, excavation at Djadjiling Rockshelter north of the Development Envelope has been dated to 40,911±580 calibrated years before the present (cal. BP) (Cropper and Law 2018), making it one of the oldest archaeological sites in Australia dating to this period (Balme et al. 2019). The Djadjiling Rockshelter, HS-A1, and HD07-3A-PAD13 located outside the Proposal's Development Envelope, within the area of the Hope Downs 1 Ministerial Statement 584 boundary.

The Djadjiling Range (Figure 11-3), which stretches along the northern edge of the Development Envelope, is associated with a secret and important song line known to the Banjima as *Wardilba* (Bulter et al. 2018) (Figure 11-3). Sources of *martamarta* (red), *babakuna* (yellow), and *mirimirdi* (white) ochre have been found in the flanks of the range (Stevens 2015a).

Facing Djadjiling Range on the opposite side of the broad valley containing Pebble Mouse Creek is BHT. The upper gullies and hidden rockshelters of this range contain walled cavities and stone cairns (Stevens 2015b). These difficult-to-reach places were used to store sacred implements and objects or as burial sites.

The land also includes a mosaic of resources that are valuable to the Nyiyaparli, Banjima and Ngarlawangga People such as water, lithic raw materials, plant resources and hunting grounds. Hummock grasslands of hard spinifex (*Triodia wiseana, T. brizoides, T. plurinervata*) grow in these upland areas with sparse, scattered Acacia spp. shrubs and occasional snappy gum trees (*Eucalyptus leucophloia*). The ground surface is comprised of areas of exposed bedrock and shallow stony soils overlain by ironstone, jasperlite, chert and quartzite gravels.

During another survey at the base of Djadjiling Range, Nyiyaparli representatives noted that it was an excellent place for sourcing *jundaru* and that some of the trees would have been used over the course of generations (Stevens 2015a).



Plate 11-1: Rocky Landscape with Rockshelters

11.4.9.1. Water

Nyiyaparli People have described water as ‘flowing like the blood through a person’s body’.

Within the Development Envelope, surface water flows intermittently along Pebble Mouse Creek and Weeli Wolli Creek (*Wirlawarli*) to the northeast towards Weeli Wolli Spring, and then onto the Fortescue River 60 km downstream (Figure 11-3). Water sources are seen as interconnected and vital to the health of the land and its people, and are described as ‘living waters’. This includes but is not limited to some pools (*yinta*) and springs (*piranpa*) because they were created by *Warlu* (the ancestral water snake) who still resides in these places (Nyiyaparli Community et al. 2015). Chapter 9 contains additional images of Pebble Mouse Creek and Weeli Wolli Creek (*Wirlawarli*).

Weeli Wolli Spring is a significant permanent water source 10 km to the northeast of the Development Envelope (Plate 11-2). It is located on the border between Banjima and Nyiyaparli lands: Banjima and Nyiyaparli traditions require visitors to introduce themselves to *Warlu* by taking a handful of water and blowing into it, whereas there are reportedly dangerous repercussions if this ritual is not performed. Ben’s Oasis is another significant, permanent water source (spring) about 2 km southeast of the Development Envelope.

‘Weeli Wolli Pool’ (Place ID 14244), or Weeli Wolli Spring (about 10 km to the northeast of the Development Envelope), is listed on the Shire of the East Pilbara municipal inventory of significant places (Heritage Council of Western Australia 2020). In addition to its natural beauty, the pool is listed because it was a stopping point for cameleers, often Afghans, who maintained crucial supply routes through Western Australia’s arid interior. The presence of date palms at the pool is an indicator that it was used by camel carers and drivers as they would plant them to provide shade.

The southern flank of Djadjiling Range along the northern margin of the Development Envelope was described by Nyiyaparli representatives during one survey as ‘thick with water’ (Stevens 2015a). Rock holes in the gullies and crevices of the range would have held water and supported a variety of plant and animal resources (Stevens 2015a).

These varied water sources acted as pathways through the country, and the fresh water and ochre sources of Djadjiling Range would have made the valley below, along Pebble Mouse Creek, a favoured route for people travelling to Weeli Wolli Spring (Stevens 2015a).

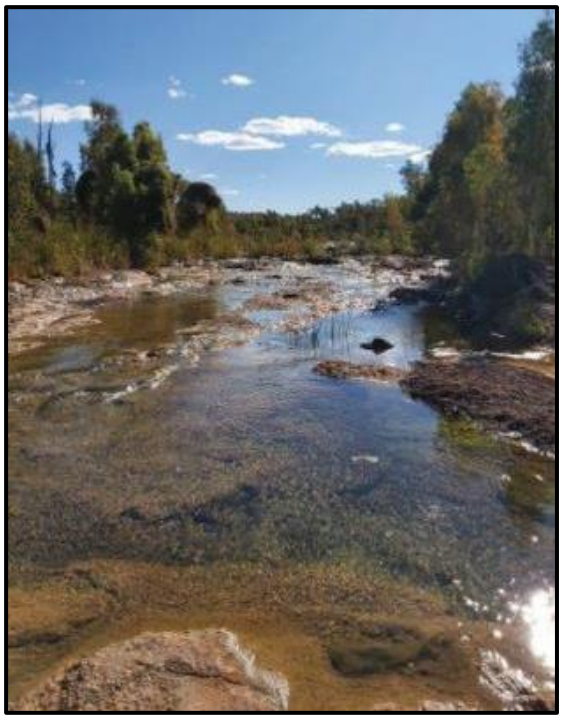


Plate 11-2 Weeli Wolli Spring

11.4.9.2. Care of Country

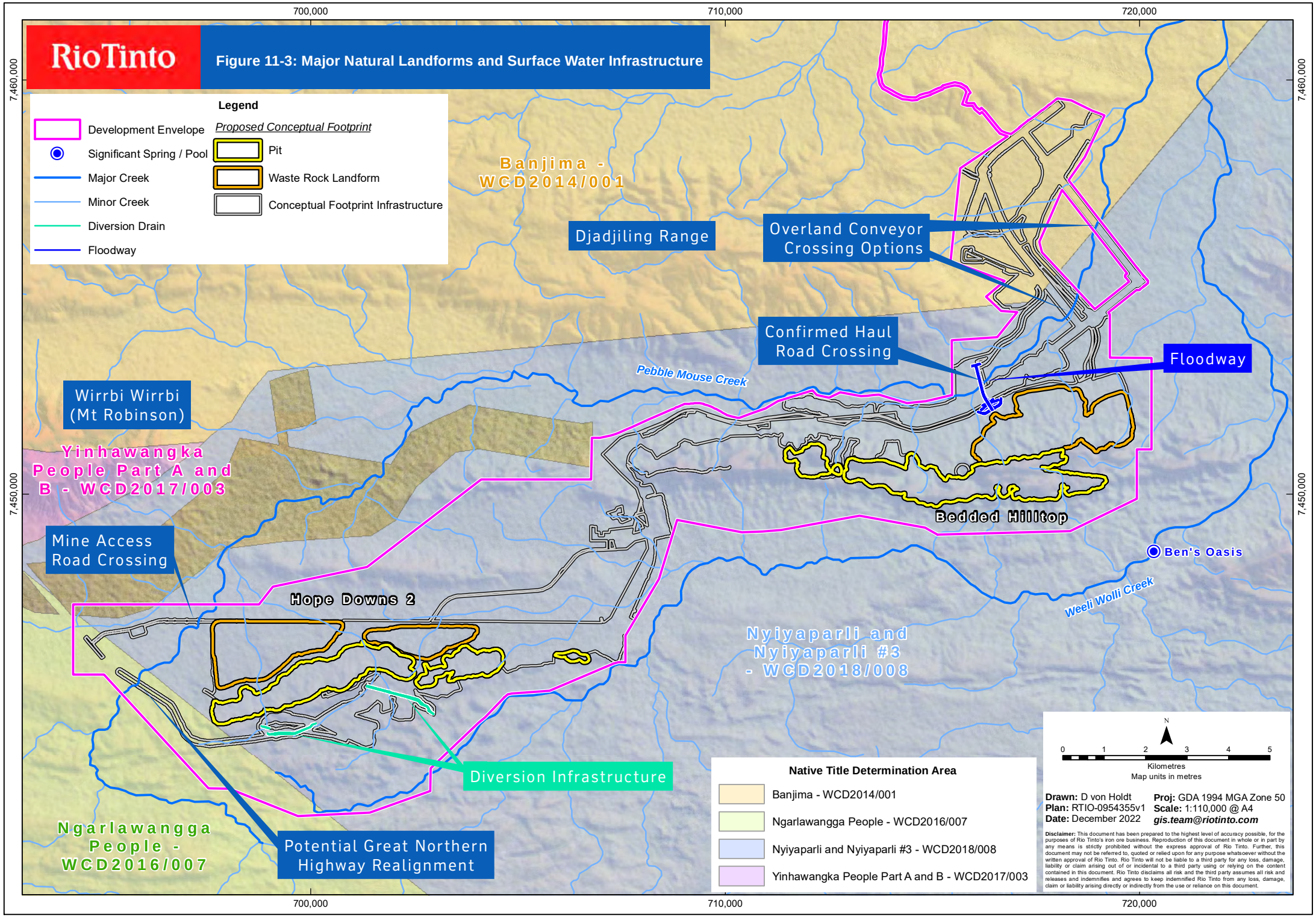
'Country' is a critical component of Traditional Owners' consideration of Social Surroundings, and all of the key themes discussed below in Section 11.5 (Potential Impacts to Social Surroundings) relate in some way to caring for Country.

Nyiyaparli Traditional Owners have expressed a concern that their ability to care for Country would be impeded if disturbance levels increase as a result of the Proposal, and animals begin to move away, or waterholes are covered with a film of dust, or some parts of Country can no longer be accessed. There is also an over-riding anxiety that *Warlu* – the Creation Serpent (see Section 11.4.9.1 'water' above) – will leave and the subsequent absence of 'spiritual balance' in the landscape would have dangerous or even devasting consequences.

As traditional custodians, and as a way to maintain connection and as part of caring for and keeping Country healthy, Traditional Owners have consistently expressed interest in being involved in Proposal processes throughout all phases from design through to closure including in-field surveys, ongoing environmental monitoring and in management. These might involve joint application of scientific and traditional methods, or as part of a team guided by other experts and specialists.



Plate 11-3 Bedded Hilltop Range from the West


RioTinto
Figure 11-3: Major Natural Landforms and Surface Water Infrastructure
Legend
Development Envelope
Significant Spring / Pool
Major Creek
Minor Creek
Diversion Drain
Floodway
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Conceptual Footprint Infrastructure
700,000
710,000
720,000
7,460,000
7,450,000
Banjima - WCD2014/001
Djadjiling Range
Overland Conveyor Crossing Options
Confirmed Haul Road Crossing
Floodway
Pebble Mouse Creek
Wirrbi Wirrbi (Mt Robinson)
Yinhawangka People Part A and B - WCD2017/003
Bedded Hilltop
Ben's Oasis
Mine Access Road Crossing
Hope Downs 2
Weeli Wolli Creek
Nyiyaparli and Nyiyaparli #3 - WCD2018/008
Diversion Infrastructure
Ngarlawangga People - WCD2016/007
Potential Great Northern Highway Realignment
Native Title Determination Area
Banjima - WCD2014/001
Ngarlawangga People - WCD2016/007
Nyiyaparli and Nyiyaparli #3 - WCD2018/008
Yinhawangka People Part A and B - WCD2017/003
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0954355v1
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11.5. Potential Impacts to Social Surroundings

The following section presents Traditional Owner values that have been provided through consultation. It also outlines the potential impacts of the Proposal to those values (categorised into themes). The section considers the following:

- An overview of the key Traditional Owner themes arising from consultation
- An overview of the potential impacts to these themes arising from the Proposal
- An assessment the potential impacts and summary of consultation outcomes by theme.

11.5.1. Key Themes and Values

Recognising each Traditional Owner group is different and has different values, concerns, and issues (and individual members have a range of views) regarding the Proposal, the following list is considered by the Proponent to encapsulate the common key broad themes and issues raised during Social Surroundings consultation:

- Water
- Sense of place and amenity (dust, noise, vibration)
- Sense of place and amenity (altered visual landscapes, land use and recreational amenity)
- Access
- Special Places (including waterholes, heritage sites and meeting places)
- Plants and animals (used socially or culturally, or with cultural associations)
- Mine closure and rehabilitation.

The key themes frequently overlap due to the holistic view of Country that Traditional Owners hold and inform the discussion of Traditional Owner Social Surroundings values presented below.

11.5.1.1. Additional Themes

Both Nyiyaparli (Stevens 2022a) and Ngarlawangga (Stevens 2022b) Social Surroundings reporting raised GHG emissions as a concern with other emissions such as noise and dust. Being its own key environmental factor that can be treated separately from Social Surroundings for the purpose of this ERD, GHG emissions are addressed wholly under Chapter 10 and are not discussed further in this section.

Banjima Social Surroundings reporting also identified the key themes ‘Capacity building and sustainable business’ and ‘Banjima governance and processes’ (Banjima People and Archae-aus 2022). While aspects of these themes are considered relevant to the EIA for this Proposal under the EP Act most elements of these themes are considered more appropriate to be managed in accordance with, or integrated into, other Agreements between the Banjima Traditional Owners and the Proponent. Aspects may be incorporated into a SCHMP, if required.

11.5.2. Potential Environmental Impacts – Overview

The following section provides a summary of the key Social Surroundings issues associated with this Proposal as assessed against the infield surveys and site visits and consultations undertaken with Traditional Owners and key stakeholders. Further detail on each identified impacts is provided in Sections 11.5.3 – 11.5.10.

Table 11-7 outlines the potential direct and indirect impacts relevant to the key Social Surroundings themes.

Table 11-7: Potential Impacts to Social Surroundings from the Proposal

Social Surroundings Theme / Value	Potential Impacts	
	Direct	Indirect
Water	• Alteration surface water flows due to construction of bridges, crossings, and other linear infrastructure • Groundwater draw-down for operational water supply (i.e., for ore processing, dust suppression and other mining related activities) • Reduction in catchment area	• Reduction in local water quality arising from mining activities which cause erosion, sedimentation, or dust deposition

Sense of Place and Amenity (dust, noise, and vibrations)	• Increased dust, noise, and vibration levels as a result of the Proposal including such activities as:
	  ○ Construction related activities (i.e., construction of a new bridge over Pebble Mouse Creek)
	  ○ Operational related activities (i.e., blasting, transportation of ore via haul trucks and road trains, processing ore)
	• Increased dust, noise, and vibration impacts on people
	• Vibration impacts destroy or diminish structural integrity of special places particularly rock shelters and bat caves
		• Dust accumulation in water features and along drainage lines adversely impacts the ecology and quality of water for drinking, bathing, and recreational use
		• Noise and vibration adversely impact people's enjoyment, and use of country (including at camping spots and other areas used for cultural purposes)
		• Alteration of sense of place: social, cultural and environmental dimensions (by people and animals) due to diminished amenity and aesthetics caused by dust, noise and vibrations
		• Increased dust leads to reduced visibility and safety for drivers using Great Northern Highway in areas near the Development Envelope

Sense of Place and Amenity (visual landscapes, land use and amenity)	• Changes to local landforms (associated with pit development (i.e., removal of sections of the BHT ridgeline, waste rock landforms and land bridges) result in altered visual character of landscapes within the region • Changes to or alteration of important cultural landmarks used by Traditional Owners to navigate and pass down: stories of connection between places; and connection between people and place	Alteration of the sense of place: social, cultural, and environmental dimensions; including land use (by people and animals), visual and recreational experience and enjoyment of country due to changes to landscapes, landscape features.
Access	• Reduced access to country to undertake native title rights (temporary or otherwise) including places and sites of social, cultural and heritage significance such as BDH16-03	• Changes to (temporary or otherwise) during construction and mining operations, the usual access routes within the Development Envelope which provide access to Special

Social Surroundings Theme / Value	Potential Impacts	
	Direct	**Indirect**
	• Reduced access to country to undertake native title rights (temporary or otherwise)	Places in close proximity to the Proposal (i.e., Weeli Wolli Creek and Springs, sections of the Weeli Wolli creek line, HOPE 4_07 heritage site complex (Nyiyaparli) and parts of Pebble Mouse Creek • Potential temporary disruptions to road users accessing the GNH associated with construction of and temporary or permanent realignment of the road
Special places	• Direct impact to Special Places such as sites of significant cultural heritage (BDH16-03 rock shelter at BHT and HOPE4-07 heritage complex), and culturally significant waterholes (GHD19-07-WS) and (HD214_04) and/or other significant sites found in previously unsurveyed areas within the Development Envelope • Disturbance of Country and to, places and sites of social, cultural and heritage significance within the Development Envelope including: o The waterhole at HD2 (HD214_04) on Nyiyaparli Country o The waterholes at BHT (GHD19-07-WS), on Nyiyaparli Country o BDH16-03 rock shelter at BHT on Nyiyaparli Country o Cave 10 at BHT on Nyiyaparli Country o Cave 7 on Ngarlawangga Country o Sections of Pebble Mouse Creek (including in the vicinity of the proposed crossings) on Nyiyaparli, Banjima and Ngarlawangga Countries	The potential for indirect impacts such as dust, noise, and loss of amenity to special places outside of, but in close proximity to the Development Envelope (i.e., HOPE 4-07, bat caves, Weeli Wolli Creek, Pebble Mouse Creek, and nearby waterholes).
Plants and Animals (of Cultural Significance used socially or culturally, or with cultural associations)	• Clearing of native vegetation (including riparian vegetation) results in loss of plants and animals and the habitats that support them (including culturally and environmentally significant plants and animals) • Reduction in plants and animals of cultural/spiritual significance	• Potential impact to plants and animals of cultural significance, results in reduced ability to undertake customary practices associated with gathering native food and medicines as a result of indirect impacts associated with implementation of the Proposal • Disturbance of plants and animals of cultural significance due to changes in landscape, habitats, water sources and

Social Surroundings Theme / Value	Potential Impacts	
	Direct	Indirect
	• Total final land area available for native flora and fauna habitats is reduced due to landform changes	migration pathways reduces customary practices associated with hunting and storytelling

Mine Closure and Rehabilitation	• Ongoing (residual) amenity and visual impacts to country associated with final landform (i.e., remaining pit voids, permanent drainage features, abandonment bunds and rehabilitation outcomes) that are unable to support:
	  ○ the return of native plants and animals
	  ○ Safe and unfettered access to country by Traditional Owners to resume social and cultural activities due to safety considerations
	• Ongoing (residual) physical and biological impacts to country and potential chemical impacts associated with final landforms (i.e., remaining waste rock landforms, pit voids and land bridges)	

11.5.3. Water

11.5.3.1. Key Concerns

Water is at the centre of Traditional Owner life, culture, and spirituality and as such, recognised as a critical element of country, and cultural and ecological landscapes. Social Surroundings concerns and queries raised by Traditional Owners in relation to water included:

- The potential for mining and associated infrastructure to interfere with natural creek flows and plans for retention or removal of water-related infrastructure at closure
- The potential impacts on creek water quality from mining activities, and the monitoring and management of downstream impacts on water – such as the effect of diversions and runoff from waste rock landforms and control of erosion, sediment, pollutants, and dust
- The volume of water supply required for the Proposal, its source and use for dust control
- The potential for extraction and use of water for mining related activities to conflict with traditional beliefs and practices causing stress and concern relating to retaining ongoing spiritual connection to country and cultural obligations to care for country and people
- The cumulative impacts of mining activities in the wider area by multiple proponents and the potential opportunity to act cooperatively in considering water impacts and management.

11.5.3.2. Consultation Outcomes

Traditional Owners have confirmed water in all its cultural meaning - along with water use, management, and quality, is integral to perceptions of 'healthy Country' and is their highest priority (Stevens 2022 a, 2022b Herrmann and Millett 2021 and Banjima People and Archae-aus 2022).

The cultural importance of the association between water in and on the land and the water serpent *Warlu* is paramount (Stevens 2022a). Nyiyaparli Traditional Owners often refer to water as 'living water', a natural element and feature of the landscape imbued with spiritual potency. In keeping with their worldview regarding landscape, waterholes are not seen as separate features but connected. Disturbance of natural water flows, and the introduction of excessive industrial noise, is believed to risk the *Warlu* spirit abandoning its resident waterholes, with adverse ecological and spiritual consequences. Practically, a waterhole without water will support less resources and its aesthetic and amenity qualities will be reduced or lost. Therefore, the health and integrity of creeks is of particular concern.

Nyiyaparli Traditional Owners have consistently drawn attention to the value of Weeli Wolli Creek (*wirlawarli*) as a highly sacred place of particular spiritual and cultural importance (for Nyiyaparli as well as Traditional Owner groups up and down-stream), which they want to avoid being damaged. The pools and shade along the creek make it an ideal meeting, camping, and fishing place (Stevens 2022a).

Although outside (albeit downstream of) the Development Envelope, the culturally significant Weeli Wolli Spring has been raised by Traditional Owners during Social Surroundings consultation. Concerns raised relate to potential impacts on the spring from water supply and disposal activities undertaken for the nearby Hope Downs 1 operations (that requires dewatering of BWT pits). Traditional Owners are aware that Hope Downs 1 operations is coming towards the end of operational life and have expressed concern about what will happen at Weeli Wolli Spring during this time of change, particularly concerns around the potential for the spring to suddenly dry out when surplus water discharge ceases from HD1, and the creek begins to return to natural ephemeral flow regimes. Given HD2 water supply will, in part, come from surplus HD1 dewater, concerns were raised about if/how this would impact the spring and Weeli Wolli Creek, downstream of the gabion.

Traditional Owners have also raised concerns about potential impacts to Ben's Oasis from the Proposal (noting that the Proposal is AWT, requiring no pit dewatering). The spring at Ben's Oasis is not expected to be impacted by the Proposal however, due to its proximity to the Development Envelope, further

consultation with Nyiyaparli Traditional Owners is being undertaken as part of Social Surroundings work and ethnographic surveys to understand if there are any specific concerns or management requirements at this location.

Nyiyaparli Traditional Owners have also requested the Proponent investigate options to reduce the corner of the waste rock landform near Pebble Mouse Creek.

Ngarlawangga Traditional Owners are concerned with potential impacts on water flow in the two main creeks due to the proposed re-routing of the GNH, given the upper tributaries of Weeli Wolli Creek and Pebble Mouse Creek are west of the GNH within Ngarlawangga land. All Traditional Owners have also expressed the desire for ongoing involvement in water monitoring and management programs associated with the Hope Downs 1 operations and future expansions.

11.5.3.3. Potential Impacts

Potential water related concerns associated with the Proposal raised by Traditional Owners include:

- Interfering with *Warlu* or other spiritual entities through impacts from noise and/or disruption to surface water flows, creeks, or significant waterholes
- Pebble Mouse Creek crossings: potentially impacting the flow of Pebble Mouse Creek (assessed in Chapter 9).
- The potential effect on Traditional Owner water-related cultural obligations, and to other groups upstream and downstream of the diversion along the two main creek systems
- Under the current proposed Conceptual Footprint:
    - Most of the catchment from the minor tributary feeding into Pebble Mouse Creek which is associated with the HD2 waterhole (HD214_04) will be lost to the HD2 pit
    - A series of waterholes at BHT (GHD19-07-WS) will be lost to waste rock landform development
- Traditional Owner concerns regarding Weeli Wolli Spring are noted in Section 11.5.3.2. The Proposal will not impact the Spring and these concerns will be addressed through the Hope Downs 1 operations related forums.

11.5.4. Sense of Place and Amenity (Dust, Noise and Vibrations)

11.5.4.1. Key Concerns

Dust is a significant concern for Traditional Owners, repeatedly raised in consultation. Key concerns raised with respect to dust, noise and vibration are:

- The impacts of dust accumulating in water features and along drainage lines – including ecological and water quality effects and with respect to the enjoyment of place
- The effect of dust emissions on Country including amenity and aesthetics, special places, animals, plants, and people
- The volume (and source) of water required to suppress dust under standard practice
- Noise and vibration impacts to Sense of Place, enjoyment, and use of Country (including at camping spots and other areas used for cultural purposes etc.)
- Noise and vibration impacts to animals, including making existing habitats undesirable
- Potential vibration impacts to heritage sites and special places (also refer Section 11.5.5)
- Increased dust leads to reduced visibility and safety for drivers using GNH in areas near the Development Envelope.

11.5.4.2. Consultation Outcomes

The values captured in this section reflect the holistic Sense of Place Traditional Owners are understood to attach to the broad dimensions of areas under their guardianship – e.g., land, waters and sky. The Proposal has the potential to indirectly impact the enjoyment and use of, and connection with, related intangible values tied to Country, and culturally important utilisation of places, plants, and animals through the generation of dust emissions and deposition, as well as the emission of noise and vibration from mining and related activities.

11.5.4.3. Dust

Traditional Owners often express how unpleasant the visual effect of dust that settles on country – vegetation as well as pools along waterways – along with the airborne dust clouds that can linger around operational areas, and how this makes use of Country for cultural activities such as camping, less appealing. The dust observable in these areas supports a perception that standard practice dust suppression has limited effectiveness despite the volume of water used. Traditional Owners have provided anecdotal feedback that dust layers settling on still pools left them prone to excess algal growth and would like this investigated, along with a focus on minimising dust deposition into creeklines (Stevens 2022a and 2022b).

Concerns regarding dust, noise and vibration impacts on the health and wellbeing of Traditional Owners, mine workers and consultants/contractors undertaking regular or intermittent work within the Development Envelope was raised on a number of occasions during Social Surrounds consultations. Ongoing human health and safety concerns included, airborne dust and associated contaminants, regular and prolonged exposure to mining related noise (i.e., blasting) and driver visibility for drivers using the Great Northern Highway.

Dust emissions from ore transport along haul roads has been regularly raised in meetings and field trips as a particular concern (although dust from all sources is of interest), with a high interest in alternatives such as use of conveyor or road trains on sealed roads (ore transport options are discussed in more detail in Section 2.1.3.4. During consultation on ore transport options, Nyiyaparli indicated that the haul truck option was not acceptable to them due to potential dust emissions, but either of the other two options (crush-convey and road train) were acceptable. Consultation also identified a common desire

amongst Traditional Owners to see innovation in dust management to minimise water use in handling and transport (e.g., covers on dust emitting plant or vehicles).

Traditional Owners also expressed concern regarding dust from operations becoming an eyesore, impacting waterholes, vegetation, and fauna, affecting cultural activities, and diminishing people's enjoyment of Country (Section 11.5.5). Nyiyaparli considered, anecdotally, that dust often settles on still pools forming a layer on the surface that is visually unappealing and suspected of promoting algal blooms.

As part of Social Surroundings consultation, Traditional Owners identified the following places within the Development Envelope as being of particular concern regarding increased dust impact:

- The waterhole at HD2 (HD214_04) on Nyiyaparli Country
- The waterholes at BHT (GHD19-07-WS) if impacts to these waterholes cannot be avoided on Nyiyaparli Country
- BDH16-03 rock shelter at BHT on Nyiyaparli Country
- Cave 10 at BHT on Nyiyaparli Country
- Cave 7 on Ngarlawangga Country
- Pebble Mouse Creek (including in the vicinity of the proposed crossings at HD2) on Nyiyaparli, Banjima and Ngarlawangga Country.

In addition, the following areas outside the Development Envelope but in proximity to the Proposal were also identified as being of concern to Nyiyaparli Traditional Owners regarding increased dust impacts:

- The HOPE4-07 site-complex
- Weeli Wolli Creek (including Ben's Oasis and Weeli Wolli Spring).

11.5.4.4. Noise and Vibrations

While feedback from Traditional Owners indicates the visual effect of dust as of most concern in terms of potential impact on amenity of these places, noise is also an issue that has been raised during consultation. In particular, Ngarlawangga feedback included concerns regarding dust, noise and chemical pollution on plants, animals, and water.

This includes the effect of noisy plant and machinery on places such as camping spots or other areas used for cultural purposes. For example, Nyiyaparli expressed annoyance that a location on Weeli Wolli Creek visited during Social Surroundings consultation was 'not the same' (e.g., for enjoyable camping) due to existing mining activities and therefore, any additional noise (such as reversing beepers) from the Proposal would likely exacerbate the annoyance (Stevens 2022a). Nyiyaparli People also expressed sadness due to their view that some animals like kangaroos and emus have become locally scarce and believe it relates to noise from existing mining activities in the region.

11.5.4.5. Potential Impacts

Potential indirect impacts to this theme/value include:

- Increased dust and noise levels as a result of construction and mining and associated activities.
- Disturbance to sites and places of social, cultural and heritage significance as a result of mining activities particularly during construction
- Alteration of the sense of place and liveability (for people and animals), social, cultural and environmental dimensions, land use (by people and animals) and association, experience and enjoyment of country due to dust and noise and changes to landscapes and landscape features
- Reduced visibility and increased safety risks for drivers travelling on GNH.

Mining by its nature alters natural landforms, particularly with respect to pit voids and waste rock landforms. The direct visual impact of these changes is addressed in Section 11.5.5. The Proponent acknowledges the linkages between direct visual effects of landform changes and the more holistic, or combined, impact of visible dust, and noise, on a broader, interconnected sense of place for Traditional Owners.

Traditional Owners, particularly Nyiyaparli, have asked that priority be given to avoiding and minimising these impacts at Weeli Wolli Creek and the landscape to the north of the creekline up to the overlooking ridgelines to protect the Sense of Place and cultural values in these parts of their Country. Nyiyaparli have indicated that the Sense of Place and ability to enjoy cultural activities and Country have been diminished by existing operations near and along Pebble Mouse Creek and the north side of the ridgeline more broadly. Nevertheless, Traditional Owners would like relevant impacts to be minimised in this area where possible.

Dust created by the Proposal also has the potential to impact visual amenity for the wider community from vantage points, and increased dust also has the potential to impact visibility for drivers on Great Northern Highway.

More broadly, the Proposal has the potential to contribute to cumulative dust and noise impacts in the region, which already has a number of mining operations in close proximity (refer to Section 11.4.4).

Air Emission and Noise and Vibration Modelling has been undertaken. Appendix F7 provides Hope Downs 2 Air Quality Assessment and Appendix F8 provides the Noise and Vibration Impact Assessment.

11.5.5. Sense of Place and Amenity (Altered Visual Landscapes)

11.5.5.1. Key Concerns

Key concerns raised with respect to Sense of Place and amenity included:

- Pit development and construction of waste rock landforms and land bridges has potential to affect the visual character of the landscape
- Changes to or alteration of cultural landmarks used by Traditional Owners to navigate and pass down: stories of connection between places; and connection between people and place
- Potential disruption to vistas from three prominent high points (within 3.5- 32 km from the Development Envelope)
- Disruption to visual amenity along the southern ridgeline and areas visible from Weeli Wolli Creek.

11.5.5.2. Consultation Outcomes

Section 11.5.7 describes the key landscape features which have been identified as important to the Traditional Owners.

The alteration to the general landscape from the Proposal is challenging for Traditional Owners, particularly Nyiyaparli People whose land is most physically affected. These alterations include changes to prominent landforms from excavation of the BHT deposit as it is in an elevated landscape position, as well as the excavation of the HD2 deposit and the construction of large waste rock landforms and land bridges adjacent to the pit areas. Nyiyaparli Traditional Owners have indicated the priority area they would like protected from the visual effect of changes to landscape is along Weeli Wolli Creek.

In addition to the alternation of the physical landscape as a result of mining activities, visual landscapes and amenity will be altered by the presence of mining infrastructure and equipment, people, increased dust and other changes.

Feedback also included the potential for eyesores such as rubbish, including the deliberate construction of ‘boot trees’ and ‘hard hat mounds’ found at some mine operations. Traditional Owners have expressed general concern regarding waste management and would like to be involved in discussions about this issue.

For the Nyiyaparli People, Weeli Wolli Creek emerged as the most important landscape feature relevant to the Proposal, although any waterway, such as Pebble Mouse Creek and associated ‘*yinta’* (permanent or semi-permanent pool along the creeks and rivers) holds a level of cultural importance (Stevens 2022a). These two major creek lines are important to Banjima and Ngarlawangga People, including as a cultural boundary between the Nyiyaparli and Banjima traditional lands.

Recognising the landscape to the north of the deposit ridgeline is affected by existing Hope Downs 1 operations, the Nyiyaparli People have requested impacts to the southern aspects of the ridgeline and areas visible from Weeli Wolli Creek be avoided and minimised where possible. Where relevant, this will inform additional visual impact assessment work.

11.5.5.3. Potential Impacts

Landform changes will occur from the development of mine pits and placement of mineral waste management infrastructure including waste rock landforms and land bridges. Pit voids post closure will remain as permanent changes to the landscape at each deposit.

The HD2 and BHT deposits are approximately 8 km apart at their closest points. Both deposits sit between the upper reaches of the Weeli Wolli Creek and Pebble Mouse Creek lines, with the BHT ridgeline locally prominent in the context of the immediate surrounding landscape.

Disturbance associated with BHT, including permanent pit voids, waste rock landforms and land bridges, is concentrated on the northern side of the ridgeline such that visual impacts from southern viewpoints (i.e., from Weeli Wolli Creek) are not expected to be significant.

Traditional Owners have acknowledged there will be a higher level of visual impact on the northern side of the deposits as viewed from Pebble Mouse Creek and this will occur in a landscape already affected by existing adjacent operations.

Pit development has potential to affect the visual character of the landscape as observed from:

- Special places including Weeli Wolli Creek and Pebble Mouse Creek generally, and specific locations such as Weeli Wolli Springs, Ben's Oasis, HOPE4-07 and BHD 16-03
- Surrounding high observer points accessible to the wider community, including Mt Robinson, Mt Meharry and The Governor. The views from Mt Meharry are not expected to change, however, views from Mt Robinson will take in proposed waste rock landforms (Rio Tinto 2020c). Views from The Governor will also take in proposed waste rock landforms (Rio Tinto 2020c). The effect of the Proposal on views from Mt Robinson and The Governor are therefore expected to be locally significant in that the occasional visitor that climbs to the highest viewing points at or near their peaks may be affected. The Mt Robinson rest area is much lower in the landscape and not expected to be visually affected at all by the Proposal
- Great Northern Highway.

The HD2 deposit intersects the Great Northern Highway. The Proposal will therefore require a realignment of a portion of the Great Northern Highway, to enable access to the deposit. This also has the potential to alter the visual amenity for road users. During operations and closure, some waste rock landforms will be visible from the Great Northern Highway where the current alignment is close to the western end of the proposed Conceptual Footprint (Rio Tinto 2020c).

The exact location and design of the Great Northern Highway realignment is yet to be determined and the Proponent is committed to ongoing consultation with the Ngarlawangga and Nyiyaparli Traditional Owners, Main Roads, BHP, and the Shire of East Pilbara as mine planning progresses. An analysis of the final design will be undertaken to confirm impacts are not different to or greater than the preliminary design. As a result, from the point of view of a member of the public driving along Great Northern Highway, the disturbance associated with the Proposal is not expected to result in a significant difference to the visual landscape.

The Proponent acknowledges the linkages between direct visual effects of landform changes and the more holistic, or combined, impact of visible dust, and noise, on a broader, interconnected Sense of Place for Traditional Owners. Consultation with Traditional Owner groups regarding the significance of visual amenity impacts from culturally important areas is ongoing and to be determined by those groups and the Proponent aims to achieve informed non-opposition to the proposed outcomes.

11.5.6. Access to Country

11.5.6.1. Key Concerns

Key concerns raised by Traditional Owners with respect to access to Country are:

- Reduced extent of freely and safely accessible areas on their Country – particularly Weeli Wolli Creek and associated places, as well as reduced access to exercise native title rights and enjoy Country generally (including special places, waterholes, places to hunt or collect resources, camping spots and any place of social significance)
- Limitations and difficulties Traditional Owners face to visit Country due to Proponent controls on access, activities associated with mining and exploration, and the presence of physical barriers
- As Weeli Wolli Creek and Weeli Wolli Springs are publicly accessible, maintaining access to these areas for the public is also an important consideration.

11.5.6.2. Consultation Outcomes

The Nyiyaparli, Banjima and Ngarlawangga Traditional Owners have native title rights in accordance with their respective determinations (Section 11.4.8), including rights to access Country and exercise traditional rights on that Country. Maintaining access to Country is important for the purpose of hunting, camping, collecting natural resources, attending ritual and ceremonial activities, visiting special places, enjoyment of and caring for Country and other purposes such as teaching - young people especially - about culture, tradition, and landscape-based narratives (Stevens 2022a and 2022b). Access for day trips or longer periods for these cultural purposes is integral to Traditional Owner lifestyle and to the continuance of cultural identity.

Traditional Owners understand and accept that active mining areas cannot be accessed for safety reasons. However, they have commonly expressed anxiety and dissatisfaction with limits on access to country that has occurred with existing mines and mining-related activity and are concerned this will continue and be compounded under this Proposal (Stevens 2022a, Stevens 2022b, Herrmann and Millett 2021). This applies not only to areas close to mining activity but with respect to more distant locations within their native title lands (e.g., due to rail line fencing, or because of exploration activity). Traditional Owners have expressed a desire to see the Proponent work constructively with them to facilitate access to Country.

Ngarlawangga People have raised concerns about mine workforce accessing Country without permission and going to places governed by cultural protocols, such as gender restrictions (Herrmann and Millett 2021). The concern relates to not only the perception of disrespect for culture but the spiritual safety of people accessing areas they are not culturally permitted to do. The Ngarlawangga Traditional Owners did not expect a blanket ban on Proponent staff accessing sites, rather indicating that appropriate consultation should occur prior, with visitors being escorted around relevant places by Traditional Owners.

Traditional Owners have indicated a preference for access to Country, particularly Weeli Wolli Creek and Weeli Wolli Spring and adjacent areas, to be available year-round. There are several access routes for the spring and creek, but Traditional Owners mostly use the Hope Downs private Mine Access Road, which will be retained even with the Proposal – although this Access Road will likely be temporarily closed for 18-24 months due to safety reasons given construction works and first ore transport. Traditional Owners have said access needs to be easy and not restricted (i.e., by permit systems, fences, and gates). Related concerns include the condition, location, and safety of the current road to Weeli Wolli Creek, with some hunting and camping areas potentially becoming inaccessible.

Ngarlawangga People consider that the existing Great Northern Highway alignment presents multiple social impacts, including a disincentive to visit and enjoy their Country due to the presence of the road

and volumes of traffic. They have concerns that the proposed re-alignment may create further impacts in this regard.

Nyiyaparli Traditional Owners also have concerns regarding the location of the Great Northern Highway as current options included potential alignments intersecting their Country which may disrupt access for Nyiyaparli People to their land. They also have concerns that the public may, as a result of any new alignment, be able to access additional areas of their Country beyond Weeli Wolli Spring. Nyiyaparli Traditional Owners are not supportive of this.

Banjima Traditional Owners have indicated a concern about being able to access hunting areas without the need to worry about the safety of mine personnel due to firearms used for hunting.

Consultation regarding potential re-alignment of Great Northern Highway with Main Roads and adjacent tenure holders has commenced and may impact the final alignment route. As options are developed and consultations with third parties progress the Proponent will continue consult with Main Roads to finalise the alignment, land assembly and construction model for the Great Northern Highway re-alignment. The alignment will also be compliant with Main Roads requirements, including the required 1-kilometre buffer from mining / blasting activities.

11.5.6.3. Potential Impacts

Traditional Owner access to most areas of the Development Envelope will be restricted during the construction, operation, and rehabilitation of the Proposal. These restrictions on access may be permanent or temporary depending on the nature of the activity undertaken. The Proponent acknowledges that the loss of unrestricted access is an impact in relation to the site BHD16-03 rock shelter.

One of the main access routes to Weeli Wolli Creek gabion (the water discharge point from the Hope Downs 1 operations) and Weeli Wolli Springs from the Great Northern Highway is via the Hope Downs private Mine Access Road, which will be realigned by the Proposal. However, access to the gabion and springs via the re-aligned Mine Access Road will be maintained.

All but a small section of the upper catchment of Weeli Wolli Creek is located outside the Development Envelope. However, current access to sections of the creek line as well as to the HOPE4-07 heritage site-complex is via roads within the Development Envelope, this has potential to be affected by changes to, or management of, these roads as result of the Proposal. Parts of Pebble Mouse Creek can also be reached utilising existing roads located within the Development Envelope and therefore could be similarly affected.

At closure, most areas within the Development Envelope will become generally accessible to Traditional Owners once rehabilitation and safety and stability completion criteria are achieved; however, access to some areas will be permanently affected due to safety considerations, such as:

- Pit voids with abandonment bunds installed outside the Zone of Instability (ZOI) to prevent access (for safety reasons)
- Flooding or surface water drainage structures.

Other aspects affecting access to Country within the Development Envelope post-closure include the removal or retention of tracks and roads, fencing, rail, and other infrastructure that may be potential barriers to movement.

The re-alignment of up to 6 km of Great Northern Highway has the potential to temporarily disrupt access to users of this road during construction. The proposed HD2 pit intersects the current alignment of the Great Northern Highway, and in order to access the ore in this part of the pit, the Proponent will require the temporary or permanent re-alignment of up to 6 km of the Great Northern Highway. Ongoing design work and consultation with key stakeholders including Main Roads and the Shire of East Pilbara is underway in order to determine the approach that will cause minimal disruptions while still allowing access to road resources.

11.5.7. Special Places (Including Heritage Sites and Places

11.5.7.1. Key Concerns

During consultation regarding the Proposal, several landscape scale values and concerns were raised which had the potential to be impacted either directly or indirectly. These are mostly outlined in concern specific parts of Section 11.5 (water, dust and noise, plants and animals and access to Country for example). Additional concerns raised included:

- Increased visibility of Traditional Owner culture on site and support for sharing of culture, including recording of knowledge and Country, including cultural mapping and Traditional Ecological Knowledge consultation/projects
- The potential impact on culturally significant waterholes in the region and associated effects on indigenous animals of cultural importance to Traditional Owners that rely on these waterholes
- Avoidance of heritage sites and restricted access to significant sites along the Great Northern Highway
- Concerns regarding the keeping of artefacts salvaged from disturbed areas and the desire to engage with the Proponent around joint planning an appropriate facility.

11.5.7.2. Consultation Outcomes

There are numerous heritage sites and other culturally important places in and around the Development Envelope (Stevens 2022a and 2022b).

Special places for Traditional Owners include heritage sites recognised for their archaeological and ethnographic value under Aboriginal heritage legislation, but also includes other, culturally important, areas such as waterholes, camping spots and any place of social and cultural significance (Stevens 2022a and 2022b). In other words, Aboriginal cultural heritage includes a range of sites and places, some of which may not be deemed ‘sites’ under the AH Act, as well as places and areas for social and cultural activities such as resource collection or visiting Country to learn and teach Traditional Law and Lore.

For cultural and protective reasons, some places, sites and features may not be allowed to be mapped, described or be made available to the public domain. This does not diminish their importance. Cultural protocols are required to be followed with respect to Traditional Lore some of which involve finding ways to communicate to others (e.g., the Proponent) to ensure the person providing the information does not breach Traditional Law (Stevens 2022a and 2022b).

11.5.7.3. Potential Impacts

Waterways

Weeli Wolli Creek

Weeli Wolli Creek is a major creek which is highly significant to Banjima and Nyiyaparli Traditional Owners. The creek is located to the east/southeast of the Development Envelope with the upper reaches of the creek situated within the southern extent of the Development Envelope at the HD2 deposit.

This ephemeral creek holds mythological associations with the *Warlu* (creation serpent) and is used as a cultural boundary between the Banjima and Nyiyaparli People. Many sites are located within and adjacent to the creek line including highly significant places such as Weeli Wolli Springs and HOPE4-07. Cultural values of the spring have traditionally been co-managed by Banjima and Nyiyaparli People with both groups acknowledging the need to consider input from the other group at various locations along its length.

Pebble Mouse Creek

Pebble Mouse Creek is a tributary which flows into Weeli Wolli Creek and is a key ephemeral water source for the Banjima, Nyiyaparli and Ngarlawangga Traditional Owners. Pebble Mouse Creek is situated to the north and north-west of the Development Envelope and is intersected by the existing Hope Downs 1 operations and rail line.

As part of the Proposal, at least two new creek crossings will be required to support Proposal infrastructure. Based on consultation to date with the Nyiyaparli, Banjima and Ngarlawangga Traditional Owners, their primary concerns are around the blockages of ephemeral surface water flow during different magnitude flood events, and movement and build-up of sedimentation. Movement of sedimentation via Pebble Mouse Creek and into Weeli Wolli Creek (and potentially reaching Weeli Wolli Springs) was a particular concern for Traditional Owners. Hydrological modelling of potential flood events indicates that there will be minimal impact to flow rates during normal flow events as well as minimal additional movement of sediment affecting Weeli Wolli Creek. Consultation is ongoing with all three Traditional Owner groups in regard to the placement and design of the crossings, to provide additional information about potential impacts to the creeks and to better understand Banjima and Nyiyaparli Traditional Owner concerns.

Weeli Wolli Springs

Weeli Wolli Creek is a major creek which is highly significant to Banjima and Nyiyaparli Traditional Owners. The creek is located to the east/southeast of the Development Envelope with the upper reaches of the creek situated within the southern extent of the Development Envelope at HD2.

This ephemeral creek holds mythological associations with the Warlu (creation serpent) and is used as a cultural boundary between the Banjima and Nyiyaparli People. Many sites are located within and adjacent to the creek line including highly significant places such as Weeli Wolli Springs and HOPE4-07. Cultural values of the spring have traditionally been co-managed by Banjima and Nyiyaparli with both groups acknowledging the need to consider input from the other group at various locations along its length.

Nyiyaparli Heritage Places

Survey coverage to date has identified a total of 149 heritage places of varying significance within the Development Envelope on Nyiyaparli Country. Of these, 85 heritage places are currently within the proposed Conceptual Footprint. Options to redesign infrastructure and mine pits to avoid these sites are currently being completed. As of 1 November 2022, Level 1 archaeological recording (i.e., recording of sufficient detail for submission to the DPLH to make an assessment on whether a place constitutes a site, in accordance with the Rio Tinto Heritage Survey Guidelines, 2022) has been completed on all 85 sites within the proposed Conceptual Footprint. Ethnographic assessment has been completed on 26 of 85 sites.

As a result of these consultations, Nyiyaparli Traditional Owners have identified several sites of significance that they wish to investigate avoidance for or for which avoidance has already been committed to by the Proponent. These sites are detailed in Appendix F1. Nyiyaparli has expressed the desire to manage Country holistically and for the Proposal impacts to be considered as together. Any impacts to individual sites, whether archaeological or ethnographic, must be considered not only in relation to the impacts to that site but also in terms of the potential impact it may have to the entire cultural landscape. As such, future ethnographic and social surroundings consults will look to further define cultural values of the landscape and determine connections between different sites and areas that are culturally significant.

Ben’s Oasis

Ben’s Oasis is an important permanent water source situated on Weeli Wolli Creek and located 1.3 km southeast of the Development Envelope at BHT. The spring is not expected to be impacted by the

Proposal however, due to its proximity to the Development Envelope, further consultation with Nyiyaparli Traditional Owners is being undertaken as part of Social Surroundings work and Ethnographic surveys to understand if there are any specific concerns or management requirements at this location.

BDH16-03

Located in the northern section of BHT on Nyiyaparli Country, BDH16-03 is a rockshelter containing artefacts and rock art. Consultations with Nyiyaparli Traditional Owners to date indicate the site is highly significant and can be used to pass on traditional knowledge to future generations. Key concerns raised in regard to this site are potential impacts relating to vibrations, dust, visual amenity, and access.

HOPE4-07

Located to the east at HD2, and straddling both sides of Weeli Wolli Creek, HOPE4-07 is a large site complex consisting of a number of unique archaeological features including several rock shelters with potential sub-surface deposit, dense artefact scatters, pitted stone quarry areas and grinding areas.

Consultations with Nyiyaparli Traditional Owners to date indicate that the site is highly significant, however, further work is required to understand management requirements associated with the different types of heritage values present within (and any overarching ethnographic values that may extend beyond). Key concerns raised have been the potential impacts relating to dust, visual amenity, and access.

Waterholes

Waterholes are generally of high cultural significance to Traditional Owners as they represent places that sustain not only human life but plant and animal life also. Waterholes are also regarded as places where people would gather or seek out along a known travelling route.

Two culturally significant waterholes have been identified by Nyiyaparli Traditional Owners during Heritage Survey work within the Development Envelope on Nyiyaparli Country (HD214_04 at HD2 and GHD19-07-WS at BHT).

GHG19-07-WS

Located in the northwest at BHT on Nyiyaparli Country. It consists of a series of five waterholes situated within a minor creek line. This location is proposed to be impacted by a waste dump in the proposed conceptual design. However, following Social Surroundings consultation with Nyiyaparli, redesign options are being considered to avoid the location, to allow for it to be managed in-situ. Undertaking further redesign work investigating options that may allow avoidance of the site and an associated buffer is part of the Nyiyaparli SCHMP commitments. Impacts to the site will be managed via approvals under the ACH Act.

HD214_04

This waterhole is located to the west at HD2 on Nyiyaparli Country. It is estimated to be approximately 1 m deep with artefacts located in the vicinity. It is associated with a minor tributary (creek line) to Pebble Mouse Creek along with a number of other heritage sites. The site is located within the HD2 pit area and is proposed to be impacted by the Proposal. Undertaking further redesign work investigating options that may allow avoidance of the site and an associated buffer is part of the Nyiyaparli SCHMP commitments. Impacts to the site will be managed via approvals under the ACH Act.

Rockshelters

To date, there are 17 rock shelters that have been recorded within the proposed Conceptual Footprint. Of these, 13 are located within the BHT area and four are located within the HD2 area.

Ngarlawangga Heritage Places

Survey coverage to date has identified a total of 17 heritage places of varying significance within the Development Envelope on Ngarlawangga Country. Of these, 12 heritage places are currently located within the proposed Conceptual Footprint.

As of 1 November 2022, only site bypass recording has been completed on these sites. Further consultation as well as Level 1 archaeological recording (i.e., recording of sufficient detail for submission to the DPLH to make an assessment on whether a place constitutes a site, in accordance with the Rio Tinto Heritage Survey Guidelines, 2022) will be required if it is determined that any sites within the proposed Conceptual Footprint will be impacted. Ethnographic site avoidance assessment has been completed on all of these sites.

Ngarlawangga Traditional Owners have expressed the desire to manage Country holistically and for the impacts of the Proposal to be considered together. Any impacts to individual sites, whether archaeological or ethnographic, must be considered not only in relation to the impacts to that site but also in terms of the potential impact it may have to the entire cultural landscape. As such, future ethnographic and social surroundings consults will look to further define cultural values of the landscape and determine connections between different sites and culturally significant locations.

Banjima Heritage Places

Survey coverage to date has identified one heritage place (HD2006-6; artefact scatter) within the Development Envelope on Banjima Country. This site was cleared for the mine development following consultation and salvage with Banjima and with Government approval. The temporary Hope Downs 1 Artefact Repository is located within the Development Envelope but will not be impacted by the Proposal.

Of particular significance to the Banjima People is Djadjaling Rockshelter, Weeli Wolli Creek and Weeli Wolli Spring. Djadjaling Rockshelter is located 400 m to the west of the Development Envelope. Excavations document over 40,000 years of occupation in the area by Banjima ancestors (Cropper and Law 2018). This is among the oldest excavated sites in Australia and documents technological innovation, management of global climate change and the relationships between places at the Hope Downs Hub. Weeli Wolli Creek and Weeli Wolli Spring are shared by Banjima and Nyiyaparli People and are discussed in more detail earlier in this section (see Section 11.4.9.1). Associated with these water systems are sinkholes of mythological importance. These are at least 200 m from the Proposal, between the Development Envelope and Weeli Wolli Creek.

Any impacts to individual sites, whether archaeological or ethnographic, must be considered not only in relation to the impacts to that site but also in terms of the potential impact it may have to the entire cultural landscape. As such, future ethnographic and social surroundings consults will look to establish cultural values of the landscape and determine connections between different sites and culturally significant locations.

11.5.8. Plants and Animals

11.5.8.1. Key Concerns

Key concerns raised by Traditional Owners with respect to plants and animals include:

- A reduction in the presence, health and abundance of culturally significant plant and animal species
- A reduction in the presence, health and abundance of other plant and animal populations
- A reduction in biodiversity within the Development Envelope during operations and, depending on rehabilitation outcomes, potentially permanently post-closure
- Interference in Traditional Owners' cultural role as land managers and caretakers which may impact their ability to care for Country as its cultural custodians (e.g., fire management practices)
- Traditional Owner involvement in Proposal management and monitoring.

11.5.8.2. Consultation Outcomes

The importance of 'looking after Country' is paramount for Traditional Owners because it symbolises who they are, informs how they should live, and provides for their existence. It is a cultural-ecological ethos founded in relationships of respect – for each other, ancient traditions, flora, and fauna, 'living water' as well as spirits in the land, stories and narratives that belong in the land, or waters – embedded in a set of rights and responsibilities created in the Dreaming' (Stevens 2022a and 2022b).

Traditional Owners are concerned with not only plants and animals that have specific cultural associations, but their Care for Country ethos means that they are culturally responsible for maintaining healthy Country, meaning they are obliged to care for all plants and animals that occur on Country. The Proposal area includes culturally significant plant and animal species.

These plants and animals may:

- Be important food sources, such as bush tucker plants, kangaroos, emus, goannas and bush turkey
- Be used for medicine
- May hold other cultural significance such as ceremonial uses, for clothing, for structures and toolmaking
- May be part of important stories
- May be an indication of the health of Country.

Ngarlawangga Traditional Owners have expressed concerns about impacts to the Pebble Mound Mouse and Ghost Bats (refer to Chapter 7). Nyiyaparli, Ngarlawangga and Banjima People share concerns about the potential for impacts to culturally important species. This is due to interference with migration pathways and local eradication or significant reduction of populations, or from clearing of vegetation. This reduction or clearing leads to a need to access these resources from neighbouring Country, which may impact social relationships and create cultural obligations.

Nyiyaparli and Ngarlawangga Traditional Owners perceived an impact from recent increases in Great Northern Highway traffic on bush tucker animals. They have queried the prioritisation of monitoring and research of listed species over culturally important species with Ngarlawangga Traditional Owners highlighting that culturally important (e.g., bush tucker and bush medicine) plant and animal species are as important, if not more important to them than species listed under environmental legislation or by environmental agencies (Herrmann and Millett 2021).

Nyiyaparli and Ngarlawangga People have discussed the need to record and map their own traditional ecological knowledge, key species, and cultural values so that potential impacts could be better understood and addressed.

11.5.8.3. Potential Impacts

Broadly, Traditional Owner groups have expressed concerns about their ability to protect animals and plants and key locations such as waterholes that support the animals and plants in accordance with their cultural responsibilities (i.e., Care for Country) should the Proposal proceed. Traditional Owners are also concerned that particular animals and plants which are highly valued by them as a source of food, medicines, resources such as wood or ash, ritual or mythological or other cultural association may be significantly reduced within and in proximity to the Development Envelope.

The Proposal has the potential to add to cumulative impacts to plants and animals in the region, which already has a number of mining operations in close proximity. Key potential impacts of concern identified include impacts to loss of individuals or populations of plants or animal species, loss of biodiversity, impacts to animals as a result of loss and fragmentation of habitat and migration pathways and social and cultural impacts of loss of culturally significant plants and animals.

11.5.9. Mine Closure and Rehabilitation

11.5.9.1. Key Concerns

Key concerns and potential impacts raised by Traditional Owners with respect to mine closure and rehabilitation include:

- Improved mine planning to reduce ongoing and cumulative impacts
- Post-closure rehabilitation, including backfill of pits
- Ongoing (residual) physical and biological impacts to Country and potential chemical impacts through the permanent existence of waste rock landforms, pit voids and land bridges (final landforms)
- Ongoing (residual) amenity and visual impacts to country including those with respect to position, scale, shape and visual nature of final landforms, pit voids, permanent drainage features and rehabilitation outcomes - noting Nyiyaparli Traditional Owners' desire for landforms and rehabilitated country to be as natural looking as possible
- Recognition of Native Title rights in post-mining land use - Nyiyaparli People expect to resume/continue the activities associated with Native Title rights with unfettered access to all country that supports cultural activities and all species with particular attention to culturally important plant and animal species
- Closure and rehabilitation design that includes culturally important aspects such as useful or important plant species, fauna habitat creation for key animals and features that reflect traditional stories and understanding of the land
- Ongoing amenity impacts associated with rehabilitation which may not enable return of valuable species to Traditional Owner culture and well-being
- Amenity impacts associated with the potential permanent loss of temporary water holes and special places.

11.5.9.2. Consultation Outcomes

Traditional Owners that hold Native Title rights will continue as the traditional custodians of the land after mine closure, so are concerned with what legacy they will inherit. The Nyiyaparli Traditional Owners preference is for any altered landform to be returned to something resembling its natural state ('i.e., to be 'natural looking'), wherever possible. Nyiyaparli Traditional Owners have expressed a strong preference not to be left with abandoned pit voids or pit lakes and would like to know the number and extent of abandoned pit voids to remain on their land. Recognising that achieving this for some pits is not feasible, Nyiyaparli Traditional Owners have expressed a desire for further and ongoing engagement to investigate ways that, post-mine closure, Country does not represent a liability and may be able to be returned to some form that provides the ability to resume traditional social and cultural activities wherever possible.

Nyiyaparli Traditional Owners have indicated a strong preference for pits to be backfilled and rehabilitated. Where this is not achievable, the Nyiyaparli People wanted to know about revegetation and land-forming options to minimise visual impacts and reinstate some use of this area as a habitat for animals.

Nyiyaparli Traditional Owners have an interest in rehabilitation and the rehabilitation process, including potential to be involved in the various aspects of revegetation (e.g., seed collection and storage, plant nursery, ethnobotanical surveys to identify key species to target as part of a revegetation mix) as well as timeframes and current examples to demonstrate results and guide expectations and understanding. Consultation field trips included visits to rehabilitation areas and final landforms at nearby existing mining operations.

Traditional Owners have indicated a preference for rehabilitation to occur as soon as practicable after mining activity is completed. The Proponent has presented information to Nyiyaparli Traditional Owners during consultation on rehabilitation sequencing and timing to demonstrate what is feasible and expected to be achieved in this regard.

Banjima Traditional Owners too have an interest in developing economic opportunities within and beyond mining, including with respect to rehabilitation and closure activities.

11.5.10. Cumulative Impacts

As noted in Section 11.5 above, consultation outcomes with Traditional Owners have highlighted concerns regarding cumulative impacts in the vicinity of the Proposal. This concern extends more broadly across the areas of their native title determinations.

They include the potential cumulative impacts:

- On water from mining activities in the wider area by multiple proponents
- Traditional Owner water-related cultural obligations, and to other groups upstream and downstream of the diversion along the two main creek systems (Pebble Mouse Creek and Weeli Wolli Creek)
- Dust accumulation in water features and along drainage lines – including ecological and water quality effects and with respect to the enjoyment of place
- Noise, visual amenity, and visual landscapes in the region, which already has a number of mining operations in close proximity
- Plants and animals in the region, particularly the loss of individuals or populations of plants or animal species, loss of biodiversity and impacts to animals as a result of loss and fragmentation of habitat and migration pathways and social and cultural impacts of loss of culturally significant plants and animals.

Importantly, Traditional Owners are concerned that the above examples of potential cumulative impacts will impede their ability to care for Country - with animals moving away, or waterholes becoming covered with a film of dust, or some parts of Country no longer being accessible.

The Proponent recognises these concerns regarding cumulative impact and will seek to address them through the co-development of SCHMPs, where relevant.

11.6. Mitigation

The Proponent is committed to ensuring that, wherever possible, the Proposal avoids or minimises potential impacts on the social surroundings of Traditional Owners and other potentially impacted people/s who interact with or live in close proximity to the Development Envelope.

To achieve this, the Proponent has undertaken engagement with relevant Traditional Owner groups, as outlined in Section 11.3. The Proponent has then worked to make changes to the Proposal design, in consultation with Traditional Owners, in order to avoid and minimise impacts to values identified through Social Surroundings consultations with Traditional Owners. The changes to the Proposal made as a result of this process are outlined in Table 11-8 and Figure 11-4. Further work is ongoing with other key community stakeholders who may also be impacted by the Proposal.

11.6.1. Mitigation Overview

The Proponent has applied the mitigation hierarchy to the Proposal to ensure it meets the EPA's objective in relation to Social Surroundings. General principles in this regard include:

- **Avoid** – the Proponent will undertake engagement and consultation, including in-field consultation, with Traditional Owner groups and relevant stakeholders to inform the Proposal design, with the aim of avoiding impacts to Social Surroundings, where practicable
- **Minimise** - the Proponent, in consultation with Traditional Owners and relevant stakeholders, will identify significant impacts to Social Surroundings values and seek to minimise direct and indirect impacts that may be a result of the implementation of the Proposal, wherever practicable
- **Rehabilitate:**
    - Rehabilitation and final landform design will consider Traditional Owner and relevant stakeholder views
    - Rehabilitation activities will be undertaken progressively over the LOM and opportunities to involve Traditional Owner groups in the rehabilitation of their Country will be explored, where practicable.

The Proponent has prepared and will implement the Mine Closure Plan (MCP), in accordance with the *Statutory Guidelines for Mine Closure Plans* (DMIRS 2020b) for the Proposal. (Refer Appendix A4). The implementation of the MCP is expected to be a condition of any Ministerial Statement associated with the Proposal.

The tables in Section 11.6.2 to 11.6.6 below summarise how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during the Proposal design to develop appropriate mitigation and management strategies to address the key potential impacts on Social Surroundings. The management and mitigation measures and outcomes outlined in in these tables may change subject to further consultation and reflect the current understanding.

11.6.1.1. Social and Cultural Heritage Management Plan

The ESD requires the Proponent to prepare a SCHMP, in consultation with each Traditional Owner group, where potential significant impacts require management. The following assessment outlines the requirement for an SCHMP with each Traditional Owner group, specifically for this Proposal:

- **Nyiyaparli**: Given all mining activities (mine pits and waste rock landforms) are located on Nyiyaparli Country, significant impacts have been assessed for Nyiyaparli Country. A draft SCHMP has been co-developed with the Nyiyaparli People
- **Ngarlawangga**: Significant impacts to Ngarlawangga Country would relate to the re-alignment of Great Northern Highway. Once final alignment of the Great Northern Highway is determined, an SCHMP will be co-developed with the Ngarlawangga People if the re-alignment impacts Ngarlawangga Country. Noting however that the option to realign the Great Northern Highway

onto Ngarlawangga Country is not the Central Case option for the Proposal, and consequently may not be required.

- **Banjima**: No significant impacts have been identified for Banjima People, given the part of the Proposal located on Banjima Country is infrastructure, predominantly transport, ore handling and ancillary (such as power and communications).

The SCHMP describes the social, cultural and heritage values within the relevant Country and will specify the measures to be taken to avoid and minimise impacts to social, cultural and heritage values on that land during the implementation of the Proposal. The mitigation hierarchy has been applied to the impacts identified in the SCHMP and discusses proposed objectives/outcomes, monitoring, management, and mitigation measures, to be implemented to appropriately minimise impacts to Social Surroundings.

The SCHMP primarily focuses on mitigation of indirect impacts, addressing Traditional Owner concerns regarding these impacts to Social Surroundings and facilitating Traditional Owner consultation and ongoing involvement with respect to issues raised. Direct impacts on Social Surroundings are also addressed in the SCHMPs by way of approaches already agreed during consultation (i.e., avoidance of significant values). The SCHMPs addresses the Proponent's obligations in relation to Traditional Owner involvement in site monitoring and reporting by the Proponent to the Traditional Owner Prescribed Body Corporates (PBCs).

Where the Proposal has the potential to cause direct impacts to heritage sites, the Proponent, in consultation with the relevant Traditional Owner group, will use the processes established under the Aboriginal heritage legislation (through the section 18 approval process under the AH Act, through ACHMPs prepared in consultation with Traditional Owners as required under the ACH Act (Section 137) or via a combination of these processes).The Proponent will also take on board Traditional Owner concerns with regard to heritage management within broader and ongoing Social Surroundings consultation, under relevant SCHMPs or other ongoing and regular consultation arrangements, in accordance with best practise and its own community and social performance guidelines.

11.6.1.2. Design changes to avoid or reduce impacts

Significant work has been undertaken to include Traditional Owner feedback from Social Surroundings consultation in Proposal decisions and to refine the mine design, and Nyiyaparli Traditional Owners have indicated appreciation for the efforts of the Proponent in this regard. Social Surroundings consultation continues and further design changes in response to Traditional Owner feedback are being investigated. A summary of key design changes made to date are provided in Table 11-8 below.

Table 11-8: Summary of Existing Design Changes to Avoid and Reduce Impacts from the Proposal

Social Surroundings Theme / Value	Changes to Avoid and Reduce Potential Impacts		
	Avoid	Reduce (Minimise or Rehabilitate)	Refer to
Water	Alteration of surface water flows due to construction of bridges, crossing, and other linear infrastructure. • The Development Envelope has been reduced to exclude areas of Weeli Wolli Creek adjacent to the HD2 deposit (approximately 6 km) and minimise areas of Pebble Mouse Creek that are within the Development Envelope • The proposed Conceptual Footprint has been reduced to avoid direct impacts to Weeli Wolli Creek and Pebble Mouse Creek through the removal of the waste rock landforms: o South of the HD2 deposit near Weeli Wolli Creek o North of the BHT deposit	Alteration of surface water flows from surface water management. Surface water management infrastructure including Pebble Mouse Creek crossings, diversion drains, levees and culverts. The diversion configuration will divert flow from a tributary of Pebble Mouse Creek around the pit and towards Weeli Wolli Creek.	Inland Water Chapter
	Groundwater drawdown • The Proposal, as described, involves AWT table mining and will not require significant groundwater abstraction (water supply only)	Groundwater drawdown Use of HD1 surplus dewater for the Proposal's water supply to minimise groundwater abstraction for Proposal water supply.	
	Reduction in catchment area • The Proponent has reduced the area of the Development Envelope by 12% • Changes to reduce the area of the Development Envelope avoiding most of Weeli Wolli Creek (approximately 6 km), and avoiding sections of Pebble Mouse Creek	N/A	
	Reduction in local water quality arising from mining activities which cause erosion, sedimentation, contamination, or dust deposition. Changes to the conceptual footprint to remove a proposed waste rock landform south of BHT to avoid potential associated impacts to Weeli Wolli creek including run-off, sedimentation, or other changes to water quality	Reduction in local water quality arising from mining activities which cause erosion, sedimentation, contamination, or dust deposition. • Crossing of Pebble Mouse Creek limited to a maximum of four crossings for the Proposal • Diversion drain built to divert flood waters away from the HD2 pit and allow it to flow	

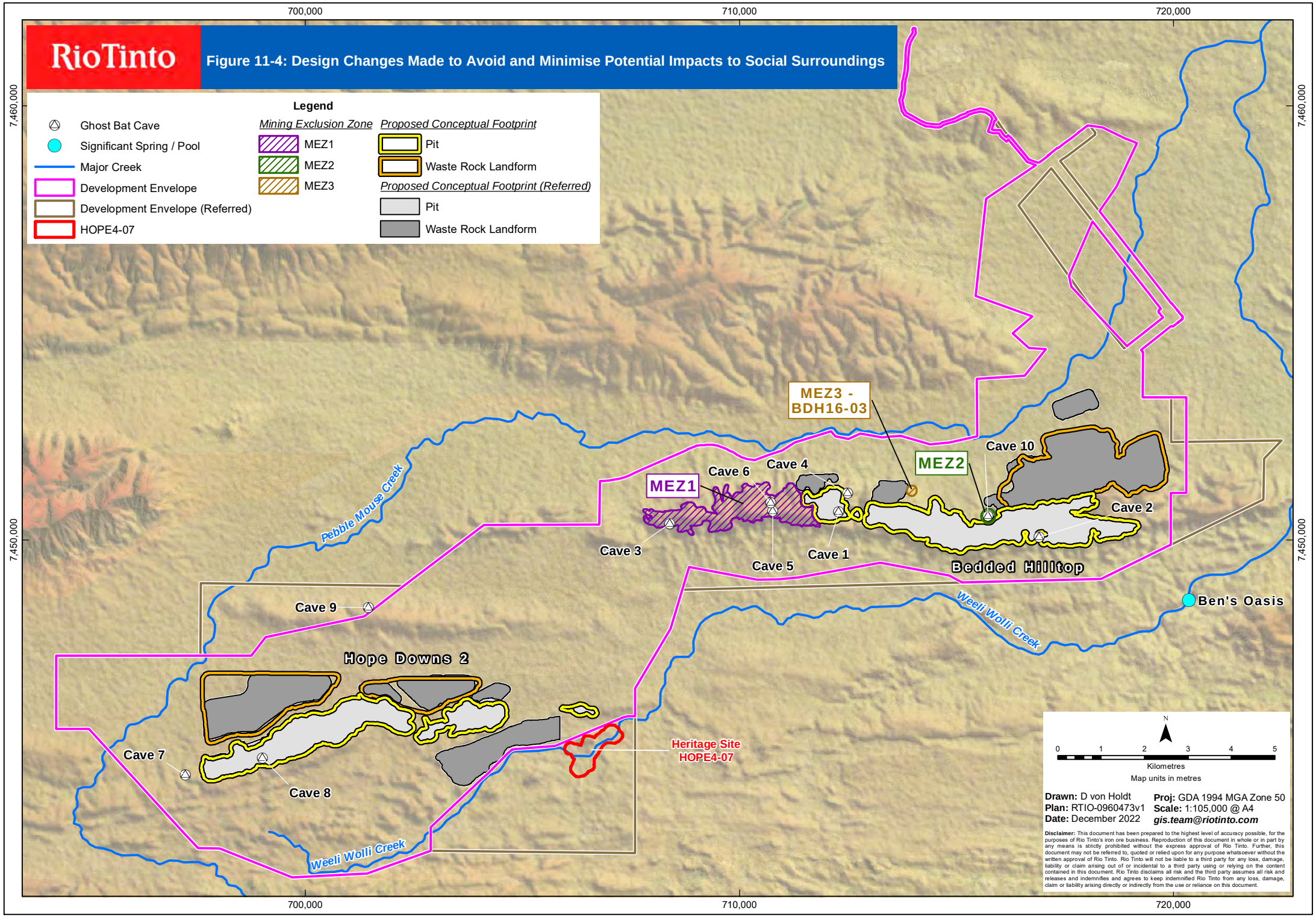
Social Surroundings Theme / Value	Changes to Avoid and Reduce Potential Impacts		
	Avoid	Reduce (Minimise or Rehabilitate)	Refer to
		back into Weeli Wolli Creek thereby retaining water flow and creek health	

Sense of place and Amenity (dust, noise, and vibrations)	• The proposed Conceptual Footprint has been amended to move waste rock landforms to avoid direct impacts to the general amenity of these areas, associated with dust deposition, noise, and vibrations, including waster rock landforms:
	  ○ South of the HD2 deposit near Weeli Wolli Creek
	  ○ North of the BHT deposit
	• Three MEZs are proposed, with 100 – 150 m buffers, which will apply to protect significant ecological and cultural values including:
	  ○ MEZ1 – Significant fauna species and their habitats (i,e., Ghost bats (Caves 3, 5, and 6), and Northern Quoll habitat (55 ha of habitat and 178 ha of connected habitat)
	  ○ MEZ2 – to ensure that the integrity and surrounding habitat of the potential maternity Ghost Bat cave (a Category 2 cave, Cave 10) is maintained for use by Ghost Bats
	  ○ MEZ3 – A site of significant cultural heritage at BHT (BDH16-03)
	• MEZs are defined as an area within the Development Envelope where no mining excavation will occur, and only low impact activities associated with environmental and cultural monitoring and management may be implemented. MEZ1 contains existing communications infrastructure that is to be maintained. No more than 5% of the total area covered by the MEZ can be cleared for low impact activities. There is to be no clearing of critical MNES habitat (Gorge/Gully and Breakaway types), no impact to Ghost Bat caves and no clearing of P2 flora within MEZ
		The use of road trains on sealed roads as the preferred ore transport option from HD2 to the HD1 plant to minimise dust emissions and water use associated with dust suppression.	SS Chapter
			Chapter

Sense of place and Amenity (landscape features)	• The proposed Conceptual Footprint has been amended to remove the waste rock landform near the HOPE4-07 heritage complex to avoid direct impacts to visual amenity from Weeli Wolli Creek • The Proponent has limited mining activity visible on the southern façade of BHT, including removing a proposed waste rock landform from an earlier version of the proposed Conceptual Footprint	N/A	SS Chapter

Social Surroundings Theme / Value	Changes to Avoid and Reduce Potential Impacts		
	Avoid	Reduce (Minimise or Rehabilitate)	Refer to
Access	• The proposed Conceptual Footprint has been reduced to minimise impacts to special places and maximise access particularly special places as identified by Nyiyaparli People • Access to BDH16-03 by Nyiyaparli People will be achieved via existing Hope Downs 1 Land Access Protocols amendment (which includes escorted access to restricted sites) • Road options have been developed to provide Nyiyaparli Peoples unrestricted access to HOPE4-07 and the associated part of Weeli Wolli Creek	A temporary route during road realignment and the implementation of a Traffic Management Plan has been proposed with the Shire of East Pilbara to minimise impacts resulting from the re-alignment of the Great Northern Highway. Rhodes Ridge Road (RR road) will be maintained by Rio Tinto during the closure of the mine access road which intersects Great Northern Highway to the west of RR road.	Chapter 2 & SS Chapter
Special places	• The Development Envelope has been reduced south of HD2, to ensure that the HOPE4-07 heritage complex falls outside the Development Envelope. This design change will avoid direct impacts to HOPE4-07 heritage complex, which was of high importance to the Nyiyaparli people in the Social Surroundings consultation • The proposed Conceptual Footprint has been amended to remove a waste rock landform south of BHT to avoid impact to: ○ areas of breakaway and gorge/gully landforms (that are more likely to contain caves and rock shelters that have potential to be heritage sites) ○ Ben's Oasis primary catchment and most of Weeli Wolli Creek ○ MEZ3, with a 100 m buffer, will apply to significant heritage site BDH16-03, within which direct disturbances will be avoided ○ Changes to the alignment of the powerline corridor to HD1 to avoid a heritage site buffer (Banjima) ○ Infrastructure has been located to avoid heritage sites, where possible	The Development Envelope has been minimised through project optimisation to reduce the total extent of disturbance.	SS Chapter
Plants and Animals	• Proposal design amendments undertaken to minimise direct impacts to: ○ groundwater-related impacts to flora and vegetation (including riparian species) ○ Weeli Wolli Creek further reducing impacts to Priority 2 flora species ○ areas of breakaway and gorge/gully landforms and habitats that contain caves and a higher concentration of significant plant and animal species	N/A	Flora and Vegetation, Terrestrial Fauna and MNES

Social Surroundings Theme / Value	Changes to Avoid and Reduce Potential Impacts		
	Avoid	Reduce (Minimise or Rehabilitate)	Refer to
	○ potential flooding of upstream vegetation ○ clearing to impacts vegetation and habitat ○ existing animal crossings • Three MEZs are proposed, with 100 – 150 m buffers, which will apply to protect significant ecological and cultural values including: ○ MEZ1 - Significant fauna species and their habitats (i,e., Ghost bats (Caves 3, 5, and 6), and Northern Quoll habitat (55 ha of habitat and 178 ha of connected habitat) ○ MEZ2 – to ensure that the integrity and surrounding habitat of the potential maternity Ghost Bat cave (a Category 2 cave, named Cave 10) is maintained for use by Ghost Bats ○ MEZ3 – A site of significant cultural heritage at BHT (BDH16-03)		


RioTinto
Figure 11-4: Design Changes Made to Avoid and Minimise Potential Impacts to Social Surroundings
Legend
Ghost Bat Cave
Significant Spring / Pool
Major Creek
Development Envelope
Development Envelope (Referred)
HOPE4-07
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Proposed Conceptual Footprint (Referred)
Pit
Waste Rock Landform
700,000
710,000
720,000
7,460,000
7,450,000
MEZ3 - BDH16-03
MEZ2
MEZ1
Cave 10
Cave 6
Cave 4
Cave 2
Cave 3
Cave 5
Cave 1
Bedded Hilltop
Pebble Mouse Creek
Cave 9
Ben's Oasis
Weeli Wolli Creek
Hope Downs 2
Heritage Site HOPE4-07
Cave 7
Cave 8
Weeli Wolli Creek
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0960473v1
Date: December 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:105,000 @ A4
gis.team@riotinto.com
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11.6.2. Water

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to water-related social surroundings. Water related mitigation actions and design changes already identified are summarised in Table 11-8 above. Mitigation actions requiring ongoing consultation with Traditional Owners and other stakeholders are outlined in Table 11-9 below and, where required for additional context, discussed below.

11.6.2.1. Avoidance – Project Design

In response to a request from Nyiyaparli Traditional Owners, the Proponent amended the Development Envelope to remove almost 6 km of Weeli Wolli Creek from within the Development Envelope and avoid most sections of Weeli Wolli Creek, and a section of Pebble Mouse Creek by:

- Moving the Development Envelope boundary to the north of Weeli Wolli Creek, adjacent to the HD2 deposit, to provide confidence that both direct and indirect impacts to the creek in this area would be avoided
- Moving the easternmost boundary of the Development Envelope near BHT west and away from Weeli Wolli Creek to provide confidence that indirect impacts to the creek in this area would be avoided
- Moving the Development Envelope boundary north of the waste rock landform south and to remove a section of Pebble Mouse Creek.

In response to a request from Nyiyaparli Traditional Owners, the Proponent also amended the proposed Conceptual Footprint to remove the south-east waste rock landform at HD2 deposit, which was located adjacent to Weeli Wolli Creek. This avoided potential impacts to Weeli Wolli Creek. In order to achieve this design change, the north-west waste rock landform was increased in area (Figure 11-4).

The Proposal will build either a crush and conveyor option or a road train ore transport option, to transport ore from HD2 deposit to Hope Downs 1 operations processing facilities. Only one option will be required and constructed, however this impact assessment covers the potential impact of both options. The crossings associated with each option are:

- Road trains: one potential crossing of Pebble Mouse Creek for the long-term road train (LTRT) plus another crossing to access a potential transfer pad location (TP4)
- Conveyor: one crossing of Pebble Mouse Creek would be required for this transport option, there are currently two locations where this crossing may be located (Figure 2-5).

A crossing of Pebble Mouse Creek is required to construct the new Mine Access Road. The re-alignment of a 6 km section of the Great Northern Highway may require a new crossing of Pebble Mouse Creek, in the form of a bridge, however the requirement for this crossing is still to be determined, as the final engineering design for the Proposal is still being completed.

Consultations with the Ngarlawangga People have indicated their preference for the potential Great Northern Highway crossing to be bituminised to assist with minimising dust emissions to the creek. However, the potential risk of bitumen washing downstream during flood events and causing more damage (including contamination of the environment), than dust accumulation, is part of ongoing conversations to be addressed with the Ngarlawangga People via the SCHMP.

The Proponent will continue to engage with Traditional Owners regarding their concerns regarding proposed crossings over Pebble Mouse Creek and ensure that the ongoing involvement of relevant Traditional Owner groups in monitoring water quality and water impacts associated with Weeli Wolli Spring, Pebble Mouse Creek and affected waterholes is supported wherever possible and requested. Measures agreed with Traditional Owners will be included in the SCHMP.

11.6.2.2. Application of the Mitigation Hierarchy for Impacts to Social Surroundings

The following table identifies proposed mitigations to social surrounds related ‘Water’ impacts that were identified in Table 11-7 that require further exploration by the Proponent in consultation with Traditional Owners to agree and achieve appropriate mitigation measures and controls.

Table 11-9: Application of the Mitigation Hierarchy for Impacts to Social Surroundings - Water

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Impacts to Water	**Measures to minimise**			
	The Proponent will: • Use surplus water from adjacent Hope Downs 1 operations, to reduce water abstraction from HD2 borefield, where practicable • Ensure water supply production bores are placed in aquifers that are isolated from groundwater dependent environmental values including Ben's Oasis	A Proposal specific SCHMP is being developed in consultation with the Nyiayparli People which identifies the processes to be followed with regards to the avoidance of impacts to culturally significant water values. Where impacts to Water are significant, and relevant, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	Yes – Groundwater Operating Strategies developed as part of Groundwater licences require Proponents to provide detail on management of groundwater levels.	Avoidance is the first and preferred strategy in the EPA mitigation hierarchy.
	The Proponent will prepare an SCHMP with Nyiyaparli Traditional Owners which will consider measures to: • minimise impacts through improved design and/or implementation of relevant practice standards, as appropriate • reduce residual impacts to local water quality such as erosion, sedimentation, or dust deposition (i.e., construction of crossings during dry season) • Conduct additional and/or ongoing water monitoring at important water sites to inform	A Proposal specific SCHMP is being developed in consultation with the Nyiayparli People which identifies the processes to be followed with regards to the minimisation of impacts to culturally significant water values. Where impacts to Water are determined to be significant, and relevant, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	No	A ministerial condition requiring preparation and implementation of a Nyiyaparli SCHMP is expected.

Potential Impact	Mitigation	Standard Business Practice or Project Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	appropriate management of those areas			
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's: and will work in collaboration with the Nyiyaparli People to rehabilitate impacts to culturally significant water values as identified through consultation, surveys, and the Social Surroundings baseline assessment process. Refer also to Section 11.6.8.	A Proposal specific SCHMP has been developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to the rehabilitation of impacts to water. Where impacts to Water are significant, and relevant, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	DMIRS for development of the Mine Closure Plan (Appendix A4).	This closure strategy is consistent with the EP Act precautionary principle.
	Proposed Limits on Impacts to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Nyiyaparli SCHMP.		Ministerial condition requiring the Proponent to Implement the Nyiyaparli SCHMP during all phases of the Proposal.	
	Hope Downs 2 MCP		Ministerial condition requiring the Proponent to implement the MCP.	

11.6.3. Sense of Place and Amenity (Dust, Noise and Vibrations)

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to Traditional Owner and wider community values in relation to dust, noise and vibrations, including as they relate to sense of place, social and cultural dimensions, user experience and enjoyment of Country. Dust, noise and vibration related mitigation actions and design changes already identified are summarised in Table 11-10 above. Mitigation actions requiring ongoing consultation with Traditional Owners and other stakeholders are outlined in Table 11-10 below and, where required for additional context, discussed below.

11.6.3.1. Avoid – Project Design

Avoidance measures are captured in Table 11-10.

11.6.3.2. Minimisation – Project Design

The changes to the Development Envelope in response to a request from Nyiyaparli Traditional Owners to minimise sections of Weeli Wolli Creek and Pebble Mouse Creek within the Development Envelope, (as discussed in Section 11.6.2) and to remove HOPE4-07 from the Development Envelope are also expected to reduce the potential effects of dust and noise on Weeli Wolli Creek, parts of Pebble Mouse Creek and HOPE4-07. The following changes to the proposed Conceptual Footprint will reduce potential effects of dust and noise in key locations:

- In response to requests from Nyiyaparli Traditional Owners, a waste rock landform south of the HD2 deposit and close to Weeli Wolli Creek and HOPE4-07 was removed from the proposed Conceptual Footprint[7] to reduce the potential effects of dust and noise in these locations
- Considering the above feedback from Nyiyaparli Traditional Owners, three small, proposed waste rock landforms north of BHT were removed from the proposed Conceptual Footprint, as shown in Figure 11-4 to reduce the potential effects of dust and noise on Pebble Mouse Creek.

Implementation of the following MEZs will reduce the effects of dust and noise in these locations, including in respect of:

- MEZ1: a MEZ at the western end of the BHT deposit which includes three Ghost Bat and Pilbara Leaf-nosed Bat caves (Cave 3, 5 and 6) and areas of Northern Quoll habitat (see also Chapter 7)
- MEZ2: a 150 m MEZ around Cave 10, a Category 2 (potential maternity) Ghost Bat cave and Category 4 Pilbara Leaf-nosed Bat cave
- MEZ3: A 100 m MEZ around rock shelter BDH 16-03 (see Figure 11-4).

The Proposal design includes the transport of ore from HD2 deposit to the Hope Downs 1 operations ore processing facilities via road trains on a sealed road or via conveyor, which would minimise the dust generated from ore transport.

11.6.3.3. Application of the Mitigation Hierarchy for Social Surrounds

The following table identifies proposed mitigations to Social Surrounds related ‘Dust, Noise and Vibration’ impacts that were identified in Table 11-7 that require further exploration by the Proponent in consultation with Traditional Owners to agree and achieve appropriate mitigation measures and controls.

[7] Noting that the area of the north-west waste rock landform was increased in order to make this design change.

Table 11-10: Application of the Mitigation Hierarchy for Social Surroundings - Sense of Place and Amenity (Dust, Noise and Vibrations)

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Indirect impacts				
Indirect Impacts to Sense of Place (Dust, Noise & Vibration)	**Measures to Minimise**			
	The Proponent will employ the following minimisation measures: • Implement MEZ to avoid adverse impacts to culturally significant rockshelter BDH16-03 (MEZ3) and bat caves (MEZ1 and MEZ2) • Construct sealed roads at road train crossings over Pebble Mouse Creek • Dust suppression techniques such as sprayers on crushers and water trucks which will utilise surplus water. These are expected to help minimise dust generated during construction and operation • Limiting the amount of disturbed land to as small as reasonable, reducing the amount of dust producing surfaces • The implementation of speed limits on unsealed roads and tracks to reduce dust creation The Proponent will also consider measures to reduce adverse impacts to the visibility of drivers using the Great Northern Highway.	Industry Standards (for dust, noise, and vibration). A Proposal specific SCHMP is being prepared in consultation with the Nyiayparli People which will identify processes to be followed with regards to the minimisation of impacts to special places and culturally significant heritage sites caused by noise, dust, and vibration. Where impacts to Sense of Place and Amenity are significant, and relevant, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	DWER for adherence to the Noise Regulations. DMIRS for implementation of noise safety requirements.	Measures to be proposed in the SCHMP have been developed to meet the current industry standards for managing dust, noise, and vibration levels. The management strategy will consider the amounts of noise, dust, and vibration generated in instances where it impacts key culturally significant heritage sites. These management strategies have been implemented across the Proponents operations in the Pilbara and are regarded as having a high level of certainty.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Development and implementation of a Traffic Management Plan to manage impacts from dust during the construction and mining operations adjacent to the re-alignment of Great Northern Highway, if required.	Proposal specific.	Main Roads Act 1930 Authorisation required for the re-alignment of Great Northern Highway and associate works.	
	Implementation of a Blast Management Plan to manage impacts from noise and vibrations and maintenance of the structural integrity of the significant caves.	Industry standard.	No	The Proponent has a well-established blasting management procedure across their mine sites in the Pilbara region and management plans for significant cave structures. Standard practice for blast management. Vibration limits for certain places are expected under Ministerial conditions.
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's: and will work in collaboration with the Nyiyaparli People to rehabilitate impacts to culturally significant Sense of Place values as identified through consultation, surveys, and the Social Surroundings baseline assessment process. Refer also to Section 11.6.8 Post Closure.	Proposal specific MCP has been developed, based on Rio Tinto standard approach to closure planning.	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4).	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice. The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
				The Closure Strategy is consistent with the EP Act precautionary principles.
	Proposed Limits on Impacts to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Nyiyaparli SCHMP		Ministerial condition requiring the Proponent to Implement the Nyiyaparli SCHMP during all phases of the Proposal.	

11.6.4. Sense of Place and Amenity (Visual Landscape, Land Use and Amenity)

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to Traditional Owner and wider community values in relation to altered visual landscapes, including as they relate to sense of place, social and cultural dimensions, user experience and enjoyment of Country. Altered visual landscape related mitigation actions and design changes already identified are summarised in Table 11-8 above. Mitigation actions requiring ongoing consultation with Traditional Owners and other stakeholders are outlined in Table 11-11 below and, where required for additional context, discussed below.

11.6.4.1. Avoidance – Project Design

In response to feedback from Nyiyaparli Traditional Owners, a waste rock landform south of the HD2 deposit and close to Weeli Wolli Creek and HOPE4-07 was removed from the Conceptual Footprint. The HD2 north-western waste rock landform was expanded to offset the removal of the waste rock landform close to Weeli Wolli Creek (Figure 11-4). Avoiding a range of potential impacts including impact to visual amenity associated with the creek and HOPE4-07.

11.6.4.2. Minimisation - Project Design

The Proponent has refined its mine plan to minimise visual impact on landforms by retaining the southern facade of the BHT deposit, and removing a proposed waste rock landform, to reduce visual impacts from Weeli Wolli Creek.

A proposed additional landbridge at BHT was also removed from an earlier version of the mine design to reduce visual impacts.

Where required under SCHMPs with Traditional Owners, consultation will continue with Traditional Owners in respect of mine closure planning and outcomes, including work to reduce impacts to visual amenity and visual landscapes.

Following consultation, Nyiyaparli Traditional Owners requested the reduction or, preferably, removal of a waste rock landform originally proposed to be located south of the HD2 deposit and close to the HOPE4-07 heritage site-complex and Weeli Wolli Creek. The Proponent has confirmed the removal of this waste rock landform from the Conceptual Footprint, which will avoid the creation of impacts in this area and will significantly minimise the visual impact of the Proposal from the HOPE4-07 heritage complex and the creek.

Ongoing engagement and consultation with Traditional Owners with respect to closure design including final landforms and rehabilitation to minimise visual amenity impacts will be incorporated into the SCHMPs (if required).

11.6.4.3. Application of the Mitigation Hierarchy for Social Surrounds

The following table identifies proposed mitigations to social surrounds related ‘Visual Landscape, Land Use and Amenity’ impacts that were identified in Table 11-7 that require further exploration by the Proponent in consultation with Traditional Owners to agree and achieve appropriate mitigation measures and controls.

Table 11-11: Application of the Mitigation Hierarchy for Social Surrounds - Sense of Place and Amenity (Visual Landscape, Land Use and Amenity)

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts to Sense of Place and Amenity (Visual Landscape, Land Use and Amenity)				
Direct impacts to Sense of Place and Amenity (Visual Landscapes, Land Use and Amenity)	**Measures to Minimise**			
	The Proponent will work with potentially affected Traditional Owners to explore further design changes/optionality within the Conceptual Footprint to minimise impacts to culturally important visual landmarks and amenity to the extent practicable. Refer to Table 11-8 for design changes already made	The ACHMP will target continued protection of important cultural heritage landscape values, land marks and amenity. ACHMPs will be developed with Ngarlawangga and/or Banjima People where significant impacts to Visual Landscape, Land Use and Amenity are identified as being significantly impacted	AH Act ACH Act	Avoidance is the most effective mechanism for reducing direct impacts to cultural heritage visual landscape and amenity values. The Proponent's GIS and Approval Request Systems are an established mechanism for prioritising avoidance of higher value areas providing a high level of confidence that clearing will not be greater than assessed. The Proponent also utilises its Integrated Heritage Management Program (IHMP) as an additional step of assurance. The IHMP is a formalised management system which provides for improved governance of Heritage sites. These controls are considered effective in avoiding unacceptable direct impacts to heritage sites.
Indirect Impacts				
Indirect Impacts to Sense of Place and Amenity (Visual Landscape, Land Use and Amenity)	**Measures to Rehabilitate**			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's: and will work in collaboration with the Nyiyaparli People to design and rehabilitate the final landform with consideration of culturally	Proposal specific MCP has been developed, based on Rio Tinto standard approach to closure planning	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4)	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice. The MCP must detail all legal obligations for rehabilitation and closure that affect

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	significant visual landscape and amenity values, as identified through consultation, surveys, and the Social Surroundings baseline assessment process. Refer also to Section 11.6.8			post-mining land use and closure outcomes (DMIRS 2020 b) The Closure Strategy is consistent with the EP Act precautionary principles
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Hope Downs 2 Mine Closure Plan		Ministerial condition requiring the Proponent to implement the Hope Downs 2 Mine Closure Plan.	

11.6.5. Access to Country

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to Traditional Owner values in relation to access. Related mitigation actions and design changes already identified are summarised in Table 11-8. Mitigation actions requiring ongoing consultation with Traditional Owners and other stakeholders are outlined in Table 11-12 and, where required for additional context, discussed below.

11.6.5.1. Avoidance – Project Design and Traffic Management

The Proponent is committed to avoiding significant disruption of access to the Weeli Wolli Creek gabion and Weeli Wolli Springs by the Proposal. The Proponent will seek to do this by maintaining access via the re-aligned Mine Access Road, or otherwise during busy construction periods when using that road may not be feasible.

The Proponent will otherwise avoid as far as practicable restricting access to areas of social, cultural of heritage significance within the Development Envelope. In cases where risk-related restrictions may be required, an escort or alternate access will be made available in these instances. The relevant SCHMP, agreed with Traditional Owners, will provide protocols to communicate these changes with the respective Traditional Owner groups.

The Proponent is working with Main Roads WA and other key stakeholders to discuss design options for the re-alignment of up to 6 km of the Great Northern Highway. Once a final design concept has been agreed, a Traffic Management Plan will be prepared.

11.6.5.2. Minimisation

Rio Tinto holds existing Land Access Protocols with Nyiyaparli, Banjima and Ngarlawangga. These Land Access Protocols have been recognised as not fit for purpose in their current form. Rio Tinto is committed to improving these Protocols and has been working to revise these documents with both Groups. The revised Land Access Protocols are currently in development and have not been finalised, however, revision of these Protocols is expected to be included as a management action in the Nyiyaparli SCHMP.

As part of co-developing the SCHMP, the Proponent will work with Nyiyaparli to confirm areas required to remain accessible (within health and safety limitations) during operations or following closure and investigate options to further minimise restrictions on these areas and access generally.

Where relevant and required SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners that may address access considerations.

11.6.5.3. Application of the Mitigation Hierarchy for Social Surrounds

The following table identifies proposed mitigations to social surrounds related ‘Access to Country’ impacts that were identified in Table 11-7 that require further exploration by the Proponent in consultation with Traditional Owners to agree and achieve appropriate mitigation measures and controls.

Table 11-12: Application of the Mitigation Hierarchy for Social Surroundings - Access to Country

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Direct impacts to access	**Measures to Minimise**			
	The Proponent will work in collaboration with the Nyiyaparli People to minimise impacts to accessing country. The Proponent will attempt to minimise any access disruption where practicable. The Proponent will provide alternative means of access where possible should previously existing access routes be impacted as part of the development. The Proponent implement the requirements of the Land Access Protocol/s (LAP): • The Proponent will prepare and maintain a LAP that is endorsed by the Traditional Owners. The LAP shall outline access requirements, agreed communications as required, for enabling access, identify no-go zones and areas where access may be restricted at times and how this will be managed	Proposal specific SCHMP is being developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to the mitigation/rehabilitation of impacts to access. Where impacts to access to country are significant, and relevant to this Proposal, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	Yes – Mining Act and Mine Safety and Inspection Act 1994 (WA).	The Proponent's GIS and Approval Request Systems are an established mechanism for prioritising avoidance of higher value areas providing a high level of confidence that clearing will not be greater than assessed. The Proponent also utilises its Integrated Heritage Management Program (IHMP) as an additional step of assurance. The IHMP is a formalised management system which provides for improved governance of Heritage sites. These controls are considered effective in minimising direct impacts to Nyiyaparli People's access to country.
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. The MCP will be updated in consultation with Traditional Owners on a regular basis to ensure its objectives remain relevant and aligned to	Proposal specific SCHMP is being developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to the mitigation/rehabilitation of impacts to access.	Yes – DMIRS for implementation of the MCP (Appendix A4).	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice. The MCP must detail all legal obligations for rehabilitation and closure that affect

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	stakeholder expectations, including access. Refer also to Section 11.6.8.	Where impacts to access to country are significant, and relevant to this Proposal, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	Yes – Mining Act and Mine Safety and Inspection Act 1994 (WA).	post-mining land use and closure outcomes (DMIRS 2020b). The closure strategy is consistent with the EP Act precautionary principle.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Nyiyaparli SCHMP		Ministerial condition requiring the Proponent to Implement the Nyiyaparli SCHMP during all phases of the Project	
Indirect Impacts to Access				
Indirect impacts to access	**Measures to Avoid**			
	The Proponent has committed to maintaining access to Weeli Wolli Creek gabion and Weeli Wolli Springs throughout construction, operation, and closure. • The Proponent will attempt to minimise any access disruptions where practicable • The Proponent will provide alternative means of access where possible should previously existing access routes be impacted as part of the development	Proposal Specific.	Yes – Mining Act and Mine Safety and Inspection Act 1994 (WA).	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a and 2020b). The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes, as agreed with relevant stakeholders (DMIRS 2020b).
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. The MCP will be updated in consultation with Traditional Owners on a regular basis to ensure its objectives remain relevant and aligned to	Proposal specific SCHMP is being developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to the mitigation/rehabilitation of impacts to access.	Yes – DMIRS for implementation of the MCP (Appendix A4)	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice. The MCP must detail all legal obligations for rehabilitation and closure that affect

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	stakeholder expectations, including access. Refer also to Section 11.6.8.	Where impacts to access to country are significant, and relevant to this Proposal, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	Yes – Mining Act and Mine Safety and Inspection Act 1994 (WA).	post-mining land use and closure outcomes (DMIRS 2020b) The closure strategy is consistent with the EP Act precautionary principle.
	Proposed Limits on Impacts to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Nyiyaparli SCHMP		Ministerial condition requiring the Proponent to Implement the Nyiyaparli SCHMP during all phases of the Proposal	

11.6.6. Special Places (including Aboriginal Heritage Sites and Places)

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to Traditional Owner cultural heritage sites. Related mitigation actions and design changes already identified are summarised in Table 11-8. Mitigation actions requiring ongoing consultation with Traditional Owners and other stakeholders are outlined in Table 11-13 and, where required for additional context, discussed below.

Numerous archaeological sites have been recorded in the Development Envelope including artefact scatters, quarries, reduction areas, rock shelters and scarred trees. Site BDH16-03 will be protected by a 100 m MEZ to prevent vibrational (and other) impacts from mining affecting the structural integrity of the rock shelter. Following changes to the mine planning, HOPE4-07 is now located outside the Development Envelope and not expected to be affected by active mining. However, culturally significant rock shelters such as those that occur at BDH16-03 and HOPE4-07 will undergo geotechnical assessment to assess stability and manage vibration levels in order to minimise the risk of damage.

These geotechnical assessments will inform a Blast Management Plan to monitor and manage the level of vibrations and fly-rock reaching the rock shelters based on the rock shelter's structural stability and cultural significance. Where impacts from vibration are unavoidable, the Proponent will seek appropriate approvals under the AH Act or ACH Act. The Proponent will consult with the relevant Traditional Owners and provide the relevant aspects of the Blast Management Plan and monitoring data to the groups, as agreed in the SCHMP. Heritage surveys will be completed within proposed disturbance areas yet to be surveyed to inform mine planning and any approval requirements under Aboriginal heritage legislation.

Ongoing consultation with the Traditional Owner groups will occur throughout the life of the mine to assess opportunities during mine and design and planning, and then in closure planning, to avoid and minimise impacts to special places and to Country, in particular in the event ongoing social surroundings surveys (e.g., ethnobotanical studies) and consultation identifies previously unknown important areas.

11.6.6.1. Existing Aboriginal Cultural Heritage Management Plans

The Proponent has developed and implemented (Aboriginal) Cultural Heritage Management Plans (CHMPs) relevant to the existing Hope Downs 1 operations area. The plans currently refer to areas within the Proposal Development Envelope, including the proposed accommodation camp/s, location of pits, waste rock landforms, land bridges and infrastructure. The CHMPs:

- Outline consultation processes
- Include risk assessment for relevant activities
- Provide protocols and procedures for the management of cultural heritage sites (e.g., survey protocols; management measures such as fencing and signposting; management of heritage incidents)
- Provide guidelines for onsite Rio Tinto Personnel to ensure that work practices are sensitive to, and respectful of, the heritage and cultural values pertaining to each Traditional Owner group
- Provide clarity and consistency for the Traditional Owners regarding how cultural heritage is managed by Rio Tinto within their lands
- Assist the Proponent in complying with the NTAs and legislation (Australian Government and State), as well as Rio Tinto's own cultural heritage standards and guidelines.

Relevant parts of the existing Hope Downs 1 operations CHMPs will be utilised where beneficial to inform the development of the SCHMPs for the Proposal.

Approval for impacts to heritage values for this Proposal will be managed via Aboriginal heritage legislation and the IHMP. Any disturbance will be in accordance with approvals under s.16 and/or s.18

of the AH Act (or ACH Permit and/or a project specific ACHMP under the ACH Act) and as agreed with Traditional Owners through consultation, based on the principle of free, prior, and informed consent.

11.6.6.2. Avoidance – Project Design

The Development Envelope was significantly reduced south of HD2 and east of BHT to avoid impacts to the HOPE4-07 heritage complex (avoided by the Development Envelope altogether), Weeli Wolli Creek and large areas of its catchment and breakaway and gorge/gully landforms (that are more likely to contain caves and rock shelters that have potential to be heritage sites).

The proposed Conceptual Footprint was amended to remove a large waste rock landform near Weeli Wolli Creek and HOPE4-07, with the north-west waste rock landform at HD2 deposit was expanded to compensate for the change (see Table 11-13).

A Mining Exclusion Zone, MEZ3, will be established to protect the disturbance of Heritage site BDH16-03. MEZ3 includes the application of a 100 m buffer, within which direct disturbance will not occur.

To date, there are 17 rockshelters recorded within the proposed Conceptual Footprint. Of these, 13 are located within the BHT area and four are located within the HD2 area. The Proponent is investigating options for avoidance and have presented some indicative scenarios to Nyiyaparli for consideration should Nyiyaparli not support direct impact at these locations. These sites will be managed in accordance with the requirements of the ACH Act.

Two culturally significant waterholes were also identified by Nyiyaparli Traditional Owners during Heritage Survey work within the Development Envelope and proposed Conceptual Footprint. HD214_04 at HD2 is a grouping of 5 small waterholes located along a small drainage line in the HD2 pit. GHD19-07-WS is located at BHT within the proposed waste rock landform. Given their small size and locations on rocky substrate, the waterholes are understood to be rain-fed and ephemeral; however, monitoring will need to be undertaken to better understand these features. Nyiyaparli have requested the Proponent investigate options to modify the Conceptual Footprint to avoid these places or, if avoidance is not practicable, to investigate options to minimise or offset impacts.

The Proponent has committed to undertaking further redesign work investigating options that may allow avoidance of the site and an associated buffer as part of the Nyiyaparli SCHMP. Impacts to these sites will be managed via approvals under the ACH Act.

11.6.6.3. Avoidance – Workforce

Proponent workforce will not be permitted to access areas outside direct disturbance and operational areas without authorisation.

11.6.6.4. Application of the Mitigation Hierarchy for Social Surround

The following table identifies proposed mitigations to social surrounds related ‘Access to Country’ impacts that were identified in Table 11-7 that require further exploration by the Proponent in consultation with Traditional Owners to agree and achieve appropriate mitigation measures and controls.

Table 11-13: Application of the Mitigation Hierarchy for Social Surroundings - Special Places (including Aboriginal Heritage Sites and Places)

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Direct impacts to Special Places	**Measures to Avoid**			
	The Proponent will work in collaboration with Nyiyaparli People to avoid to the extent practicable impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process. Special Places can include water holes (i.e., (GHD19-07-WS) and (HD214_04), rock shelters and/ or other significant sites found in previously unsurveyed areas in the Development Envelope). The Proponent will employ the following avoidance measures: • MEZ3 has been established to protect rockshelter BHD16-03, with a 100 m buffer from the rockshelter location • Places identified as significant by the Nyiyaparli People and/or their supporting consultants through archaeological and ethnographic surveys or the Social Surroundings baseline assessment process are recorded in the Proponent's GIS system as heritage places and will be avoided where practicable, as identified in the ACHMP where this is determined necessary and appropriate in consultation with Nyiyaparli People	A Proposal specific ACHMP will be developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to Special Places including heritage sites to be avoided. ACHMPs will be developed with Ngarlawangga and/or Banjima People where direct impacts to Special Places including heritage sites are identified as being significantly impacted.	AH Act ACH Act	Avoidance is the most effective mechanism for reducing direct impacts to cultural heritage values. The Proponent's GIS and Approval Request Systems are an established mechanism for prioritising avoidance of higher value areas providing a high level of confidence that clearing will not be greater than assessed. The Proponent also utilises its Integrated Heritage Management Program (IHMP) as an additional step of assurance. The IHMP is a formalised management system which provides for improved governance of Heritage sites. These controls are considered effective in avoiding unacceptable direct impacts to special

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Site induction to include maps identifying no-access areas, cultural and heritage training, advice to all personnel regarding unauthorised access (to be recorded as an incident), and details of required access permissions			places including heritage sites.
	Measures to Minimise			
	The Proponent will work in collaboration with the Nyiyaparli, Ngarlawangga and Banjima People to minimise to the extent practicable impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process.	A Proposal specific ACHMP is being developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to Special Places including heritage sites to be avoided. ACHMPs will be developed with Ngarlawangga and/or Banjima People where direct impacts to Special Places are identified as being possibly impacted.	*Aboriginal Heritage Act* -1972 Section 16 – 18 Applications; and ACH Act ACHMP requirements.	The Proponents GIS and Approval Request Systems are an established mechanism for prioritising avoidance of higher value areas providing a high level of confidence that clearing will not be greater than assessed. The Proponent also utilises its IHMP as an additional step of assurance. The IHMP is a systematized management system which provides for improved governance of Heritage values.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
				These controls are considered effective in minimising direct impacts to special places including heritage sites.
	Measures to Mitigate			
	Where direct impact to a heritage place is deemed unavoidable, cultural material will be salvaged. The Proponent will employ the following mitigation measures when conducting salvage of cultural material: • Cultural material will be salvaged by suitably qualified professionals and with the participation of the Nyiyaparli, Ngarlawangga and Banjima People • Cultural material will be salvaged in accordance with authorisation under required legislation and in line with the Proponent's Salvaged Materials Procedure • Salvaged material will be stored in accordance with directions from the relevant RTNBC and Traditional Owner group members	Proposal Specific. A Proposal specific SCHMP is being developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to heritage sites to be avoided. SCHMPs will be developed with Ngarlawangga and/or Banjima People where direct impacts to Special Places are identified as being possibly impacted.	*Aboriginal Heritage Act* -1972 Section 16 – 18 Applications; and ACH Act ACHMP requirements.	Salvage of cultural material is considered the most effective mechanism for mitigation when a cultural heritage site is impacted. The Proponent's Heritage Information Management System (HIMS) is an established mechanism for documenting and preserving salvaged cultural material data. These controls are considered effective in mitigating direct impacts to special places including heritage sites.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Nyiyaparli SCHMP		Ministerial condition requiring the Proponent to implement the Nyiyaparli SCHMP during all phases of the Proposal.	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Indirect Impacts to Special Places				
Indirect impacts to Special Places (i.e., indirect impact such as dust, noise, vibration, and loss of amenity to special places)	**Measures to Minimise**			
	The Proponent will prepare an SCHMP with potentially affected Traditional Owners that is expected to include: • Dust, noise, and vibration monitoring • Dust, noise, and vibration management measures (i.e., dust suppression to minimise dust creation) Where dust, noise and/or vibration impacts are significant, SCHMPs will also be developed with Ngarlawangga and Banjima Traditional Owners.	Proposal specific SCHMP is being developed in consultation the Nyiyaparli People to identify processes to be followed with regards to the minimisation of impacts to Special Places caused by noise, dust, and vibration. SCHMPs will be developed with Ngarlawangga and/or Banjima People where significant impacts to Special Places are identified as being possibly impacted.	No	These measures have been developed to meet the current industry standards for managing dust, noise, and vibration levels. The management strategy will consider the amounts of noise, dust and vibration generated in instances where it impacts special places (including key culturally significant heritage sites). These management strategies have been implemented across the Proponents operations in the Pilbara and are regarded as having a high level of certainty.
	Proposed Limits on Impacts to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – manage through industry standard practice.		NIL	

11.6.7. Plants and Animals

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to plants and animals by the Proposal. Related mitigation actions and design changes already identified are summarised in Table 11-7 above. Mitigation actions requiring ongoing consultation with Traditional Owners and other stakeholders are outlined in Table 11-14 below and, where required for additional context, discussed below.

11.6.7.1. Minimisation

The Proponent has refined the proposed Conceptual Footprint and reduced the Development Envelope significantly to the south of HD2. This is expected to reduce impacts to plants and animals in this area.

The Proponent will avoid unnecessary or unapproved clearing by ensuring ground disturbance is managed through the through Proponent's GIS and Approval Request Systems. Records of vegetation removal are collected and retained and reported annually through the Proposal's Annual compliance reporting.

11.6.7.2. Rehabilitation

The Proponent will work with Traditional Owners to ensure culturally important plants are considered for use in rehabilitation and if suitable species are identified (through the ethnobotanical surveys or other sources) and incorporated into the MCP (processes for consultation and involvement of Traditional Owners in this regard are also expected to be included in the co-designed SCHMPs).

The Proponent also acknowledges Traditional Owner's extensive knowledge regarding culturally important plants and animals. As such continued consultation and engagement will occur with Traditional Owners to understand and manage these better throughout the approval process and during the life of the Proposal, to be included within the SCHMPs as relevant. Relevant upcoming activities include the aforementioned ethnobotanical surveys.

11.6.7.3. Application of the Mitigation Hierarchy for Social Surrounds

The following table identifies proposed mitigations to social surrounds related 'Plants and Animals' impacts that were identified in Table 11-7 that require further exploration by the Proponent in consultation with Traditional Owners to agree and achieve appropriate mitigation measures and controls.

Table 11-14: Application of the Mitigation Hierarchy for Social Surrounds - Plants and Animals of Cultural Significance

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Direct impacts to Plants and Animals of Cultural Significance	**Measures to Minimise**			
	The Proponent will work in collaboration with the potentially affected Traditional Owners as required, to minimise to the extent practicable impacts to culturally significant flora and fauna values identified through consultation, surveys, and the Social Surroundings baseline assessment process. To further minimise the impacts the Proponent will utilise existing disturbed areas, wherever practicable.	A Proposal specific SCHMP is being developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the avoidance of these. SCHMPs will be developed with Ngarlawangga and/or Banjima People where indirect impacts to culturally significant animals and plants are identified as being impacted.	No	• The Proponent's GIS and Approval Request Systems are an established mechanism for prioritising avoidance of higher value areas providing a high level of confidence that clearing will not be greater than assessed • These controls are considered effective in avoiding unacceptable direct impacts to culturally significant flora and fauna values
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. In addition, the Proponent will investigate the following measures: • Assess rehabilitation seed mixes and seek to incorporate identified culturally significant species (bush tucker/medicine) where practical	A Proposal specific SCHMP will be developed in consultation with the Nyiyaparli People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the avoidance of these. SCHMPs will be developed with Ngarlawangga and/or Banjima People where indirect impacts to culturally significant animals and plants are identified as being impacted.	No	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a and 2020b). The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes, as agreed with relevant stakeholders (DMIRS 2020b). The Mine Closure Strategy is consistent with the EP Act precautionary principles.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Monitor rehabilitation areas for return of bush tucker and bush medicine species			
	The MCP includes objectives for Progressive rehabilitation to: • Minimise the amount of cleared land and revegetate using local native species, where practicable • Minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement, where practicable • Ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use • Final landforms are stable and consider ecological and hydrological factors	Industry standard	Yes– DMIRS for development of MCP.	These measures follow the Statutory Guidelines for Mine Closure Plans which are consistent with industry leading practises (DMIRS 2020b). Proposal EMP addressing management measures applicable to the terrestrial fauna environmental factor (Appendix A7).
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Nyiyaparli SCHMP		Ministerial condition requiring the Proponent to implement the Nyiyaparli SCHMP.	
Indirect Impacts				
	The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020a), that will include targets and measures with respect to the use of culturally important plants in revegetation. Where practicable, rehabilitation will be undertaken	Project specific MCP has been developed, based on Rio Tinto standard approach to closure planning. SCHMP with Nyiyaparli Traditional Owners will be developed and will include framework for ongoing	Yes – DMIRS for development of the Mine Closure Plan (see Appendix A4).	These measures follow the Statutory Guidelines for Mine Closure Plans which are consistent with industry leading practises (DMIRS 2020b).

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement.	consultation in respect of closure planning and outcomes.		
	Proposed Limits on Impacts to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Nyiyaparli SCHMP		Ministerial condition requiring the Proponent to implement the Nyiyaparli SCHMP during all phases of the Proposal.	

11.6.8. Post-Closure

The draft MCP for the Proposal is included in Appendix A4. A summary of the approach to closure and how it relates to the Social Surroundings environmental factor is provided below. The MCP will be updated on a regular basis to ensure its objectives remain relevant and aligned to stakeholder expectations, and its strategies and plans are appropriate to achieve closure outcomes.

The proposed post-mining land use assumes that the land (the subject of the Proposal) will be rehabilitated to create a safe, stable, and non-polluting landscape revegetated with native species to the extent practicable, to be consistent with identified environmental and social, cultural and heritage outcomes and ensure the site is compatible with the current surrounding land use (including making landforms as natural-looking as is practicable to blend in with the surrounding landscape).

The main closure objective for Social Surroundings values of the Proposal is to preserve, protect and manage those values in the area in cooperation with the Traditional Owners and other stakeholders. Management of Traditional Owner Social Surroundings values for closure will be conducted through processes incorporated into the co-designed Nyiyaparli SCHMP (as well as SCHMPs with Ngarlawangga and Banjima Traditional Owners if required and relevant), and as based on ongoing consultation.

Heritage sites will be managed in consultation with the relevant Traditional Owner group, and in accordance with the AH Act and/or the ACH Act, as applicable.

Closed pits will not be backfilled to existing ground level as there is not enough waste material to backfill to the surface once the ore is removed, although opportunities for in-pit disposal of waste rock will be identified and assessed over the life of operations. Linear infrastructure will be removed, where applicable (including Pebble Mouse Creek Crossings).

The Proponent will continue to engage with Traditional Owners through established arrangements such as under NTAs, or as detailed in the relevant SCHMPs as appropriate, to consider backfill options particularly in relation to minimising long term impact on areas of cultural importance.

Rehabilitation and design options will also be considered to minimise visual impacts and allow for the reintroduction of local flora (including bush tucker/medicine) and fauna to access and utilise the areas.

11.7. Assessment of Significance of Residual Impacts to Social Surroundings

11.7.1. Assessment of Residual Impacts to Social Surroundings

This section identifies residual impacts to Social Surroundings after the application of the avoidance, minimisation, and mitigation hierarchy (as identified in tables within Section 10.6) and assesses whether these are significant. The significance of the impacts (direct, indirect, and cumulative) of the Proposal are assessed in a local and regional context as appropriate. It should be noted that in relation to impacts to Country, it is considered that whether an impact is deemed significant or not can only be determined on the basis of the views of Traditional Owners and therefore ongoing consultation with Nyiyaparli, Banjima and Ngarlawangga members is vital.

It is intended that the impacts themselves and the proposed mitigation measures will be captured in a draft SCHMP/s to be co-developed with relevant Traditional Owners who will have input into the type and extent of mitigations that are appropriate to avoid, minimise, offset and/or rehabilitate each impact.

The SCHMP/s will:

- Focus primarily on mitigation of indirect impacts, addressing Traditional Owner concerns regarding these impacts to social surroundings and facilitating Traditional Owner consultation and ongoing involvement with respect to issues raised
- Direct impacts on social surroundings are also likely to be addressed in the SCHMP/s by way of approaches already agreed during consultation (i.e, avoidance of significant values)
- The SCHMP/s will also address the Proponent's obligations in relation to Traditional Owner involvement in site monitoring and reporting by the Proponent to the Traditional Owner PBCs.

11.7.1.1. Sense of Place and Amenity (Visual Landscape. Land Use and Amenity

- Changes to or alteration of important cultural landmarks used by Traditional Owners to navigate and pass down: stories of connection between places; and connection between people and place (Direct Impact)
- Alteration of the sense of place: social, cultural, and environmental dimensions; including land use (for people and animals), visual and recreational experience and enjoyment of country due to changes to landscapes, landscape features. (Indirect Impact).

Landform changes will occur from the development of mine pits and placement of mineral waste management infrastructure including waste rock landforms and landbridges. Pit voids post closure will remain as permanent changes to the landscape at each deposit.

The alteration to the general landscape from the Proposal is challenging for Traditional Owners, particularly Nyiyaparli people whose land is most physically affected, and this issue was raised during Social Surroundings consultation. The Proponent acknowledges that an altered landscape may affect the Nyiayparli People's ability to navigate their Country and to pass knowledge down through stories: (i.e., stories of connection between places; and connection between people and place (i.e., southern ridgeline and associated areas visible from Weeli Wolli Creek).

Landform alterations include changes to prominent landforms from excavation of the BHT deposit as it is in an elevated landscape position, as well as the excavation of the HD2 deposit and the construction of large waste rock landforms and landbridges adjacent to the pit areas. Given the permanent nature of these landform changes, the Proponent consider these residual impacts to be significant and these will be managed through the Mine Closure Plan and co-developed SCHMP/s, as required.

11.7.1.2. Special Places

- Direct impact to Special Places such as culturally significant waterholes (GHD19-07-WS) and (HD214_04) and/or other significant sites found in previously unsurveyed areas within the Development Envelope.

The Proponent has endeavoured to avoid, manage, and mitigate as many significant impacts as practicable to Special Places, including Heritage sites, when developing this Proposal.

Though changes to the Proposal have been made to minimise known potential impacts, it is recognised that the Proposal will result in direct and indirect impacts to Special Places. Table 11-11 outlines where the Proponent has mitigated actions related to Special Places. The Proponent acknowledges that Traditional Owners should determine whether impacts on their heritage places and lands are deemed significant and further work is required with Traditional Owners to explore the most appropriate mitigation measures and controls for those impacts.

A summary of outstanding heritage survey work is outlined in Table 11-4 and Section 11.5.7 which indicates that the Proposal's Conceptual Footprint is composed of:

- 86% of Nyiyaparli People's Native Title Determined area including 85 identified heritage places. As of 1 November 2022, Level 1 archaeological recording has been completed on all 85 sites within the conceptual footprint, however ethnographic assessment has been completed on 26 of 85 sites leaving 59 outstanding
- 1% of Ngarlawangga People's Native Title Determined area including 12 heritage places yet to undergo Level 1 archaeological recording, and as required ethnographic assessment. Noting however that the option to realign the Great Northern Highway onto Ngarlawangga Country is not the Central Case option for the Proposal, and consequently may not be required
- 10% of Banjima People's Native Title Determined areas with no heritage places identified as likely to be impacted.

Work will continue with Traditional Owners to undertake archaeological and ethnographic surveys to assess and record Special Places. Actions to address additional risks to identified Special Places arising from the Proposal will be co-developed within SCHMPs and/or ACHMP as required.

11.7.1.3. Plants and Animals

- Disturbance of plants and animals (particularly culturally significant plants and animals) due to changes in landscape, habitats, water sources and migration pathways reduces customary practices associated with hunting and storytelling
- Total final land area available for native flora and fauna habitats is reduced due to landform changes.

Traditional Owner groups have expressed concerns about their ability to protect animals and plants and key locations such as waterholes that support the animals and plants in accordance with their cultural responsibilities.

The Proponent acknowledges that the landscape and consequently, habitats and water sources will be affected in parts of the Development Envelope. Following the application of mitigation measures outlined in Section 11.6.6, the residual impact on plants and animals is not considered significant.

Continued consultation and engagement will occur with Traditional Owners to better understand and manage culturally important plants and animals throughout the approval process and during the life of the Proposal. This includes through ethnobotanical surveys or other sources. The Proponent will work with Traditional Owners to co-designed SCHMPs, where required.

11.7.1.4. Mine Closure and Rehabilitation

Ongoing impacts to country post closure associated with final landforms (including pit voids, remaining waste rock landforms, abandonment bunds and land bridges). These relate to:

- Visual impacts to country - arising from an inability to return country to pre-mining landscape
- Amenity impacts - where safe and unfettered access to country by Traditional Owners to resume social and cultural activities is restricted due to safety considerations
- Biological impacts – potential chemical impacts to country and the disturbance or reduction of native plants and animals due to changes in habitat, water sources or migration pathways.

The post-mining landscape and environment was raised a number of times throughout the Social Surroundings consultation. Nyiyaparli Traditional Owners indicated a strong preference for pits on their Country to be backfilled. Ongoing residual impacts to country post mining are considered significant – particularly on Nyiyaparli country.

The Proponent intends to create a safe, stable, and non-polluting landscape including making landforms as natural-looking as is practicable to blend in with the surrounding landscape. The Proponent will work with all three Traditional Owner groups in the development of the MCP and to co-develop management actions within SCHMPs, where relevant.

11.7.1.5. Access to Country

- Potential temporary disruptions to road users accessing the GNH associated with construction of and temporary or permanent realignment of the road.

The Proponent recognises that tourists visiting the region as well as Pilbara residents will be impacted particularly in terms of their requirements to use the Great Northern Highway. Any realignment works to the Highway will be developed in accordance with Main Roads WA's standard procedures and through an appropriate Traffic Management Plan. Traffic disruptions are likely to be temporary. Any residual impacts are not considered significant.

The Proponent will work with Nyiyaparli Traditional Owners to co-develop SCHMP based on the central case option for the Great Northern Highway realignment. Should another option be pursued, the Proponent will work with Ngarlawangga Traditional Owners to co-develop a relevant SCHMP. Noting however that the option to realign the Great Northern Highway onto Ngarlawangga Country is not the Central Case option for the Proposal, and consequently may not be required.

11.7.2. Assessment of Significance of Residual Impacts

11.7.2.1. Non-significant Residual Impacts

The assessment of residual impacts, following the application of proposed avoidance and management measures associated with the Proposal that demonstrate non-significant residual impacts to Social Surroundings include:

- Direct and indirect impacts to cultural values and the traditional usage of the land for the Banjima People. Impacts are considered non-significant given they relate to infrastructure only (no mining activities on Banjima country) and impacts are not different than those already experienced through implementation of the Hope Downs 1 Ministerial Statements (MS 584, 893 and 1025)
- There will be no direct impacts to Weeli Wolli Creek and the only direct disturbance to Pebble Mouse Creek is for essential linear (creek crossing) infrastructure, including potentially a bridge for the Great Northern Highway re-alignment
- No direct impact will occur to two identified sites of significant cultural heritage interest - BDH16-03 and HOPE4-07

- No European heritage sites have been documented within the Development Envelope
- Re-alignment of the Great Northern Highway, in accordance with a Traffic Management Plan, to be developed in consultation with Main Roads WA, Traditional Owners and other key stakeholders. The plan will be developed following further design work and stakeholder consultation.

11.7.2.2. Significant Residual Impacts

After application of mitigation measures, the following significant residual impacts are predicted to Social Surroundings:

- Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Nyiyaparli People. These impacts will be managed through a co-developed SCHMP, where impacts require management.
- Direct impact to two identified pools – HD2 waterholes (HD214_04) and BHT waterhole (GHD19-07-WS)
- Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Ngarlawangga People, if the Great Northern Highway re-alignment is located on Ngarlawangga country. These impacts will be managed through a co-developed SCHMP.
- Direct and indirect impacts resulting from the re-alignment of the Great Northern Highway as a result of implementation of the Proposal. These impacts will be managed through a Traffic Management Plan, which is to be approved by Main Roads WA.

Potential direct impacts to heritage values will be appropriately managed via Aboriginal heritage legislation and the IHMP. Any disturbance will be in accordance with approvals under s.16 and/or s.18 of the AH Act (or ACH Permit and/or ACHMP under the ACH Act) and as agreed with Traditional Owners through consultation, based on the principle of free, prior and informed consent.

Ongoing engagement with Traditional Owners will be managed through engagement frameworks established through existing agreements and SCHMPs (where relevant and required).

11.8. Environmental Outcomes

11.8.1. Summary of Significant Residual Impacts and Proposed Conditions

A summary of the Social Surroundings assessment and the Proposed conditions is provided in Table 11-15.

Table 11-15: Assessment Findings and Proposed Conditions for Social Surroundings

Significant Residual Impact to Value	Assessment Finding	Recommended conditions and DMA regulation
Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Nyiyaparli People	• Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Nyiyaparli People. • Significant work has been undertaken to include Traditional Owner feedback from Social Surroundings consultation in Proposal decisions and to refine the mine design,	Proposed to be regulated through implementation of: • Ministerial conditions requiring the implementation of the agreed Nyiyaparli SCHMP

Significant Residual Impact to Value	Assessment Finding	Recommended conditions and DMA regulation
	• Nyiyaparli Traditional Owners have indicated appreciation for the efforts of the Proponent in this regard. • Social Surroundings consultation continues and further design changes in response to Traditional Owner feedback are being investigated. • These impacts will be managed through a co-developed SCHMP, where impacts require management.	
Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Ngarlawangga People, if the Great Northern Highway re-alignment is located on Ngarlawangga Country	• Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Ngarlawangga People. • Significant work has been undertaken to include Traditional Owner feedback from Social Surroundings consultation in Proposal to refine the alignment of Great Northern Highway and the HD2 deposit mine design. • Social Surroundings consultation continues and further design changes in response to Traditional Owner feedback are being investigated. • These impacts will be managed through a co-developed SCHMP, where impacts require management.	Proposed to be regulated through implementation of: • Ministerial conditions requiring the development and implementation of a Ngarlawangga SCHMP, if the Great Northern Highway re-alignment impacts Ngarlawangga Country
Direct and indirect impacts resulting from the re-alignment of the Great Northern Highway	• Re-alignment of the Great Northern Highway, in accordance with a Traffic Management Plan, to be developed in consultation with Main Roads WA, Traditional Owners and other key stakeholders. The plan will be developed following further design work and stakeholder consultation	Proposed to be regulated through implementation of: • Ministerial conditions requiring the development and implementation of a Traffic Management Plan for the construction and operation of the Great Northern Highway re-alignment.

11.8.2. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Social Surroundings are set out below:

- Avoid, where practicable, and otherwise minimise direct and indirect impacts to the environment which impact to Nyiyaparli social and cultural values as a result of implementation of the Proposal, in accordance with the draft Nyiyaparli SCHMP
- Avoid, where practicable, and otherwise minimise direct and indirect impacts to the environment which impact to Ngarlawangga social and cultural values as a result of implementation of the Proposal, in accordance with the SCHMP
- Avoid, where practicable, and otherwise minimise direct and indirect impacts resulting from the re-alignment of the Great Northern Highway as a result of implementation of the Proposal, in accordance with the Traffic Management Plan.

Based on consultation and engagement with Traditional Owners, the Proposal was assessed as having a significant residual impact on social surroundings-related environmental values in relation to the Nyiyaparli People and Ngarlawangga Peoples Traditional Lands, specifically those related to the preservation of cultural amenity of the area within and nearby to the Proposal.

Waterholes are generally of high cultural significance to Traditional Owners, two culturally significant waterholes have been identified by Nyiyaparli Traditional Owners within the Development Envelope on Nyiyaparli Country (HD214_04 at HD2 and GHD19-07-WS at BHT) that will be directly impacted by the Proposal. Given the importance of water in arid landscapes and its social surroundings importance to Traditional Owners, the Proponent is working to avoid and/or mitigate impacts to BHT and HD2 pools, in consultation with the Nyiyaparli Traditional Owners.

The Proponent considers that there is a process of consultation and engagement in place with Traditional Owners and key stakeholders to inform the application of the EPAs mitigation hierarchy to ensure the Proponent can meet the EPAs objective for Social Surroundings.

In accordance with EPA guidance draft conditions/limits have been proposed in Section 11.8.1 the Proponent considers the Proposal can be managed to meet the EPA's objective "to protect Social Surroundings from significant harm".

Required measures and management approaches will be agreed in the Nyiyaparli SCHMP. The Nyiyaparli SCHMP has been co-developed with Nyiyaparli Traditional Owners. A SCHMP will be co-developed with the Ngarlawangga Traditional Owners, should significant impacts be associated with the re-alignment of Great Northern Highway. The co-developed SCHMP/s will ensure the Proponent continues to apply the EPA's mitigation hierarchy (avoid, minimise, mitigate) to all activities undertaken in relation to this Proposal, through consultation and partnership with Traditional Owners and their representatives. A condition requiring the implementation of these SCHMP's is expected for this Proposal.

12. OFFSETS

This section summarises the Proposal's predicted significant residual environmental impacts in the Hamersley IBRA subregion and proposed offsets.

The process of identifying significant residual impacts and determining appropriate offsets follows the framework provided by the *WA Environmental Offsets Policy* (GoWA 2011) and the *WA Environmental Offsets Guidelines* (GoWA 2014) while ensuring that the type and scale of the offsets proposed for MNES are appropriate and consistent with the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a) in addition to the State's requirements.

12.1. Objective

Environmental offsets are actions that provide environmental benefits which counterbalance the significant residual environmental impacts or risks of a proposal or activity. Unlike mitigation actions, which occur on-site as part of the Proposal and reduce the direct impact of that proposal, offsets are generally undertaken outside of the Development Envelope and counterbalance significant residual impacts.

Environmental offsets need only be applied where the residual impacts of a proposal are determined to be significant after avoidance, minimisation, and rehabilitation have been pursued. To ensure consistency and transparency on whether offsets should be applied to a proposal, the significance of residual impacts has been determined by applying the residual impact significance model (RISM) provided in the Environmental Offsets guidelines. This model outlines how significance is determined and when an offset is likely to be required, or may be required, in relation to relevant EPA environmental factors and the relevant clearing principles in Schedule 5 of the EP Act (GoWA 2014), whilst ensuring that the type and scale of the offsets proposed for MNES are appropriate and consistent with the EPBC Act (DSEWPaC 2012a).

The mitigation hierarchy of 'avoid, minimise, rehabilitate and offset' has been considered in assessing the biodiversity factors for this Proposal. This will continue to be applied during the implementation phase, as far as reasonably practicable, such that impacts are first avoided, then minimised, rehabilitated and finally offset if significant residual impacts are unavoidable. This approach is consistent with both State and Federal policy and guidance.

The GHG factor has different mitigation, which has been considered in assessing the GHG factor for this Proposal, namely:

- Avoid – Avoid emissions through best practice design
- Reduce – Reduce emissions over the Project life
- Offset – Offset some or all residual emissions where abatement is not feasible.

12.2. Policy and Guidance

12.2.1. West Australian Environmental Offset Policy

The Government of Western Australia's *WA Environmental Offsets Policy* (2011) (the Policy) seeks to protect and conserve environmental and biodiversity values for present and future generations. The Policy ensures that economic and social development may occur while supporting long-term environmental and conservation values. The Policy seeks to ensure that environmental offsets are applied in specified circumstances transparently to create certainty and predictability while acknowledging that some environmental values are not readily replaceable. It serves as an overarching framework to underpin environmental offset assessment and decision-making in Western Australia.

12.2.2. West Australian Environmental Offset Guidelines

The Government of Western Australia's Environmental Offset Guidelines (2014) (the Guidelines) complements the Policy by clarifying the determination and application of environmental offsets in Western Australia. The application of the Guidelines is designed to ensure that decisions made on environmental offsets are consistent and accountable under the EP Act.

The Guidelines expand on the Policy to:

- Ensure that the basis for decision-making on environmental offsets is understood by decision-makers, government officers, industry and the community and consistently applied by decision-makers
- Ensure transparency in the determination and application of offsets
- Provide a basis for auditing, compliance and enforcement.

Notably, the Guidelines establish that environmental offsets are designed to address significant residual environmental impacts that remain after on-site avoidance and mitigation measures have been undertaken.

12.2.3. Environmental Protection Act 1986

12.2.3.1. Biodiversity Factors

The rate, scale and nature of current and future developments in the Pilbara, combined with the impacts of other land uses and threatening processes, have been identified as a concern by the EPA (EPA 2014). In relation to the potential for significant residual impacts, the EPA (2014) identified a concern regarding the regulation and management of cumulative impacts on native vegetation due to impacts from clearing, pastoralism, feral animals, weeds and climate change in the Pilbara, and the lack of reliable information on the extent and condition of native vegetation at a regional scale.

The EPA has determined that a proactive approach to compensating for clearing native vegetation in the Pilbara is required. DWER has therefore established a strategic regional conservation initiative to consolidate and manage offset funds to support delivery of coordinated offset projects for the Pilbara bioregion, namely the Pilbara Environmental Offsets Fund (PEOF). The WA Government has established the PEOF in response to recommendations from the EPA for a strategic, coordinated approach to applying environmental offsets to achieve broad-scale biodiversity conservation outcomes.

According to the policy and associated guidelines, the PEOF consolidates financial contributions for environmental offsets for Pilbara resource and infrastructure projects approved under the EP Act. Financial contributions to the PEOF will be used to implement conservation projects that counterbalance any significant residual impacts of those developments at a landscape level in the Pilbara.

The EPA notes that in establishing and implementing the PEOF, the WA Government has committed to ensuring that the offsets implemented via the PEOF are underpinned by the principles set out in the Policy (GoWA 2011). The six principles are:

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 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.

Specifically, the offsets of this Proposal align with Principles 1, 3, 4, 5 and 6.

Strategic approaches, such as using a fund, can provide a coordinating mechanism to implement offsets across a range of land tenure (GoWA 2014). Funds should be used for landscape-scale on-ground actions in the Pilbara IBRA region and indirect actions (such as research) that will directly counterbalance the significant residual impacts and contribute to biodiversity conservation outcomes in the region (DWER 2019, 2022).

Contributions to the PEOF to offset the significant residual impact from clearing native vegetation considered in good to excellent condition have been used as the standard offset approach by the EPA and proponents in the Pilbara since 2012. Where there are other environmental values with elevated significance, a higher offset rate (i.e. dollars per hectare cleared) is applied to account for this greater value.

12.2.3.2. Greenhouse Gas Emissions

In its assessment of the Proposal, the EPA may request information on any considered and proposed mitigations that demonstrate that all reasonable and practicable measures have been applied at each step of the mitigation hierarchy, including offsetting emissions (carbon offsets) through the implementation of a GHG emission offset package to offset some or all residual emissions (EPA 2020b).

The EPA has advised that where carbon offsets are implemented, they should meet offset integrity principles and be based on clear, enforceable and accountable methods (EPA 2020b). For example, the EPA recognises ACCUs issued under the *Carbon Credits (Carbon Farming Initiative) Act 2011* as meeting these standards. Compliance offsets under the Safeguard Mechanism and voluntary offsets purchased to reduce residual emissions may contribute to a proponent's Greenhouse Gas Management Plan and will be recognised by the EPA.

The State's *Greenhouse Gas Emissions Policy for Major Projects* (GoWA 2019) declares that local innovation and local benefits are encouraged, particularly in the development of carbon offsets, and indicates a willingness to consider credible international offsets to limit abatement costs (GoWA 2019).

12.2.4. Environment Protection and Biodiversity Conservation Act 1999

The *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a) outlines the Australian Government's approach to using environmental offsets under the EPBC Act.

This policy is intended to provide a transparent framework to provide greater certainty for businesses considering actions that may be subject to an offset requirement while promoting consistency and providing robust, positive environmental outcomes.

The policy is accompanied by the Offsets assessment guide, developed to give effect to the policy requirements, utilising a balance sheet approach to estimate impacts and offsets for threatened species and ecological communities.

The policy and guide provide a decision support framework to normalise the judgements associated with determining proposed offsets for a given impact. The overarching test of both the policy and the guide is that suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the environment aspect protected by national environment law and affected by the proposed action.

12.2.5. Memorandum of Understanding Concerning the Pilbara Environmental Offset Fund

On 19 November 2020, the State and Commonwealth governments established a memorandum of understanding to enable achievement of landscape-scale biodiversity outcomes for MNES via the PEOF. The agreement means that the PEOF now collects and deploys the environmental offset monies paid by industry under State and Commonwealth (as a condition under Part 9 or 10 of the EPBC Act (DAWE 2020) environmental legislation.

12.3. Assessment and Significance of Residual Impact – EP Act

12.3.1. Biodiversity Impacts

Environmental offsets will only be applied where the residual impacts of the Proposal are determined to be significant after avoidance, minimisation, and rehabilitation have been pursued (GoWA 2014). These measures have been detailed in the relevant impact assessment chapters (Section 6.6, 7.6, 8.4.8, 8.5.6, 9.6 and 13.9.6) and are summarised in Table 12-1.

The significance of residual impacts to biodiversity values has been determined according to the RISM provided in the WA Environmental Offsets Guidelines (GoWA 2014) as summarised in Table 12-2.

The Proposal will result in clearing up to 4,900 ha of native vegetation in the Hamersley IBRA subregion. Following the application of the mitigation hierarchy, the following residual environmental impacts are considered significant impacts and therefore require to be offset:

- Clearing approximately 4,205 ha of native vegetation in good to excellent condition, including:
    - Approximately 1,471 ha of native vegetation (in good to excellent condition) which does not overlap significant fauna habitat
    - Up to 105 ha of Critical habitat for Northern Quoll, Ghost Bat and Pilbara Olive Python, comprising 67 ha Breakaway and 38 ha Gorge/Gully habitat
    - Approximately 2,659 ha of Supporting habitat for MNES species as per the following home ranges for each species:
        - 1 km from records of Northern Quoll within the Development Envelope
        - 12 km from Category 1 and 2 Ghost Bat roosts, or Category 3 Ghost Bat roosts within an apartment block
        - 1 km from records of the Pilbara Olive Python within the Development Envelope
        - Category 4 Pilbara Leaf-nosed Bat roosts (with a 20 m buffer from the recorded cave location).

The clearing of native vegetation will impact terrestrial fauna habitats. Based on significant survey work and advice from Pilbara subject matter experts, the offsets proposed are specific to the characteristics of the Proposal. The assessment of residual impacts on MNES fauna habitats are further discussed in Section 13.9.6.

12.3.2. Greenhouse Gas Emissions

After the avoidance and reduction measures, the Proposal is expected to contribute net GHG emissions (Scope 1 emissions) of approximately 2,019,454 t CO_2-e through the project's life, with five-year targets set to progress to 50% by 2030. If the Proponent cannot meet the proposed targets by implementing emissions reduction initiatives, the Proponent will offset the excess emissions by retiring credible carbon units, which are further discussed in 10.5.3.

Table 12-1: Quantification of Residual Impact to be Offset

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
Environmental Factor: Flora and Vegetation (Chapter 6)				
<u>Context/Key Survey Findings:</u> The Development Envelope comprises the following flora and vegetation values: • Native vegetation in good to excellent condition • Two vegetation types of high local significance • Ten vegetation types of moderate local significance • Presence of riparian vegetation along Pebble Mouse Creek and associated moderate drainage lines • Twelve Priority flora species (recorded) • Low abundance of weeds **<u>Predicted Impact/Outcome</u>** • Direct disturbance to vegetation limited to 4,900 ha (of which approximately 4,205 ha is in good to excellent condition) • Direct impact to vegetation units of high local significance, of up to 31 ha, consisting of: o 12 ha of the vegetation type D4 o 19 ha of the vegetation type H2 • Direct disturbance of up to 12 ha of riparian vegetation considered to be of high local significance, represented by vegetation type D4 • Retention of at least 656 *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2) individuals within the Development Envelope • Retention of at least 172 *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) individuals within the Development Envelope • Retention of at least 1,909 *Aristida lazaridis* (P2) individuals within the Development Envelope	**<u>Avoidance</u>** The Proposal has been designed to avoid potential impacts by: • The Proponent has avoided impacts to flora and vegetation, specifically riparian vegetation units, through the reduction of the Development Envelope, especially through excluding approximately 6 km of Weeli Wolli Creek • Establishing MEZ1 to the west of the BHT deposit. MEZ1 has primarily been established to protect MNES fauna and habitat but has the added effect of protecting the following P2 Priority flora: o *Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2), approximately 85% of recorded within the Development Envelope is within MEZ1 o *Hibiscus* sp. Gurinbiddy Range (P2), approximately 13% of recorded within the Development Envelope is within MEZ1 • Ensuring clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Avoiding the introduction of new weeds species listed as WoNS entering the Development Envelope by implementing the measures in the EMP (Appendix A7) and the Proponent's internal procedures have been developed to meet the current industry standards for managing the potential introduction and spread of weeds. The EMP weed management measures will minimise the spread and introduction of weed species within the Development Envelope • Clearing activities would not be undertaken when fire danger ratings are severe or high **<u>Minimisation</u>** The Proposal has been designed to minimise potential impacts by: • MEZs will minimise impacts to nine vegetation types, including one of high local significance and three of moderate local significance • Ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • The Proponent will take measures, as outlined in the EMP (Appendix A7), to minimise the introduction or spread of any new weed species. This will include key actions such as periodic weed spraying and equipment weed hygiene protocols • Dust suppression techniques such as sprayers on crushers and water trucks which will utilise surplus water. These are expected to help minimise dust generated during construction and operation	The Proponent will: • The Proponent will develop a Mine Closure Plan (MCP) following DMIRS Guidelines (DMIRS 2020a) • The Proponent is committed to progressive rehabilitation to minimise the amount of cleared land and revegetate using local native species, where possible • The MCP (Appendix A4) includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use, including: o Topsoil and vegetation (including woody debris) would be re-spread over rehabilitated areas to act as a seed source and to protect the soil from erosion o Local provenance seed and propagated material will be used (if required) to rehabilitate disturbed areas • A site undergoing rehabilitation will be opportunistically sprayed to remove any weed species present The MCP (Appendix A4) includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use, including: • Topsoil and vegetation (including woody debris) would be re-spread over rehabilitated areas to act as a seed source and to protect the soil from erosion • Local provenance seed and propagated material will be used (if required) to rehabilitate disturbed areas • A site undergoing rehabilitation will be opportunistically sprayed to	**<u>Can the environmental values be rehabilitated? Evidence?</u>** All rehabilitation is undertaken in accordance with the Proponent's Rehabilitation Procedures. **<u>Operator experience in undertaking rehabilitation?</u>** Rio Tinto conducts rehabilitation activities progressively at all its operations in the Pilbara. All rehabilitation is undertaken according to the Rehabilitation Handbook, which is reviewed and updated periodically to reflect changes in industry standards, reflect new knowledge obtained through research and development, and adopt learnings from ongoing rehabilitation projects. • The Rehabilitation Handbook addresses: o Soil resource management o Rehabilitation techniques o Local provenance species seeding practices o Records and data management o Ongoing monitoring **<u>What is the type of vegetation being rehabilitated?</u>** The Proponent purchases appropriate local provenance seeds from commercial seed suppliers for rehabilitation. Stringent controls on seed quality, provenance, and storage are in place and seed pre-treatments are researched and incorporated for some species to maximise the potential of applied seed to germinate successfully and persist. **<u>Time scale</u>** Once internal stakeholders have signed off areas as no longer required for current or future operations, they are added to the progressive rehabilitation implementation schedule. However, mine plans are dynamic and subject to continuous revision. Progressive rehabilitation will continue to be undertaken throughout the life of the Proposal where practicable; however, most	• Clearing of up to 4205 ha of native vegetation in Good to Excellent Condition The direct disturbance of vegetation in Good to Excellent condition in the Pilbara is recognised by the EPA as a significant residual impact and will be offset.

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
	• Limiting the amount of disturbed land to as small as reasonable, reducing the amount of dust producing surfaces • The implementation of speed limits on unsealed roads and tracks to reduce dust creation • Implementation of fire management measures carefully managed and monitored hot works (implementation of hot works permit system), vehicle movement (not leaving cleared tracks) and disposal of potential fire-starting waste [e.g., cigarette butts]) is expected to minimise the risk of bushfires as a result of the Proposal • Firefighting equipment will be located around the site and in vehicles. Fire response procedures and personnel training, including site inductions on fire prevention and management, will also be provided	remove any weed species present • Indicative closure completion criteria will ensure that only weeds that are already found locally are present within rehabilitated areas	of the rehabilitation will be undertaken at closure. **Credibility of the rehabilitation proposed (evidence of demonstrated success)** Rehabilitation success across existing operational areas has been variable to date. Some areas indicate positive performance and very good rehabilitation, and poor rehabilitation outcomes observed in some other historical areas. In response and in consultation with DMIRS, the Proponent has recently undertaken extensive revisions of mine closure planning (for all its Pilbara operations) to ensure, among other things, improved detail is provided on how closure objectives, such as those related to progressive rehabilitation, will be achieved successfully. Evidence of demonstrated success is provided in Appendix G1.	
Environmental Factor: Terrestrial Fauna (Chapter 7)				
Context/Key Survey findings: The Development Envelope comprises the following terrestrial fauna values: • Critical Gorge/Gully and Breakaway (roosting and breeding) habitats for the Northern Quoll (EN), Ghost Bat (VU) and Pilbara Olive Python (VU) and potential SRE species, including nine (9) caves suitable for Ghost Bats: o One (1) Category 2 cave (Cave 10) o Two (2) Category 3 caves (Cave 1 & 5) o Six (6) Category 4 caves (Cave 2, 3, 4, 6, 7 and 8) • Supporting Minor Drainage, Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Rocky Hill and Stony Plain (foraging and dispersal) habitats for the Ghost Bat and Northern Quoll • Suitable habitat for the Pilbara Olive Python (VU), Grey Falcon (VU), Night Parrot (CE), Fork-tailed Swift (MI), Gane's Blind Snake (P1), Pilbara Barking Gecko (P2), Western Pebble-mound Mouse (P4), and Letter-winged Kite (P4) • Nine (9) Category 4 roosts considered Supporting habitat for the Pilbara Leaf-nosed Bat were recorded within the Development Envelope • Records of the Priority 2 reptile: *Lerista macropisthopus remota* • Three high-value SRE fauna habitat types • Three confirmed and 35 potential SRE species **Predicted Impact/Outcome**	The Proposal has been designed to manage and minimise the following potential impacts to terrestrial fauna: **Avoidance** Retention of critical fauna habitat through: • Excluding the southern flank of the BHT from the proposed Conceptual Footprint will retain a movement corridor along Weeli Wolli Creek and Pebble Mouse Creek • Establishing two MEZs (MEZ1 and MEZ2) at BHT, that includes: o Category 2 Ghost Bat cave (Cave 10) o Three Category 3 and 4 Ghost Bat caves (Caves 3, 5 and 6) o Significant Northern Quoll, Ghost Bat and SRE habitat o Avoid indirect impacts to other fauna species in the local area • Clearing activities will not be undertaken when fire danger ratings are severe or higher **Minimisation** The Proposal has been designed to minimise potential impacts by: • Clearing of high significance habitat being restricted through authorised extents • Uploading the known location of significant fauna habitat types in the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents	The Proponent will: During rehabilitation the Proponent will ensure that: • The development of an MCP will include objectives to ensure vegetation on rehabilitated land is: o Self-sustaining and compatible with post-mining land use o Final landforms are stable and consider ecological and hydrological factors • MCP will be regularly updated to be constant with DMIRs Guidelines • Borrow pits to be designed, constructed and rehabilitated to minimise surface water ponding • Conduct rehabilitation according to the Rehabilitation Handbook and will include fauna and habitat monitoring • Rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement	Credibility of the rehabilitation proposed (evidence of demonstrated success) • Evidence of demonstrated success is provided in Appendix G1.	**Extent** Clearing of: • Up to 105 ha of critical Gorge/Gully and Breakaway (roosting and breeding) habitat, comprising 67 ha Breakaway habitat and 38 ha Gorge Gully habitat • Approximately 2,659 ha of supporting Minor Drainage, Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Rocky Hill and Stony Plain (foraging and dispersal) habitats **Quality** • Critical Gorge/Gully and Breakaway (roosting and breeding) habitat for MNES species • Supporting Minor Drainage, Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Rocky Hill and Stony Plain (foraging and dispersal) habitats for MNES species **Land Tenure** Not applicable **Time Scale**

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	

• Direct disturbance to terrestrial fauna habitat limited to 4,900 ha
• Direct disturbance of 105 ha is of high value habitat, comprising of:
  ○ 67 ha of Breakaway habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python
  ○ 38 ha of Gorge/Gully habitat – considered to be Critical for Northern Quoll, Ghost Bat and Pilbara Olive Python
• Direct disturbance of 2,659 ha is of moderate value habitat, comprising of:
  ○ 369 ha of Rocky Hill habitat – considered to be Supporting for Northern Quoll, Grey Falcon and Ghost Bat
  ○ 269 ha of Minor Drainage habitat – considered to be Supporting for Northern Quoll, Ghost Bat, and Grey Falcon
  ○ 70 ha of Alluvial Plain habitat – considered to be Supporting for Ghost Bat
  ○ 917 ha of Low Hills and Slopes habitat – considered to be Supporting for Ghost Bat
  ○ 601 ha of Mulga Woodland habitat – considered to be Supporting for Ghost Bat
  ○ 433 ha of Stoney Plain habitat – considered to be Supporting for Ghost Bat
• No direct impacts to confirmed and potential SRE populations within the Development Envelope
• Direct disturbance to no more than two caves within the Development Envelope, comprised of:
  ○ One Category 3 (Cave 1) and one Category 4 (Cave 8) Ghost Bat roosts, both caves are also Category 4 Pilbara Leaf-nosed Bat caves
• Retention of significant value habitat within Mining Exclusion Zones
• MEZ1 (233 ha) – established to protect:
  ○ Northern Quolls recorded at the southern extent of the range of the species (as identified in the baseline surveys)
  ○ Northern Quoll habitat (55 ha of Critical habitat and 178 ha of Supporting habitat)
  ○ Ghost Bat habitat (one Category 3 (Cave 5) and two Category 4 caves (Caves 3 and 6); 55 ha of Critical habitat and 225 ha of Supporting habitat)
  ○ Pilbara Leaf-nosed Bat habitat (three Category 4 caves)
• MEZ2 (8 ha) established to protect the integrity of the potential maternity Ghost Bat roost (a Category 2 cave, Cave 10), and the surrounding Supporting habitat
	• Ensuring all clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system
	• Confining vehicle traffic to defined roads and tracks
	• Undertaking progressive clearing to allow fauna to migrate away from clearing activities or machinery movements
	• Implementing speed limits to minimise the risk of fauna injury or mortality from vehicle strike
	• Restricting vehicle traffic to defined roads and tracks
	• Removing roadkill from trafficable areas to reduce the risk of an increase in predators
	• Installation of reflectors on any barbed wire fences to help prevent the entanglement of bat species
	• Conducting site induction programs to provide information on significant fauna including their appearance and habitats. Training would also discuss standard operating procedures in the event of fauna interactions
	• Constructing artificial water sources with egress points
	• The measures in the EMP (Appendix A7) and the Proponent's internal procedures have been developed to meet the current industry standards for managing the potential introduction and spread of weeds. The EMP weed management measures will minimise the spread and introduction of weed species within the Development Envelope
	• Implementing dust suppression management strategies to minimise the impact of fugitive dust to below 77g/m^2/month (Matsuki et al. 2016), including the utilisation of water carts
	• Implementing a feral cat control and monitoring program around the MEZs as well as waste management procedures to minimise the number of feral species attracted to the site
				Clearing will be undertaken progressively.

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
Environmental Factor: Subterranean Fauna (Chapter 8)				
<u>Context/Key Survey Findings</u>: The Development Envelope comprises the following subterranean fauna values: **<u>Troglofauna</u>** • Total species richness ranges from 17.7 to 24 species, with the 15 taxa collected in 2018 and 2019 representing an estimated 63% to 85% of the total species predicted to occur in the Development Envelope. • The extrapolation of the observed species accumulation curve indicates that increasing the survey effort by more than 100% (i.e. from 283 to 566 samples) will likely record an additional four troglofauna species • Within BHT, troglofauna were recorded from 27 (50%) of the 54 sites sampled, and 36 (23%) of the 158 samples collected in 2018 and 2019 • Within HD2, troglofauna were not collected as commonly as at BHT, with material recorded from 10 (29%) of the 38 sites sampled, and 13 (10%) of the 124 samples collected <u>Stygofauna</u> • Eighteen stygofauna taxa were recorded within the Development Envelope • No stygofauna taxa were recorded from within the proposed BHT pits or any section of HD2 **<u>Predicted Impact/Outcome</u>** • The Brockman Iron Formation (BHT only) will be reduced in extent within the Development Envelope (approximately 35% will remain, based on surface geology) for troglofauna, however it has been shown that this formation is continuous outside of the Development Envelope • The reduction in extent may impact on the distribution of two of the five restricted troglofauna taxa that have only been recorded in the Brockman Iron Formation and within the proposed pit outlines: (Eukoenenia `sp. OES2` and Lagynochthonius `sp. WAM-PSE096`). However, the assessment concludes that the Proposal will not result in significant irreversible impacts to the troglofauna assemblage and populations of individual taxa • No residual impacts to stygofauna associated with direct or indirect impacts are expected, primarily due to the Proponent's decision to restrict mining to AWT • Limit the Proposal's groundwater abstraction to that which is necessary for construction and operation	Avoidance The Proposal has been designed to avoid potential impacts by: • Reducing the extent of the Development Envelope • The establishment of several MEZ's across the Development Envelope will protect a sizable portion of subterranean habitat • AWT mining and avoiding direct impacts to stygofauna as a result of mine dewatering and associated groundwater drawdown and/or discharge Minimisation • Ensuring the disturbance of vegetation across the Proposal is minimised at all times and that areas no longer required for use are rehabilitated as soon as practicable • Managing groundwater abstraction to ensure groundwater drawdown is not greater than the predicted amount • Ensuring hydrocarbons and other potentially polluting substances are properly managed and spills/leaks are fully remediated as soon as practicable • Limiting groundwater abstraction to that which is necessary for construction and operation • Undertaking groundwater abstraction in accordance with a licence managed under the RiWI Act • Borefields will be located and operated to ensure drawdown is minimised and not greater than predicted	The Proponent will: • The Proponent will implement a Mine Closure Plan (MCP) following DMIRS Guidelines (DMIRS 2020a) • The Proponent is committed to progressive rehabilitation to minimise the amount of cleared land and revegetate using local native species, where possible • Ensure the final landform is stable and considers ecological and hydrological factors • Ensure contamination risks have been appropriately managed • Vegetation of rehabilitated land is self-sustaining and compatible with the final land use • Measures to achieve these objectives will include but are not limited to: ○ Rehabilitation of waste dumps and other disturbed areas ○ Deep ripping/scarification of compacted areas to improve infiltration ○ Opportunistic backfilling into pit voids during operations as they become available or post closure ○ Removal of stockpiles ○ Hydrocarbon management	The Proponent approach to rehabilitation is outlined in Flora and Vegetation in this table Credibility of the rehabilitation proposed (evidence of demonstrated success) Evidence of demonstrated success is provided in Appendix G1	The Proponent considers that potential impacts can be managed, and that the residual impact will not be significant
Environmental Factor: Inland Waters (Chapter 9)				

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
Context/Key Survey Findings: Two main waterways of significance occur within the Development Envelope and its immediate surrounds: • Weeli Wolli Creek • Pebble Mouse Creek These watercourses support two pools, located outside of the Development Envelope, that are considered to be of high ecological and cultural significance: • Weeli Wolli Spring – located downstream of the confluence of Weeli Wolli Creek and Pebble Mouse Creek • Ben's Oasis – Significant feature of Weeli Wolli Creek The following Inland Waters values are located within the Development Envelope: • Aquifers related to HD2 water supply **Predicted Impacts / Outcomes**: • No project attributable impacts to groundwater levels or water quality when compared to pre-mining conditions of: o Ben's Oasis o Weeli Wolli Spring • No project attributable impacts to surface water flow paths or quality in Weeli Wolli Creek • Implementation of the Proposal such that the hydrological regime and water quality of Pebble Mouse Creek is maintained so as to ensure no downstream impacts to Weeli Wolli Creek •	The Proposal has been designed to manage and minimise the following potential impacts to Inland Waters: **Avoidance** Relocation of waste rock landforms to outside of the Weeli Wolli Creek/Ben's Oasis primary catchment. • Reduction in Development Envelope by 17.7% • AWT table mining and will not require significant groundwater abstraction • Production bores will be placed in aquifers that are isolated from groundwater-dependent environmental values including Ben's Oasis • Abstraction within the BHT deposit area will be avoided • Impacts to downstream water quality will be avoided by constructing the crossings during the dry (no-flow) season **Minimisation** The proposed water management strategy will involve the following measures: • Groundwater abstraction requirements will be minimised by maximising the use of surplus mine dewater from HD1 • Proposed abstraction volumes to be within the sustainable yield of the HD2 groundwater resources • Diversion infrastructure will be implemented at HD2 deposit through the implementation of a levee and two drains. The drain configuration will divert flow a tributary of Pebble Mouse Creek towards Weeli Wolli Creek Water quality measure include: • Impacts to downstream water quality will be avoided by constructing the crossings during the dry (no-flow) season • Linear infrastructure will be designed to convey high frequency flood events (up to 1 in 10 AEP) through culverts or similar. Infrastructure may be designed to allow overtopping in lower frequency events • Crossings will be constructed in accordance with best industry practice and will include the use of rock armour to limit potential scouring effects, to minimise erosion risk and impacts to water quality during significant flow events (1:100 AEP) • Where possible, surface water diversions will be constructed to avoid natural flows from entering disturbed areas, including mining voids. The flow diversions will be designed, constructed and maintained so as to minimise flow velocities and scour potential • Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements	During rehabilitation the Proponent will ensure that: • Groundwater bores will be decommissioned in accordance with relevant guidelines, once no longer required • All disturbed areas that are no longer required will be stabilised and, if appropriate, rehabilitated • All surface water diversions remaining after closure are designed and engineered to minimise impacts on local hydrological regimes, ensure long term stability across the realistic range of expected flow events, and do not significantly cause or contribute to water quality impacts • The crossings will be completely removed during closure, in accordance with the MCP. Removal will be completed during the dry (no-flow) season and the creek bed and banks appropriately stabilised to reduce erosion and ensure natural values are re-established • Modelling will be used to ensure the integrity of legacy structures, such as waste rock landforms, is retained over the long term • All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure	The Proponent approach to rehabilitation is outlined in Flora and Vegetation in this table. Credibility of the rehabilitation proposed (evidence of demonstrated success) • Evidence of demonstrated success is provided in Appendix G1	The Proponent considers that potential impacts can be managed, and that the residual impact will not be significant.

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
	and industry guidelines, including within secondary containment. These substances will not be stored within or near creeklines, or within floodplains • All personnel involved in the storage and handling of potentially contaminating materials will be appropriately trained and supported by adequate resources including signage, spill kits and PPE			
Environmental Factor: Greenhouse Gas Emissions (Chapter 10)				
Predicted Impact/Outcomes The Proposal is expected to contribute annual carbon dioxide equivalent (CO_2-e) as follows: • Scope 1 emissions: Diesel and land clearing – no more than 200,518 tonnes of carbon dioxide equivalent (tCO_2-e) per annum • Scope 2 emissions: Electricity generation – no more than 6,330 tCO_2-e per annum Through the LOM, the Proposal will contribute total emissions of: • Scope 1 emissions: 1,930,833 tCO_2-e • Scope 2 emissions: 2,108,075 tCO_2-e • Scope 3 emissions: up to 382 Mt CO_2-e	The Proponent will implement the following measures to manage and minimise GHG emissions, where practicable: **Avoidance** • The Proponent has study and development processes that identify, assess and where practicable develop existing, innovative and new technology developments **Minimisation** • Progress on the basis of Road Train instead of Haul Trucks to improve fuel efficiency • Fixed Plant: Investigation into upgrading the plant including replacing the HP800 crushers with HP900 crushers (including drives) • Mine Design: The ongoing design and mine plan optimisation • Design and construct non-process infrastructure buildings with 5-star Greenstar rating in accordance with the National Construction Code • Minimise haulage distance and diesel use by utilising HD1 South Crusher for the majority of the HD2 ores • Minimise stop/start through the design of haul roads • Optimise haulage distances between the pit exits and waste dumps • Optimise the design of Pebble Mouse Creek haul road crossing to reduce the haulage distance to the HD1 South Crusher Emission abatement projects may be implemented as part of the Proposal or at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld, as part of the Rio Tinto decarbonisation strategy.	• Net emissions from the Proposal are expected to decrease over the coming years as a result of: • The implementation of emissions reduction measures and subsequent decrease in emissions intensity • Retirement of Credible Offset Units in relation to the Proposal for 2025, 2030, 2035, 2040, 2045 and 2050 will occur where the measures to avoid or reduce emissions are insufficient to meet Scope 1 interim and long-term emissions reduction targets. Rehabilitation will include establishing vegetation on rehabilitated landforms and therefore, there will be some capture of carbon at closure. This has not been taken into account in the emissions calculations.	Not applicable	The Proponent considers that potential impacts can be managed and that residual impacts will not be significant. If the expected reductions are not achieved, then offsets would be provided to ensure net emissions are no greater than expected.
Environmental factor: Social Surroundings (Chapter 11)				
Context/Key Survey Findings: Recognising each Traditional Owner group is different and has different values, concerns, and issues (and individual members have a range of views) regarding the Proposal, the following list is considered by the Proponent to encapsulate the common key broad themes and issues raised during Social Surroundings consultation: • Water • Sense of place and amenity (dust, noise, vibration)	The Proposal has been designed to manage and minimise the following potential impacts to Social Surroundings: **Avoidance** The Proposal has been designed to avoid the following potential impacts to water values are outlined above in Inland Waters: • The Development Envelope has been reduced to exclude areas of Weeli Wolli Creek adjacent to the HD2 deposit (approximately 6 km) and minimise	The Proponent will: • The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's: and will work in collaboration with the Nyiyaparli People to rehabilitate impacts to culturally significant Social surroundings values as identified through consultation,	Not applicable	**Extent** • Clearing up to 3,908 ha on Nyiyaparli land • Clearing up to 244 ha on Banjima land • Clearing up to 53 ha on Ngarlawangga land **Quality**

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	

• Sense of place and amenity (altered visual landscapes, land use and recreational amenity)
• Access
• Special Places (including waterholes, heritage sites and meeting places)
• Plants and animals (used socially or culturally, or with cultural associations)
• Mine closure and rehabilitation
 	
The key themes frequently overlap due to the holistic view of Country that Traditional Owners hold and inform the discussion of Traditional Owner Social Surroundings values
 	
Predicted Impact/Outcomes:
 	
The proposed avoidance and management measures associated with the Proposal that demonstrate non-significant residual impacts to Social Surroundings include:
 	
• Direct and indirect impacts to cultural values and the traditional usage of the land for the Banjima People. Impacts are considered non-significant given they relate to infrastructure only (no mining activities on Banjima country) and impacts are not different than those already experienced through implementation of the Hope Downs 1 Ministerial Statements (MS 584, 893 and 1025)
• There will be no direct impacts to Weeli Wolli Creek and the only direct disturbance to Pebble Mouse Creek is for essential linear (creek crossing) infrastructure, including potentially a bridge for the Great Northern Highway re-alignment
• No direct impact will occur to two identified sites of significant cultural heritage interest - BDH16-03 and HOPE4-07
• No European heritage sites have been documented within the Development Envelope
• Re-alignment of the Great Northern Highway, in accordance with a Traffic Management Plan, to be developed in consultation with Main Roads WA, Traditional Owners and other key stakeholders. The plan will be developed following further design work and stakeholder consultation
 	
After application of mitigation measures, the following significant residual impacts are predicted to Social Surroundings:
 	
• Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Nyiyaparli People. These impacts will be managed through a co-developed SCHMP, where impacts require management
• Direct and indirect impacts to cultural values, special places, and the traditional usage of the land for the Ngarlawangga People, if the Great Northern Highway re-alignment is located on Ngarlawangga country. These impacts will be managed through a co-developed SCHMP
	areas of Pebble Mouse Creek that are within the Development Envelope
	
	The Proposal has been designed to avoid the following potential impacts to Sense of place and Amenity (dust, noise, and vibrations) values, in particular:
	
	• The proposed Conceptual Footprint has been amended to move waste rock landforms to avoid direct impacts to the general amenity of these areas, associated with dust deposition, noise, and vibrations, including waster rock landforms
	• Three Mining Exclusion Zones are proposed, with 100 – 150m buffers, which will apply to protect significant ecological and cultural values
	
	The Proposal has been designed to avoid the following potential impacts to Sense of place and Amenity (landscape features) values, in particular:
	
	• The proposed Conceptual Footprint has been amended to remove the waste rock landform near the HOPE4-07 heritage complex to avoid direct impacts to visual amenity from Weeli Wolli Creek
	• The Proponent has limited mining activity visible on the southern façade of BHT, including removing a proposed waste rock landform from an earlier version of the conceptual footprint
	
	The Proposal has been designed to avoid the following potential impacts to access values, in particular:
	
	• The proposed Conceptual Footprint has been reduced to minimise impacts to special places and maximise access particularly special places as identified by Nyiyaparli People
	• Access to BDH1603 by Nyiyaparli People will be achieved via existing Hope Downs 1 Land Access Protocols amendment (which includes escorted access to restricted sites)
	• Road options have been developed to provide Nyiyaparli Peoples unrestricted access to HOPE4-07 and the associated part of Weeli Wolli Creek
	• The Proponent has committed to maintaining access to Weeli Wolli Creek gabion and Weeli Wolli Springs throughout construction, operation, and closure
	  ○ The Proponent will attempt to minimise any access disruptions where practicable
	  ○ The Proponent will provide alternative means of access where possible should previously existing access routes be impacted as part of the development
	
	The Proposal has been designed to avoid the following potential impacts to Special places values, in particular:
	
	• The Development Envelope has been reduced south of HD2, to ensure that the HOPE4-07 heritage complex falls outside the Development Envelope. This design change will avoid direct impacts to HOPE4-07 heritage complex, which was of high
		surveys, and the Social Surroundings baseline assessment process
		• Work in collaboration with the Nyiyaparli, Banjima and Ngarlawangga People during rehabilitation of the site
		• Consult with Nyiyaparli, Banjima and Ngarlawangga People regarding the proposed closure landform designs, including proposed visual impact from key vantage points of cultural heritage importance
		• Assess rehabilitation seed mixes and seek to incorporate identified culturally significant species (bush tucker/medicine) where practical
				4,205 ha of native vegetation is in Good to Excellent condition.
				
				Land Tenure
				
				Not applicable.
				
				Time Scale
				
				• Clearing will be undertaken progressively

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
• Potential direct impacts to heritage values will be appropriately managed via Aboriginal heritage legislation and the IHMP. Any disturbance will be in accordance with approvals under s.16 and/or s.18 of the AH Act (or ACH Permit and/or ACHMP under the ACH Act) and as agreed with Traditional Owners through consultation, based on the principle of free, prior and informed consent • Ongoing engagement with Traditional Owners will be managed through engagement frameworks established through existing agreements and SCHMPs (where relevant and required)	importance to the Nyiyaparli people in the Social surroundings consultation • The proposed Conceptual Footprint has been amended to remove a waste rock landform south of BHT to avoid impact to: ○ Areas of breakaway and gorge/gully landforms (that are more likely to contain caves and rock shelters that have potential to be heritage sites) ○ Ben's Oasis primary catchment and most of Weeli Wolli Creek • Mining Exclusion Zone 3, with a 100m buffer, will apply to significant heritage site BDH16-03, within which direct disturbances will be avoided • Changes to the alignment of the powerline corridor to HD1 to avoid a heritage site buffer (Banjima) • Infrastructure has been located to avoid heritage sites, where possible • The Proponent will work in collaboration with Nyiayparli People to avoid to the extent practicable impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process. Special Places can include water holes (i.e., (GHD19-07-WS) and (HD214_04), rock shelters and/ or other significant sites found in previously unsurveyed areas in the Development Envelope) • Places identified as significant by the Nyiyaparli People and/or their supporting consultants through archaeological and ethnographic surveys or the Social Surroundings baseline assessment process are recorded in the Proponent's GIS system as heritage places and will be avoided where practicable, as identified in the ACHMP where this is determined necessary and appropriate in consultation with Nyiyaparli People • The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Site induction to include maps identifying no-access areas, cultural and heritage training, advice to all personnel regarding unauthorised access (to be recorded as an incident), and details of required access permissions **<u>Minimisation</u>** The Proposal has been designed to minimise the following potential impacts to water values are outlined above in Inland Waters: • Surface water management infrastructure including Pebble Mouse Creek crossings, diversion drains, levees and culverts. The diversion configuration will divert flow from a tributary of Pebble Mouse Creek around the pit and towards Weeli Wolli Creek			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
	• Use of surplus water from adjacent operations, such as HD1, for the Proposal's water supply to minimise groundwater abstraction for Proposal water supply • Crossing of Pebble Mouse Creek limited to a maximum of four crossings for the Proposal • Diversion drain built to divert flood waters away from the HD2 pit and allow it to flow back into Weeli Wolli Creek thereby retaining water flow and creek health The Proposal has been designed to minimise the following potential impacts to Sense of place and Amenity (dust, noise, and vibrations) values: • The use of road trains on sealed roads as the preferred ore transport option from HD2 to the HD1 plant to minimise dust emissions and water use associated with dust suppression • Implement MEZ to avoid adverse impacts to culturally significant rockshelter BDH16-03 (MEZ 3) and bat caves (MEZ 1 & 2) • Construct sealed roads at road train crossings over Pebble Mouse Creek • Dust suppression techniques such as sprayers on crushers and water trucks which will utilise surplus water. These are expected to help minimise dust generated during construction and operation • Limiting the amount of disturbed land to as small as reasonable, reducing the amount of dust producing surfaces • The implementation of speed limits on unsealed roads and tracks to reduce dust creation • The Proponent will also consider measures to reduce adverse impacts to the visibility of drivers using the Great Northern Highway • Development and implementation of a Traffic Management Plan to manage impacts from dust during the construction and mining operations adjacent to the re-alignment of Great Northern Highway, if required • Implementation of a Blast Management Plan to manage impacts from noise and vibrations and maintenance of the structural integrity of the significant caves The Proposal has been designed to minimise the following potential impacts to access values: • A temporary route during road realignment and the implementation of a Traffic Management Plan has been proposed with the Shire of East Pilbara to minimise impacts resulting from the re-alignment of the Great Northern Highway. Rhodes Ridge Road (RR road) will be maintained by Rio Tinto during the closure of the mine access road which intersects Great Northern Highway to the west of RR road			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation	Likely Rehabilitation Success	
	• The Proponent will work in collaboration with the Nyiayparli People to minimise impacts to accessing country • The Proponent will attempt to minimise any access disruption where practicable • The Proponent will provide alternative means of access where possible should previously existing access routes be impacted as part of the development • The Proponent implement the requirements of the Land Access Protocol/s (LAP). The Proponent will prepare and maintain a LAP that is endorsed by the Traditional Owners. The LAP shall outline access requirements, agreed communications as required, for enabling access, identify no-go zones and areas where access may be restricted at times and how this will be managed The Proposal has been designed to minimise the following potential impacts to Special places values: • The Development Envelope has been minimised through project optimisation to reduce the total extent of disturbance • The Proponent will work in collaboration with the Nyiyaparli, Ngarlawangga and Banjima People to minimise to the extent practicable impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process The Proposal has been designed to minimise the following potential impacts to plants and animals values: • The Proponent will work in collaboration with the potentially affected Traditional Owners as required, to minimise to the extent practicable impacts to culturally significant flora and fauna values identified through consultation, surveys, and the Social Surroundings baseline assessment process The Proponent will prepare an SCHMP with Nyiyaparli Traditional Owners which will consider measures to: • Minimise impacts through improved design and/or implementation of relevant practice standards, as appropriate • Reduce adverse impacts to local water quality such as erosion, sedimentation, or dust deposition (i.e., construction of crossings during dry season) • Conduct additional and/or ongoing water monitoring at important water sites to inform appropriate management of those areas • Dust, noise, and vibration monitoring • Dust, noise, and vibration management measures (i.e., dust suppression to minimise dust creation)			

Table 12-2: Residual Impact Significance Model (RISM)

Part IV Environmental Factors	Flora and Vegetation			Terrestrial Fauna	
Part V Clearing Principles	Rare Flora	Threatened Ecological Communities	Remnant Vegetation	Wetlands and Waterways	Habitat for Fauna
Residual impact that is environmentally unacceptable and cannot be offset	None identified	None identified	None identified	None identified	None identified
Significant residual impacts that will require an offset – All significant residual impacts to species and ecosystems are protected by statute or where the cumulative impact is already at critical level	None identified	None identified	• The Proposal is located within the Hamersley IBRA subregion • Clearing up to 4,205 ha of native vegetation in good to excellent condition of which approximately 1,471 ha does not overlap critical or supporting MNES habitat types (Gorge/gully, Breakaway, Minor Drainage, Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Rocky Hill and Stony Plain) within the Development Envelope, including 31 ha of high local significance vegetation • Contribution to the Pilbara Environmental Offsets Fund will be made at a dollar rate per ha of vegetation cleared which is in good to excellent condition (refer to Section 12.5)	None identified	• Clearing up to 105 ha of critical Gorge/Gully and Breakaway (roosting and breeding) habitat, comprising 67 ha Breakaway habitat and 38 ha Gorge Gully habitat for State and Commonwealth listed fauna species (including Northern Quoll, Ghost Bat, and Pilbara Olive Python) • Clearing approximately 2,659 ha of supporting Minor Drainage, Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Rocky Hill and Stony Plain (foraging and dispersal) habitats
Significant residual impacts that may require an offset – Any significant residual impact to potentially threatened species and ecosystems, areas of high environmental value or where the cumulative impact may reach critical levels if not managed	None identified	None identified	None identified	None identified	None identified
Residual impacts that are not significant	No Threatened flora species listed under the EP Act or EPBC Act have been recorded within the Development Envelope.	No TECs listed under the EPBC Act or BC Act have been recorded within the Development Envelope.	None identified	Hydrological regimes will be maintained. Therefore, the Proposal is not expected to impact aquatic fauna significantly.	The Proposal is not expected to significantly impact Night Parrot, Fork-tailed Swift and Oriental Plover (MNES species), as suitable habitat is widespread throughout the region.

12.4. Assessment of Significant Residual Impact – EPBC Act

Significant residual impacts for environmental values recognised under Commonwealth policy have been determined in accordance with the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a) and the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE 2013).

Four MNES species have been recorded (Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, and Oriental Plover) or are considered likely to occur (Pilbara Olive Python, Fork-tailed Swift, Grey Falcon) within the Development Envelope. The Proposal has been designed to avoid and minimise potential impacts to these species as far as practicable.

Following the application of the mitigation hierarchy, the Proposal is predicted to result in significant residual impacts due to the clearing of:

- Up to 105 ha of Critical habitat for the Northern Quoll, Ghost Bat and Pilbara Olive Python, and
- Approximately 2,659 ha of Supporting habitat for the Northern Quoll and Ghost Bat.

This area of Supporting habitat also includes habitat that potentially supports the Grey Falcon, while impacts are residual they are not considered significant, as outlined in Section 13.3.4.1.

The areas of critical and supporting habitat identified above contain the locations of eight Category 4 Pilbara Leaf-nosed Bat caves, which are considered supporting habitat for the species. One Category 4 Pilbara Leaf-nosed Bat cave is located outside the area of impact.

No significant residual impacts are predicted for the Pilbara Olive Python, Grey Falcon, Fork-tailed Swift, Pilbara Leaf-nosed Bat and Oriental Plover as the Proposal is unlikely to result in a substantial loss or modification of important habitats for these species (discussed in further detail in Section 13.3.4.1).

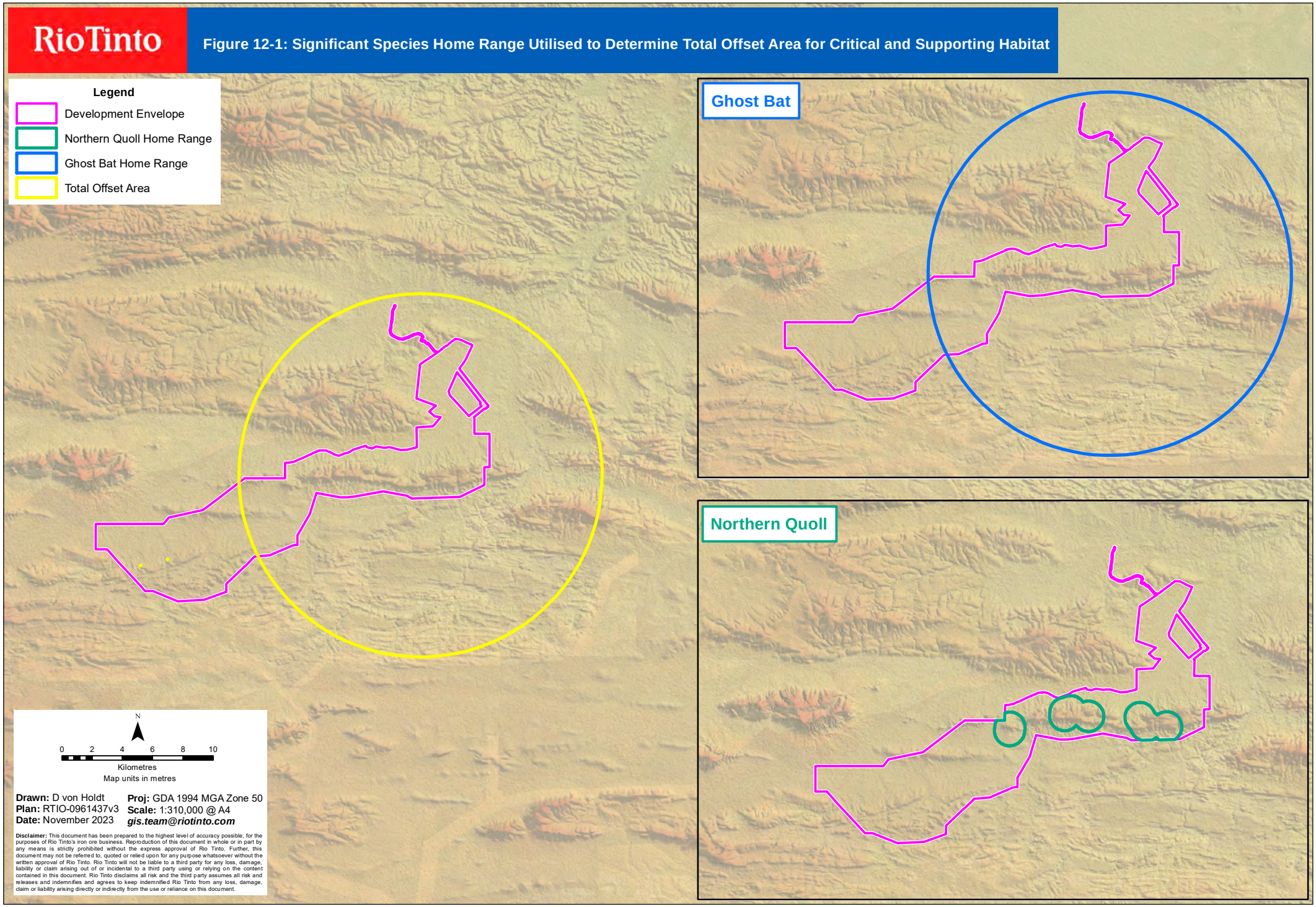
It is noted that the EPBC Act referral guidelines provide broad definitions of Critical habitat at the national level; however, this should not preclude the use of extensive Pilbara datasets for MNES species to inform a more detailed understanding and assessment of the significance of habitats and impacts at a local and regional level. Where sufficient scientific information exists, the detailed understanding of local species occurrence and habitat use in the Development Envelope has been used to support a local definition of habitat critical to local populations' survival. Below is a summary of the significance assessment of each MNES species.

Supporting habitat has been calculated on the individual fauna species' home range. Recovery plans, research and VHF bat tracking programs at locations across the Pilbara have informed suitable distances for defining the individual fauna species' home range, which comprise; 1 km from recorded locations within the Development Envelope for Northern Quoll; 12 km from the Category 2 cave for Ghost Bats and 1 km from recorded locations, within the Development Envelope for Pilbara Olive Python. These areas were mapped and consolidated into a single GIS spatial layer incorporating all Supporting habitats and included in the Impact Reconciliation Plan (Figure 12-1).

A detailed assessment of residual impacts for each MNES species are discussed in Chapter 13.

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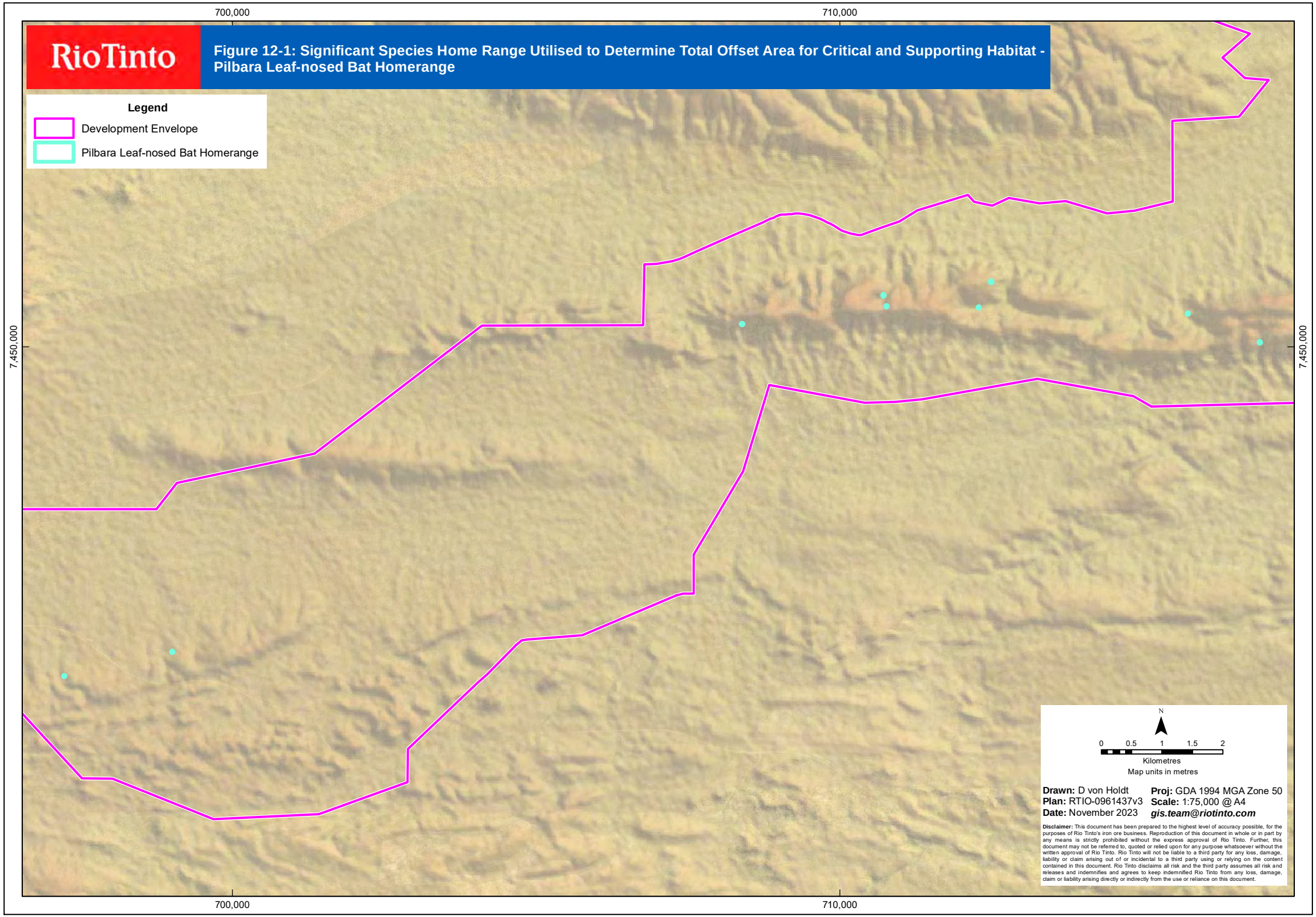
Figure 12-1: Significant Species Home Range Utilised to Determine Total Offset Area for Critical and Supporting Habitat



Drawn: D von Holdt
Plan: RTIO-0961437v3
Date: November 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:310,000 @ A4
gis.team@riotinto.com

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Figure 12-1: Significant Species Home Range Utilised to Determine Total Offset Area for Critical and Supporting Habitat - Pilbara Leaf-nosed Bat Homerange
Legend
Development Envelope
Pilbara Leaf-nosed Bat Homerange
700,000
710,000
7,450,000
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0961437v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @ A4
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12.4.1. Northern Quoll

The Northern Quoll population within the Development Envelope is considered a low-density population (due to low number of records within the Development Envelope) (Astron 2020a, 2023d).

Denning habitat within the Development Envelope satisfies the definition of Critical habitat under the Commonwealth *Northern Quoll Referral Guideline* (DoE 2016a), including rocky habitats such as Gorge/Gully and Breakaway. No Northern Quoll dens were recorded in the surveys of the Development Envelope, although there is potential that they do occur.

Foraging and dispersal habitat adjacent to denning habitat in the Development Envelope is considered Supporting habitat, which includes Minor Drainage and Rocky Hill. Rocky Hill habitats adjoining Pebble Mouse and Weeli Wolli Creeks have heightened importance given the denning habitat's proximity to the foraging and dispersal area.

After application of the mitigation hierarchy, the Proposal is expected to result in the following residual impact to the Northern Quoll:

- Clearing up to a maximum of 105 ha (37% within the Development Envelope) of Critical Gorge/Gully (38 ha) and Breakaway (67 ha) habitats
- Clearing of approximately 297 ha of Supporting habitat, which includes 33 ha of Minor Drainage and 264 ha of Rocky Hill habitats within 1 km of records of Northern Quoll within the Development Envelope.

These are considered to be significant residual impacts after the mitigation hierarchy has been applied, and offsets are proposed.

12.4.2. Ghost Bat

As most Ghost Bat Roosts are located within Gorge/Gully and Breakaway habitats, these habitat types are considered to provide Critical breeding and roosting habitat for the species within the Development Envelope. Records, genetic analysis of scats and tracking data obtained from Ghost Bats within the survey area support the limited amount of published literature on the species' movements and habitat preferences. Specifically, the species commonly forages upon plains, generally within proximity to roosting sites and most commonly moves small distances (~12 km) between roosting sites. For these reasons, Supporting foraging and dispersal habitat is represented by all habitat within 12 km of the Category 2 (Cave 10) roost (Figure 13-3).

Of the 9 caves within the Development Envelope that may support Ghost Bats, up to 2 will be removed, comprising one Category 3 roost and one Category 4 roost.

Category 3 and 4 roosts are not considered Critical habitat for the Ghost Bat. MEZ1 has been established to protect the one significant roost (a Category 2 potential maternity roost). Of the two Category 3 and six Category 4 Ghost Bat roosts within the Development Envelope, post implementation of the Proposal, it is predicted that Caves 1 and 2 will be retained within MEZ1 respectively.

After application of the mitigation hierarchy, the Proposal is expected to result in the following residual impacts to the Ghost Bat:

- Clearing up to a maximum of 105 ha (37% within the Development Envelope) of Critical Gorge/Gully (38 ha) and Breakaway (67 ha) habitats
- Clearing of approximately 2,659 ha of Supporting habitat, comprising all foraging and dispersal habitat within 12 km from the Category 2 roost (Cave 10). This includes:
    - 70 ha of Alluvial Plain habitat (38.3%)
    - 917 ha of Low Hills and Slopes habitat (32%)
    - 269 ha of Minor Drainage habitat (54%)

- 601 ha of Mulga Woodland habitat (44.3%)
- 369 ha of Rocky Hill habitat (50.3%)
- 433 ha of Stony Plain habitat (61.3%).

These are considered to be significant residual impacts after the mitigation hierarchy has been applied, and offsets are proposed.

12.4.3. Pilbara Olive Python

The Gorge/Gully and Breakaway habitat mapped within the Development Envelope provides potential Critical breeding and shelter habitat for the Pilbara Olive Python. Given the Pilbara Olive Python was not recorded during any of the surveys, no Supporting habitat (within 1 km from of recorded locations) for the species is defined within the Development Envelope. However this does not indicate an absence of the species within the Development Envelope as the species is notoriously difficult to sight directly due to its elusive and nocturnal nature. Of the 14 historical records of the species within 40 km of the Development Envelope, the majority of these records (10) occur along Weeli Wolli Creek.

After application of the mitigation hierarchy, the Proposal is expected to result in the following residual impact for Pilbara Olive Pythons:

- Clearing up to a maximum of 105 ha (37% within the Development Envelope) of Critical Gorge/Gully (38 ha) and Breakaway (67 ha) habitats
- No Supporting habitat occurs within the Development Envelope, as there are no records of the Pilbara Olive Python within the Development Envelope.

These are considered to be significant residual impacts after the mitigation hierarchy has been applied, and offsets are proposed.

12.4.4. Summary of Residual Impacts to MNES Species

The impacts discussed in the above sections are not additive. A higher offset rate (i.e. dollars per hectare cleared) is applied to avoid duplication of offsets with an overlap between State and Commonwealth environmental interests (offsets for residual impacts under EP Act and EPBC Act) and other environmental values with elevated significance. This accounts for impacts on habitats with a higher level of significance. These values are summarised in Table 12-3. Differing offset rates apply, with higher rates applicable to the most significant values impacted (discussed in Section 12.5.1).

Table 12-3: Summary of Significant Residual Impacts to MNES Species Habitat Requiring Offsets

Habitat Type	Value for Species	Species	Habitat Use	Offset Area (ha)
Gorge/Gully	Critical	Northern Quoll	Denning and foraging	38
		Ghost Bat	Roosting and foraging	
		Pilbara Olive Python	Breeding and shelter	
Breakaway	Critical	Northern Quoll	Denning and foraging	67
		Ghost Bat	Roosting and foraging	
		Pilbara Olive Python	Breeding and shelter	

Habitat Type	Value for Species	Species	Habitat Use	Offset Area (ha)
Minor Drainage	Supporting	Northern Quoll	Foraging and dispersal	269
		Ghost Bat		
Rocky Hill	Supporting	Northern Quoll	Foraging and dispersal	369
		Ghost Bat		
Alluvial Plain	Supporting	Ghost Bat	Foraging and dispersal	70
Low Hills and Slopes	Supporting	Ghost Bat	Foraging and dispersal	917
Mulga Woodland	Supporting	Ghost Bat	Foraging and dispersal	601
Stony Plain	Supporting	Ghost Bat	Foraging and dispersal	433

12.5. Proposed Offsets

12.5.1. Biodiversity Factors

The Proponent proposes environmental offsets for biodiversity factors in financial contributions to the PEOF at the specified rates outlined in Table 12-4 to clear native vegetation in 'Good to Excellent' condition, high significance local vegetation and high significance MNES habitats. The offset rate per hectare for the Hamersley IBRA subregion was sourced from the PEOF webpage on the WA.gov.au website and will be subject to adjustment in accordance with the Consumer Price Index (CPI) (GoWA 2022).

In addition, rates pertaining to EPBC Act offsets for residual impacts of clearing of Critical breeding, denning and roosting habitat and Supporting habitat for MNES species (Northern Quoll and Ghost Bat) are also included in Table 12-4.

Areas requiring offsets outlined below and throughout this ERD are conservative estimates based upon the current mine planning information at the time of preparing this ERD. An Impact Reconciliation Procedure (IRP; Appendix G2) will determine the actual quantum of impact and offsets required.

The proposed offset rates for contributions to the PEOF and the estimated areas are provided in Table 12-4.

The total offset value is estimated at approximately $6,103,581 (Table 12-4). The contributions to the PEOF are inclusive and offsets at the higher rates for MNES also include benefits to the other listed environmental values. Where offsets are required for an environmental value subject to offsets under one or more environmental values, the higher amount shall apply.

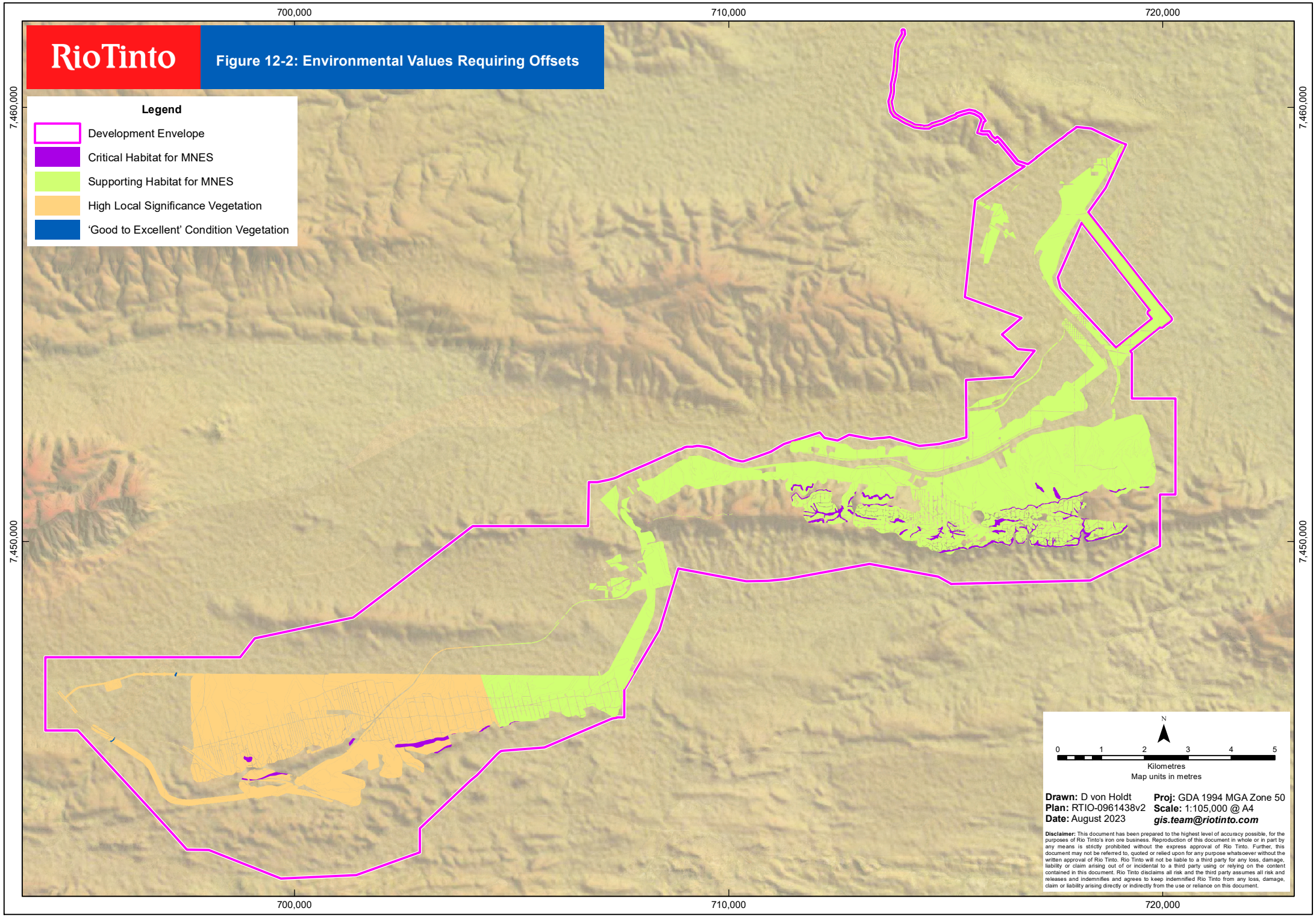
Table 12-4 presents the proposed environmental offsets for the Proposal under the EP Act and EPBC Act based on the information provided in Chapter 13.

The actual offset amounts will be based on the extent of actual clearing, which will be reported biennially in an Impact Reconciliation Report per the IRP provided in Appendix G2. The PCD specifies that the total clearing extent will not exceed 4,900 ha.

Table 12-4: Environmental Values from the Proposal that Require Offset

Environmental Value	IBRA Subregion	Potential Extent of Significant Residual Impact	Proposed Offset Rate
Clearing of Critical habitat (denning, roosting and breeding) for MNES species in the form of Gorge/Gully and Breakaway habitat for: • Northern Quoll • Ghost Bat • Pilbara Olive Python	Hamersley	Up to 105 ha	$3,306/ha
Clearing of Supporting habitat (foraging and dispersal) for MNES species: Northern Quoll, Ghost Bat and Pilbara Leaf-nosed Bat Supporting habitat is defined as: • Northern Quoll – Minor Drainage and Rocky Hill habitat within 1 km of a Northern Quoll record • Ghost Bat – all habitat within 12 km of Category 1 and 2 roosts (other than Critical habitat) • Pilbara Leaf-nosed Bat – habitat within 20 m of a category 4 Pilbara Leaf-nosed Bat cave (other than Critical habitat)		Approximately 2,659 ha	$1,653/ha
Clearing of high local significance vegetation types		Up to 31 ha	$1,653*/ha
Clearing of native vegetation in 'good to excellent' condition in the Hamersley IBRA subregion		Approximately 1,471 ha	$890*/ha

**Rates are as published at https://www.wa.gov.au/service/environment/business-and-community-assistance/program-pilbara-environmental-offsets-fund and annually adjusted for inflation. Where environmental values overlap, only the highest applicable rate will be applied (e.g. riparian vegetation in Good to Excellent would be offset at the higher rate, not the sum of the base rate and higher rate).*


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Figure 12-2: Environmental Values Requiring Offsets
Legend
Development Envelope
Critical Habitat for MNES
Supporting Habitat for MNES
High Local Significance Vegetation
'Good to Excellent' Condition Vegetation
700,000
710,000
720,000
7,460,000
7,450,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0961438v2
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:105,000 @ A4
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12.5.2. Greenhouse Gas Emissions

The Proponent will consider offset emissions where abatement is insufficient against the interim and long-term targets. Offsets will be delivered by retiring credible offsets units in 2025, 2030, 2035, 2040, and 2045 as follows:

- An ACCU may be retired for the purpose of meeting the Proposal interim target and also any Safeguard Mechanism obligations. It is noted that at present the Australian National Registry of Emissions Units, which is used for ACCUs, does not have a publicly available real-time retirement register.
- Integrate principles of the International Carbon Reduction and Offset Alliance (ICROA) in relation to the sourcing and use of credible offsets units for carbon offsetting
- Credible offset units sourced will be based on the principles outlined in ICROA's Technical Specification: real, measurable, permanent, and additional. Independently verified and unique
- The Proponent may also use other offset units that meet integrity principles and are based on clear, enforceable and accountable standards

Only credible offset units sourced from projects that are or will be validated, verified and registered, including but not limited to:

- Clean Development Mechanism
- Climate Action Reserve
- Gold Standard
- Joint Implementation
- Verified Carbon Standard
- American Carbon Registry
- Emissions Reduction Fund of the Australian Government
- UK Woodland Carbon Code.

12.6. Consistency with Offset Policies

The approach to offsetting the significant residual impacts associated with the Proposal is considered to be consistent with the six principles outlined in the WA Environmental Offset Policy (GoWA 2011) and with the eight offset principles outlined in the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a). Table 12-5 and Table 12-6 summarise how these principles have been considered during the development of the offsets approach.

Table 12-5: Considerations of Principles of WA Offset Policy

Principle	Response
Environmental offsets will only be considered after avoidance and mitigation options have been pursued	The planning and design process has included avoidance and minimisation of impact. The Proponent has considered various options to avoid environmental impacts to areas of Critical and Supporting habitats where practicable, including reduction of the Proposal's Development Envelope from 14,085 ha to 12,409.5 ha. In particular, the Proposal has been designed to minimise direct impacts to the following: • Important landform features, such as the gorge/gully and breakaway landforms/habitat types that support multiple environmental values

Principle	Response
	• Connectivity of Critical habitat – landform corridors such as the extent of Low Hills and Slopes habitat south of the BHT deposit and adjacent to Weeli Wolli Creek • Important roost site for MNES Bat species (no direct impacts and minimising indirect impacts) • Surface water systems by reducing the Development Envelope to exclude Weeli Wolli Creek and Pebble Mouse Creek, as far as practicable • Significant fauna habitat features, including significant Ghost bat caves
Environmental offsets are not appropriate for all projects	The identified significant residual impacts are considered appropriate to offset as they are neither minor (too minor to require an offset) nor likely to be considered environmentally unacceptable regardless of offsets.
Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted	The Proponent commits to providing cost-effective, relevant, and proportionate financial offsets to counterbalance the significant residual impacts to the identified environmental values. The offsets for vegetation clearing are considered appropriate in that the significant residual impacts identified are not related to one specific Threatened species or community. Rather, they relate to the cumulative loss of vegetation due to clearing in the Pilbara. Therefore, the PEOF's contribution will allow the implementation of offset projects that will benefit Pilbara vegetation and flora values more broadly and in turn, fauna habitat values.
Environmental offsets will be based on sound environmental information and knowledge	The Pilbara is predominantly Crown land, so traditional land acquisition offsets are not possible. On-ground conservation actions are difficult for a single proponent to implement due to tenure constraints, including pastoral leases and mineral tenements. Contribution to the PEOF, if utilised, is not a traditional offset where, for example, a single conservation project would need to consider sound environmental information and knowledge about a particular species or community. However, the conservation and research projects to be implemented at a broad scale through the PEOF are intended to address the cumulative impacts of mining in the Pilbara as identified by the EPA and provide a more detailed understanding of conservation values in the Pilbara region to improve decision making regarding conservation and management.
Environmental offsets will be applied within a framework of adaptive management	The Proponent understands that an adaptive management framework should be applied to environmental offsets to consider the potential risks. One of the key risks associated with the PEOF as an environmental offset being applied for the majority of projects in the Pilbara is managing the time lag between establishing offsets and generating the anticipated benefits. This challenge and the adaptive management framework around conservation outcomes are being addressed in developing the PEOF mechanisms, including partnerships, scheduling, procurement, funding arrangements, performance measures and reporting requirements in consultation with stakeholders. The Proponent has experience in on-ground implementation and adaptive management of offsets and, therefore, can contribute knowledge to this process.
Environmental offsets will be focused on longer term strategic outcomes	The EPA recognises that establishing the PEOF is consistent with this principle in those strategic approaches, such as using the PEOF, will provide a mechanism to coordinate the implementation of offsets across a range of land tenures (GoWA 2014). The Pilbara Fund provides a strategic, coordinated approach to the application of environmental offsets to achieve broad-scale biodiversity conservation outcomes for the Pilbara region. The Proponent recognises the commitment of the EPA to this strategic approach and has contributed

Principle	Response
	via being a participant in the working group for the establishment of the PEOF.

Table 12-6: Consideration of Commonwealth Offset Principles

Principles	Responses
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The offset contribution to the PEOF is expected to contribute to large environmental offset projects that deliver wider benefits to landscape scale values and threatened species.
Suitable offsets must be built around direct offsets but may include other compensatory measures	The proposed offset is a financial contribution to the PEOF, which will be used for on-ground improvement, rehabilitation and conservation.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	The proposed offset rates reflect the conservation status of the species impacted and the significance of the habitat impacted. A higher offset rate applies when a species or significant population is known to occur.
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	The proposed offset applies an offset contribution for each hectare of significant residual impact and is therefore proportionate in size. Differing offset rates apply, with higher rates applicable to the most significant values impacted.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	The rate proposed for MNES offsets is consistent with that commonly applied to MNES in the Pilbara for EPBC Act offsets and includes inherent consideration of the likelihood of offset project success.
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	According to recent, similar offset determinations, the proposed offsets address both the EP Act and EPBC Act requirements.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The Proponent will provide a financial contribution to the PEOF for the significant residual impacts to MNES from the Proposal. Projects implemented under the PEOF will be designed, endorsed by the State Government, with implementation overseen by DWER.
Suitable offsets must have transparent governance arrangements, including being readily measured, monitored, audited, and enforced.	The State Government oversees the PEOF in accordance with the *Pilbara Environmental Offsets Fund Governance Framework* (DWER 2019d). Offsets are also documented in the publicly available Environmental Offsets Register.

12.7. Stakeholder Consultation Regarding Offsets

The Proponent has had preliminary discussions with the EPA and DCCEEW regarding providing offsets for significant residual impacts to native vegetation in ‘good to excellent’ condition and Critical and Supporting habitats for MNES (Section 13.4). Further consultation will be undertaken during the assessment process.

13. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

To be consistent with the EPBC Act, the Proposal is referred to as the Proposed Action in this section. Further information regarding the Proposed Action is presented in Chapter 2, including the definition of the Development Envelope.

This section provides a comprehensive description of the potential impacts of the Proposed Action on the MNES species recorded or likely to occur within the Development Envelope.

13.1. Controlled Action Provisions (EPBC 2021/9035)

A Delegate of the Commonwealth (the Minister for the Environment) has determined the Proposed Action to be a Controlled Action under section 75 of the EPBC Act and, therefore, requires assessment and a decision on whether approval should be granted under the EPBC Act.

The controlling provisions listed were threatened species and communities (section 18 and 18A). The MNES species include:

- Northern Quoll (*Dasyurus hallucatus*) – Endangered
- Night Parrot (*Pezoporus occidentalis*) – Endangered
- Ghost Bat (*Macroderma gigas*) – Vulnerable
- Grey Falcon (*Falco hypoleucos*) - Vulnerable
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – Vulnerable
- Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable

The Proposed Action was determined to be assessed by accredited assessment under the Bilateral Agreement between the Commonwealth and Western Australian governments.

13.2. Relevant Policy and Guidance

The significance and management of potential impacts on MNES have been assessed in the context of the following:

- Approved conservation advice and/or recovery plans, where available, for each relevant MNES, specifically whether:
    - A population is an important population
    - Available habitat in the Development Envelope is Critical habitat for the local population or species
    - The outcomes align with recovery plans or conservation advice actions for MNES likely to be impacted by the Proposed Action.
- Threat Abatement Plans
- The application of the mitigation hierarchy, including avoidance, minimisation, rehabilitation, and offset measures to the design and implementation of the Proposed Action
- Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DoE 2013).

13.2.1. Approved Conservation Advice and Recovery Plans

Approved conservation advice and recovery plans for MNES known or likely to occur within the Development Envelope or listed in the controlling action are identified in Table 13-1. These documents identify overall conservation objectives, critical habitats, important populations, key threats, and priority management actions and are very relevant to the assessment process. In addition, the Minister must

consider the content of approved conservation advice to ensure the Proposed Action aligns with the conservation advice and/or recovery plan objectives.

Note that there are no recovery plans for the Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Grey Falcon, or the Fork-tailed Swift.

Table 13-1: Approved Conservation Advice, Listing Advice and Recovery Plans

Guidance	Objective/Priorities
Commonwealth Listing Advice on Northern Quoll (*Dasyurus hallucatus*) (TSSC 2005)	Priority Recovery and Threat Abatement Actions: • Investigate the need to establish captive breeding programs • Identify areas of Critical habitat The list does not encompass all actions that may benefit this species but highlights those considered the highest priority at the time of listing.
National Recovery Plan for the Northern Quoll *Dasyurus hallucatus* (Hill and Ward 2010)	Identifies the national recovery objective as: 'To minimise the rate of decline of Northern Quoll in Australia and ensure that viable populations remain in each of the major regions of distribution into the future.' • Several recovery objectives are identified, including the following relevant to the Proposed Action: • Identify potential refuge habitats in Western Australia where quolls might be most likely to persist in the long-term alongside Cane Toads • Halt Northern Quoll decline in areas not yet colonised by Cane Toads • Investigate factors causing declines in Northern Quoll populations not yet affected by Cane Toads • Manage key Northern Quoll populations in areas not currently affected by Cane Toads to halt population declines • Reduce the impact of feral predators on Northern Quolls
EPBC Act referral guideline for the endangered Northern Quoll *Dasyurus hallucatus* (DoE 2016a)	Identifies Critical habitat and important populations, recommended survey methods, actions likely to result in significant impacts and management/mitigation measures that are effective and appropriate for this species.
Conservation Advice *Macroderma gigas* Ghost Bat (TSSC 2016a)	Identifies primary conservation actions as: • Protect roosts from mining, human disturbance, and collapse • Replace the top strands of barbed wire in fences near roost sites with single-strand wire Also identifies key conservation and management actions, survey, and research priorities
Information Sheet A review of Ghost Bat ecology, threats and survey requirements (Bat Call WA 2021a)	This document addresses the following information gaps: • Roosting habitat descriptions, both natural, artificial, and Critical habitat definitions • Guidance on mitigation measures for roost under threat • Information on population dynamics of the species • Guidance on foraging requirements and range
Conservation Advice *Rhinonicteris aurantia* (Pilbara form) Pilbara Leaf-nosed Bat (TSSC 2016b)	Identifies national conservation objectives, which are summarised below: • Ensure that activities do not have a significant impact • Eliminate key threats and halt the predicted decline • Protect and manage known roosts • Identify and protect high-value foraging habitats around roost sites

Guidance	Objective/Priorities
	• Support research on occurrence, population size and ecological requirements The Conservation Advice also provides specific guidance about what does and does not comprise habitat critical to the survival of this species, and outlines guidance as to what impacts may be considered significant to Pilbara Leaf-nosed Bat.
Information Sheet A review of Pilbara Leaf-nosed Bat ecology, threats and survey requirements (Bat Call WA 2021b)	This document addresses the following information gaps: • Roosting habitat descriptions, both natural, artificial, and Critical habitat definitions • Guidance on mitigation measures for roost under threat • Information on population dynamics of the species • Guidance on foraging requirements and range
Approved Conservation Advice for *Liasis olivaceus barroni* (Olive Python – Pilbara subspecies) (DEWHA 2008a)	Identifies research priorities, regional and local priority actions, which include (but are not limited to the following that are relevant to this Proposed Action: • Identify populations of high conservation priority • Ensure development does not result in residual impact known populations • Manage changes to hydrology • Raise awareness of the species
Conservation Advice *Falco hypoleucos* Grey Falcon (TSSC 2020)	Identifies conservation actions as: • Support improved fire and grazing management in areas where Grey Falcons are known to occur • Protect known nesting trees and include adequate exclusion buffers concerning proposed developments and land clearing activities • Support the establishment and survival of replacement nest trees in areas where Grey Falcon are known to breed • Retain artificial structures with known or potential Grey Falcon nests • Control invasive cats in areas where Grey Falcons are known to occur, especially in known roosting and nesting areas
Conservation Advice *Pezoporus occidentalis* (Night Parrot) (TSSC 2016c)	Identifies conservation actions as: • Where known populations can be identified, monitor these to identify key threats • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary • Liaise with managers/owners of any properties found to support the Night Parrot to ensure management practices support the requirements of the species • Investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure • In key areas, ensure impacts of livestock and feral herbivores are minimised • Implement appropriate management recommendations outlined in the Threat Abatement Plans for Predation by Feral Cats (DoE 2016a) and European Red Fox (DEWHA 2008b) • Develop and implement a management plan for the control and eradication of feral camels and other herbivores in the local region • Develop and implement a suitable fire management strategy for Night Parrot. The strategy should aim to restrict burning to discrete patches,

Guidance	Objective/Priorities
	at least until studies can be completed on the fire ecology of the species and its key food plants • Establish a captive breeding population for the species if a viable source population can be found • Investigate options for linking, enhancing or establishing additional populations
Night Parrot Interim recovery plan for Western Australia (1996 to 1998) (Blyth 1996)	To decrease the probability of extinction of the Night Parrot by achieving the following aims: • Find one or more populations of the Night Parrot that can be studied and monitored and learn how best to locate the birds in the wild • Research on movements, home range, activity patterns, food and feeding behaviour biology, detailed habitat requirements and major threat processes • Use the information gathered to; plan larger-scale searches and more detailed research programs, plan and conduct emergency management actions seen to be necessary to maintain the population(s) and be the basis for a recovery plan
Referral guideline for 14 birds listed as migratory species under the EPBC Act (DoE 2015b)	There is no approved Conservation Advice, Listing Advice or Recovery Plan for Fork-tailed Swift (*Apus pacificus*). The referral guideline for migratory species identifies the following conservation objective: • To retain the habitats and resources necessary for the species to migrate successfully and, where appropriate, breed throughout their natural range in Australia

13.2.2. Threat Abatement Plans

Threat abatement plans (TAPs) establish national frameworks to guide and coordinate Australia's response to threats to biodiversity. These documents identify research, management and other priority actions required to protect threatened species. The Australian Government develops and facilitates the implementation of the TAPs by establishing partnerships and cooperative programs. When considering the approval of a project, the Minister must not act inconsistently with a TAP. The TAPs and their associated objectives are outlined in Table 13-2.

Table 13-2: Relevant Threat Abatement Plans for the Proposed Action

Threat Abatement Plan	Objectives
Threat abatement plan for predation by feral cats (DoE 2015a)	The goal of this TAP is to minimise the impact of feral cats on biodiversity by: • Protecting affected threatened species • Preventing further species and ecological communities from becoming threatened The TAP has four objectives: • Effectively control feral cats in different landscapes • Improve the effectiveness of existing control options for feral cats • Develop or maintain alternative strategies for threatened species recovery • Increase public support for feral cat management and promote responsible cat ownership
Threat abatement plan for predation by the European red fox (DEWHA 2008b)	This TAP identifies localised fox control measures applicable in specific areas of high conservation value and where: • Chances of reinvasion must be nil or very close to it

Threat Abatement Plan	Objectives

	• All foxes must be accessible and at risk during the control operation
	• Foxes must be killed at a higher rate than their ability to replace losses through breeding
	• Where local eradication is not practicable, two strategies for localised management can be used, as follows:
	  ○ Sustained management, where control is implemented on a continuing, regular basis
	  ○ Intermittent management, where control is implemented at critical periods of the year when damage is greatest and short-term control will reduce impacts to acceptable levels

Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by Cane Toads (DSEWPaC 2011c)	This TAP focuses on how native animals and natural environments can be protected from Cane Toads. The plan aims to: • Identify native species and ecosystems at risk due to Cane Toads • Reduce the impact of Cane Toads on native species and ecosystems • Communicate information about Cane Toads and their impacts The TAP has three objectives: 1. To identify priority native species and ecological communities (including those that are protected matters under the EPBC Act) at risk from the impact of Cane Toads 2. To reduce the impact of Cane Toads on populations of priority native species and ecological communities 3. To communicate information about Cane Toads, their impacts and this TAP
Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses (DSEWPaC 2012b)	This TAP aims to minimise the residual impacts of the five listed types of grass on affected native species and ecological communities. To achieve this goal, the TAP has six main objectives: 1. Develop an understanding of the extent and spread pathways of infestation by the five listed grasses 2. Support and facilitate coordinated management strategies through the design of tools, systems and guidelines 3. Identify and prioritise key assets and areas for strategic management 4. Build capacity and raise awareness among stakeholders 5. Implement coordinated, cost-effective on-ground management strategies in high-priority areas 6. Monitor evaluate and report on the effectiveness of management programs

Feral cats (*Felis catus*) have been recorded within the Development Envelope and are known to occur within the surrounding area (Astron 2019b). Clearing native habitats may create opportunities for feral cats to increase their range. The actions documented in the TAP for predation by feral cats (DoE 2015a) are relevant to the Proposed Action.

No European Red Foxes (*Vulpes vulpes*) were recorded within the Development Envelope (Astron 2019b). In the Pilbara, this species typically inhabits areas near the coast, and the Proposed Action is unlikely to increase the opportunity for the species to move further inland. The actions

documented in the TAP for predation by the European red fox (DEWHA 2008b) are not considered relevant to the Proposed Action.

The Cane Toad (*Rhinella marina*) is not yet established in the Pilbara, and the Proposed Action is not expected to introduce the species. Therefore, the actions documented in the TAP for the biological effects, including lethal toxic ingestion caused by Cane Toads (DSEWPaC 2011c), are not relevant to the Proposed Action, also given that it focuses on the research and identification of the impacts of Cane Toads.

There are no grass species from the TAP to reduce the impacts on northern Australia's biodiversity by the five listed types of grass (DSEWPaC 2012b) within or surrounding the Development Envelope (Astron 2019b). Therefore, the actions documented in the TAP are not relevant to the Proposed Action.

13.2.3. Significant Impact Guidelines

Significant impact guidelines inform the impact assessment of MNES required under the EPBC Act. In accordance with these guidelines, the assessment of 'listed threatened species and communities' is presented within the context of the following key concepts:

- Habitat critical to the survival of a species
- Any population for species listed as Endangered or Critically Endangered under the EPBC Act and an 'important population' for species listed as Vulnerable under the Act.

'Habitat critical to the survival of a species' refers to necessary areas:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may include but is not limited to habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or an ecological community and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act (DoE 2013).

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans and/or populations that are (DoE 2013):

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity
- Populations that are near the limit of the species range.

An assessment of significance for each MNES species is presented in this chapter and reflects additional information provided by survey information presented after the submission of the EPBC referral.

13.2.4. Other Policy and Guidance

The following policy and guidance statements were also considered in the design of flora and vegetation, fauna and targeted MNES surveys and in the impact assessment for MNES:

- EPA Statement of Environmental Principles, Factors and Objectives (EPA 2021c)
- EPA Environmental Factor Guideline: Flora and Vegetation (EPA 2016a)

- EPA Technical Guideline: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b)
- EPA Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c)
- EPA Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a)
- EPA Technical Guidance: Sampling methods for Terrestrial vertebrate fauna (EPA 2016e)
- EPBC Act referral guideline for the endangered northern quoll Dasyurus hallucatus - EPBC Act Policy Statement (DoE 2016a)
- Interim guideline for preliminary surveys of Night Parrot (Pezoporus occidentalis) in Western Australia (DPaW 2017)
- Survey guidelines for Australia's threatened bats (DEWHA 2010f)
- Survey guidelines for Australia's threatened birds (DEWHA 2010b)
- Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a)
- Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b)
- National Light Pollution Guidelines for Wildlife, including Marine Turtles, Seabirds and Migratory Shorebirds (DotEE 2020).

13.3. Existing Environmental Values Relevant to MNES

The following section provides an overview of the findings for MNES 'Listed under threatened species and ecological communities under s18 and s18A of the EPBC Act' recorded within the Development Envelope and surroundings.

13.3.1. EPBC Act Protected Matter Search

A search of the EPBC Act Protected Matters Search Tool (PMST) was conducted to support the referral of the Proposed Action, using a 40 km search radius from a point central to the Development Envelope (23°04'04" S, 119°01'56" E). The PMST returned 18 MNES species, listed as Threatened and Migratory species, consisting of one reptile, 13 birds and four mammal species. Fauna species listed as Marine and Invasive were not considered in this assessment.

13.3.2. Desktop and Field Surveys

The Proponent has been undertaking biological surveys of the Hope Downs Hub, and its neighbouring projects (e.g., West Angelas iron ore project) since 1998 and has an extensive record and good understanding of the ecological values of the broader site and the region generally. These surveys have been used to inform the current assessment and are listed in Astron 2020a.

Table 13-3 summarises the Proposed Action specific and other relevant regional surveys and studies undertaken for MNES species. The Proposed Action-specific study/survey reports are provided in Appendix C1 to C9. Figure 13-1 shows the spatial extent of the various surveys.

13.3.2.1. Surveys for the Development Envelope

The key studies and surveys for the Proposed Action are the Astron (2019b) detailed fauna survey, and the Astron (2020b) MNES fauna assessment, with the latter study involving additional survey effort to that of the detailed fauna survey, but with a focus on MNES fauna. The Proponent has undertaken a long-term baseline monitoring program for Northern Quoll to determine the utilisation of HD2 and BHT deposits. This monitoring uses a network of motion cameras (Astron 2023a, 2023b, 2023c and 2023d), as well as further assessments of potential Ghost Bat caves (Astron 2020c) and Grey Falcon presence and habitat utilisation (Astron 2023f).

13.3.2.2. Surveys of the Surrounding Area

The Proponent also commissioned Astron (2020d) to undertake a comprehensive review of all historical fauna and habitat surveys conducted across the Hope Downs area and reconcile the survey outcomes with those of the more recent assessments (i.e., Astron 2019b) in order to create a consolidated map of the fauna habitats across the combined Hope Downs area (totalling 36,944 ha; Figure 13-1) to provide additional context on the local distribution of fauna habitat types. Note that the combined area includes the Development Envelope for the previously approved Hope Downs Iron Ore Mine (including Baby Hope) and associated infrastructure, for which there are still vegetation clearing allowances.

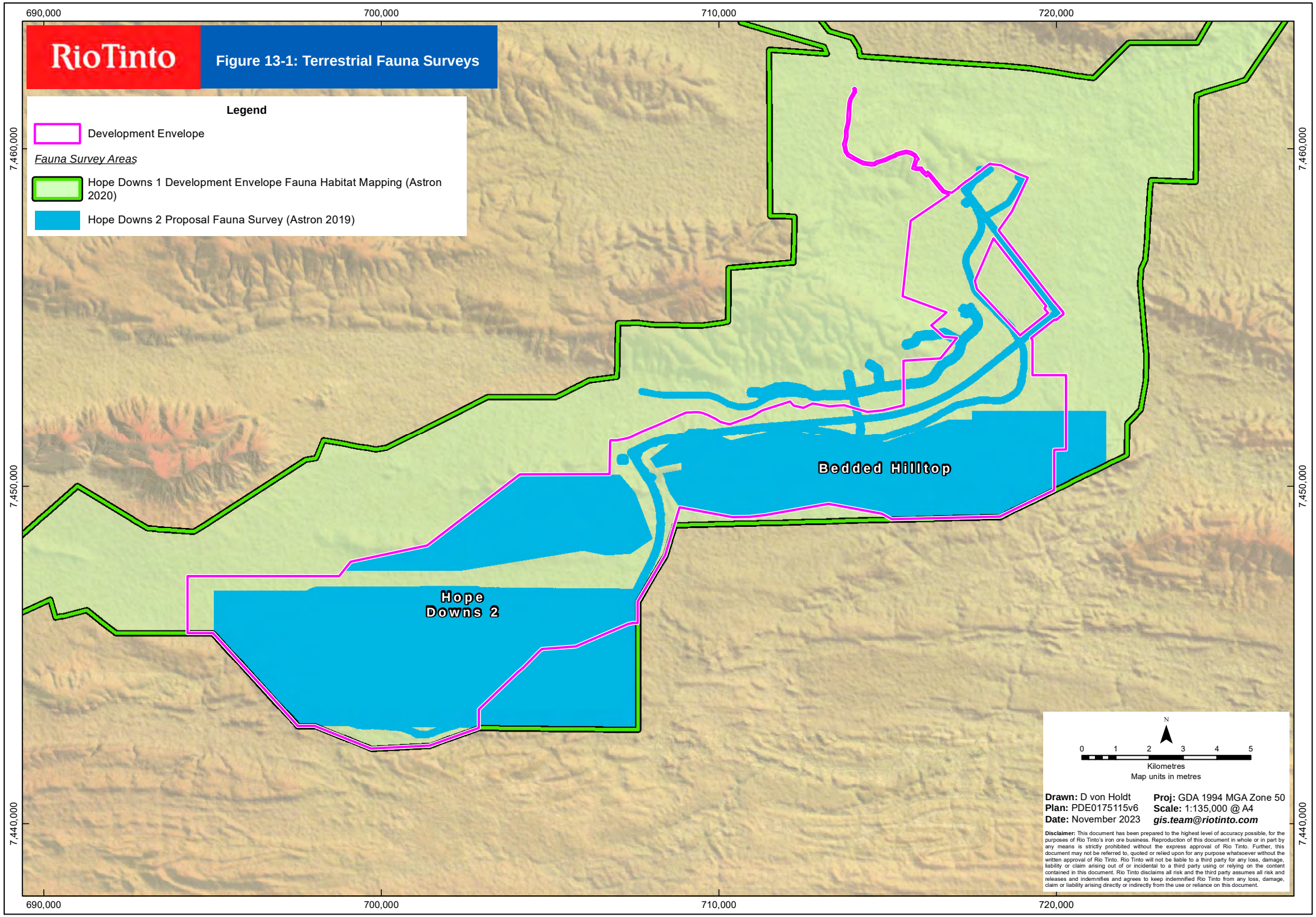
13.3.2.3. Surveys Conducted for Nearby Projects

The Proposed Action is located approximately 45 km west of the Proponent's Hope Downs 4 Iron Ore Mine (EPBC 2008/4636), 3.5 km NE of the Robe River Mining Company's West Angelas Iron Ore Mine (EPBC 2018/8299 and 2021/8923), and 13 km SE of BHP's Mining Area 'C' Southern Flank Iron Ore Project (EPA Assessment No. 2085). Biological surveys conducted to support these projects have been used to further expand the understanding of the Proposed Action in the wider landscape context. The location and key characteristics of these projects are described in more detail in Section 2.1.2.

Table 13-3: Summary of Technical Studies for MNES Fauna

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
Hope Downs 2 Proposal Detailed Fauna Survey (Astron 2019b) Appendix C1	2017-2019	Desktop review and detailed field survey	**Timing:** Phase 1 – 21st November to 2nd December 2017; Phase 2 – 18th to 27th May 2018; Phase 3 – 8th March to 18 March 2019. **Methods:** 12 habitat assessments across the eight habitat types; cave assessments; 19 trapping sites (each a suite of cage, pitfall, Elliott, and funnel traps), 1,539 total trap nights, 38 hrs of avifauna censuses, 202 camera trap nights, 108 nights of bat acoustic surveys, 34 nights of acoustic surveys for Night Parrot, targeted searches, and nocturnal spotlighting.	Northern Quoll: 14 records, plus scats. Pilbara Leaf-nosed Bat: 3 echolocation recordings. Ghost Bat: 9 echolocation recordings, 1 visual observation, plus scats. Oriental Plover: 1 record.
Hope Downs Development Envelope Fauna Habitat Mapping (Astron 2020d) Appendix C2	2017/2020	Desktop review and mapping with ground-truthing	**Timing**: N/A. **Methods:** Review historic surveys and habitat mapping associated with Hope Downs and Baby Hope Proposals. Reconcile map units and boundaries with Astron (2019b) using latest high-resolution aerial photography. Conduct fauna habitat assessments (42) at locations where mapping in doubt. Review and describe habitat value for MNES species.	N/A
Hope Downs 2 Proposal Ghost Bats Cave Characteristics Report (Astron 2020c) Appendix C3	2020	Targeted searches of known caves and prospective habitat	**Timing:** 25 February – 2 March 2020. **Methods:** Map internal dimensions and those of the entrance; record number of Ghost Bat scats and if any bats are present; record other annotations and take photographs.	Ghost Bat: 1 record. Secondary evidence (scats) of Ghost Bats at all 9 caves and Northern Quoll at two caves.
Hope Downs 2 Proposal - Ghost Bat Memo (Astron 2023e) Appendix C4	2022	Desktop review	**Timing:** N/A. **Methods**: Review and summary of identified Ghost Bat caves in the 2019 Fauna Survey (Astron 2019b) and MNES Fauna Assessment (Astron 2020b), including categorisation of caves within the Development Envelope in accordance with the guidance provided in the BatCall WA (2021a) publication on Ghost Bats.	N/A
Hope Downs 2 Proposal – Grey Falcon Environmental Impact Assessment (Astron 2023f) Appendix C5		Desktop review	**Timing:** N/A **Methods:** Desktop review of fauna surveys from 2008-present to assess the likelihood of Grey Falcon within the Proposal area and potential the impact of the Proposal	N/a

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
Hope Downs 2 Proposal MNES Fauna Assessment (Astron 2020b) Appendix C6	2019	Desktop review and Targeted terrestrial MNES Vertebrate Fauna Survey	**Timing:** 17 – 27 September 2019 **Methods**: Review of a previously completed three phase Level 2 vertebrate fauna assessment of the survey area and a targeted MNES field survey to better understand the distribution of MNES species within the survey area and to address the gaps in effort and coverage of the previously completed surveys.	No records
Hope Downs 2 Proposal Matters of National Environmental Significance Northern Quoll Monitoring Phase 3 of 3 Results (July – October 2022) and Phases 1 to 3 Summary Report (Astron 2023d) Appendix C7	2020-22	Remote camera deployment and monitoring	**Timing:** Phase 1: September-November 2020, Phase 2: October 2021-February 2022, Phase 3: July-October 2022. **Methods:** Deployment of remote field cameras and long-term monitoring at five locations – 35 cameras; Phase 1 (2,128 trap nights), Phase 2 (4,151 trap nights), Phase 3 (2,221 trap nights)	One Northern Quoll opportunistic scat record during Phase 1 (2020).
Hope Downs 2 Proposal Long-Term Motion Cameras Feb to Sep 2020 (Astron 2023a) Appendix C9	2020	Remote camera deployment and monitoring	**Timing:** 27-29 February 2020 (deployment) to 11-13 September 2020 (total 2,355 trap nights); targeted searching of suitable habitat for secondary evidence. **Methods:** Deployment of 12 remote field cameras at 12 locations (1 camera per location).	Northern Quoll: 2 records.


RioTinto
Figure 13-1: Terrestrial Fauna Surveys
Legend
Development Envelope
Fauna Survey Areas
Hope Downs 1 Development Envelope Fauna Habitat Mapping (Astron 2020)
Hope Downs 2 Proposal Fauna Survey (Astron 2019)
Bedded Hilltop
Hope Downs 2
690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0175115v6
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:135,000 @ A4
gis.team@riotinto.com
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13.3.3. MNES Habitat Mapping and Utilisation

13.3.3.1. Habitat Significance for MNES

The Significant Impact Guidelines (DoE 2013) provide broad definitions of Critical habitat for MNES fauna species at the national level. However, this should not preclude the use of extensive Pilbara datasets for MNES species to inform a more detailed understanding and assessment of the significance of habitats and impacts at a local and regional level. Where sufficient scientific information exists, the detailed understanding of local species occurrence and habitat use in the Development Envelope has been used to support a local definition of core habitat critical to the survival of local populations.

The habitats mapped within the Development Envelope were assigned local significance ratings based on whether they provided core habitat critical to the survival of MNES fauna species. Table 13-4 describes the criteria used to assign each significance rating.

Table 13-4: Habitat Significance Assessment Criteria for MNES Fauna Species under the EPBC Act

Habitat Significance	Assessment Criteria
High	Provides core breeding/refugia/shelter sites (i.e. denning, roosting or water sources) for MNES fauna species. These habitats are considered Critical habitat for the survival of MNES species within the Development Envelope.
Moderate	Provides foraging and dispersal habitat for MNES fauna species. These habitats are considered Supporting habitat when they are within the home range of the MNES species. These habitats are more widespread and of lower importance than the high significance (Critical) habitats.
Low	Habitat does not directly support any MNES fauna species but may represent limited foraging and dispersal habitat. MNES fauna species are not dependent on this habitat. This habitat is widespread in the local and regional areas.
Nil	Cleared areas that do not provide any fauna habitat.

For the assessment of the Proposed Action:

- **Critical habitat** for an MNES species is defined as “habitat used for breeding, such as denning, roosting and nesting”. This aligns with the assessment criteria for high significance habitat types shown in Table 13-4
- **Supporting habitat** for an MNES species is defined as “foraging and dispersal habitat for a significant species within the species' home range”. This definition aligns with the assessment criteria for moderate significance habitat types shown in Table 13-4.

The MNES fauna species home range is defined as:

- Northern Quoll – 1 km from Northern Quoll records within the Development Envelope
- Pilbara Leaf-nosed Bat – 10 km from Category 1, 2 and 3 roosts, within the Development Envelope
- Ghost Bat – 12 km from Category 1 and 2 roosts
- Pilbara Olive Python – 1 km from Pilbara Olive Python records within the Development Envelope.

13.3.3.2. Fauna Habitat Types

Eight fauna habitat types were mapped within the Development Envelope (Astron 2019b): Breakaway; Gorge/Gully; Minor Drainage; Rocky Hill; Alluvial Plain; Low Hill and Slopes; Mulga Woodland; and

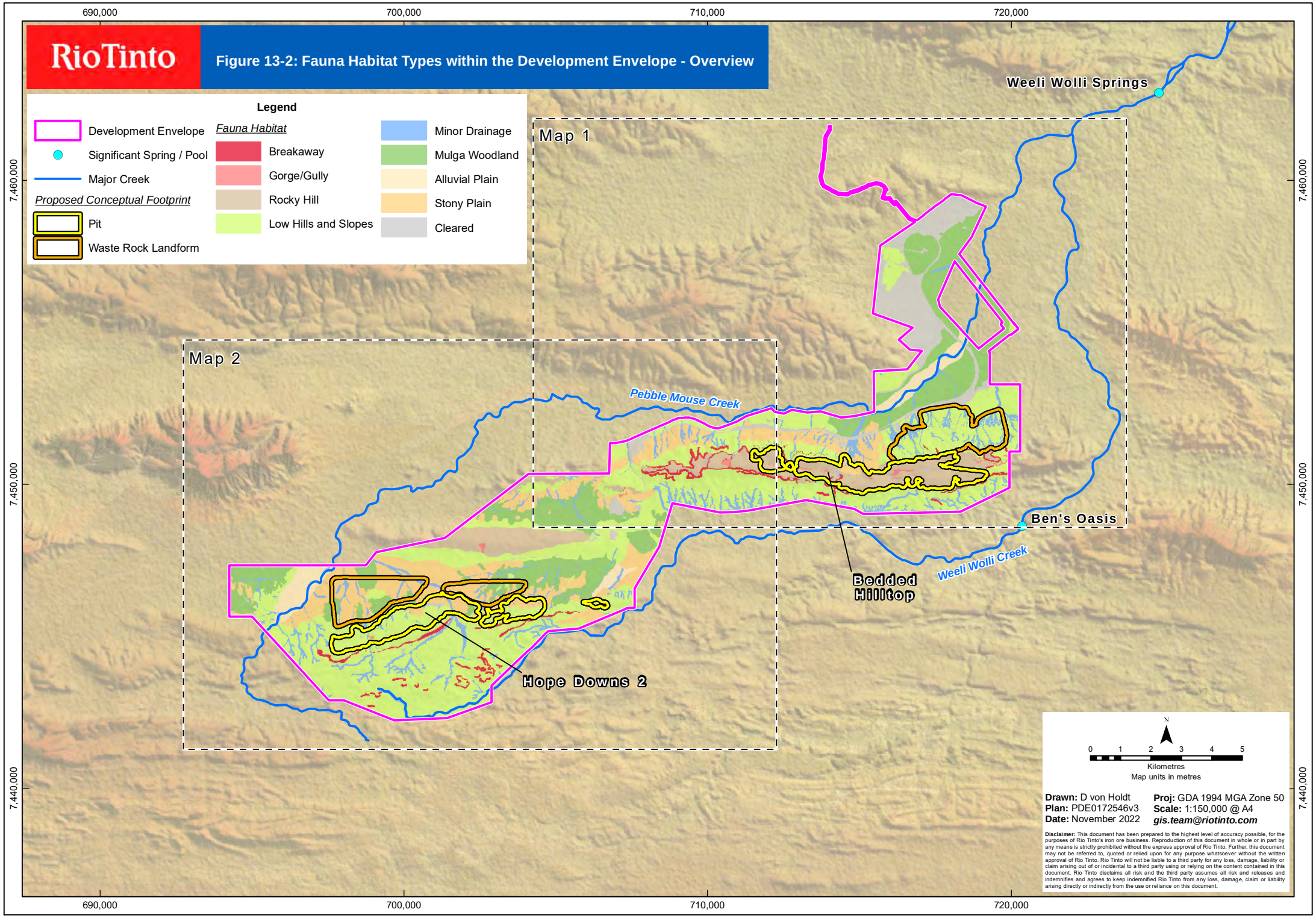
Stony Plain. The habitat types are described in Table 13-5 and shown in Figure 13-2. All habitat types were considered to be widespread throughout the Pilbara Bioregion (Astron 2019b).

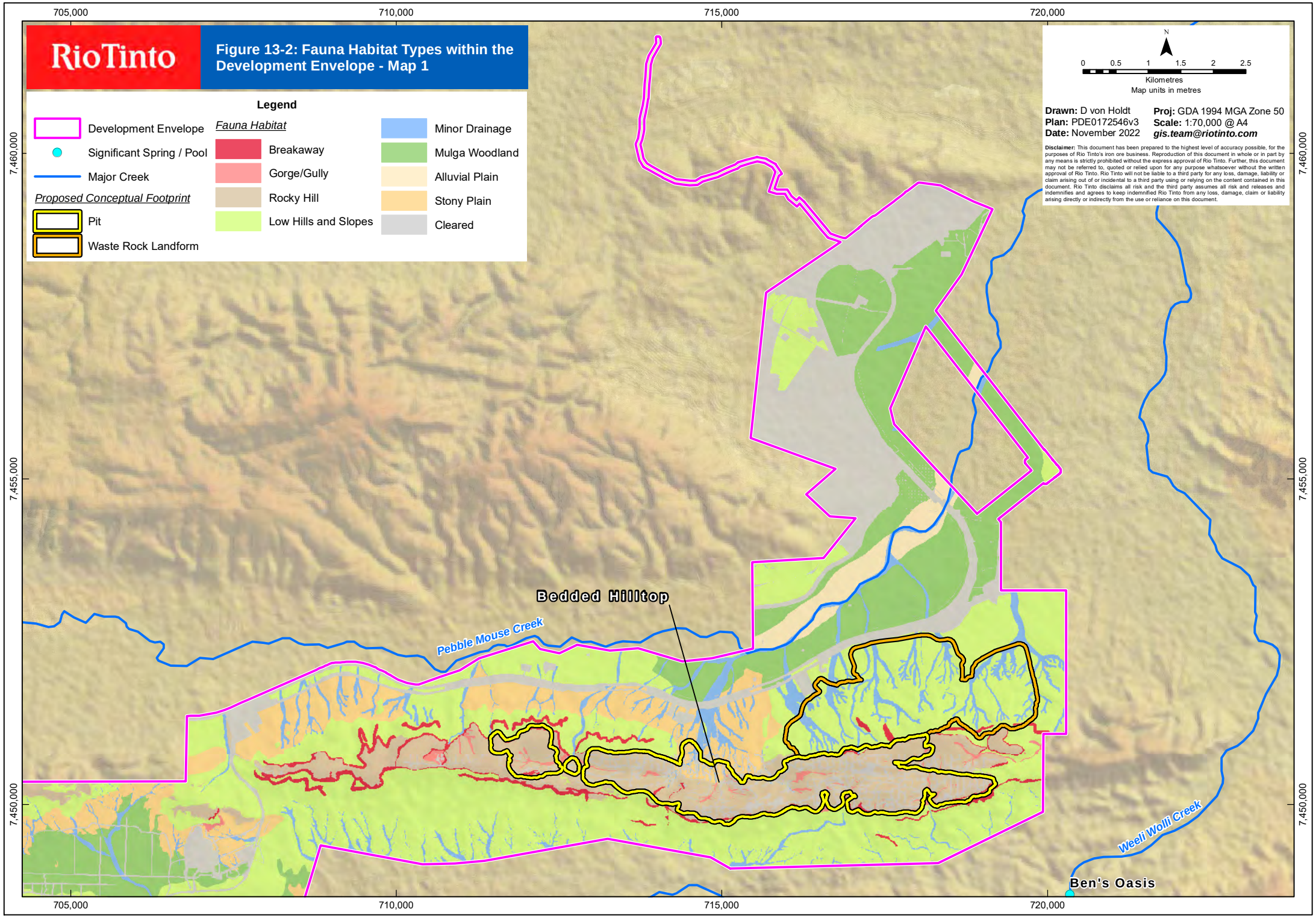
Table 13-5: MNES Fauna Habitat within the Development Envelope

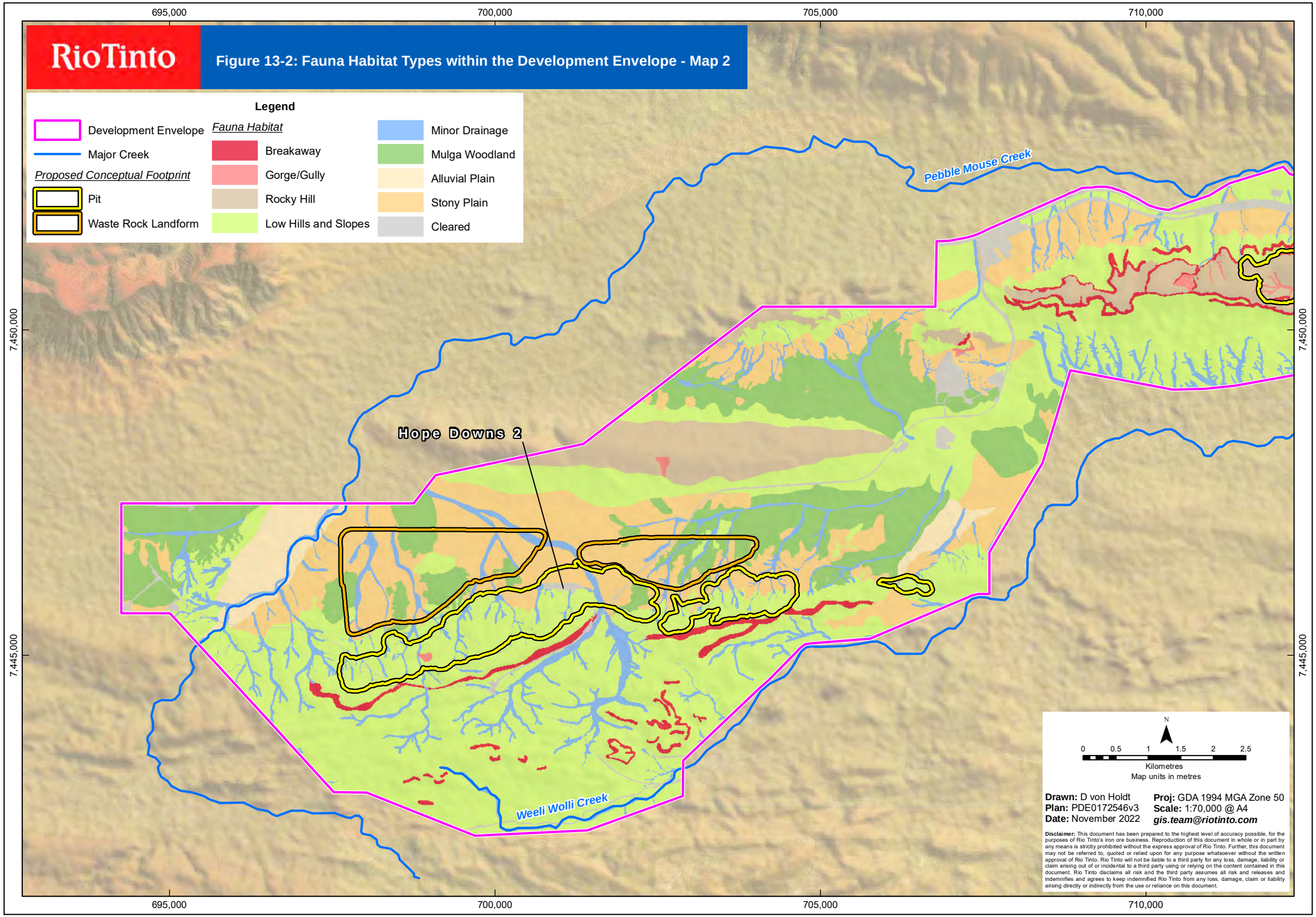
Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for MNES Species	Extent within Development Envelope (ha)	Representative Photograph
High Significance						
Breakaway Limited extent	Single sided rock faces, generally on steep mid-upper slopes comprising of bare rock outcrops or cliffs.	Vegetation within this habitat type tends to include *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia* spp. tall shrubs over *Triodia pungens* very open hummock grassland, sometimes with scattered tussock grasses	Caves (roost/feed caves), cracks and crevices, sheltered leaf litter	Critical habitat for: • Northern Quoll • Ghost Bat • Pilbara Olive Python	223.6	
Gorge/Gully Limited extent	Incised rock features that have moderate to steep sides and slopes. Deeper examples can support distinctly different vegetation from surrounding landscape and provide refugia for moisture and from fire.	Vegetation within this habitat type tends to include *Eucalyptus* and *Corymbia ferriticola* scattered low trees scattered over *Triodia pungens* open hummock grassland and scattered tussock grasses	Overhangs, crevices, caves, tree hollows, ephemeral, semipermanent water	Critical habitat for: • Northern Quoll • Ghost Bat • Pilbara Olive Python	63.2	
Moderate Significance						
Minor Drainage Limited extent	Small drainage channels less than 10 m in width. Often with thick Acacia growth along banks. It does not include the minor drainage depressions that flow off of high ground. This habitat is less likely to support surface water for long periods after rainfall events.	Vegetation within this habitat type tends to include Scattered *Eucalyptus victrix* woodland over *Petalostylis labicheoides* and *Acacia* spp. Tall open shrubland over tussock grassland.	Hollow bearing trees and logs, thick ground cover/vegetation, deep leaf litter	Supporting habitat for: • Northern Quoll • Ghost Bat • Pilbara Olive Python • Grey Falcon	917.9	
Rocky Hill Widespread	Encompasses hill features from footslopes to ridges and hilltop plateaus. The hills are greater in heightened steepness of gradient then the lower hills and slopes. This habitat can be on isolated hills or a series of ridgelines.	Vegetation within this habitat type tends to include *Eucalyptus leucophloia* subsp. l*eucophloia* and *Corymbia hamersleyana* scattered low trees to low open woodland over mixed open shrubland over open *Triodia wiseana, T. pungens, T. vanleeuwenii* hummock grassland	Shallow overhangs, boulders and crevices	Supporting habitat for: • Northern Quoll • Ghost Bat • Grey Falcon	967.3	
Low Significance						

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for MNES Species	Extent within Development Envelope (ha)	Representative Photograph
Alluvial Plain Widespread	Habitat type is associated with flood plains adjacent to drainage lines. Often contains tussock grasses and has a high vegetation cover. The substrate is generally alluvial silt loamy clay. The low-lying areas have a very slight to negligible height gradient.	Vegetation within this habitat type tends to include *Acacia pruinocarpa, A. aptaneura, Eremophila longifolia* tall open shrubland over tussock grassland	Dense leaf litter, termite mounds and spinifex clumps, cracking clays	Supporting habitat for: • Ghost Bat	340.5	
Low Hills and Slopes Widespread	Low undulating hills and extensive footslopes with a gradual gradient. The low hills have rounded summits without plateaus and generally do not contain cliff faces or rocky outcropping.	Vegetation within this habitat type tends to include *Eucalyptus leucophloia* subsp. *leucophloia* and/or *Corymbia hamersleyana* scattered low trees over mixed *Acacia spp*. Open shrubland over open *Triodia pungens, T. vanleeuwenii* hummock grassland	Termite mounds, Triodia hummocks, minimal leaf litter	Supporting habitat for: • Ghost Bat	5,116.3	
Mulga Woodland Widespread	Stands of Mulga over clay or stony substrate. Differs from other plains with Mulga vegetation habitat types, by having a monoculture of Mulga.	Vegetation within this habitat type tends to include *Acacia catenulata* tall shrubland over *Eremophila fraseri* scattered tall shrubs over *Triodia pungens* very open hummock grassland	Limited microhabitats, termite mounds, minimal leaf litter	Supporting habitat for: • Ghost Bat	1,831.2	
Stony Plain Widespread	Substrate of the Stony plains is predominately made of stones, gravel and cobbles. The areas generally have a very slight to no gradient. This habitat type also contains grasses and ground story vegetation.	Vegetation within this habitat type generally includes *Acacia aptaneura, A. pruinocarpa, A. catenulata* tall shrubland over *Triodia pungens* (and sometimes *T. vanleeuwenii*) hummock grassland or tussock grassland	Limited leaf litter, termite mounds and spinifex clumps	Supporting habitat for: • Ghost Bat	1,517.5	
Negligible Significance						

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for MNES Species	Extent within Development Envelope (ha)	Representative Photograph
Cleared	Historical disturbance, including existing tracks and drill pads.	NA	None	Limited	1,432.2	
Total					12,409.5	


RioTinto
Figure 13-2: Fauna Habitat Types within the Development Envelope - Overview
Legend
Development Envelope
Significant Spring / Pool
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Fauna Habitat
Breakaway
Gorge/Gully
Rocky Hill
Low Hills and Slopes
Minor Drainage
Mulga Woodland
Alluvial Plain
Stony Plain
Cleared
Map 1
Map 2
Weeli Wolli Springs
Pebble Mouse Creek
Ben's Oasis
Weeli Wolli Creek
Bedded Hilltop
Hope Downs 2
690,000
700,000
710,000
720,000
7,460,000
7,450,000
7,440,000
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172546v3
Date: November 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @ A4
gis.team@riotinto.com
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RioTinto
Figure 13-2: Fauna Habitat Types within the Development Envelope - Map 1
Legend
Development Envelope
Significant Spring / Pool
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Fauna Habitat
Breakaway
Gorge/Gully
Rocky Hill
Low Hills and Slopes
Minor Drainage
Mulga Woodland
Alluvial Plain
Stony Plain
Cleared
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172546v3
Date: November 2022
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Scale: 1:70,000 @ A4
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705,000
710,000
715,000
720,000
7,460,000
7,455,000
7,450,000
Bedded Hilltop
Pebble Mouse Creek
Weeli Wolli Creek
Ben's Oasis


RioTinto
Figure 13-2: Fauna Habitat Types within the Development Envelope - Map 2
Legend
Development Envelope
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Fauna Habitat
Breakaway
Gorge/Gully
Rocky Hill
Low Hills and Slopes
Minor Drainage
Mulga Woodland
Alluvial Plain
Stony Plain
Cleared
695,000
700,000
705,000
710,000
7,450,000
7,445,000
Pebble Mouse Creek
Hope Downs 2
Weeli Wolli Creek
N
0 0.5 1 1.5 2 2.5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0172546v3
Date: November 2022
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13.3.3.3. Important Habitat Features

In addition to mapping of broad fauna habitat types, several caves have been recorded in the Development Envelope and represent potentially significant habitat features.

Caves

Caves are considered important ecological habitat features in the Pilbara due to the stable microclimate and shelter they provide to a range of fauna, including the significant species Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python. A total of nine caves (including overhangs) were recorded within the Development Envelope and are characterised in Table 13-6 as per their Ghost Bat cave classifications (Astron 2020c).

Table 13-6: Characteristics and Utilisation of Ghost Bat Caves identified within the Development Envelope

Cave Type (Ball Call WA 2021a)	Caves Within Development Envelope
Category 1: Maternity/diurnal roost sites with permanent Ghost Bat occupancy (Critical Habitat)	None identified.
Category 2: Maternity/diurnal roost caves with regular Ghost Bat occupancy (Critical Habitat)	Cave 10 (BHT).
Category 3: Diurnal roost caves with occasional Ghost Bat occupancy (Supporting Habitat)	Cave 1 (BHT), Cave 5 (BHT).
Category 4: Nocturnal roost caves with opportunistic Ghost Bat usage (Supporting Habitat)	Cave 2 (BHT), Cave 3 (BHT), Cave 4 (BHT), Cave 6 (BHT), Cave 7 (HD2) and Cave 8 (HD2).

Five of the caves (Cave 3, 4, 5, 6 and 7) occur within the Breakaway habitat, one cave (Cave 1) is within Rocky Hill habitat, and the remaining three caves (including Cave 10 (Category 2)) are within Gorge/Gully habitat. This is typical of Ghost Bat cave locations throughout the Pilbara bioregion (Astron 2020b).

In terms of utilisation of the caves by Pilbara Leaf-nosed Bat, the nine caves are all classified as Category 4 roosts (nocturnal refuges), which are caves occupied at night for resting or feeding. These caves are not considered Critical habitat but are important for the persistence of a species within an area (Bat Call WA 2021b).

13.3.4. Likelihood of Occurrence

No flora species listed under the EPBC Act were recorded within the Development Envelope (Astron 2019b and 2020b), nor any habitat suitable to support any species identified in the PMST database search and therefore not considered further in this Chapter.

No ecological communities listed under the EPBC Act were recorded within the Development Envelope (Astron 2019b and 2020b) and, therefore not considered further in this Chapter.

Table 13-7 describes the likelihood of fauna species listed under the EPBC Act identified in the PMST to occur within the Development Envelope and its general vicinity. Four of these (MNES) fauna species have been recorded within the Development Envelope:

- Northern Quoll (*Dasyurus hallucatus*) – Endangered
- Ghost Bat (*Macroderma gigas*) – Vulnerable
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – Vulnerable
- Oriental Plover (*Charadrius veredus*) – Migratory.

Two species, the Pilbara Olive Python (*Liasis olivaceus barroni*; Vulnerable*)* and the Grey Falcon (*Falco hypoleucos*; Vulnerable), were considered to have a high to moderate likelihood of occurrence within the Development Envelope but were not recorded within the Development Envelope. These species are discussed further in Section 13.3.4 and Section 13.9.

The remaining 11 species from the PMST search (Table 13-7) are considered as only having a low likelihood of occurring within the Development Envelope due to the lack of suitable habitat present and paucity of nearby records, despite a good survey record (most are Migratory species). These species are not discussed further in this section.

Table 13-7: EPBC Act Listed Fauna Species and Likelihood of Occurrence in the Development Envelope

Species	EPBC Conservation Status	Broad Habitat Type	Likelihood of Occurrence within Development Envelope
Mammals			
Northern Quoll (*Dasyurus hallucatus*)	Endangered	Rocky hills, gorges, mesas, high and low plateaus, low slopes and stony plains with spinifex	Recorded The Northern Quoll was recorded 14 times during the detailed baseline survey and on four occasions during follow-up surveys/monitoring. The majority of this was from motion camera detection and scats. This evidence was generally associated with the BHT deposit, particularly the Gorge/Gully and Breakaway habitats. The Proponent has undertaken 3 phases of targeted northern quoll monitoring at BHT deposit area, subsequent to the baseline survey effort. Results of this monitoring are provided in Astron 2023e.Over the course of this program, there was one record of northern quoll activity. As such, it is concluded that BHT is likely to represent a low-density population.
Ghost Bat (*Macroderma gigas*)	Vulnerable	Rocky gorges and breakaways with caves and crevices	Recorded Evidence of Ghost Bats was recorded on 12 occasions within the Development Envelope, including: • Six scat locations – Caves 1, 4, 5, 7 and 10 as well as one opportunistic observation along a drainage line • Four echolocation calls – Two near Cave 4 at the BHT deposit, one near Cave 8 and one to the north of the HD2 deposit • Two physical sightings – One in Cave 8 and one flying over Breakaway habitat in the vicinity of Cave 8 Nine caves have been mapped within the Development Envelope, all of which are likely to support the Ghost Bat population. Of the nine, one was recorded as a Category 2 cave (Cave 10), two as Category 3 caves and the remaining six as Category 4 caves. This categorisation was based on utilisation and structural characteristics; further detail is presented in Section 13.7.

Species	EPBC Conservation Status	Broad Habitat Type	Likelihood of Occurrence within Development Envelope
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	Vulnerable	Deep caves with high humidity and stable temperatures, watercourses, riparian vegetation, hummock grassland and sparse tree and shrub savannah.	Recorded Three calls associated with this species were recorded within the Development Envelope. However, no presence of this species was recovered from any of the investigated caves, suggesting that they are Category 4 nocturnal roost caves. Despite extensive survey efforts, no Category 1 to 3 caves have been recorded in the Development Envelope. These caves were categorised based on species usage and structural characteristics; further detail is presented in Section 13.8. As no Category 1 to 3 caves were recorded within the Development Envelope, no habitat types are considered to be Critical habitats. Additionally, due to the distance to the nearest permanent diurnal roost, Turee Creek Roost (>10 km), none of the habitat types meet the definition of Supporting habitat either. Despite this, the recording of calls within the Development Envelope indicates that the species does use the habitat types within the Development Envelope to forage, but they are likely only to be moderately important to the survival of the species.
Greater Bilby (*Macrotis lagotis*)	Vulnerable	Sand or sandy loam in hummock grassland (*Triodia* species) and or *Acacia* shrubland.	Low The species have not been recorded previously in the Development Envelope or surrounding area, and suitable habitat does not occur.
Reptiles			
Pilbara Olive Python (*Liasis olivaceus barroni*)	Vulnerable	Escarpments, deep gorges, water holes and rock piles associated with permanent pools in rocky areas.	High This species is likely to be found in the Gorge/Gully, Breakaway and Minor Drainage habitats, particularly at sites that have the potential to support semi-permanent water. There are 14 previous records of the species in the vicinity of the Consolidated Mapping Area, 10 of which are associated with Weeli Wolli Creek. However, this species has not been recorded in the Development Envelope.
Birds			
Oriental Plover (*Charadrius veredus*)	Migratory	Various habitats, including coastal (mudflats, sandbanks, sandy or rocky beaches) and inland environments (arid or semi-arid grasslands).	Recorded One individual has been opportunistically sighted in the Development Envelope, and its presence was likely due to the foraging opportunities on the grass oval at the mine village. This species has not previously been recorded within the Development Envelop vicinity.

Species	EPBC Conservation Status	Broad Habitat Type	Likelihood of Occurrence within Development Envelope
Grey Falcon (*Falco hypoleucos*)	Vulnerable	Timbered lowland plains, particularly Acacia shrublands that are near tree-lined watercourses. It has been observed in treeless areas and tussock grassland, open woodland.	Moderate Suitable supporting habitat is present within the Development Envelope; however, records in the local region (45 km radius) are very low (two birds at Hope Downs 4, 45 km away; potentially a breeding pair). This species is typically vagrant and nomadic by nature.
Night Parrot (*Pezoporus occidentalis*)	Endangered	Treeless or sparsely wooded long unburnt spinifex hummock plains and often interspersed with chenopods. Habitat types are most likely to support these features: Colluvial Plain and Alluvial Plain.	Low No habitat currently suitable for the species was found within the Development Envelope. The Stoney Plain habitat has been impacted by recent fires (Astron 2020b) and mining exploration, and as such, there is no habitat available. No Night Parrot calls were recorded during any surveys, despite 34 nights of acoustic recordings in the most suitable habitats of the Development Envelope. As of May 2023, the only occurrences of the Night Parrot within the Pilbara IBRA region have been in the Fortescue Marsh and there have been no new Night Parrot locations confirmed and announced from within the Pilbara IBRA region (Northover et.al. 2023). The Fortescue Marsh is approximately 50 km north of the Development Envelope.
Fork-tailed Swift (*Apus pacificus*)	Migratory	Variety of habitats and is entirely aerial inhabits. This species is an aerial forager with no specific habitat within the Development Envelope.	Moderate Suitable habitat is present within the Development Envelope. This species is a seasonal migrant only present at certain times of the year.
Yellow wagtail (*Mocrotis lagotis*)	Migratory	A variety of damp/wet habitats with low vegetation.	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.
Grey wagtail (*Motacilla cinerea*)	Migratory	Various habitat types with open waterbodies are present.	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.
Barn swallow (*Hirundo rustica*)	Migratory	Coastal lowlands, particularly near towns, cities and particularly near water. Forages over open habitats with areas of a high density of insects (i.e., wetlands).	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.

Species	EPBC Conservation Status	Broad Habitat Type	Likelihood of Occurrence within Development Envelope
Curlew Sandpiper (*Calidris ferruginea*)	Critically Endangered/ Migratory	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creek line flats, tidal flats or grassy edges of wetlands.	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.
Sharp-tailed Sandpiper (*Calidris acuminata*)	Migratory	Freshwater soaks mangrove mudflats, river pools, saltwork ponds, sewage ponds, flooded samphire flats and grasslands.	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.
Pectoral Sandpiper (*Calidris melanotos*)	Migratory	Mainly swamps, lagoons, river pools, irrigation channels and sewerage ponds. Also, in samphire flats around estuaries and salt lakes.	Low The species have not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.
Common Greenshank (*Tringa nebularia*)	Migratory	A variety of freshwater, marine and artificial wetlands, including swamps, open muddy or rocky shores of lakes and large rivers, sewerage farms, saltworks, muddy coastal flats, mangroves and estuaries.	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.
Common Sandpiper (*Actritis hypoleucos*)	Migratory	Claypans, reservoirs, dams, pools, lakes and billabongs; estuaries and deltas of streams.	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.
Australian Painted Snipe (*Rostratula astralis*)	Migratory	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creek line flats, tidal flats or grassy edges of wetlands.	Low This species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur.

Source: Astron 2019b and Astron 2020b.

13.3.4.1. MNES Species with Low Likelihood of Occurrence in the Development Envelope

Night Parrot (*Pezoporus occidentalis*)

The Night Parrot is listed as Endangered under the EPBC Act. This species was not recorded during any of the fauna surveys and is considered unlikely to be present within or to occasionally utilise the habitats within the Development Envelope (Astron 2020b). No night parrots were recorded during the two consecutive fauna surveys (Astron 2019b and 2020b) which involved passive acoustic surveys using Autonomous Recording Units (ARUs) at multiple locations within the prospective habitat (Stony Plain habitat containing *Triodia* and Minor Drainage Line containing *Triodia*) over a total effort of 34 recording nights. The ARU data was analysed by Dr. Robert Bullen (Appendix I in Astron 2019b and Appendix G in Astron 2020b).

Astron (2019b) undertook a habitat assessment for the Night Parrot and concluded that the species was considered as having a Low likelihood of occurrence due to lack of old growth spinifex and chenopod shrublands, recent fires and prolonged presence of pastoral and mining activities in the area.

While some vegetation present in the Development Envelope might superficially appear suitable for Night Parrot (Astron 2019b); however, spinifex is a common species that is common across Australia, Blyth (1996) notes that spinifex can be found in as much as half the area of the Australian continent. Accordingly, the likelihood of Night Parrot utilising, or indeed relying on, the habitat within the survey area is considered to be negligible, and, therefore, the species is not considered any further in this assessment.

Previous fauna surveys conducted for the nearby Baby Hope (Biota 2015a), Hope Downs 4 (Ninox Wildlife Consulting 2009b), Mining Area C (Biologic 2017), West Angelas (Ecologia 2014, N. Jackett 2019) and Roy Hill (Ecologia 2009, Strategen 2018) proposals have not been able to confirm the presence of Night Parrot beyond the Fortescue Marshes, approximately 50 km north of the Proposed Action. This is supported by work undertaken by Northover *et.al*. (2023) that demonstrates that the species is not known in or around the area of the Proposal. As of May 2023, the only occurrences of night parrots within the Pilbara IBRA region have been in the Fortescue Marsh and there have been no new night parrot locations confirmed and announced from within the Pilbara IBRA region (Northover *et.al*. 2023). As such the Development Envelope is not considered to contain critical or supporting Night Parrot habitat. Therefore, this species is not discussed further in this assessment.

Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is listed as Vulnerable under the EPBC Act. This species occurs in low densities across arid and semi-arid parts of Australia, including Western Australia (TSSC 2020). The Grey Falcon hunts in habitats ranging from wooded drainage systems to open spinifex plains. It has been observed in Acacia shrublands near tree-lined creeks and rivers and frequents tussock grassland and open woodland (TSSC 2020).

There have been no Grey Falcon records inside the Development Envelope. The next closest record is approximately 45 km south-east of the survey area. The Proposed Action will not disturb this area; therefore, the Grey Falcon nest site will not be impacted.

Potential suitable breeding and nesting habitat for this species is vegetation associated with Major Drainage Line habitat with established tall trees. However, no Major Drainage Line habitat (preferred breeding habitat) is present within the Development Envelope (Astron 2023f). Minor Drainage Line habitat is not considered suitable breeding habitat due to the lack of mature trees within this habitat. The closest potential breeding habitat for the Grey Falcon is the sections of Weeli Wolli Creek near Weeli Wolli Spring, which contains discharge points that support riparian vegetation with larger trees, approximately 5 km north-east of the Development Envelope, since it provides tall, established trees for breeding (Astron 2023f).

The-habitat types Minor Drainage and Rocky Hill are identified as suitable for foraging and dispersal are widespread within the Pilbara, including the Development Envelope. The total area of Minor Drainage is 475 ha and Rocky Hills is 369 ha within the Development Envelope.

Other threats to Grey Falcons include predation from feral Cats, especially if nests are accessible, whilst changes in rainfall patterns may affect prey availability (TSSC 2020). It is noted that no Grey Falcon nests have been recorded in the Development Envelope or survey area. The Proponent will implement feral cat control in the Proposed Action to reduce the risk of increasing feral cat populations in the Development Envelope, including monitoring feral Cat populations and trapping in areas with high numbers of feral Cats. This is described further in the EMP (Appendix A7).

The Proponent concludes that this is not a significant residual impact to the species for the following reasons:

- the habitat types (Minor Drainage and Rocky Hill) identified as suitable for foraging and dispersal are widespread within the Pilbara, including the Development Envelope,
- the nomadic behaviour of this species
- the lack of records from on-ground survey work and
- no impact to potential breeding habitat.

It is considered that as habitat loss will be minimised, all reasonable measures to mitigate potential impacts to Grey Falcon have been implemented and residual impacts will not be significant. Therefore, this species is not discussed further in this assessment.

Oriental Plover (*Charadrius veredus*)

The Oriental Plover is a medium size migratory bird that is a non-breeding visitor to Australia. The species is most often recorded between Exmouth and Derby on the north-western coast of Western Australia (DAWE 2021). The species breeding habitat includes arid grasslands and salt pans, while non-breeding habitat includes grasslands, salt fields and coastal regions (Astron 2020b).

One Oriental Plover was recorded within the Development Envelope in Astron's Level 2 Fauna Survey (Astron 2019b). It was observed foraging on the grass oval at Hope Downs 1 camp within the Development Envelope. It was most likely attracted to the area due to the presence of foraging opportunities. This record is likely to be from a vagrant individual as this species has never been recorded before in the Development Envelope and was not recorded during any subsequent surveys (Astron 2020b). The species is unlikely to occur within the Development Envelope regularly and is unlikely to be highly dependent on any of the habitats present. Due to its migratory nature, non-breeding status in Australia and a solitary observation the Proposed Action is not expected to have a significant impact and therefore is not discussed further in this assessment.

13.4. Summary of Potential Impacts to MNES and Mitigation Hierarchy

This subsection provides a broad description of the potential impacts of the Proposed Action to MNES generally and how the Proponent has applied the mitigation hierarchy (avoid, minimise, rehabilitate) to each of the broad potential impacts to ensure that they are as low as reasonably practicable (these measures are summarised in Table 13-10).

The final mitigation avenue, which is the offsetting of unavoidable residual impacts, includes many species-specific considerations. As a result, the Proponent's offset strategy for MNES is outlined at the end of this section and described more fully in Chapter 12.

Potential broad-scale impacts of the Proposed Action on MNES recorded or likely to occur in the Development Envelope and of relevance to this assessment are:

- Habitat loss/reduction and fragmentation as a result of clearing

- Loss of fauna individuals as a result of clearing (or other interactions)
- Introduced fauna, weeds, dust and altered bushfire risk
- Disturbance from light and noise/vibration

Each of these potential impacts are described in terms of its scale and/or scope, as well as the application of the mitigation hierarchy. Significant residual impacts, which align to DCCEEW's term 'residual significant impacts', are considered in the subsequent sections.

13.4.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

The Proponent estimates that the Proposed Action will require the direct disturbance of no more than 4,900 ha of native vegetation within the 12,409.5 ha Development Envelope. The precise layout of the Proposed Action is still to be finalised, so the exact nature and extent of the clearing requirements are unknown. However, to ensure that environmental impacts are not greater than those presented in this document, upper limits have been proposed for each of the high value MNES fauna habitat types, with the remainder of the clearing taking place within low-moderate value habitat types (Table 13-8).

Table 13-8: Upper Disturbance Limits for Regional and High Significance MNES Habitat Types

Fauna Habitat Type	Extent within Development Envelope	Indicative Clearing Requirement (% of Extent within Development Envelope)	Upper Limit of Assessed Impact for Project Flexibility
High Significance Habitat			
Gorge/Gully	63 ha	36 ha (57.3%)	38 ha (60%)
Breakaway	224 ha	57 ha (25.4%)	67 ha (30%)
Moderate (M) and Low (L) Significance Habitat			
Rocky Hill (M)	967 ha	369 ha (38.2%)	The total clearing of all habitats (including High Significance habitat) will not exceed 4,900 ha.
Minor Drainage (M)	918 ha	475 ha (51.8%)	
Alluvial Plain (L)	340 ha	77 ha (22.5%)	
Mulga Woodland (L)	1,831 ha	781 ha (42.7%)	
Low Hills and Slopes (L)	5,116 ha	1,530 ha (29.9%)	
Stoney Plain (L)	1,517 ha	879 ha (57.9%)	

In terms of significant habitat features (Figure 7-2), the Proposal has the potential to impact on two of the nine caves recorded within the Development Envelope, comprising Cave 1 (Category 3 Ghost Bat roost) and Cave 8 (Category 4 Ghost Bat roost), both caves are also classified as Category 4 Pilbara Leaf-nosed Bat caves (Table 7-14). Neither of these caves are considered to be critical to the survival of either species.

Table 13-9: Caves potentially impacted within the Conceptual Footprint for Ghost Bat and Pilbara Leaf-nosed Bats

Caves Potentially Impacted	Ghost Bat Cave Category (Ball Call WA 2021a)	Pilbara Leaf-nosed Bat Cave Category (Bat Call WA 2021b)
Cave 1 (BHT)	Category 3	Category 4
Cave 8 (HD2)	Category 4	Category 4

13.4.1.1. Key Avoidance Measures

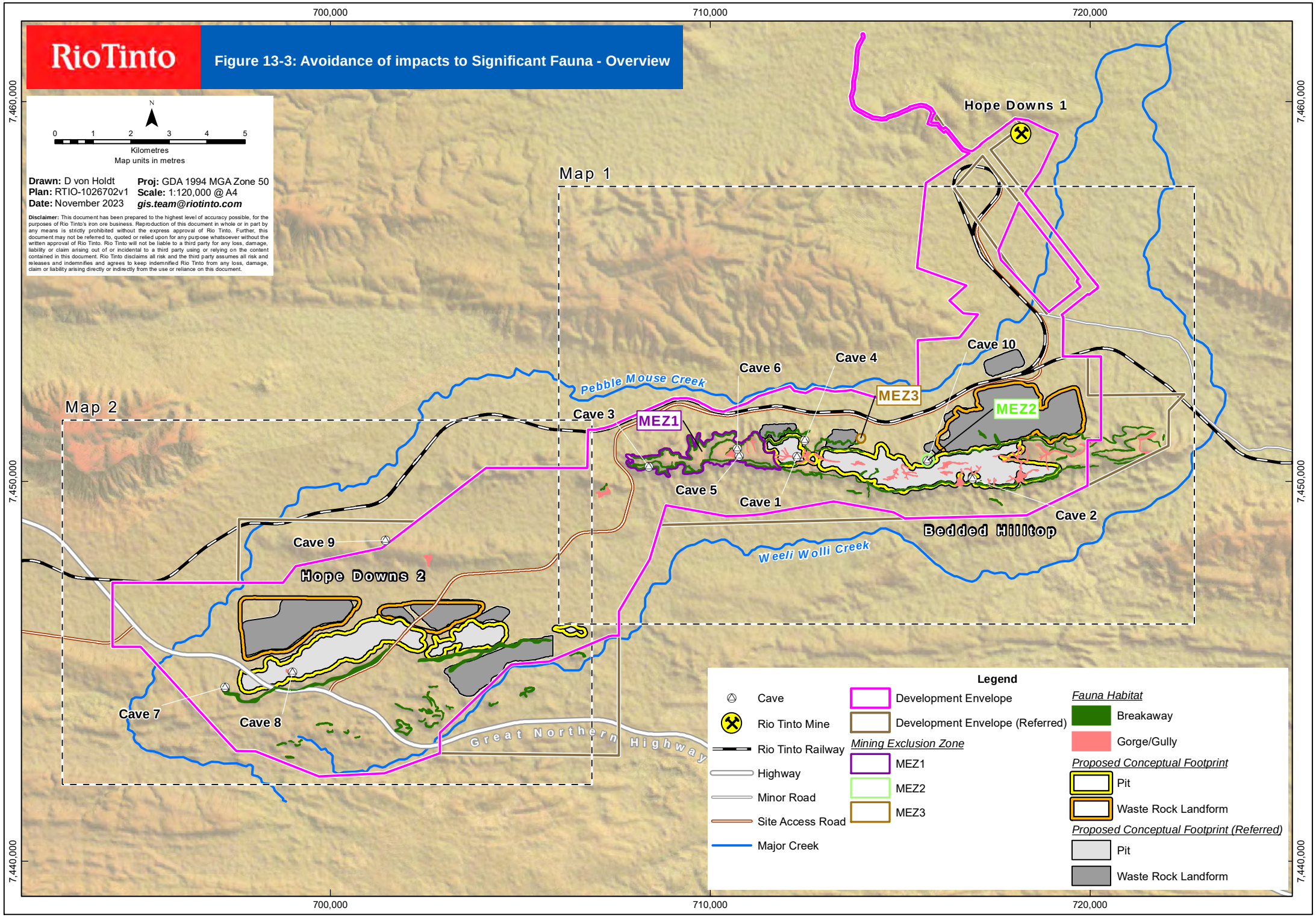
The Development Envelope and conceptual mine layout have been iteratively refined during the design phase to avoid direct impacts on high-value MNES habitat wherever practicable. MEZ1 and MEZ2 (Figure 13-3) have been established to avoid impacts to critical habitats. A full description, including the location of the Mining Exclusion Zone locations across the Development Envelope, is provided in Section 2.1.4, MEZ1 and MEZ2, including:

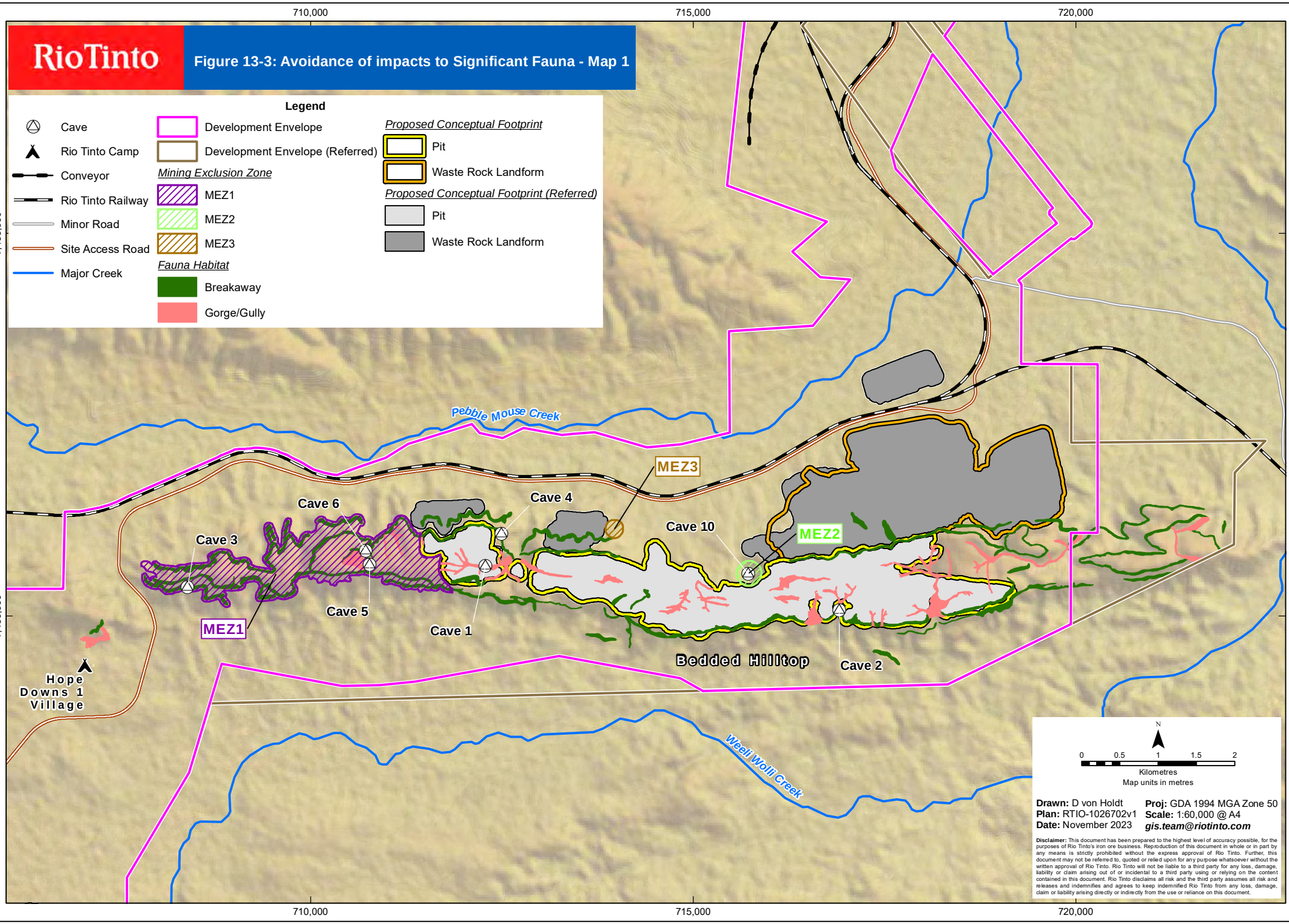
- Four of the nine caves within the Development Envelope, including the single Category 2 (potential Ghost Bat maternity roost) cave
- 241.5 ha of BHT ridgeline, which includes high-significance MNES habitat (49.3 ha of Breakaway and 5.7 ha of Gorge/Gully).

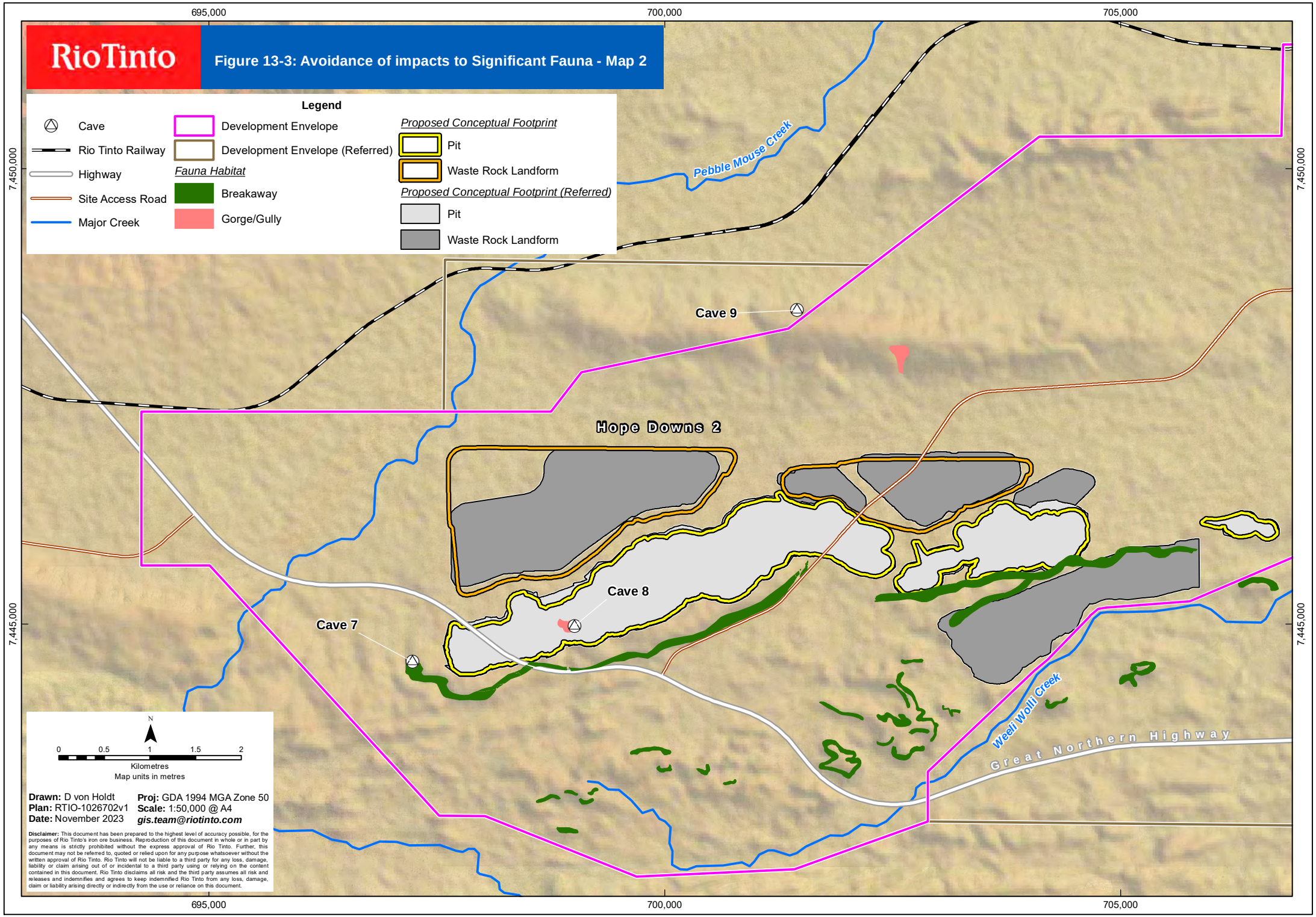
Other avoidance measures include:

- Avoidance of groundwater-related and surplus water management impacts to fauna habitats by restricting mining to AWT
- Exclusion of Weeli Wolli Creek from the Development Envelope to as large an extent as practicable
- Removal of a large waste rock landform from the referred project design to, amongst other outcomes, avoid impacts to Weeli Wolli Creek and associated fauna and habitat values
- Ensuring creek crossings are suitably designed and constructed to avoid impacts to fauna movement.

Figure 13-3: Avoidance of impacts to Significant Fauna - Overview




RioTinto
Figure 13-3: Avoidance of impacts to Significant Fauna - Map 1
Legend
Cave
Rio Tinto Camp
Conveyor
Rio Tinto Railway
Minor Road
Site Access Road
Major Creek
Development Envelope
Development Envelope (Referred)
Mining Exclusion Zone
MEZ1
MEZ2
MEZ3
Fauna Habitat
Breakaway
Gorge/Gully
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Proposed Conceptual Footprint (Referred)
Pit
Waste Rock Landform
710,000
715,000
720,000
7,455,000
7,450,000
Pebble Mouse Creek
MEZ3
MEZ2
MEZ1
Cave 1
Cave 2
Cave 3
Cave 4
Cave 5
Cave 6
Cave 10
Bedded Hilltop
Hope Downs 1 Village
Weeli Wolli Creek
N
0
0.5
1
1.5
2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-1026702v1
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:60,000 @ A4
gis.team@riotinto.com
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RioTinto
Figure 13-3: Avoidance of impacts to Significant Fauna - Map 2
Legend
Cave
Rio Tinto Railway
Highway
Site Access Road
Major Creek
Development Envelope
Development Envelope (Referred)
Fauna Habitat
Breakaway
Gorge/Gully
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Proposed Conceptual Footprint (Referred)
Pit
Waste Rock Landform
695,000
700,000
705,000
7,450,000
7,445,000
Pebble Mouse Creek
Cave 9
Hope Downs 2
Cave 8
Cave 7
Weeli Wolli Creek
Great Northern Highway
N
0
0.5
1
1.5
2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-1026702v1
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:50,000 @ A4
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13.4.1.2. Key Minimisation Measures

Key measures planned by the Proponent to ensure impacts to MNES are minimised to the greatest possible extent include:

- Designing the Development Envelope and proposed Conceptual Footprint to minimise disturbance of Critical Gorge/Gully and Breakaway habitats, as well as to Weeli Wolli and Pebble Mouse Creeks
- Setting upper limits on the clearing of Critical habitat to MNES species
- Applying blasting limits (PPV) at the Category 2 Ghost Bat cave (Cave 10) to ensure the structural integrity is maintained
- Storing the location of significant fauna habitat types within the Proponent's GIS system to ensure impacts to known locations of significant habitat types are minimised and that authorised clearing extents are not exceeded
- Ensuring all land disturbance occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system.

13.4.1.3. Key Rehabilitation Measures

The MCP (Appendix A4) includes objectives to ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use and that final landforms are stable and consider ecological and hydrological factors.

- Habitat elements considered a part of rehabilitation design includes:
- Re-establishing vegetation that is known to provide preferred food or shelter
- Retaining and replacing woody debris
- Introducing or leaving rocky features such as oversized waste burden or screen slopes
- Creating greater depth of friable soil (or suitable mineral wastes) for burrowing fauna
- Enhancing connectivity with unmined areas and maintaining the quality of these habitats
- Managing feral predators and herbivores across key areas
- Retention of leaf litter using small-scale topography.

Rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement.

13.4.2. Loss of Fauna Individuals as a Result of Clearing (or Other Interactions)

MNES species may be vulnerable to injury or mortality from vehicle and machinery movements associated with the Proposed Action and entanglement in barbed wire fences, typically used to exclude cattle and other fauna from mining operations.

13.4.2.1. Key Avoidance Measures

Avoiding high significance habitats and other measures described in Section 13.4.1 will also decrease potential impacts on individual MNES fauna.

In addition, the use of barbed wire fencing will be avoided as far as practicable. Where barbed wire fencing is required for legislative compliance, reflectors will be attached to make fencing more visible and reduce the risk of fauna injury or mortality due to entanglement.

13.4.2.2. Key Minimisation Measures

Key measures planned by the Proponent to ensure impacts to MNES are minimised to the greatest possible extent include:

- The Proponent will undertake progressive clearing to allow fauna to migrate away from clearing activities or machinery movements
- Speed limits would be implemented to minimise the risk of fauna injury or mortality from vehicle strike
- Vehicle traffic will be generally confined to defined roads and tracks
- Roadkill will be removed from trafficable areas to reduce the risk of an increase in predators and potential secondary roadkill
- Reflectors will be placed on any remaining barbed wire fences to help prevent the entanglement of bat species
- Site induction programs will provide information on significant fauna, including their appearance and habitats. Training would also discuss standard operating procedures in the event of fauna interactions
- Artificial water sources will have egress points.

13.4.2.3. Key Rehabilitation Measures

Rehabilitation will be undertaken progressively to minimise disturbed areas and reduce interactions with MNES fauna.

13.4.3. Introduced Fauna, Weeds, Dust and Altered Bushfire Risk

Introduced Fauna

Seven introduced fauna species were recorded within the Development Envelope (Cats, Dogs, European Cattle, Camels, Donkeys, Rabbits, and House mice (Astron 2019b)). These species are also known to be present in the surrounding region.

The Cane Toad is an invasive species that threatens many MNES species but is not currently established in the Pilbara. The Proposed Action does not significantly affect water availability and is not expected to increase Cane Toads' potential to become established in the Development Envelope.

Activities associated with the construction and operation of the mine have the potential to increase the abundance of these species or introduce new ones. These activities include inappropriate waste management of purifiable waste. Additionally, the increase in cleared areas can potentially increase access and predation by feral Cats and Foxes. Cane Toads are not currently in the Pilbara, and the Proposed Action will not increase the Cane Toads' potential to become established in the Development Envelope or surrounding area.

Weeds

The construction and operation of the Proposed Action have the potential to result in the introduction or spread of weed species as a result of clearing and vehicle/machinery movements. Increased weed presence may degrade fauna habitats and increase fire risk and intensity. The degradation of habitat can cause a decline in the availability of resources for fauna species and make them more vulnerable to predation from feral predators.

Dust

The Pilbara region is naturally dusty, and the Proposed Action is located near several existing mining operations. In high wind conditions, dust may temporarily be generated during clearing and operation,

which may deposit on vegetation or pools, potentially impacting fauna habitat quality if deposition rates are significant and rainfall is not sufficient to wash the settled dust or replenish affected pools.

An air quality assessment was undertaken for the Proposed Action, modelling against National Environment Protection Measures for Ambient Air Quality (Air NEPM) and other human health criteria. There is limited published research on the impacts of dust on fauna and the concentrations at which fauna may experience a negative impact (ETA 2022). As such in the absence of criteria specific to animal health, the human health criteria for fine and total airborne particulates (PM10 and TSP, respectively) are useful for considering potential effects on fauna (ETA 2022).

The study found that dust parameters will be elevated within the Development Envelope throughout the life of the mine (discussed in Section 11.5.4). The predicted ground-level concentrations of PM10 and TSP at bat cave receptors within the Development Envelope varied depending on the mining operations' proximity. However, these concentrations do not represent the concentrations within the caves themselves (which may be significantly lower) (ETA 2022).

Altered Bushfire Risk

Fire may impact fauna directly or modify habitat through altered fire frequency and intensity (Jhariya and Raj 2014). Too frequent, hot, or extensive fires during hot, dry times of the year can reduce habitat capacity to support diverse fauna assemblages by altering the vegetation structure and composition, resulting in changes in food quantity and quality and changes in cover and microhabitats (Griffiths and Brook 2014).

The recent bushfire at BHT (Astron 2019b) resulted from natural causes and not attributable to mining activities or personnel.

13.4.3.1. Key Minimisation Measures

Introduced Fauna

To manage feral animal numbers, the Proponent will implement a feral animal control and monitoring program within the MEZs and high-risk areas for MNES. This will be completed with regional control programs and the Traditional Owners. The Proponent already has industry-standard waste management procedures that aim to minimise the number of feral species attracted to the site due to improper disposal of food wastes and site procedures, which prevent animal feeding and prohibit pets on site.

Weeds

Weeds will be managed in accordance with the Proponent’s EMP and internal procedures, which includes key actions such as periodic spraying and vehicle/equipment hygiene procedures.

As part of the management, a survey and control program will be undertaken to review to identify and target high risk areas (e.g. environmental value, existing weed presence, status of weeds that are present, and potential for further transfer/dispersal, e.g. waterways and high trafficable areas).

Dust

To control dust, the Proponent will implement dust suppression management strategies to minimise fugitive dust's impact, including using water carts/ sprays.

All significant roosts (Category 2) will be placed in MEZs. Therefore, the distance to active mining will increase, reducing the risk of high dust concentrations at the cave entrance. Blast management protocols will be implemented where relevant to minimise the potential impacts of dust to bat caves. In addition, no disturbance will occur in the MEZ other than existing and authorised clearing.

Additional minimisation measures will include:

- Restricting topsoil and overburden stripping and other high dust generating activities during high winds if dust cannot be adequately controlled
- Vehicle speed limits on unsealed roads and restricted access to rehabilitated surfaces except for management purposes.

Altered Bushfire Risk

The minimisation of altered bushfire risk will be achieved through implementing effective management and work procedures of construction and operation activities, including firefighting emergency response procedures, appropriate firefighting equipment and management procedures relating to high-risk activities, especially hot works and vegetation clearing. Clearing activities will not be undertaken when the fire danger rating is high or greater. The establishment of road networks and the maintenance of firebreaks as a result of the Proposed Action will also help control the size and extent of any potential bushfires within the Development Envelope.

13.4.3.2. Key Rehabilitation Measures

Rehabilitation will include planning for bushfire minimisation and response, as well as the inclusion of closure completion criteria for weed abundance and diversity.

13.4.4. Disturbance from Light and Noise/Vibration

Light

Light emissions can disorient flying birds, particularly during migration, and cause them to divert from efficient migratory routes or collide with infrastructure (DotEE 2020). Artificial light may disrupt mammals' nocturnal foraging due to the light attracting invertebrate prey, potentially making small mammals vulnerable to predation.

Noise and Vibration

Noise emissions will arise from the construction and operation of the mine, particularly from blasting within the pits. These emissions generally dissipate with distance, with the habitats close to the pits typically the most at risk.

Potential impacts to fauna from noise can include interruptions in feeding and resting behaviour, reducing reproductive success and complete abandonment of an area, including caves (Newport et al. 2014). The recognised noise threshold for Ghost Bat and Pilbara Leaf-nosed Bat roosts is 70 dB (Bullen 2013; Bullen and Creese 2014). Above this level, noise may cause these species to abandon the caves temporarily or permanently.

Modelling of unmitigated noise levels at Cave 10 (Category 2 Ghost Bat Cave) has predicted that levels of up to 74 dB may be experienced under certain conditions and mining scenarios (Wood 2022). For all other caves, modelling predicts noise levels below the 70 dB threshold.

Vibrations are generally associated with blasting occurring within the mine pits and can result in the loss of, or damage to, nearby cave and rocky shelter microhabitats. The vibration may also impact species that utilise vibrations to detect threats or prey, such as the Pilbara Olive Python.

This assessment will use a vibration threshold for the protection of Ghost Bat and Pilbara Leaf-nosed Bat roosts of 10 mm/s (Bullen 2013; Bullen and Creese 2014; however, vibrations generated at a mine site are highly variable due primarily to variations in blast patterns. As such an overall assessment on vibration levels could not be conducted as each blast must be assessed on a case-by-case basis (Wood 2022).

13.4.4.1. Key Avoidance Measures

MEZ1 and MEZ2 include buffers of sufficient distance from active mining operations to ensure the values within the MEZ will not to be impacted by light or noise/vibration. This includes a 150 m buffer for MEZ2 around the Category 2 Ghost Bat roost.

13.4.4.2. Key Minimisation Measures

The following broad light and noise/vibration minimisation strategies are proposed:

- The use of artificial lighting will only be used where necessary for the safe conduct of mining activities
- Artificial lighting in mining areas will be shielded and directed towards active mine areas to minimise light overspill (this aligns with the National Light Pollution Guidelines for Wildlife (DotEE 2020)
- Machinery will be fitted with noise-attenuating equipment, such as mufflers and baffles, in accordance with manufacturing specifications to comply with Australian standard noise limits.

Due to the significance of several caves within the Development Envelope, the Proponent is committed to the following:

- Maintaining a 150 m blasting/excavation buffer around the extent of Cave 10 (Category 2 Ghost Bat roost) through the establishment of a MEZ (MEZ2) to protect the integrity of the potential maternity Ghost Bat roost, which is considered Critical habitat, and the surrounding Supporting habitat.
- Caves 3, 5 and 6 will be protected from disturbance within MEZ1; the closest cave (Cave 5) will be at least 650 m from mining activities.
- Establish vibration limits at the entrance to the Category 2 Ghost Bat cave (Cave 10) of 10 mm/s PPV during breeding months (1 October to 31 December) and 25 mm/s in non-breeding months, which will be monitored to ensure mining operations comply with the limit. Vibration limits will also ensure that the cave's structural integrity is maintained.

13.4.4.3. Key Rehabilitation Measures

At the completion of mining operations, including earthmoving associated with the closure and rehabilitation process, it is expected that light and noise/vibration sources will no longer be in operation/use.

13.5. Summary of Proposed Mitigation Relevant to MNES

A summary of the Proposed management of MNES fauna, including avoidance and minimisation, is provided in Table 13-10 and outlined in the EMP (attached in Appendix A7).

Table 13-10: Summary of Residual Impacts to MNES Fauna Species Following Implementation of Management and Mitigation Measures

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impact
Habitat Loss/Reduction and Fragmentation as a Result of Clearing	The Proposed Action has been designed to prioritise the avoidance of MNES habitat clearing, particularly: • Critical denning, roosting and shelter habitat for the Northern Quoll, Ghost Bat and Pilbara Olive Python • Supporting foraging and dispersal habitat for the Northern Quoll, Ghost Bat, Grey Falcon, Night Parrot and Pilbara Leaf-nosed Bat In addition, the Proposed Action has been designed to include the following avoidance measures: • Designing the Development Envelope and Conceptual Footprint to minimise disturbance of Critical Gorge/Gully and Breakaway habitats, as well as to Weeli Wolli and Pebble Mouse Creeks • Establishment of MEZs that include the location of four of the nine Ghost Bat caves and Critical habitat, including the Category 2 cave and 241 ha of BHT ridgeline, which includes high-significance MNES habitat (49.3 ha of Breakaway and 5.7 ha of Gorge/Gully)	The Proposed Action will minimise impacts on Critical denning, roosting and shelter habitat through the following: • Implementation of upper clearing limits for Breakaway and Gorge/Gully habitat types • Application of blasting (PPV) limits at the Category 2 Ghost Bat cave (Cave 10) to ensure structural integrity is maintained • Not allowing clearing or disturbance activities to occur within the Mining Exclusion Zones 1 & 2 during the Ghost Bat breeding season. • Storing the location of significant fauna habitat types within the Proponent's GIS system to ensure impacts to known locations of significant habitat types are minimised, and that authorised clearing extents are not exceeded • Ensuring all land disturbance occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system	The MCP (Appendix A4) includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with post-closure land use. Final landforms are required to be stable and consider ecological and hydrological factors. Habitat elements considered part of the rehabilitation design includes: • Re-establishing vegetation that is known to provide food or shelter • Retaining and replacing woody debris • Retention of leaf litter using small-scale topography • Introducing or leaving in-situ rock features • Enhancing connectivity with unmined areas and maintaining the quality of these habitats • Creating greater depth of friable soil for burrowing fauna • Managing feral predators and herbivores across the key areas Rehabilitation will be conducted following the Rehabilitation Handbook, including fauna and habitat monitoring.	The Proponent considers that the following residual impacts are significant and that offsets will be required: • Clearing up to 105 ha of Critical denning, roosting and shelter habitat for the Northern Quoll, Pilbara Olive Python and Ghost Bat (comprising Breakaway and Gorge/Gully habitat types) • Clearing approximately 2,659 ha of the combined Supporting foraging and dispersal habitat for the Northern Quoll, Ghost Bat and Pilbara Leaf-nosed Bat

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impact
	• Avoidance of an additional three Ghost Bat caves within the Development Envelope outside of the MEZs • Avoidance of groundwater-related and surplus water management impacts to fauna habitats by restricting mining to AWT • Exclusion of Weeli Wolli Creek from the Development Envelope to as large an extent as practicable • Removal of a large waste rock landform from the referred project design to, amongst other outcomes, avoid impacts to Weeli Wolli Creek and associated fauna and habitat values • Ensuring creek crossings are suitably designed and constructed to avoid impacts to fauna movement			
Loss of fauna individuals	The Proponent will avoid impacts to individual MNES species by: • Implementing the Avoidance measures listed above • Avoiding the use of barbed wire fencing as far as practicable. Where barbed wire fencing is required for legislative compliance,	The Proponent will minimise impacts to individual MNES species by: • Undertaking progressive clearing to allow fauna to migrate away from clearing activities or machinery movements • Implementing vehicle speed limits on all access roads and restricting access to	Undertake rehabilitation activities progressively to minimise disturbed areas and therefore reduce interactions with MNES fauna Borrow pits will be designed, constructed, and rehabilitated to minimise surface water ponding.	The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impact
	reflectors will be attached to make fencing more visible and reduce the risk of fauna injury or mortality due to entanglement	minor tracks and off-road areas • Removing roadkill from trafficable areas • Undertake awareness training to identify significant fauna and habitat, relevant management measures, personnel/ contractor responsibilities, and incident reporting requirements (i.e., reporting fauna observations and incidents) • Establish egress points in artificial water sources (e.g. turkeys' nests and sediment ponds)		
Introduced Fauna, Weeds, Dust and Altered Bushfire Risk	The Proponent will avoid impacts to individual MNES species by implementing the habitat clearing Avoidance measures.	The Proponent will: • Implement feral animal control in co-operation with regional control programs and the Traditional Owners • Fence landfills and regularly cover putrescible wastes • Undertake dust suppression within the Development Envelope to minimise disturbance to fauna habitats. These measures will include but are not limited to, water carts and sprayers on crushers. Water supply is addressed in Section 2.1.3.6) • Implement blast management protocols to	Rehabilitation will include planning for bushfire minimisation and response, as well as the inclusion of closure completion criteria for weed abundance and diversity.	The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impact
		minimize potential impacts of dust to bat caves, as well as restricted clearing within the MEZ • During high winds, topsoil and overburden stripping and other high dust-generating activities would be restricted if risk-based assessment measures determine that dust cannot be adequately controlled • Vehicles will be required to travel at safe operating speeds on unsealed roads and will be restricted from accessing rehabilitated surfaces except for management purposes • Clearing activities will not be undertaken when fire danger ratings are high, extreme or catastrophic • Implement measures such as maintenance of fire breaks, hot works procedures and fire equipment available in buildings and vehicles • Implement fire response procedures and personnel training, including site induction on fire prevention and management		
Disturbance from Light and Noise/Vibration	The Proponent will avoid impacts to individual MNES species by implementing the habitat clearing.	The Proponent will: • Permanent lighting will be installed only where	No specific closure or rehabilitation actions are proposed.	The Proponent considers that the potential impacts can be managed

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impact
	Avoidance measures, including establishing and maintaining a 150 m buffer around the Category 2 Ghost Bat roost.	required, mainly in-pit and operational areas • Permanent lighting and temporary lighting will be shielded to minimise light spill • Permanent lighting will be directed away from sensitive areas (e.g. MEZs, significant caves, Critical habitat) • Ensure equipment design is specified to be within Australian standard noise limits • Maintain 150 m blasting/ excavation buffer around the extent of Cave 10 (Category 2 Ghost Bat roost) through the establishment of MEZ2 • Establish vibration limits at the entrance to the Category 2 Ghost Bat cave (Cave 10) of 10 mm/s (Peak Particle Velocity (PPV)) during breeding months (1 October to 31 December), and 25 mm/s in non-breeding months, which will be monitored to ensure mining operations comply with the limit		and that residual impacts will not be significant.

13.6. Northern Quoll (*Dasyurus hallucatus*)

13.6.1. Species Profile

The Northern Quoll is listed as Endangered under the BC Act and EPBC Act. It is a nocturnal, omnivorous mammal that preys on invertebrates, small mammals, reptiles, birds, carrion, and fruit. Northern Quoll weighs on average between 240 – 1,120 g, with males being larger than females (Dunlop et al. 2019).

13.6.2. Habitat Preferences and Distribution

The Northern Quoll has previously occurred across the northern portion of the Australian continent but in the last century, its distribution has significantly declined (Braithwaite and Griffiths 1994). The species' current range is discontinuous across the country's north with core populations occurring in central and north Queensland, northern parts of the Northern Territory and many areas within the Pilbara and Kimberley of Western Australia (DoE 2022). Populations of the species are also known to occur on several offshore islands within Western Australia and the Northern Territory.

Within the Pilbara, Northern Quolls are most common in the northern parts of the Pilbara region (generally within 150 km of the coast) but are much less common in the southern and south-eastern (Astron 2023c). The Northern Quoll persists in a wide variety of habitat types, including iron and sandstone ridges, screen slopes, granite boulders and outcrops, drainage lines, ravine habitat, dissecting rocky escarpment, open forest of lowland savannah and woodland (Braithwaite and Griffiths 1994. Areas of increased rockiness are preferred as they provide refuge from predators and provide areas suitable for breeding (DoE 2022). The Commonwealth listing advice states that the upper home range of this species is up to 150 ha for males and 35 ha for females (TSSC 2005), which has an approximate radius of 0.62 km (based on a 150 ha home range). For this Proposed Action, the radius of the home range has been increased to 1 km as a conservative measure.

The Pilbara population is genetically distinct from the closest other populations of the Northern Territory and Kimberly and is considered to be the least diverse of the three (Cramer et al. 2016). This population's current size is unknown; however, 4,537 records of the species have been made over the years and their distribution covers all four subregions of the Pilbara bioregion (Dunlop et al. 2019).

DBCA has previously conducted an extensive Northern Quoll monitoring program since 2012. The results of which are uploaded to the NatureMap online government database. This monitoring has led to the discovery of a range extension for the species into the Karlamilyi National Park, which is over 200 km further east of the previously recognised range of the species.

13.6.3. Key Threats and Recovery Actions

13.6.3.1. Key Threats

Key threats to Northern Quoll include habitat clearing, modification and land-use change, lethal toxic ingestion caused by Cane Toads, inappropriate fire regimes, weeds, disease, and feral predators (Hill and Ward 2010).

13.6.3.2. Recovery Actions

The overall objective of the National Recovery Plan for the Northern Quoll is (Hill and Ward 2010):

‘To minimise the rate of decline of Northern Quoll in Australia and ensure that viable populations remain in each of the major regions of distribution into the future.’

Several recovery objectives are identified in the National Recovery Plan, including the following relevant to the Proposed Action:

- Halt Northern Quoll decline in areas not yet colonised by Cane Toads

- Investigate factors causing declines in Northern Quoll populations not yet affected by Cane Toads
- Manage key Northern Quoll populations in areas not currently affected by Cane Toads to halt population declines
- Reduce the impact of feral predators on Northern Quolls.

DBCA has previously undertaken a Northern Quoll research program, which was funded by environmental offsets provided by Rio Tinto and other mining companies along with Main Roads WA (Dunlop et al. 2019). This research program was to understand better the status and ecology of the species in the Pilbara region. The program has enhanced species records (collating additional records and previously unsurveyed areas) which has allowed for the development of an updated and accurate species distribution model, and dietary analysis has identified that the species has a flexible and opportunistic omnivorous habit. Interactions between Northern Quoll and predators were a focus of the program (Dunlop et al. 2019).

Table 13-10 provides mitigation that the Proponent will implement to reduce impacts on this species and habitat.

13.6.4. Important Populations and Critical Habitat

13.6.4.1. Important Populations

Populations that constitute an 'important population' for the Northern Quoll include (DoE 2016b):

- High-density quoll populations that occur in refuge-rich habitat critical to the survival of the species and can include habitat where Cane Toads are present
- Populations free of Cane Toads and unlikely to sustain Cane Toad populations upon their arrival, for example, populations within a desert context and without permanent water
- Populations subject to conservation or research programs – that is, populations monitored by government agencies or universities.

The National Recovery Plan for the Northern Quoll identified four categories of important populations. These include populations in the Pilbara region as these are outside the Cane Toads' predicted range (Hill and Ward 2010). Cane Toads have not yet been recorded in the Pilbara region. However, it is anticipated that they will naturally colonise the Pilbara mainland (and potentially its offshore islands) between 2026 to 2064 (Kearney et al. 2008 and Tingley et al. 2013 cited in Dunlop et al. 2019).

The EPBC Act referral guidelines (DoE 2016a) for the species indicate that a high-density population may be characterised by numerous camera triggers of multiple individuals across multiple cameras or trap sites. A low-density population may be represented by infrequent captures of one or two individuals confined to one or two traps or where trapping has captured no individuals, but there is latrine evidence.

13.6.4.2. Critical Habitat

Critical habitat as defined in the National Recovery Plan for the Northern Quoll, *Dasyurus hallucatus* (Hill and Ward 2010), is habitat "where Northern Quolls are least exposed to threats or least likely to be in the future two particular broad habitat types fall into this category: rocky areas and offshore islands". Daytime den sites, in particular, provide important shelter and protection for Northern Quolls from predators and weather" and rocky areas which contain these features can retain water and contain microhabitats, creating greater prey diversity than nearby non-rocky areas (Hill and Ward 2010). While the surrounding foraging and dispersal habitats are also important, they are generally more widespread, and clearing these habitats is likely to be less significant.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) referral guidelines define Critical habitat for the Northern Quoll as habitat within the modelled distribution for the species,

providing shelter for breeding, refuge from fire, and predation by Cane Toad (DoE 2016a). Critical habitat includes:

- Offshore islands where the Northern Quoll is known to exist
- Rocky habitats such as Ranges, Escarpments, Mesas, Gorges, Breakaways, Boulder fields, Major drainage lines or Treed creeks
- Structurally diverse woodland or forest areas containing; large diameter trees, termite mounds or hollow logs.

Habitat critical to this species' survival includes dispersal and foraging habitat associated with or connecting populations important to the species' long-term survival (DoE 2016a). As per the referral guidelines (DoE 2016a), foraging and dispersal habitat is any land that comprises:

- Predominantly native vegetation in the immediate area (i.e., within 1 km) of shelter or denning habitat
- Northern Quoll records
- Land containing mostly native vegetation connected to shelter habitats within the range of the species.

Based on the Recovery Plan and considering the referral guideline, this assessment has used the term Critical habitat in relation to rocky habitats that support denning and shelter and defined Supporting habitat as foraging and dispersal habitat within 1 km of known records of Northern Quoll.

13.6.5. Occurrence and Habitat in the Development Envelope

The survey area and Development Envelope are located near the southern extent of the current mapped distribution of the Northern Quoll (Astron 2023a), with DCCEEW records of the species spread only sporadically through this part of the Hamersley Ranges (Astron 2020b; DoE 2016a).

13.6.5.1. Recorded Occurrences

A total of 14 records of Northern Quoll were made during the three-year Astron survey period. The majority of the records were captured on motion cameras (8 records), followed by fresh scats (5 records), and one male quoll was captured (Astron 2023a). Most of these were recorded around the BHT deposit in Gorge/Gully and Breakaway habitats. No recordings were made around the HD2 deposit despite using similar survey strategies. The limited number of sightings from motion cameras make an accurate population analysis unachievable; however, the results indicate that the area only has a low-density Northern Quoll population (Astron 2023d).

Annual long-term motion camera monitoring program undertaken from 2020 to 2022 has recorded few Northern Quoll within the Development Envelope, with two Northern Quoll being recorded in May 2020 and no Northern Quoll recorded in 2021 (Astron 2023a, 2023c). Astron (2023d) suggest the decline in numbers recorded in the Development Envelope is strongly associated with one or more of the following factors: a fire that burnt through the BHT ridgeline in 2019, drier than average conditions and an observed increase in the number of feral Cats.

13.6.5.2. Habitat

The Gorge/Gully and Breakaway habitats of the Development Envelope (Table 13-11, Figure 13-4) are considered Critical habitat for the Northern Quoll. These areas have the potential to possess semi-permanent water features as well as microhabitat structures which have the potential to be used for denning.

The Minor Drainage and Rocky Hill habitats are considered suitable for the dispersal/foraging of the species. They are deemed to be Supporting habitat where they occur within 1 km (species home range) of a Northern Quoll record (Table 13-11, Figure 13-4).

No Northern Quoll dens were recorded in the survey area or the Development Envelope, although it is assumed that they occur (Astron 2019b).

The proposed clearing of these habitats has been minimised, and clearing is considered a significant residual impact and will be offset.

Table 13-11: Critical and Supporting Habitat for Northern Quoll in the Development Envelope

Type	Habitat Type	Area (ha)	Total Area (ha)
Critical habitat	Gorge/Gully	63	287
	Breakaway	224	
Supporting habitat	Minor Drainage *	70	462
	Rocky Hill *	392	

** within 1 km of Northern Quoll record*

13.6.6. Assessment of Impacts

The Proposed Action may result in direct and indirect impacts to Northern Quoll. The following assessment of impacts has been identified specifically for Northern Quoll, in addition to the impacts applying more broadly for all MNES species with potential to occur within the Development Envelope (described in Chapter 12).

13.6.6.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

The Proposed Action will result in clearing up to 105 ha of Critical habitat (Breakaway and Gorge/Gully) and approximately 297 ha of Supporting habitat (Minor Drainage and Rocky Hills) within the Development Envelope. Minor Drainage and Rocky Hill habitat within 1 km of a Northern Quoll record is considered Supporting habitat (dispersal and foraging) habitat within the species' home range.

The proposed clearing of Critical and Supporting habitat is considered a significant residual impact and is proposed to be offset (See Chapter 12). The offset method and calculations for fauna habitat are detailed in Section 13.4. The Northern Quoll habitat overlaps with other MNES fauna habitats.

The remaining habitats do not represent Critical or Supporting habitat for the species and are considered of low significance.

At least 182 ha (63.4%) of Critical habitat (Gorge/Gully and Breakaway) and 165 ha (36%) of Supporting habitat (Minor Drainage and Rocky Hill) will remain available in the Development Envelope, including 81 ha within Mining Exclusion Zones. An additional 634 ha of Gorge/Gully and Breakaway habitats have been mapped within the extrapolated survey area outside of the Development Envelope. Individuals can also disperse and forage more broadly in the surrounding low significance habitats.

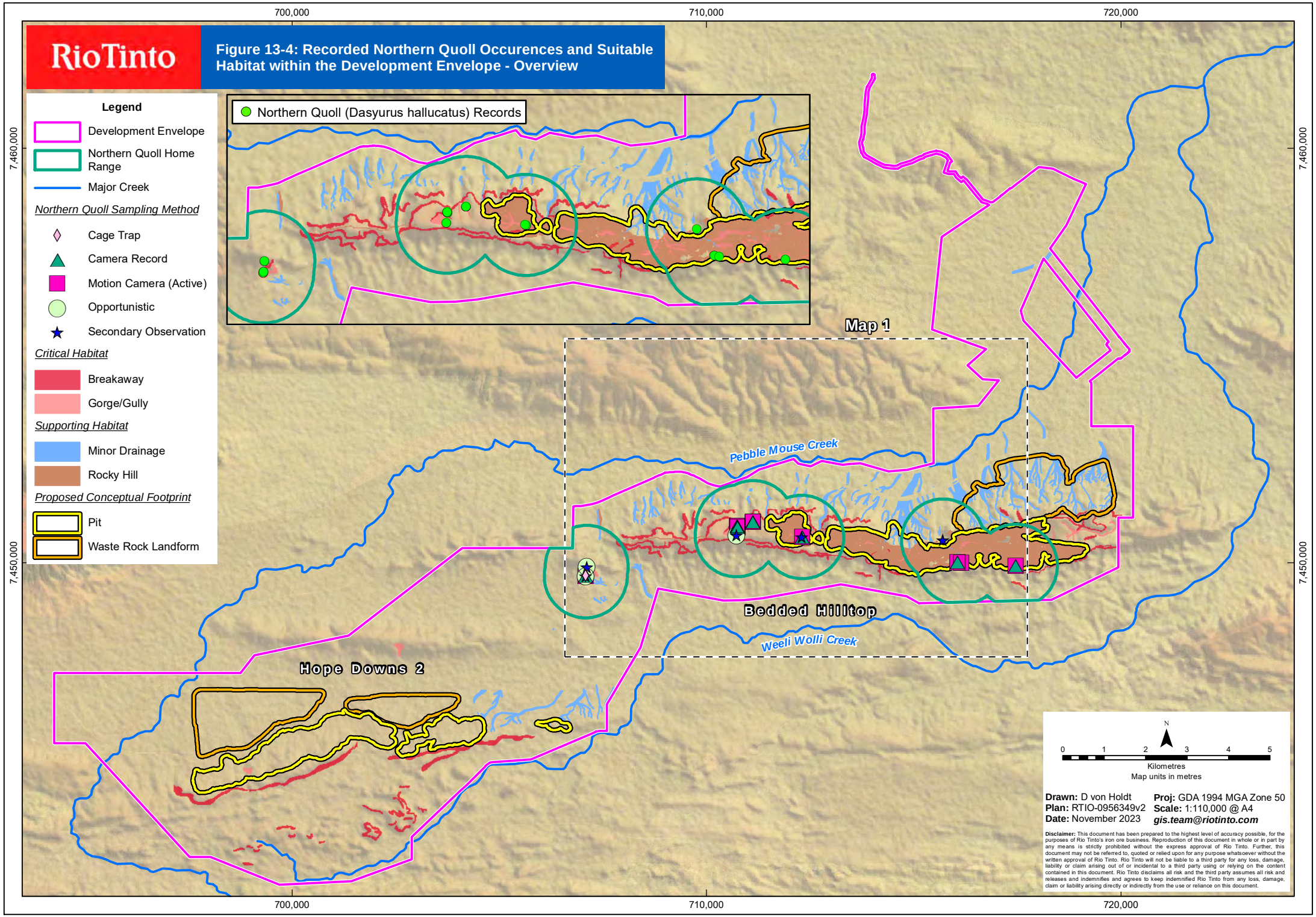
The Proposed Action includes progressive mining (i.e., not all areas will be cleared and mined simultaneously). Progressive rehabilitation of areas no longer required for mine operation will occur to minimise the presence of disturbed areas. Habitat fragmentation is not expected to significantly affect Northern Quoll habitat connectivity or movement. Northern Quolls have been recorded within operational areas at Pilbara mine sites and so can disperse through these disturbed areas.

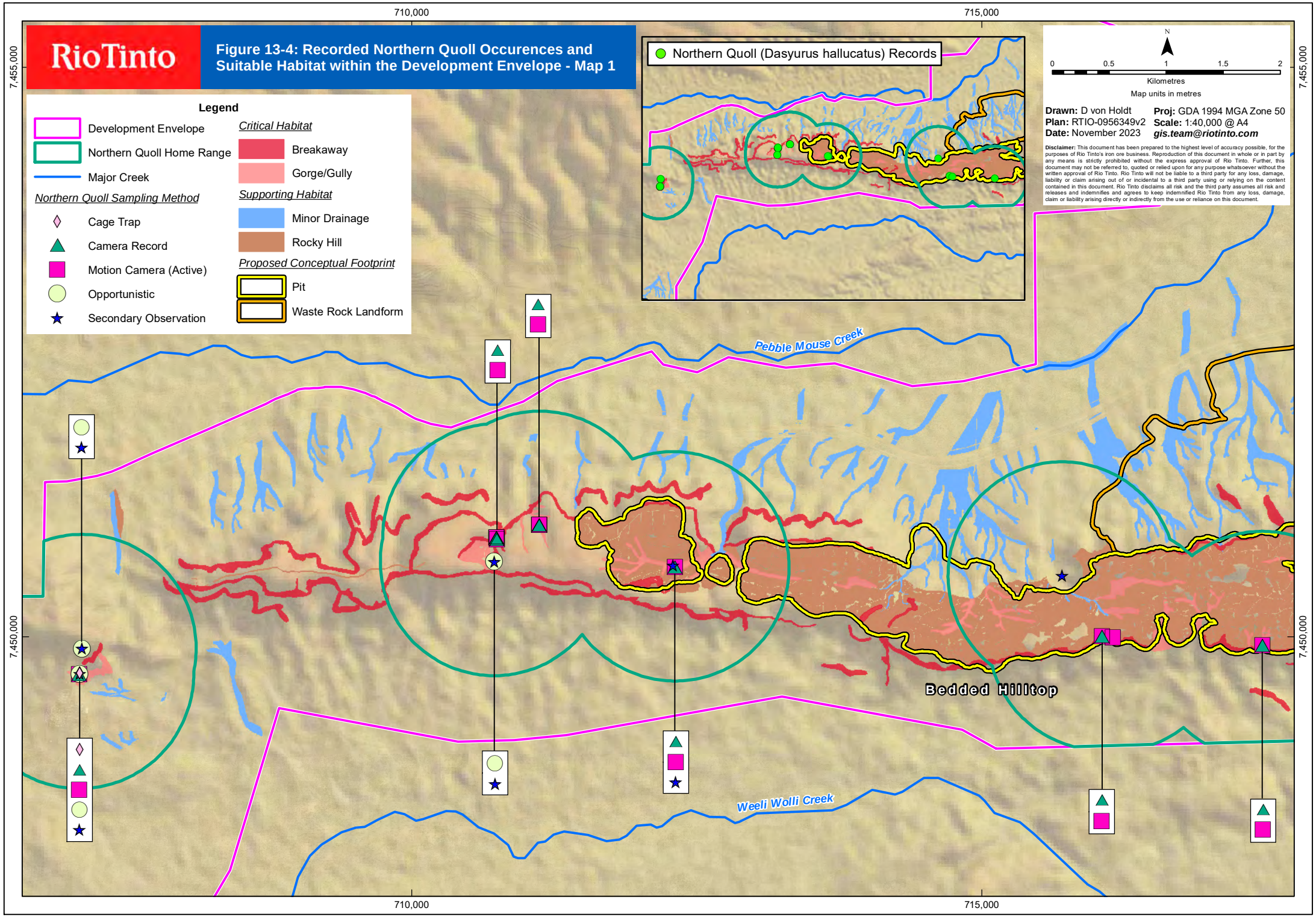
Habitat Degradation Associated with Construction and Operation Activity Fire

Changes to fire regimes can impact Northern Quoll through direct mortality, reduction in vegetation cover and food availability (DBCA 2019). Too-frequent fire can reduce the population size (DBCA 2019). However, it has been found that Northern Quolls can tolerate fire as long as these fires are low-intensity, early in the season, and the impacts on vegetation structure and composition are not exacerbated by grazing from introduced herbivores (Woinarski et al. 2014). As the Northern Quoll in the Pilbara is associated with rocky landforms, any potential changes in fire regime may have less influence on habitat

structure and quality (DBCA 2019). The Proponent will implement fire management safety procedures (i.e., firefighting emergency response procedures, appropriate firefighting equipment and management procedures relating to high-risk activities) to reduce fire risk within the Development Envelope.

After applying mitigation measures (see Section 13.5 and Table 13-10), no significant increase in the risk of habitat degradation from dust emissions or altered fire regimes is anticipated.


RioTinto
Figure 13-4: Recorded Northern Quoll Occurences and Suitable Habitat within the Development Envelope - Overview
700,000
710,000
720,000
7,460,000
7,450,000
Legend
Development Envelope
Northern Quoll Home Range
Major Creek
Northern Quoll Sampling Method
Cage Trap
Camera Record
Motion Camera (Active)
Opportunistic
Secondary Observation
Critical Habitat
Breakaway
Gorge/Gully
Supporting Habitat
Minor Drainage
Rocky Hill
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Northern Quoll (Dasyurus hallucatus) Records
Map 1
Pebble Mouse Creek
Bedded Hilltop
Weeli Wolli Creek
Hope Downs 2
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956349v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
gis.team@riotinto.com
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RioTinto
Figure 13-4: Recorded Northern Quoll Occurences and Suitable Habitat within the Development Envelope - Map 1
Legend
Development Envelope
Northern Quoll Home Range
Major Creek
Northern Quoll Sampling Method
Cage Trap
Camera Record
Motion Camera (Active)
Opportunistic
Secondary Observation
Critical Habitat
Breakaway
Gorge/Gully
Supporting Habitat
Minor Drainage
Rocky Hill
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Northern Quoll (Dasyurus hallucatus) Records
N
0 0.5 1 1.5 2
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956349v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @ A4
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710,000
715,000
7,455,000
7,450,000
Pebble Mouse Creek
Weeli Wolli Creek
Bedded Hilltop

13.6.7. Significance of Impacts

An assessment of the impacts the Proposed Action may have on the Northern Quoll as per the Significant Impact Guidelines and the Northern Quoll Referral Guidelines (DoE 2013; DoE 2016a). is detailed in Table 13-12.

Table 13-12: Assessment of the Significance of Impacts to Northern Quoll

Significant Impact Criteria	Assessment of Significance of Impacts to Northern Quoll
Potential to cause a long-term decrease in the size of a population Decrease the size of a population important for the long-term survival of the Northern Quoll and therefore interfere with the recovery of the species	The Northern Quoll has been recorded 14 times within the Development Envelope over three years. These results indicate that the local population is likely of low density. Northern Quoll was recorded predominantly in Gorge/Gully and Breakaway habitat types which provide core denning/breeding and foraging habitat. Rocky Hill and Minor Drainage habitats represent Supporting habitat for the species (Astron 2020b). Given the continued availability of Critical habitat and Supporting habitat within and around the Development Envelope, the Proposed Action is not expected to cause a long-term decrease to the low-density population that occurs within or overlaps the Development Envelope.
Potential to reduce the area of occupancy of the species Fragment a population important for the long-term survival into two or more populations	The Proposed Action can potentially reduce the area of occupancy of the Northern Quoll in a local context through the loss of Critical habitat. Northern Quoll have been recorded within the Development Envelope at a low density. However, the home range for a male can be up to 100 ha (TSSC 2005), and the species is expected to continue to exist in the remaining Critical and Supporting habitat within and surrounding the Development Envelope. Rehabilitated landforms may also provide some modified habitat value following closure.
Potential for fragmentation of an existing population into two or more populations	Significant corridors in different landforms, such as ridges, hillsides and creek lines will remain in place to allow movement around the mining area and through the landscape. Available habitat will also still occur within the Mining Exclusion Areas, the Development Envelope and the areas surrounding the Development Envelope, which will continue to support the overall Pilbara population of Northern Quoll. The proposed Conceptual Footprint has been designed to maximise habitat connectivity in an east/west direction, such as the extent of Low Hills and Slopes habitat south of the BHT deposit is adjacent to Weeli Wolli Creek that functions as a fauna movement corridor for species dispersing. The Proposed Action is therefore not expected to fragment an existing population into two or more populations, given the low density and species' mobile nature.
Potential to adversely affect habitat critical to the survival of a species Result in the loss of habitat critical to the survival of the Northern Quoll	The Proposed Action will result in the loss of approximately 105 ha of Critical habitat for the Northern Quoll. The Proposed Action will result in clearing up to 105 ha (37%) of Critical Gorge/Gully and Breakaway (denning and breeding) habitat and 297 ha (53%) of Supporting Minor Drainage and Rocky Hill (foraging and dispersal) habitat for the Northern Quoll. The remaining habitats represent limited foraging and dispersal habitat for the species and are considered of low significance. At least 182 ha (63.4%) of Critical habitat, including 55 ha (19%) within MEZ1, and 630 ha of Supporting habitat will remain available in the Development Envelope. An additional 634 ha of Gorge/Gully and Breakaway habitats have been mapped within the extrapolated survey area outside the Development Envelope. Any individuals displaced by the clearing of this habitat can disperse and forage in the surrounding habitat and more broadly in the low significance habitats.

Significant Impact Criteria	Assessment of Significance of Impacts to Northern Quoll
Potential to disrupt the breeding cycle of a population	No evidence of Northern Quoll dens or breeding have been identified within the Development Envelope. The loss of habitat within the Development Envelope is not expected to disrupt the local population's breeding cycle as sufficient and connected habitat will remain.
Potential to modify, destroy, remove isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline Introduce inappropriate fire regimes or grazing activities that substantially degrade habitat critical to the survival of the Northern Quoll or decrease the size of a population for the long-term survival of the species	Whilst the Proposed Action has the potential to modify, destroy, remove, isolate or decrease the availability or quality of Northern Quoll habitat, this will not be to the extent that the species, which occurs in low densities within the Development Envelope, is likely to decline. The Proposed Action will remove up to 105 ha of Critical habitat and 297 ha of Supporting habitat within the Development Envelope; however, at least 182 ha of Critical habitat will remain in the Development Envelope and a further 634 ha in the surrounding area. The remaining habitat will continue to provide Critical and Supporting habitat for this species. Habitat removal is unlikely to be to the extent that the Northern Quoll populations, which occur in low densities within the Development Envelope, will decline. The Proposed Action will not increase the grazing pressure within the Development Envelope. Changes to fire regimes (i.e. too-frequent) can impact vegetation; however, Northern Quoll in the Pilbara are associated with rocky landforms and, therefore, less likely to be impacted by the fire. The Proponent will effectively implement safety procedures to manage the fire risk within the Development Envelope.
Potential for the establishment of invasive species in the endangered species' habitat that are harmful to the endangered species Result in invasive species or increases of them that are harmful to the Northern Quoll becoming established in its habitat, namely Cane Toads, feral cats, Red Foxes or exotic grasses, which increases the fire risk	Cane Toads and feral predators (i.e., cats) are known threats to Northern Quoll. Cane Toads are not currently in the Pilbara, and the Proposed Action will not increase the Cane Toads' potential to become established in the Development Envelope or surrounding area. Feral cats have been recorded in the Development Envelope. The Proponent will undertake feral animal control in accordance with the EMP (Appendix A7) or in response to significant increases in feral animal sightings. An increase in the local feral cat population has a high risk of significantly impacting the Northern Quoll population within the Development Envelope. However, the Proponent's appropriate implementation of the feral cat monitoring and control program is expected to minimise its potential impact. As such, the potential increase in the feral cat population is not expected to impact the local Northern Quoll population significantly. Five grass species listed under TAP (DSEWPaC 2012b) are a threat to the habitat of Northern Quoll. These grass species have not been recorded in the Development Envelope. The Proponent will implement vehicle hygiene and weed control within the Development Envelope to reduce the risk of introducing or spreading weed species. The Proposed Action is unlikely to result in the establishment of invasive species based on implementing the above mitigation.
Potential for the introduction of disease that may cause the species to decline	Currently, there are no known diseases harmful to Northern Quoll, nor its critical habitat. There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species, nor its critical habitat to decline to decline.
Potential interference with the recovery of the species	The proposed mitigation measures (Table 13-11) are not considered at variance with TAPs and the national recovery plan (Hills and Ward 2010). The Northern Quoll population within the Development Envelope is considered a low-density population, and no evidence of breeding or denning has been observed in the Development Envelope. Therefore, it is considered unlikely that the Proposed Action will interfere with the recovery of the species.

13.6.8. Consistency with Relevant Recovery Plans and Guidance

13.6.8.1. Recovery Plan

The National Recovery Plan for the Northern Quoll (*Dasyurus hallucatus*) (Hill & Ward 2010) aims to minimise the rate of decline of the Northern Quoll in Australia and ensure that viable populations remain in each of the major regions of distribution into the future. The Proposed Action aligns with the objective of this Recovery Plan (Table 13-13).

Table 13-13: National Recovery Plan for the Northern Quoll

Objective	Actions	Proposed Action Assessment
Protect Northern Quoll populations on offshore islands from invasion and establishment of Cane Toads, cats, and other potential invasive species	Maintain biosecurity of important offshore islands through quarantine measures on the mainland.	The Proposed Action does not involve transfers to offshore islands.
	Monitor offshore islands supporting quoll populations to detect the presence of Cane Toads, cats, and any other potential invasive predator.	
	Develop and where required implement a strategy for rapid-response control of Cane Toad or cat outbreaks on offshore islands occupied by Northern Quolls.	
Foster the recovery of Northern Quoll subpopulations in areas where the species has survived alongside Cane Toads	Determine which factors affect survival and recovery of Northern Quolls in areas with cane toad.	The Cane Toad is not currently present in the Development Envelope or the wider Pilbara region.
	Use information from Action 2.1 to assist surviving populations to recover in sympatry with Cane Toads.	
	Identify potential refuge habitats in WA and NT where quolls might be most likely to persist in the long-term alongside Cane Toads.	
Halt Northern Quoll declines in areas not yet colonised by Cane Toads	Collect baseline data on population densities and monitor trends of quolls at a series of key sites not currently occupied by Cane Toads	The Cane Toad is not currently present in the Development Envelope or the wider Pilbara region. The Proponent has completed baseline investigations, including a targeted survey for the Northern Quoll to identify the Northern Quoll's possible resident populations within the Development Envelope (an area not currently occupied by Cane Toads).
	Investigate factors causing declines in Northern Quoll populations not yet affected by Cane Toads	
	Manage key quoll populations in areas not currently affected by Cane Toads to halt population declines	
	Identify the effect of pastoral land management practices on Northern Quoll persistence	
	Interim fire management at potential key quoll populations in areas not currently affected by Cane Toads	
	Refine models of the current and expected distribution of Cane Toads and Northern Quolls, incorporating predictions of climate change	
Halt Northern Quoll declines in areas recently colonised by Cane Toads	Continue research into the susceptibility of quolls to Cane Toad poisoning	The Cane Toad is not currently present in the Development Envelope.
	Test the efficacy of control measures for Cane Toads and whether they allow local persistence of quoll populations	
Maintain secure populations and source animals for future reintroductions/	Manage translocated populations of Northern Quolls on Astell and Pobassoo Islands	The Proposed Action will not result in an impact to areas of Northern Quoll habitat protected in National Parks
	NT and WA to maintain captive breeding populations of Northern Quolls	

Objective	Actions	Proposed Action Assessment
introductions if they become appropriate	Protection of key secure populations through protection of habitat in National Parks and Conservation Agreements	and Conservation Agreements.
	NT and WA to determine the status of Northern Quolls on islands with suitable habitat and assess the potential for future translocations to these islands	
Reduce the risk of Northern Quoll populations being decimated by disease	Increase knowledge and vigilance of disease in Northern Quoll populations	Currently, there are no known diseases which affect the Northern Quoll. There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species to decline.
Reduce the impact of feral predators on Northern Quolls	Assess the impacts of feral predators on populations of Northern Quolls	The Proponent undertakes feral animal control in accordance with an annual plan or in response to significant increases in feral animal sightings.
	Implement efforts to protect key Northern Quoll populations from the impacts of feral predators	
Raise public awareness of the plight of Northern Quolls and the need for biosecurity of islands and WA	Develop new and promote existing materials for educating the public on the need for quarantine measures at important island habitat for quolls and along major routes westward into Western Australia	The Proponent will implement site inductions for all onsite personnel to raise environmental awareness and identify onsite threats to Northern Quoll populations.
	Provide materials and support to Indigenous rangers and other groups responsible for habitat critical to survival for Northern Quolls to educate their communities on the importance of Cane Toad and cat control and quarantine measures	
	Implement a broader public education and awareness campaign on quolls and feral species (particularly Cane Toads and cats)	
	Develop and implement public education and awareness campaign on land management threats to quolls	

13.6.8.2. Threat Abatement Plans

As a result of its included mitigation measures to control feral cats, the Proposed Action will align with the *Threat abatement plan for predation by feral Cats* (DoE 2015a).

13.6.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.6.9.1. Significant Residual Impact

After application of mitigation measures the following significant residual impacts are predicted to the Northern Quoll:

- Clearing up to 38 and 67 ha (60% and 30%) of Critical Gorge/Gully and Breakaway (denning and breeding) habitats for the Northern Quoll, respectively. This clearing is proposed to be offset as per Chapter 12.
- Clearing approximately 334 ha and 369 ha (59.3% and 48%) of Supporting Minor Drainage and Rocky Hill (foraging and dispersal) habitat for the Northern Quoll within the species' home range. This clearing is proposed to be offset as per Chapter 12.

13.6.9.2. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to the Northern Quoll are set out below.

- The Proponent shall not clear more than the following limits of Critical (denning and breeding) habitats within the Development Envelope:
  - 38 ha of Gorge/Gully habitat
  - 67 ha of Breakaway habitat.
- The Proponent shall not clear more than a total combined 297 ha of Supporting habitats (Minor Drainage and Rocky Hill) within the Northern Quoll home range, comprising:
  - 334 ha of Minor Drainage habitat
  - 369 ha of Rocky Hill habitat.

Minimise direct and indirect impacts from the Proposed Action to Northern Quoll habitat in accordance with the EMP.

The Proponent will implement the EMP as per Appendix A7 to achieve these outcomes.

13.6.10. Conclusion

The significant residual impact, after implementation of the mitigation hierarchy, is clearing up to 105 ha of Critical Gorge/Gully and Breakaway (denning and breeding) habitat and approximately 297 ha of Supporting Minor Drainage and Rocky Hill (foraging and dispersal) habitat for the Northern Quoll, when within its home range. Environmental offsets are proposed for this clearing and are discussed in Chapter 12. Subject to conditions and implementation of offsets (Chapter 12), the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the species' survival.

13.7. Ghost Bat (*Macroderma gigas*)

13.7.1. Species Profile

The Ghost Bat is listed as Vulnerable under the BC Act and EPBC Act. It is Australia's largest micro-bat, with a wingspan of approximately 70 cm wide and weighing up to 175 grams. It is carnivorous, feeding on insects, reptiles, frogs, birds and small mammals (Bat Call WA 2021a).

13.7.2. Habitat Preferences and Distribution

The Ghost Bat occupies rocky gorges and outcrops that contain caves and crevices, which are used as nocturnal (night), diurnal (day), and maternity roosts. Ghost Bats require several suitable roosts, of varying shapes and sizes, throughout their home ranges to fulfil various ecological requirements. Roost

systems need to have vegetation complexity that opens onto plains or riparian drainage lines to provide good foraging opportunities (TSSC 2016a). Roost sites used permanently are generally deep natural caves or disused mines with a relatively stable temperature of 23°C to 28°C and a moderate to high relative humidity of 50 to 100% (TSSC 2016a). Individuals also move between roosts seasonally or according to weather conditions, and populations tend to be widely dispersed when not breeding and concentrate in relatively few roost sites when breeding (TSSC 2016a). Mating generally occurs in July and August, with gestation extending from August to October and birth between September and November. Ghost Bats do not require free surface water for drinking. They forage after sunset and before sunrise (TSSC 2016a).

In the Hamersley Range, the preferred roosting habitat appears to be caves beneath bluffs of low rounded hills composed of Marra Mamba geology and larger hills of Brockman Iron Formation (TSSC 2016a). DCCEEW considers active roosts in an area to be the most important indicator of habitat for Ghost Bats, and these roosts are generally the primary focus of conservation and monitoring (DoE 2015c).

At the time of European settlement, the Ghost Bat had a distribution across most of the north and central portions of the continent (TSSC 2016a). However, the species is currently restricted to several discontinuous populations in northern Western Australia, the Northern Territory and Northern Queensland. The species occurs in all four subregions of the Pilbara bioregion, with the largest population (approximately 1,500 individuals) occurring within the Chichester subregion (TSSC 2016a).

13.7.3. Key Threats and Recovery Actions

13.7.3.1. Key Threats

According to the conservation advice and DCCEEW Ghost Bat Report (TSSC 2016a, Bat Call 2021a), Ghost Bat populations are currently being impacted by several threats, including:

- Habitat loss from the destruction of, or disturbance to roost sites and nearby areas due to mining
- Disturbance of breeding sites due primarily to human visitation
- Modification to foraging habitat, including altered water and fire regimes
- Collision with fences, especially those with barbed wire
- Collapse or reworking of old mine adits
- Contamination and exposure to pollutants by mining residue at the roost site
- Poisoning from Cane Toads
- Introduction of predatory species
- Impacts from sound, vibration, airborne dust and NOx
- Increased light pollution.

Two potential threats have not yet been confirmed as affecting Ghost Bat populations, namely the effects of a herpes type of virus and population declines due to resource competition with red foxes and feral cats (TSSC 2016a).

13.7.3.2. Recovery Actions

There are currently no adopted or made recovery plans for the Ghost Bat.

Table 13-10 provides mitigation that the Proponent will implement to reduce impacts on this species and habitat.

13.7.4. Important Populations and Critical Habitat

13.7.4.1. Important Population

The Pilbara Ghost Bat population is genetically distinct and divergent from other populations within Australia and thus meets the definition of an important population as outlined in the Significant Impact Guidelines, being 'Key source population for either breeding or dispersal' (DOE 2013). Ghost Bats that have been recorded within the Development Envelope are considered to be a part of this wider Pilbara population.

13.7.4.2. Critical Habitat

There are currently no species-specific policy guidelines to define Critical habitat for Ghost Bats, so the definition used here is based on advice provided in DCCEEW's ecological review of Ghost Bats (Bat Calls WA 2021a). As such, Category 1 and 2 roosts are both considered to be Critical habitat for Ghost Bats. Category 3 roosts can be considered to be Critical habitat if in close association, or in an 'apartment block', with Category 1 and 2 roosts. The very rocky habitat types, where roosts are predominately found, such as Breakaways and Gorge/Gully, are also considered to be Critical habitat as any unrecorded roosts are likely to be located here.

Ghosts Bats require several suitable caves, of varying shapes and sizes throughout their home range to meet their various needs. The fauna surveys (Astron 2019b, 2020b) describe roost types using the classifications maternity, day and night roosts. Astron (2020c) has assessed each roost in the Development Envelope and assigned it a roost category based on the following roost categories of roosting habitats used by Ghost Bats within the Pilbara region (Bat Call WA 2021a):

- **Category 1** – Maternity/diurnal roost caves with permanent Ghost Bat occupancy
- **Category 2** – Maternity/diurnal roost caves with regular Ghost Bat occupancy
- **Category 3** – Diurnal roost caves with occasional Ghost Bat occupancy
- **Category 4** – Nocturnal roost caves with opportunistic Ghost Bat usage.

13.7.4.3. Supporting Habitat

Ghost Bats forage over a wide variety of habitat types, with recent data suggesting a preference for productive plains areas with thin mature woodland over patchy or clumped tussock or hummock grass (*Triodia* sp.) on sandy or stony ground (Bat Call WA 2021a). Despite the ability to utilise a wide variety of habitat types, individuals rarely fly more than 12 km from a diurnal roost, as such only suitable foraging habitats within this distance are considered to be Supporting habitat.

All other habitat types within the Development Envelope have the potential to provide foraging and dispersal opportunities for the species and thus are of moderate significance.

13.7.5. Occurrence in the Development Envelope

Ghost Bats have been recorded on 12 occasions in the Development Envelope in the form of direct observation, echolocation recordings and scats. Two individuals were sighted within the Development Envelope, one whilst foraging to the southeast of Cave 8 (a Category 4 cave) and the other roosting in the same cave (Astron 2020c).

Overall, nine cave structures were recorded within the Development Envelope (refer to Table 13-6, Figure 13-5. One cave was categorised as a Category 2 cave (Cave 10) due to it being regularly occupied by Ghost Bats (Astron 2020c). Two Category 3 caves (Cave 1 and Cave 5) were recorded, both near the BHT deposit. Due to the distance from Cave 10, neither are regarded as Critical habitat. Despite the presence of a roosting bat in Cave 8, it was classified as a Category 4 cave, due to the characteristics of the cave, lack of multiple scat and echolocation records over multiple surveys, suggesting infrequent usage. All other caves identified within the Development Envelope (Cave 2, 3, 4,

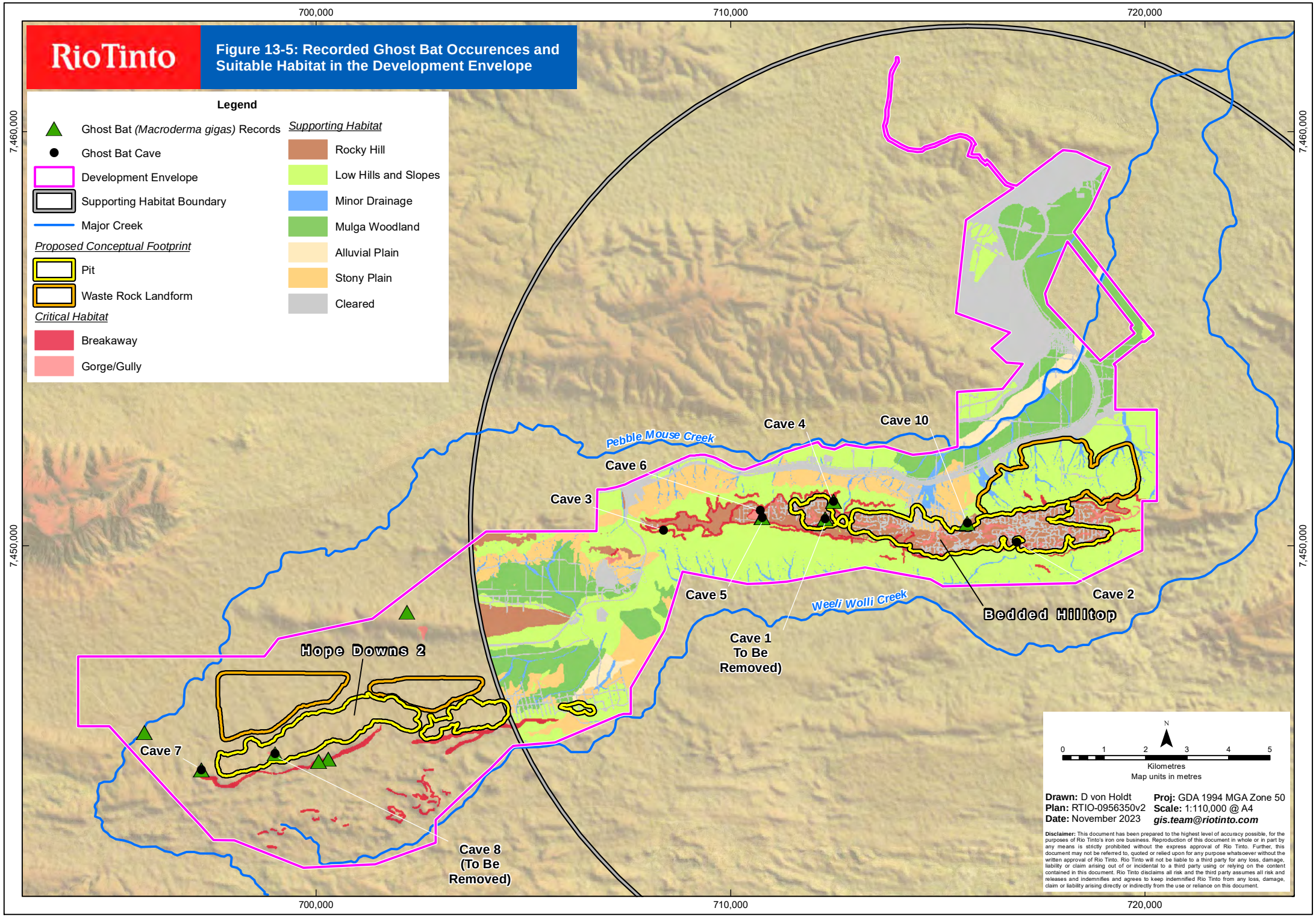
6, and 7) are Category 4 caves. The location of Ghost Bat caves and recording sites are presented in Figure 13-5.

Most of the caves within the Development Envelope were recorded within the Breakaway and Gorge/Gully habitat types, which are considered to be Critical habitat for the species. All other habitat types within the Development Envelope have the potential to provide foraging and dispersal opportunities for the species. Supporting habitat is considered to be within 12 km of the Category 2 cave (approximately 6,341 ha; Figure 13-5).

Table 13-14: Critical and Supporting Habitat for Ghost Bats within the Development Envelope

Type	Habitat Type	Area (ha)	Total Area (ha)
Critical habitat	Gorge/Gully	63	287
	Breakaway	224	
Supporting habitat	Alluvial Plain *	182	6,341
	Low Hills and Slopes *	2,863	
	Minor Drainage *	499.5	
	Mulga Woodland *	1,356	
	Rocky Hill *	735	
	Stony Plain *	705.6	

**within 12 km of a Category 2 cave (Cave 10)*


RioTinto
Figure 13-5: Recorded Ghost Bat Occurences and Suitable Habitat in the Development Envelope
Legend
Ghost Bat (Macroderma gigas) Records
Ghost Bat Cave
Development Envelope
Supporting Habitat Boundary
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Critical Habitat
Breakaway
Gorge/Gully
Supporting Habitat
Rocky Hill
Low Hills and Slopes
Minor Drainage
Mulga Woodland
Alluvial Plain
Stony Plain
Cleared
700,000
710,000
720,000
7,460,000
7,450,000
Pebble Mouse Creek
Weeli Wolli Creek
Cave 2
Cave 3
Cave 4
Cave 5
Cave 6
Cave 7
Cave 8 (To Be Removed)
Cave 10
Bedded Hilltop
Cave 1 To Be Removed)
Hope Downs 2
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956350v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
gis.team@riotinto.com
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13.7.6. Assessment of Impacts

The Proposed Action may result in direct and indirect impacts to Ghost Bats. The following assessment of impacts has been identified specifically for Ghost Bat and the impacts applying more broadly for all MNES species with the potential to occur within the Development Envelope are described in Section 13.3.4

13.7.6.1. Loss/Reduction of Fauna Habitat as a Result of Clearing

The Proposed Action will result in the clearing up to a maximum of 105 ha of Critical habitat within the Development Envelope as well as approximately 2,659 ha of Supporting habitat. Both habitats are relatively widespread in the surrounding areas (Astron 2020d).

The clearing of Critical and Supporting habitat is considered to be a significant residual impact and is proposed to be offset. Offsetting is discussed in detail in Chapter 12.

The Ghost Bat roosts within the Development Envelope are described in Section 13.3.3. A summary table is provided in Table 13-14. The Proposed Action will result in clearing two of the nine caves present within the Development Envelope. Neither of these caves are considered critical to the survival of the species, a Category 3 (Cave 1) and a Category 4 (Cave 8). To minimise the potential impact of this loss, the Proponent has ensured that caves of the same category will be retained within 2 km of the cleared caves. This is well within one nights flying for the Ghost Bats (Bat Call WA 2021a). The Proponent has modified the proposed Conceptual Footprint of the Proposed Action to ensure that the other seven caves present within the Development Envelope will not be directly impacted. This includes the implementation of MEZs:

- MEZ2: Will protect the Category 2 roost (Cave 10) and includes a 150 m buffer from the cave (Figure 13-6)
- MEZ1: Will protect one isolated Category 3 roost and two Category 4 roosts and provides a buffer distance from active mining activities as outlined in Table 13-15.

Due to the low to moderate density population of Ghost Bats in the Development Envelope, the retention of more than 60% of Critical habitat, 58% of Supporting habitat within the Development Envelope and seven of the nine recorded Ghost Bat roosts (one Category 2, one Category 3 and five Category 4), the Proposed Action is not expected to result in significant residual impacts to the regional population or conservation status of the species.

Table 13-15: Location of Ghost Bat Caves, Impacts and Mitigation Measures

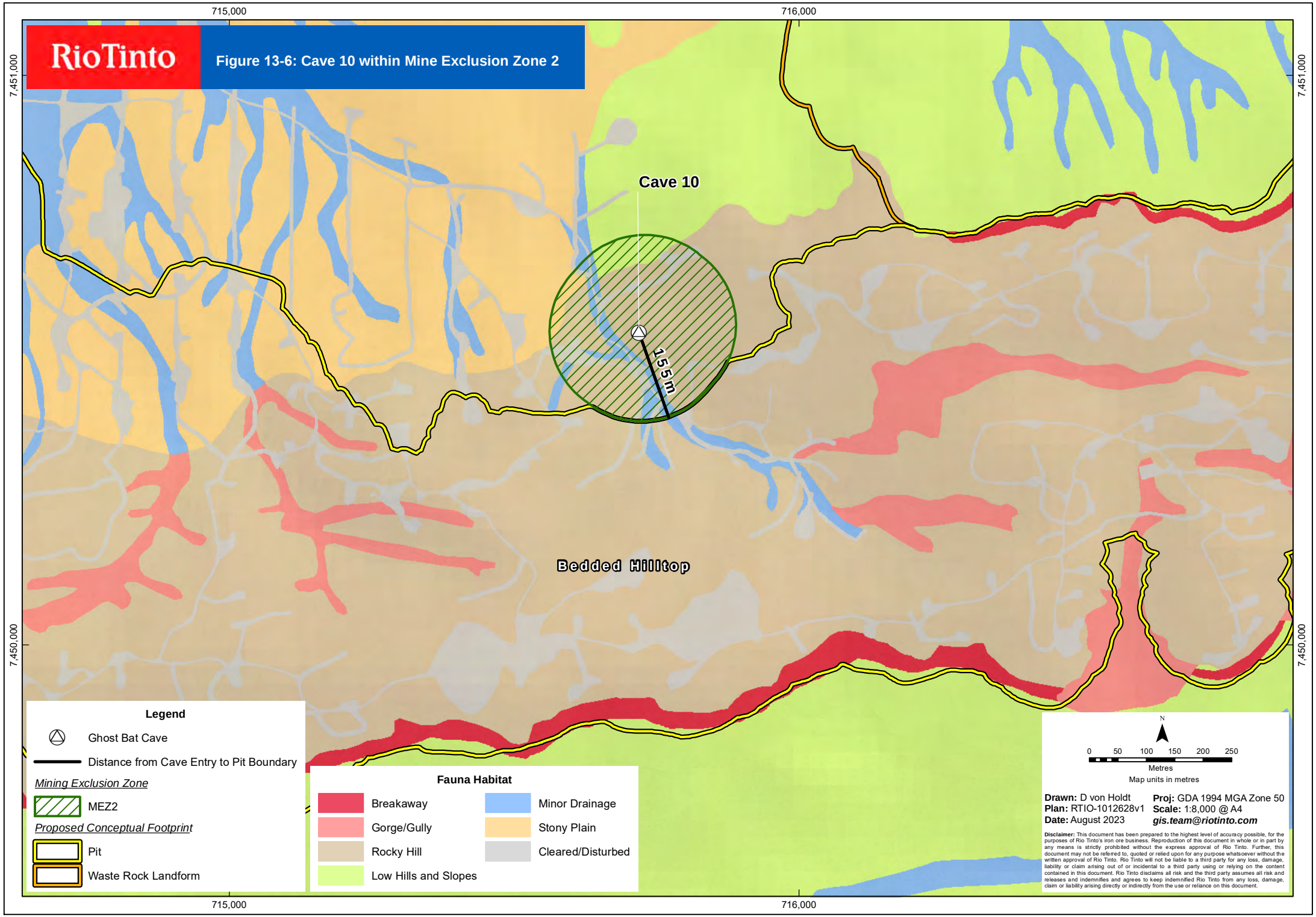
Cave	Roost Type	Proximity to Disturbance (m)	Mitigation
Cave 1 (impacted)	Category 3	Within mine pit and is proposed to be disturbed.	Unable to be avoided.
Cave 2	Category 4	25	No additional measures beyond those described in Table 13-10.
Cave 3	Category 4	>3,000	Included in MEZ1. Implementation of relevant measures as listed in Table 13-10.
Cave 4	Category 4	90	No additional measures beyond those listed in Table 13-10.
Cave 5	Category 3	>650	Included in MEZ1. Implementation of relevant measures as listed in Table 13-10.
Cave 6	Category 4	>700	Included in MEZ1. Implementation of relevant measures as listed in Table 13-10

Cave	Roost Type	Proximity to Disturbance (m)	Mitigation
Cave 7	Category 4	>350	No additional measures beyond those listed in Table 13-10.
Cave 8 (impacted)	Category 4	Within mine pit and is proposed to be disturbed.	Unable to be avoided.
Cave 9	Category 4		Development Envelope changed resulting in this cave now being located outside of Development Envelope and will not be impacted.
Cave 10	Category 2	150	MEZ2 (150 m radius) around cave entrance. . Establish vibration limits at the cave entrance of 10 mm/s (Peak Particle Velocity (PPV)) during breeding months (1 October to 31 December), and 25 mm/s in non-breeding months; verify by monitoring. Implementation of relevant measures as listed in Table 13-10.

13.7.6.2. Loss of Ghost Bat Individuals

Ghost Bats are known to become entangled in barbed wire fencing due to their low elevation flying pattern. The use of barbed wire fencing will be avoided within the Development Envelope as far as practicable, noting the requirements of pastoralists, whose leases intersect the Development Envelope, to use barbed wire in their stock fences for the effective containment of cattle. Where the use of barbed wire fencing is legislated or required, the top strand will be replaced with single-strand wire, and reflectors will be installed to deter bat interaction. The potential impacts from infrastructure are expected to be low.

By implementing mitigation and management measures, the loss of Ghost Bat individuals associated with the Proposed Action is not expected to cause significant impacts to the species.


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Figure 13-6: Cave 10 within Mine Exclusion Zone 2
715,000
716,000
7,451,000
7,450,000
Cave 10
155 m
Bedded Hilltop
Legend
Ghost Bat Cave
Distance from Cave Entry to Pit Boundary
Mining Exclusion Zone
MEZ2
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Fauna Habitat
Breakaway
Gorge/Gully
Rocky Hill
Low Hills and Slopes
Minor Drainage
Stony Plain
Cleared/Disturbed
N
0 50 100 150 200 250
Metres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-1012628v1
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:8,000 @ A4
gis.team@riotinto.com
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13.7.6.3. Disturbance from Light, Noise and Vibration

Light

The introduction of artificial lighting associated with the Proposed Action has the potential to negatively affect the behaviour of nocturnal species such as the Ghost Bat (Rowse et al. 2015). Artificial light can also indirectly impact on the behaviour of the Ghost Bats as the insects which they prey on congregate around the light sources.

By implementing the mitigation measures described in Section 13.4.4 and Table 13-10 to control light overspill, the Proponent will ensure that artificial light from the Proposed Action will not impact the species.

Noise and Vibration

Active mining during the operation phase will generate noise and vibration emissions as a result of blasting. This has the potential to cause Ghost Bat individuals to abandon roosts temporarily or permanently.

By implementing the noise and vibration mitigation measures described in Section 13.4.4 and Table 13-10, the Proponent will ensure the effects that noise and vibration from the Proposed Action have on the remaining cave structures will be minimal and will not impact the species.

13.7.7. Significance of Impacts

An assessment of the Proposed Action on Ghost Bats is detailed in Table 13-16 concerning the Significant Impact Guidelines (DoE 2013).

Table 13-16: Assessment of the Significance of Impacts to Ghost Bat

Significant Impact Criteria	Assessment of Significance of Impacts to Ghost Bat
Lead to the long-term decrease in the size of an important population of the species	A total of nine Ghost Bat roosts have been identified within the Development Envelope. Of these, only two caves (Cave 1 and Cave 8) are proposed to be cleared as a result of the Proposed Action, the former is a Category 3 and the latter a Category 4 roost. Neither of these caves are classified as Critical habitat for the species. The Proponent has ensured that there are caves of the same category within 2 km of the cleared caves to provide potential alternative roosting sites. The Proponent has designed the Conceptual Footprint to minimise the impacts to Critical habitat as far as practicable. This includes the establishment of MEZs around all of the retained caves. Due to the presence of two of the caves (Cave 2 and 4) occurring within approximately 100 m of the mine pit, there is a potential for the Ghost Bats to abandon these roosts. However, both of these caves are Category 4 caves and are of lesser importance for the regional population then other caves retained within the Development Envelope. Additionally, cave monitoring from the nearby West Angelas Mine indicates the presence of mining at this distance is unlikely to affect the continual usage of caves by Ghost Bats (Bullen 2013). The Proposed Action will result in the removal of 105 ha (36.6%) of Critical habitat comprising the Breakaway and Gorge/Gully habitat types. However, the Proponent will be retaining a minimum of 182 ha (63.4%) of Critical habitat within the Development Envelope. Given the low number of caves within the Development Envelope, the establishment of MEZ's, the retention of at least 3,864 ha (58.3%) of Critical and Supporting habitat and the widespread availability of foraging and dispersal habitat beyond the Development Envelope, the Proposed Action is not expected to cause a long-term decrease in the size of a local or regional population. It is not considered that an important Ghost Bat populations occurs within the Development Envelope.

Significant Impact Criteria	Assessment of Significance of Impacts to Ghost Bat
Potential to reduce the area of occupancy of an important population of the species	Ghost Bat foraging range is an average of 12 km (Bat Call WA 2021a) from a Category 1 or 2 roost (diurnal). One Category 2 roost (Cave 10) has been recorded within Development Envelope and MEZ2 has been established for its protection. The Proposed Action is unlikely to reduce the area of occupancy of the Ghost Bat species. As a minimum of 182 ha of Critical habitat and approximately 3,682 ha of Supporting habitat will be retained within the Development Envelope. The species is expected to continue to exist within and surrounding the Development Envelope and throughout the wider Pilbara region. Therefore, the area of occupancy for this species is unlikely to be significantly reduced as a result of the Proposed Action.
Potential for fragmentation of an existing population into two or more populations	Habitat connectivity will be maintained along the Weeli Wolli Creek and Pebble Mouse Creek within and surrounding the Development Envelope. These creeks will not be directly impacted beyond the construction of essential infrastructure, mostly narrow crossings. These linkages facilitate the connection of roosting and foraging habitats for the Ghost Bat and enable dispersal and connection between individuals and populations. Similarly, habitat connectivity will be maintained across the western end of the BHT range, through the inclusion of two MEZs, which will protect four of the caves, including Cave 10 (Category 2). The MEZs will also protect approximately 55 ha of Critical habitat and approximately 178 ha of Supporting habitat. The Ghost Bat species is a highly mobile in nature, traveling up to 20-30 km in one nights flying, and disperses widely between roosts within the local area during nocturnal foraging activities (Bat Call WA 2021a). Given the high mobility of the species, the retention of seven roosts,182 ha (63.4%) of Critical habitats and 3,682 ha (58.1%) of Supporting habitats within the Development Envelope, the Proposed Action is not expected to fragment the existing Ghost Bat population.
Potential to adversely affect habitat critical to the survival of the species	The Proposed Action will result in the clearing of up to 105 ha (36.6%) of Critical Gorge/Gully and Breakaway habitat and approximately 2,659 ha (42%) of Supporting habitat. The remaining habitats do not represent Critical habitat for the species and are considered of low significance. However, 182 ha (63.4) and 3,682 ha (58.1%) will be retained for Critical and Supporting habitat respectively Of the nine Ghost Bat roosts within the Development Envelope, two will be impacted by the Proposed Action. These are Cave 1 (Category 3) and Cave 8 (Category 4). Clearing Critical Gorge/Gully and Breakaway habitat and Supporting habitats (within the species home range) is considered a significant residual impact and is proposed to be offset (Chapter 12).
Potential to disrupt the breeding cycle of a population	There will be no direct impact on the one Category 2 roost (Cave 10) by the Proposed Action, as this location has been placed into a MEZ for protection. The Proposed Action will retain 182 ha (63.4%) of Critical habitat and approximately 3,682 ha (58.1%) of Supporting habitat. There is Gorge/Gully and Breakaway that will persist in the MEZs and survey area. Therefore, the Proposed Action is not expected to disrupt the breeding cycle of the local population.
Potential to modify, destroy, remove, isolate or decrease the availability or quality of habitat to	The Proposed Action has the potential to modify, destroy, remove, isolate, or decrease the availability or quality of habitat for Ghost Bats through the clearing of up to 105 ha (36.6%) of Critical habitat and approximately

Significant Impact Criteria	Assessment of Significance of Impacts to Ghost Bat
the extent that the species is likely to decline	2,659 ha (42%) of Supporting habitat. However, 182 ha (63.4%) and 3,682 ha (58.1%) will be retained for each respectively The Proposed Action will only impact two recorded roosts (Category 3 and Category 4) and will retain seven of the nine known roosts including retention of the only recorded Category 2 – potential maternity roost) within the Development Envelope and ensuring that for any cave removed there is suitable alterative roosting locations within 2 km. The retention of a large percentage of Critical habitat (63.4%), Supporting habitat (58.1%), and roosting sites (seven) within the Development Envelope means Ghost Bats are expected to remain in the Development Envelope and are unlikely to decline.
Potential for an invasive species that are harmful to a vulnerable species becoming established in the species habitat	Feral predators and weeds are not considered key threats to Ghost Bats (TSSC 2016a). The Proponent will undertake feral animal control in accordance with an annual plan or in response to significant increases in feral animal sightings. The Proponent will implement vehicle hygiene and weed control within the Development Envelope to reduce the risk of introducing or spreading weed species. The Proposed Action will not increase the Cane Toads' potential to become established in the Development Envelope. The Proposed Action is not expected to increase the risk of invasive species becoming established and significantly impact this species.
Potential for the introduction of disease that may cause the species to decline	A possible herpes type virus is reported to be affecting a population of Ghost Bats at Mt Etna in Queensland (TSSC 2016a); however, this has not been identified in the vicinity of the Development Envelope in Western Australia. The Proposed Action will not increase the potential for this disease to be introduced to the local population, as there is an unlikely transmission pathway.
Potential interference with the recovery of the species	The Conservation Advice for the species identifies active mitigation of threats as a key management action, including protection of land with significant colonies, replacing, and avoiding the use of barbed wire fencing, protecting roost sites and surrounding foraging areas and preventing collapse of roost sites. The Proponent commits to avoid the use of barbed wire fencing as far as practicable, noting the requirement for pastoralists, whose leases intersect the Development Envelope, to use barbed wire in stock fences for the effective containment of cattle. Where barbed wire is required by legislation, reflectors will be installed to prevent Ghost Bat interaction. The Proposed Action has also been modified to minimise disturbance within the high value habitat types. Critical roost sites have been avoided with Cave 10 being afforded additional protection by its inclusion in a 150 m MEZ, due to its status as a Category 2 roost. On this basis, the Proposed Action is not expected to interfere with the recovery of the species.

13.7.8. Consistency with Relevant Recovery Plans and Guidance

13.7.8.1. Recovery Plan

There are no recovery plans for the Ghost Bat.

13.7.8.2. Threat Abatement Plans

Feral cats have been recorded within the Development Envelope (Astron 2019b). Mine sites can attract/increase the abundance of introduced fauna due to the additional resources (food scraps, water, shelter). The Proponent will record all introduced fauna sightings and undertake feral animal control within the Development Envelope. As such, the Proposed Action will align with the TAP for predation by

feral cats (DoE 2015a). To date no foxes have been recorded within the Development Envelope however the above measures for cats will mean the Proposed Action will align with the TAP for predation by feral foxes should they be found within the Development Envelope in the future.

13.7.8.3. Conservation Advice

The primary conservation actions from the approved Conservation Advice for Ghost Bat are outlined in Table 13-1. The Proponent has avoided and implemented the following:

- Auditing of the condition and utilisation of Ghost Bat roosts during the LOM and following the cessation of mining activities
- Protection of Ghost Bat roost sites from mining activities within the Development Envelope, through:
  - Inclusion of Caves 3, 5 and 6 within the 233 ha MEZ1, with a minimum distance to active mining activities being 230 m
  - Inclusion of Cave 10 (Category 2) within MEZ2, a minimum distance to active mining activities being 150 m, to protect the integrity of the cave
- Avoidance of barbed wire fencing as far as practicable. Where barbed wire is required by legislation, etc., the top strand will be replaced with plain wire, and reflectors will be installed to prevent Ghost Bat interaction
- Education of personnel to not disturb roosting sites.

13.7.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.7.9.1. Significant Residual Impact

After application of mitigation measures, the following significant residual impacts are predicted to the Ghost Bat:

- Clearing up to 36 ha and 67 ha (60% and 30% of extent within the Development Envelope) of Gorge/Gully and Breakaway habitat respectively, considered to be Critical habitat, due to the roosting and breeding habitats they provide. This clearing is proposed to be managed via upper limits of clearing as per Table 13-8 and will be offset as per Chapter 12
- Clearing of approximately 2,659 ha (42% of extent within the Development Envelope) of Supporting habitat due to the foraging and dispersal habitats that they provide. This comprises:
  - 70 ha of Alluvial Plain habitat (38.3%)
  - 917 ha of Low Hills and Slopes habitat (32%)
  - 269 ha of Minor Drainage habitat (54%)
  - 601 ha of Mulga Woodland habitat (44.3%)
  - 369 ha of Rocky Hill habitat (50.3%)
  - 433 ha of Stony Plain habitat (61.3%)

- Clearing of two of the nine recorded Ghost Bat roosts: Cave 1 (Category 3) and Cave 8 (Category 4) within the Development Envelope.

13.7.9.2. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to the Ghost Bat are set out below.

- The proponent shall not clear more than the following limits of Critical habitats within the Development Envelope:
  - 38 ha of Gorge/Gully habitat
  - 67 ha of Breakaway habitat
- No direct or significant indirect impacts (as defined in the threshold limits, see EMP, Appendix A7) from the Proposal to Ghost Bat roosts retained within MEZ 1 and 2 shown in Figure 13-3
- Retention of seven of the nine Ghost Bat roosts recorded within the Development Envelope (one Category 2, one Category 3 and five Category 4).

The proponent will implement the EMP as per Appendix A7 to achieve these outcomes.

13.7.10. Conclusion

The significant residual impact, after implementation of the mitigation hierarchy, is clearing of up to 105 ha of Critical Gorge/Gully and Breakaway (roosting and breeding) habitat and approximately 2,659 ha of Supporting (foraging and dispersal) habitat for the Ghost Bat, when within its home range. Environmental offsets are proposed for this clearing and are discussed in Chapter 12. Subject to conditions and implementation of offsets (Chapter 12), the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the species' survival.

13.8. Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

13.8.1. Species Profile

The Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) is listed as Vulnerable under the EPBC Act. It is a moderate-sized bat weighing 8 to 11 g with a forearm length ranging 45.5 to 48.5 mm, with orange fur and a distinctive nose leaf surrounding the nostrils (Bat Call WA 2021b).

13.8.2. Habitat Preferences and Distribution

The Pilbara Leaf-nosed Bat is endemic to Western Australia and ranges throughout the Pilbara and adjoining regions of the Ashburton and Little Sandy Desert bioregions. The species is recognised as a geographically isolated form/population of the Orange Leaf-nosed bat, which is distributed across the north of the Australian continent (Armstrong 2001). The two forms are isolated by approximately 400 km of the Great Sandy Desert (Armstrong 2001).

The most updated review of the ecology of the Pilbara Leaf-nosed Bat (Bat Call WA 2021b) states that there are 48 confirmed permanent diurnal roosts (Category 1 and 2) throughout the Pilbara bioregion, including 17 known and 31 yet to be found (Bat Call WA 2021b). Thirty-eight of these roosts are naturally forming caves within the BIF in the Hamersley Ranges and eastern Pilbara. The remaining six are within disused underground mine shafts.

In the Pilbara, natural roosts are restricted to roosts formed in gorges where at least semi-permanent water is nearby (TSSC 2016b). Pilbara Leaf-nosed Bats typically roost in undisturbed roosts, deep fissures or abandoned mine shafts (Armstrong and Anstee 2000; Armstrong 2001). The species' limited ability to conserve heat and water (Baudinette et al. 2000) means they require warm (28 – 32ºC) and very humid (85 – 100%) roost sites to persist in arid and semi-arid climates (Armstrong 2001; Churchill 1991). Roost sites with such attributes are relatively uncommon in the Pilbara and the limiting factor of the species' distribution (Armstrong 2001). During the dry season (June to November), individuals are believed to aggregate in roosts that provide a suitably warm, humid microclimate (Armstrong and Anstee 2000; Armstrong 2001; Bullen and McKenzie 2011). While in the wet season (December to May), when conditions are generally wetter and more humid, individuals typically disperse roosting in seasonally suitable features (Armstrong and Anstee 2000; Armstrong 2001; Bullen and McKenzie 2011).

The Proponent commissioned Biologic to undertake a VHF tracking study of Pilbara Leaf-nosed Bat at another of its mine sites (Greater Paraburdoo) (Rio Tinto 2020d). The study's objective was to better understand the bat species' movement and determine significant habitat types including foraging habitat (Rio Tinto 2020d). The study found that the tagged bats spent approximately 70% of their time outside of the detection range (approximately 314 ha) of the VHF towers, indicating that their preferred foraging habitat occurs outside of the detection range. The bats were regularly detected in plains habitat to the north and north-east of the Paraburdoo Ranges, as well as to the south of the Western Ranges. The data collected from the study suggested that the Pilbara Leaf-nosed Bat's preferred foraging habitat was located near drainage lines and ephemeral water courses. The recent review of Pilbara Leaf-nosed Bat ecology (Bat Call WA 2021b) collated data from an extensive survey effort across the Pilbara, suggesting that the species forages widely, using nearly all productive and semi-productive habitats throughout the region.

13.8.3. Key Threats and Recovery Actions

13.8.3.1. Key Threats

Known threats to the Pilbara Leaf-nosed Bat include the loss of roosts, vegetation clearing, excavation, blasting and vehicle activity in the species' habitat, interruption of breeding activity, mine collapse and flooding, human entry of roosts, fencing and predation by feral species (TSSC 2016b).

13.8.3.2. Recovery Actions

There are currently no adopted or made recovery plans for the Pilbara Leaf-nosed Bat.

13.8.4. Important Populations and Critical Habitat

13.8.4.1. Important Populations

The population of the Pilbara Leaf-nosed Bat in the Pilbara and upper Gascoyne regions are recognised as an important population composed of one isolated interbreeding population of national significance that shows genetic divergence (TSSC 2016b). A total of 526 records of occurrence of the Pilbara Leaf-nosed Bat are currently spread throughout the region (DBCA 2021).

13.8.4.2. Critical Habitat

Habitat critical to the survival of the Pilbara Leaf-nosed Bat includes three levels of diurnal roosts and any permanent pools associated with them (Bat Call WA 2021b). The four Critical habitat roost types are:

- **Category 1: Permanent maternity diurnal roosts** – maternity roosts where young are proven to be seasonally present. These caves generally also have large colonies present
- **Category 2: Permanent non-maternity diurnal roosts** – diurnal roosts which are occupied year-round but without the proven presence of young. These generally support smaller colonies then category 1 caves
- **Category 3: Semi-permanent diurnal roosts** – occupied for part of the year, they may be used during the breeding cycle and facilitate the long-distance dispersal of the species. These caves are often associated with nearby Category 1 or 2 roosts as 'satellite' roosts, that together make up a single colony
- **Category 4: Nocturnal refuges** – occupied at night for resting or feeding. These caves are not considered Critical habitat but are important for the persistence of a species within an area.

The species has been recorded foraging widely and utilising almost all types of productive and semi-productive habitats within the Pilbara (Bat Call WA 2021b). However, the species generally do not fly further than 10 km from a permanent roost in one night to forage (TSSC 2016b) as such only suitable foraging habitat within this flying range is regarded as Supporting habitat.

The quality of these various habitat types has been classified by a foraging habitat rating in Table 13-17.

Table 13-17: Pilbara Leaf-nosed Bat Habitat Types and Rating Scale (Bat Call WA 2021b)

Habitat Rating (HR)	Description	Habitat Type		
		Plains and Low Hills	Gullies, Ridgelines and Mesas	Deep Gorges
0 (Poor)	Pilbara Leaf-nosed Bats are unlikely to be detected in these areas.	Bare open ground, such as salt pans and clay pans without vegetation.	Bare mesa and ridge line tops.	N/A
1 (Low)	Pilbara Leaf-nosed Bats are unlikely to forage in these areas but may traverse while crossing to more productive areas.	Open plain with one layer of vegetation structure (excluding scattered trees) Two layer, not complex, vegetation structure (excluding scattered trees).	Mesa and ridge line tops. Mesa side or long ridge line with simple geology and minimal caves and overhangs present. Sparse vegetation cover. Shallow non-incised gullies. Spinifex cover to gully floor.	N/A

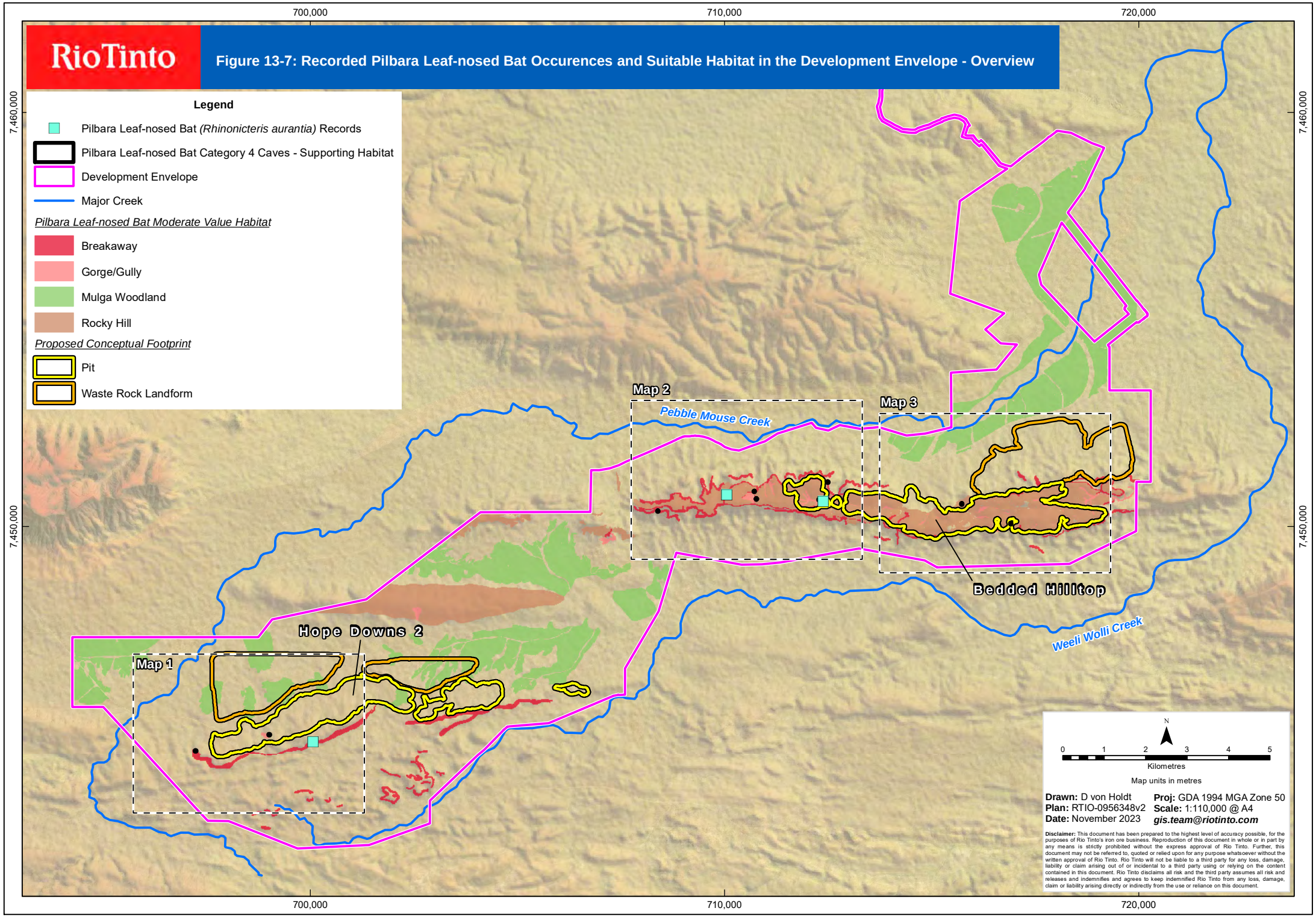
Habitat Rating (HR)	Description	Habitat Type		
		Plains and Low Hills	Gullies, Ridgelines and Mesas	Deep Gorges
2 (Moderate)	Pilbara Leaf-nosed Bat may occasionally forage in these areas due to the presence of suitable vegetation, seasonal water and may also use areas as a flyway.	Two layer, not complex, vegetation structure (excluding scattered trees). Includes ephemeral watercourse. Open mine shaft entrances.	Mesa side or long ridge line with deeply incised gullies in weathered strata (45º sloping walls). Caves and overhangs present. Shrubs in gully base. Ephemeral watercourse in gully or nearby.	N/A
3 (High)	Pilbara Leaf-nosed Bat are likely to forage in these areas if in range of a roost. They may be detected passing along creeklines, vegetation lines, rock faces or foraging in most productive areas.	Three-layer, complex vegetation structure. Includes ephemeral watercourse Includes mine adit or decline in dry locations.	Mesa side or long ridge line with deeply incised gullies in weathered strata (45º sloping walls). Caves and overhangs present. Shrubs in gully base. Ephemeral watercourse in gully or nearby.	Dry deeply incised gorge into a ridge or mountain Complex 3-layer vegetation structure. Ephemeral water course.
4 (Very High)	Pilbara Leaf-nosed Bats are very likely to forage and/or drink in these areas if in range of roost	Includes watercourses and other sites with semi-permanent or permanent surface water (natural or anthropogenic). Three layers in vegetation structure. Includes caves entrance or mine adits/declines with water nearby.	Mesa side or long ridge line with south, east or west facing, deeply incised gullies with vertical walls. Cave entrance or mine adit. Vegetation is complex. Semi-permanent or permanent water pools present. Also north facing gullies with permanent water.	Wet 'open' gorge with hills to the side. Wet 'closed' gorge with one or two vertical walls Complex 3-layer, dense vegetation structure. Semi-permanent or permanent.
5 (Outside Diurnal Roosts	Pilbara Leaf-nosed Bat are present pertinently and will be detected nightly.	Areas immediately outside a diurnal roost entrance.	Areas immediately outside a diurnal roost entrance.	Areas immediately outside a diurnal roost entrance.

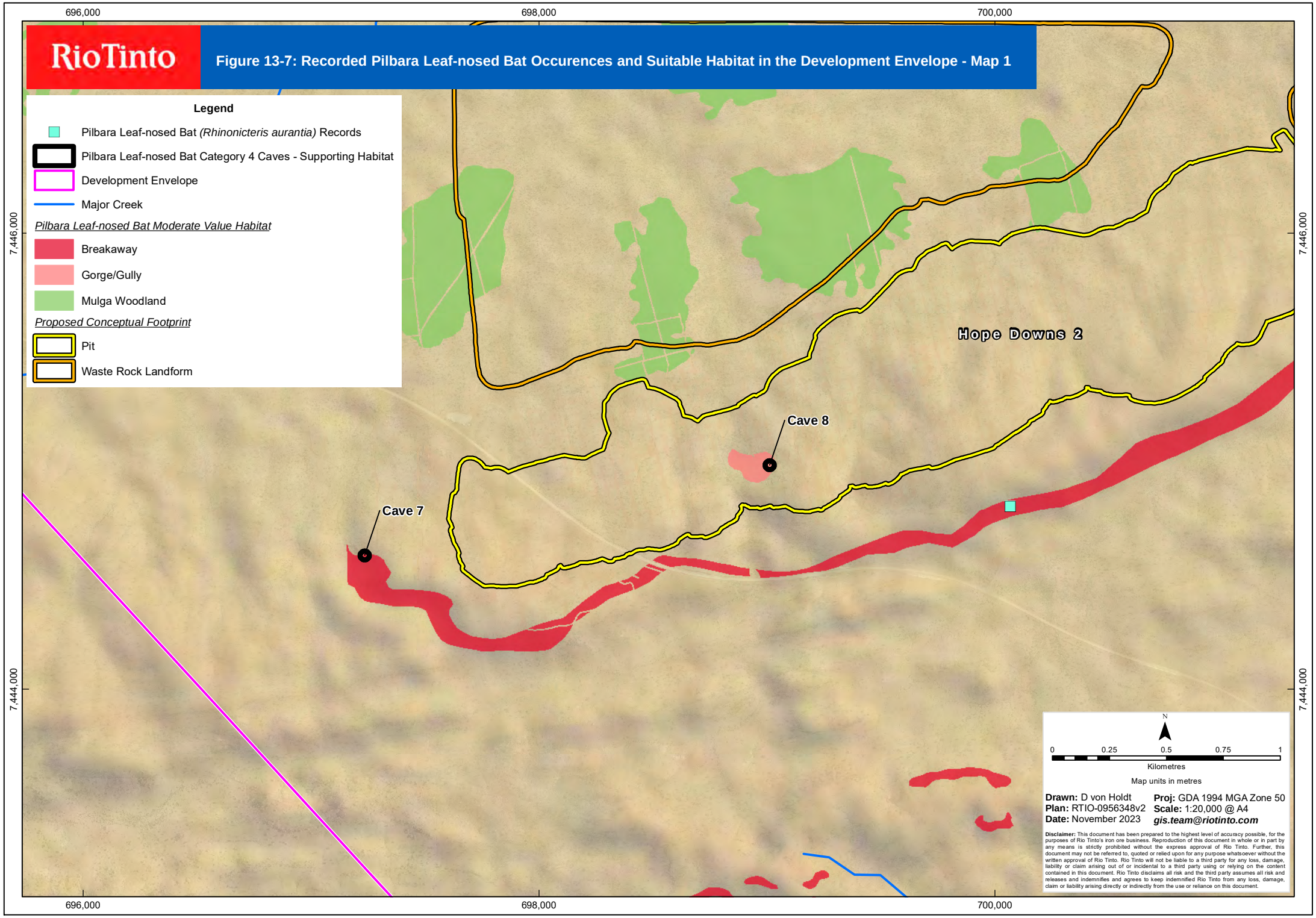
13.8.5. Occurrence in the Development Envelope

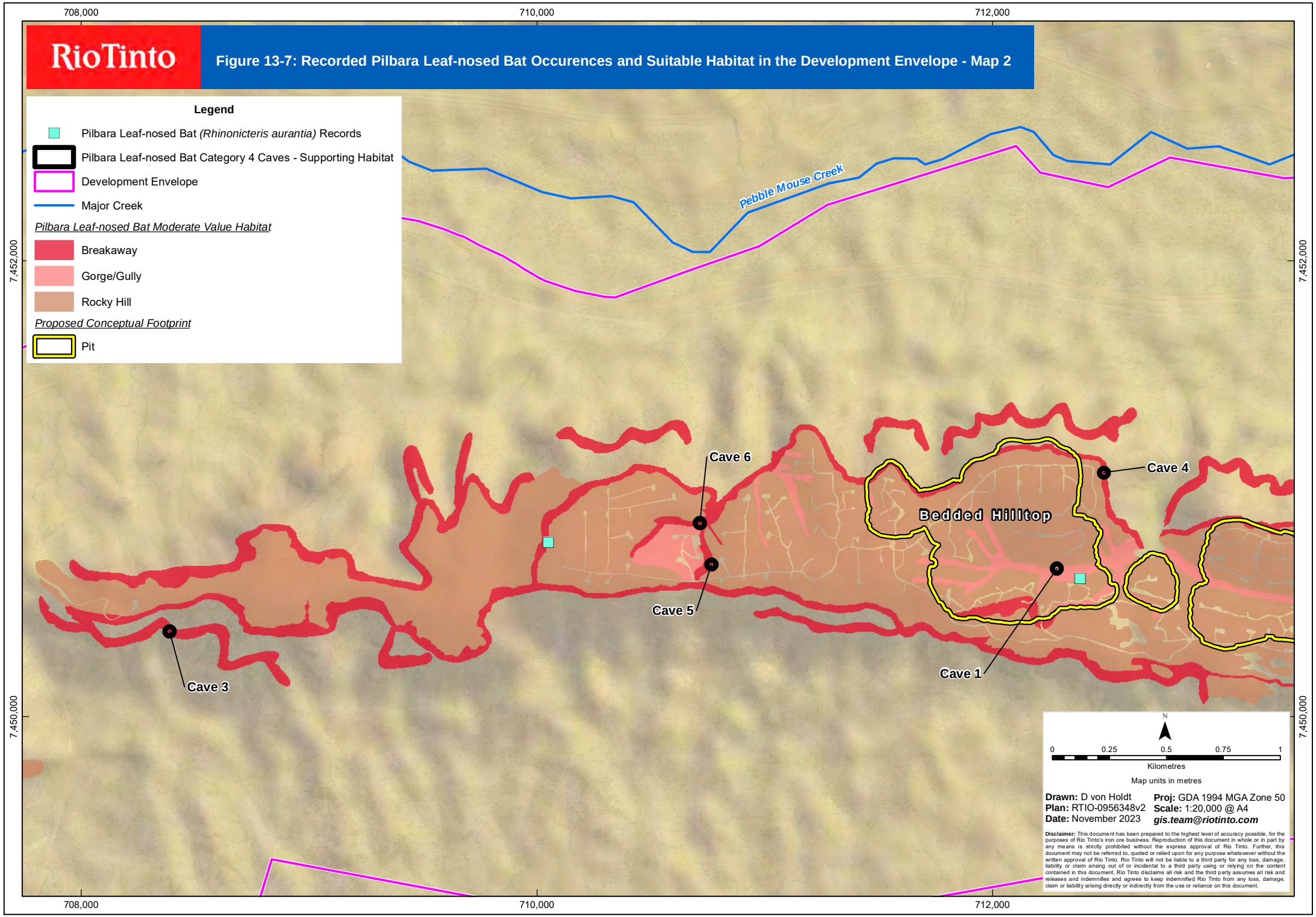
During all of Astron's surveys (a total of 125 nights of echolocation sampling) in the Development Envelope, only three Pilbara Leaf-nosed Bat calls were detected at recording stations. This suggests a low level of activity within the Development Envelope (Astron 2019b). The locations where the calls were recorded are presented in Figure 13-7. These recordings are believed to be from individuals foraging within the Breakaway and Gorge/Gully habitats in the Development Envelope, as all records were at least 3 hours after dusk. Additionally, there have only been nine other recordings near the Development Envelope as recorded by the Threatened and Priority Database (Astron 2019b).

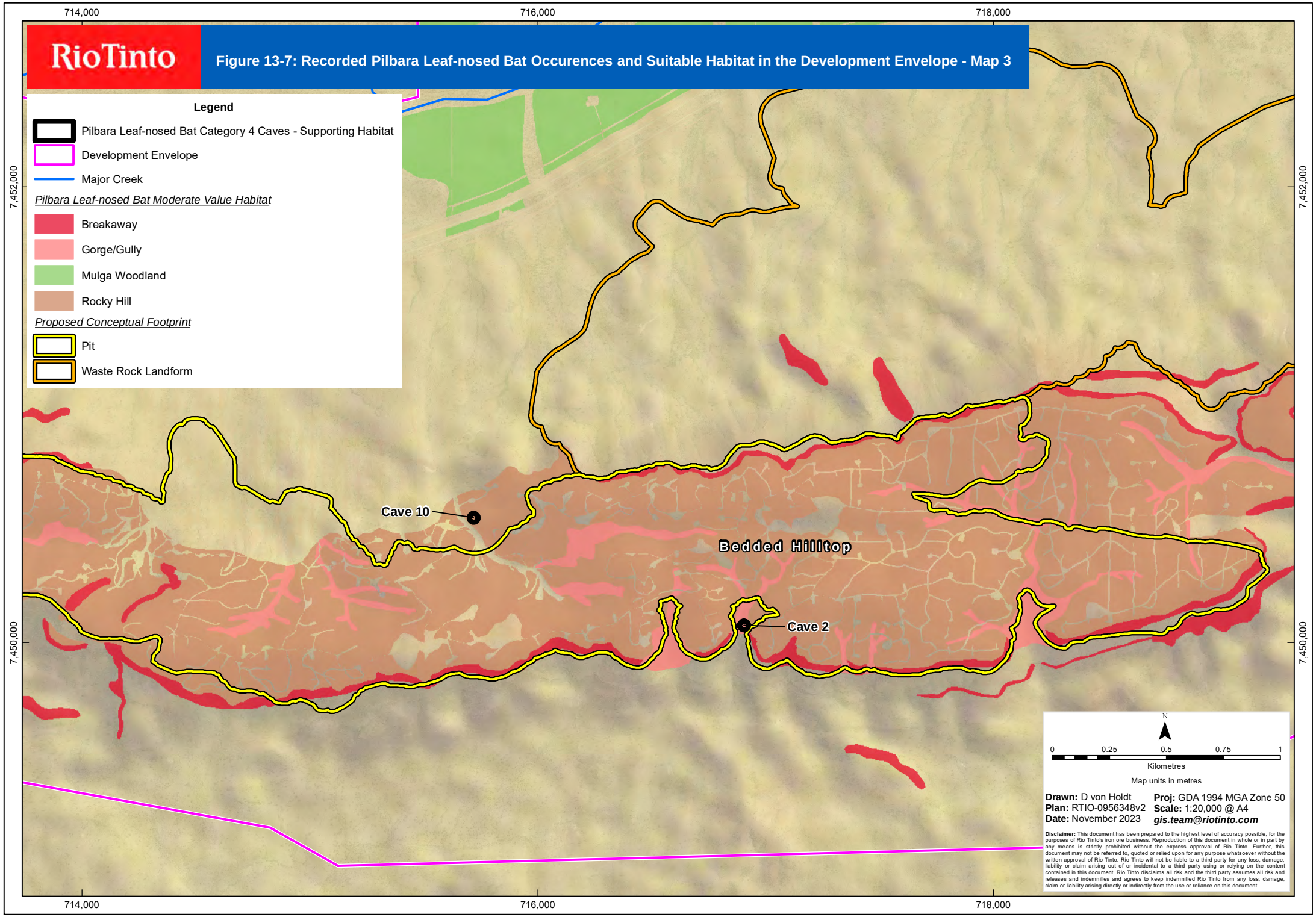
Nine caves recorded within the Development Envelope were categorised as Category 4 caves and thus the Development Envelope does not contain any Critical habitat for the species. This is supported by the limited number of Pilbara Leaf-nosed Bat calls recorded, which is consistent with the absence of any permanent or semi-permanent roosts. The nine Category 4 Pilbara Leaf-nosed Bat caves are considered Supporting habitat, including a 20m buffer around the recorded location of the cave.

All the fauna habitat types within the Development Envelope have the potential to be used for foraging by the species; however, given the limited number of records and given the distance to the nearest permanent roost (Turee Creek Roost – approximately 25 km), it is not considered to be Supporting habitat..


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Figure 13-7: Recorded Pilbara Leaf-nosed Bat Occurences and Suitable Habitat in the Development Envelope - Overview
Legend
Pilbara Leaf-nosed Bat (Rhinonicteris aurantia) Records
Pilbara Leaf-nosed Bat Category 4 Caves - Supporting Habitat
Development Envelope
Major Creek
Pilbara Leaf-nosed Bat Moderate Value Habitat
Breakaway
Gorge/Gully
Mulga Woodland
Rocky Hill
Proposed Conceptual Footprint
Pit
Waste Rock Landform
700,000
710,000
720,000
7,460,000
7,450,000
Map 1
Map 2
Map 3
Pebble Mouse Creek
Hope Downs 2
Bedded Hilltop
Weeli Wolli Creek
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956348v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
gis.team@riotinto.com
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RioTinto
Figure 13-7: Recorded Pilbara Leaf-nosed Bat Occurences and Suitable Habitat in the Development Envelope - Map 1
Legend
Pilbara Leaf-nosed Bat (Rhinonicteris aurantia) Records
Pilbara Leaf-nosed Bat Category 4 Caves - Supporting Habitat
Development Envelope
Major Creek
Pilbara Leaf-nosed Bat Moderate Value Habitat
Breakaway
Gorge/Gully
Mulga Woodland
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Hope Downs 2
Cave 8
Cave 7
696,000
698,000
700,000
7,446,000
7,444,000
N
0
0.25
0.5
0.75
1
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956348v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:20,000 @ A4
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Figure 13-7: Recorded Pilbara Leaf-nosed Bat Occurences and Suitable Habitat in the Development Envelope - Map 2
Legend
Pilbara Leaf-nosed Bat (Rhinonicteris aurantia) Records
Pilbara Leaf-nosed Bat Category 4 Caves - Supporting Habitat
Development Envelope
Major Creek
Pilbara Leaf-nosed Bat Moderate Value Habitat
Breakaway
Gorge/Gully
Rocky Hill
Proposed Conceptual Footprint
Pit
Pebble Mouse Creek
Cave 6
Cave 4
Bedded Hilltop
Cave 5
Cave 3
Cave 1
708,000
710,000
712,000
7,452,000
7,450,000
N
0
0.25
0.5
0.75
1
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956348v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:20,000 @ A4
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Figure 13-7: Recorded Pilbara Leaf-nosed Bat Occurences and Suitable Habitat in the Development Envelope - Map 3
Legend
Pilbara Leaf-nosed Bat Category 4 Caves - Supporting Habitat
Development Envelope
Major Creek
Pilbara Leaf-nosed Bat Moderate Value Habitat
Breakaway
Gorge/Gully
Mulga Woodland
Rocky Hill
Proposed Conceptual Footprint
Pit
Waste Rock Landform
714,000
716,000
718,000
7,452,000
7,450,000
Cave 10
Cave 2
Bedded Hilltop
N
0
0.25
0.5
0.75
1
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: RTIO-0956348v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
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13.8.6. Assessment of Impacts

The Proposed Action may, directly and indirectly, impact Pilbara Leaf-nosed Bat, as identified in Section 13.4. The following information describes those impacts and their mitigation in more detail. The significance of each impact is summarised. Additional assessment of the impacts using the MNES Significant Impact Guidelines (DoE 2013) is provided in Section 13.5.

13.8.6.1. Loss/Reduction of Fauna Habitat as a Result of Clearing and Habitat Fragmentation

The Proposed Action will not impact any critical habitat type within the Development Envelope. The nine Category 4 Pilbara Leaf-nosed Bat roosts are considered Supporting habitat, of these, two Category 4 caves will also be impacted due to the implementation of the Proposed Action. It is noted that Category 4 caves are not regarded as critical to the species' survival.

Approximately 7,509.5 ha of habitat with a moderate habitat rating will be retained within the Development Envelope. Seven Category 4 roosts will also be retained within the Development Envelope, all within flying distance of any disturbed roosts. This is likely to be more than sufficient to continue to support the needs of the limited number of Pilbara Leaf-nosed Bats which currently utilise the Development Envelope. As such the Proposed Action is not expected to result in significant residual impacts to the regional population or conservation status of the species.

13.8.6.2. Loss of Pilbara Leaf-nosed Bat Individuals

Pilbara Leaf-nosed Bats have the potential to become entangled in barbed wire fencing due to their low elevation flying pattern. The use of barbed wire fencing will be avoided within the Development Envelope as far as practicable, noting the requirements of pastoralists, whose leases intersect the Development Envelope, to use barbed wire in their stock fences for the effective containment of cattle. Where the use of barbed wire fencing is legislated or required, the top strand will be replaced with single-strand wire, and reflectors will be installed to deter bat interaction. The potential impacts from infrastructure are expected to be low.

By implementing mitigation and management measures, the loss of Pilbara Leaf-nosed Bat individuals associated with the Proposed Action is not expected to cause significant impacts to the species.

13.8.6.3. Disturbance from Light, Noise and/or Vibrations Resulting in the Displacement of Fauna Associated with Construction and Operational Activities

The Proposed Action will generate light, noise and vibration emissions due to clearing, construction and mine operation.

Light

The Pilbara Leaf-nosed Bat is curious about light sources (DotEE 2019). Light emissions may alter nocturnal foraging activities, particularly if light enters potential nocturnal refuges or attracts invertebrates, a known food source for the species. Temporary mobile lighting in active excavation areas may result in temporary and localised areas of light spilling onto habitat within the Development Envelope, and attraction to light sources may also give rise to collisions with vehicles. However, as the light will be directed away from the retained habitat and light emissions will affect only a small proportion of the Pilbara Leaf-nosed Bat foraging habitat, light emissions are not expected to impact this species significantly.

Noise and Vibration

Active mining during the operational phase will generate noise and vibration emissions as a result of blasting activities. However, noise and vibration impact from mining operations are not expected to

significantly impact the Pilbara Leaf-nosed Bat given there is no Critical habitat or Category 1 – 3 roosts within the Development Envelope.

By implementing the noise and vibration mitigation measures described in Section 13.4.4, and the associated measures relating to the Ghost Bat (but applicable to the Pilbara Leaf-nosed Bat) as outlined in Table 13-10 the Proponent will ensure the effects that noise and vibration from the Proposed Action will be minimal and will not impact the Pilbara Leaf-nosed Bat.

13.8.7. Significance of Impacts

An assessment of the Proposed Action on Pilbara Leaf-nosed Bat is detailed in Table 13-18, based on the Significant Impact Guidelines (DoE 2013).

Table 13-18: Assessment of the Significant Impact to Pilbara Leaf-nosed Bat

Significant Impact Criteria	Assessment of Significance of Impacts to Pilbara Leaf-nosed Bat
Lead to the long-term decrease in the size of an important population of the species.	The population of Pilbara Leaf-nosed Bats in the Pilbara is considered part of an important population, and the individuals recorded in the survey area and Development Envelope form part of that population. There are no Category 1 and 2 roosts within the Development Envelope. Nine Category 4 roosts consisting of nocturnal refuges have been recorded within the Development Envelope. Two of these Category 4 roosts will be impacted. The nearest permanent diurnal roost is located approximately 25 km away at Turee Creek. Given that approximately 7,509.5 ha of moderately rated habitat and seven Category 4 roosts will also be retained within the Development Envelope, the species is expected to continue to exist within and surrounding the Development Envelope and wider Pilbara region.
Potential to reduce the area of occupancy of an important population of the species	The Proposed Action will not reduce the area of occupancy of the Pilbara Leaf-nosed Bat through the loss of Critical habitat. The Proposed Action not result in the clearing of any Critical habitat and Supporting habitat comprising two Category 4 roosts. As such the Proposed Action is not expected to result in a reduction of the area occupied by the species.
Potential for fragmentation of an existing population into two or more populations	The Proposed Action is not expected to fragment the existing Pilbara Leaf-nosed Bat population given that the Proposed Action will not impact any permanent or semi-permanent roosts and extensive moderately rated habitat will remain within the Development Envelope (7,509.5 ha). The species is also highly mobile, known to disperse widely and will be able to maintain population connectivity across the habitat disturbance generated by the Proposal.
Potential to adversely affect habitat critical to the survival of the species	None of the habitat types within the Development Envelope meet the definition of Critical habitat for the Pilbara Leaf-nosed Bat. This is due to the absence of any permanent or semi-permanent roosts within the Development Envelope, distance from a known permanent roost (Category 1-3) and the very low activity level recorded within the Development Envelope. As such the Proposed Action will not adversely affect any Critical habitat.
Potential to disrupt the breeding cycle of a population	No maternity Pilbara Leaf-nosed Bat roosts (Category 1 and 2) have been recorded within the Development Envelope. Only three calls were recorded within the Development Envelope, and they all occurred at least three hours after dusk, which is not consistent with the occurrence of a nearby permanent roost cave, and therefore the individuals recorded are likely foraging individuals only (Astron 2019b). The Proposed Action will therefore not impact any permanent diurnal roost and will not impact the breeding cycle of a population.
Potential to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Proposed Action will not result in clearing of any Critical habitat and impact Supporting habitat comprising two Category 4 roosts.. The approved conservation advice indicates that a reduction in habitat availability could result in a decline of the species in a region (TSSC 2016a).

Significant Impact Criteria	Assessment of Significance of Impacts to Pilbara Leaf-nosed Bat
	A total of 7,509.5 ha of the same habitat will be retained within the Development Envelope. This amount of retained habitat is deemed sufficient to support the any Pilbara Leaf-nosed Bats, which may use the habitat types within the Development Envelope. As such, the Proposed Action is not expected to modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the bioregions Pilbara Leaf-nosed Bat population will decline.
Result the establishment of invasive species in the endangered species habitat that are harmful to the endangered species	The approved Conservation Advice for the species suggests that invasive species are not expected to significantly impact the Pilbara Leaf-nosed Bat (TSSC2016b).
Potential for the introduction of disease that may cause the species to decline	Currently there are no known diseases harmful to the Pilbara Leaf-nosed Bat and there is no evidence to suggest that the Proposed Action would introduce disease that may cause the species to decline.
Potential interference with the recovery of the species	Key management actions for the recovery of the species include protection of land with significant colonies, replacement of barbed wire fencing, protection of roosts and protection of the structural integrity of roosts (TSSC 2016b). The Proposed Action will directly impact two Category 4 roosts; however, four other Category 4 roots will be retained within MEZs. The Proponent will avoid the use of barbed wire fencing, as far as practicable, noting the requirement for pastoralists, whose leases intersect the Development Envelope, to use barbed wire in stock fences. Where barbed wire fencing is required, reflectors will be installed to deter interaction. On this basis, the Proposed Action will not interfere with the recovery of the Pilbara Leaf-nosed Bat.

13.8.8. Consistency with Relevant Recovery Plans and Guidance

13.8.8.1. Recovery Plan

There are no recovery plans for Pilbara Leaf-nosed Bat.

13.8.8.2. Threat Abatement Plans

There are no TAPs identified as being relevant for the Pilbara Leaf-nosed Bat.

13.8.8.3. Conservation Advice

The Proposed Action has contributed to / will contribute to the following primary conservation actions:

- Discover new roosts – nine previously unidentified roosts have been recorded within the Development Envelope
- Discover new occurrences – three echolocation records have been recorded within the Development Envelope, within which none have been recorded previously
- Protect roosts – seven of the nine roosts will be protected from direct and indirect impacts through the implementation of MEZs
- Assess and protect foraging habitat – the retention of up to 7,509.5 ha of potential foraging habitat within the Development Envelope and its widespread distribution in the surrounding area.

13.8.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.8.9.1. Predicted Environmental Outcome

A very low-density population of Pilbara Leaf-nosed Bats has been recorded within the Development Envelope. The Proposed Action is predicted to result in the following environmental outcomes in relation to Pilbara Leaf-nosed Bats:

- No impact to Critical habitat within the Development Envelope
- Proposed impact to Supporting habitat comprising of two Category 4 Pilbara Leaf-nosed Bat roosts within the Development Envelope
- Retention of at least 7,509.5 ha of moderate habitat within the Development Envelope
- Retention of seven of the nine Pilbara Leaf-nosed Bat roosts recorded within the Development Envelope (all Category 4).

13.8.10. Conclusion

The significant residual impact, after implementation of the mitigation hierarchy, is clearing of Supporting (foraging and dispersal) habitat comprising of two Category 4 Pilbara Leaf-nosed Bat roosts. Environmental offsets are proposed for this clearing and are discussed in Chapter 12. Subject to conditions and implementation of offsets (Chapter 12), the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the species' survival.

13.9. Pilbara Olive Python (*Liasis olivaceus barroni*)

13.9.1. Species Profile

The Pilbara Olive Python (*Liasis olivaceous barroni*) is listed as Vulnerable under the EPBC Act. It is a dull olive-brown to pale fawn or rich brown python with a white/cream belly, pale lips finely dotted with pale grey or brown. It can grow up to 4 m in length but has an average size of 2.5 m (DEWHA 2008a).

13.9.2. Habitat Preferences and Distribution

The Pilbara Olive Python is endemic to the Pilbara and northern parts of the Gascoyne bioregions, distributed from the Burrup Peninsula, Ord Ranges and Meentheena south to Nanutarra and Newman in the Pilbara, with an isolated population occurring at Mt Augustus in the Gascoyne region (Bush & Maryan 2011; Storr et al. 2002).

Pilbara Olive Python can be found in a variety of habitats but is found more often in moist habitats such as gorges, rivers, pools, and surrounding hills (Burbidge 2004; DSEWPaC 2011b). In the Hamersley region, this snake is often noted near permanent waterholes in rocky ranges or among riverine vegetation (DSEWPaC 2011b and Pearson 1993). The species is most active in the summer months soon after dark, emerging from daytime shelters and foraging until the early morning hours (DSEWPaC 2011b). Individuals spend the cooler winter months within caves and rock crevices away from water sources. Individuals occupy distinct home ranges (87–449 ha), and males can travel distances of up to 4 km during the breeding season (June to August) to locate females (DotEE 2019).

13.9.3. Key Threats and Recovery Actions

13.9.3.1. Key Threats

Key threats to the Pilbara Olive Python population include predation by feral cats and foxes, competition for food sources with feral predators, and habitat loss (DEWHA 2008a).

13.9.3.2. Recovery Actions

The Perth Zoo and Curtin University are conducting DNA research of this species through blood samples. This will help ecologists determine if Pilbara Olive Pythons are present in an area by using eDNA sampling in water and soil instead of relying on traditional survey techniques to locate this elusive species.

DBCA has undertaken research projects on the Pilbara Olive Python in the Pilbara in the past, including genetic surveys of the species, which investigated differences between and within populations of Olive Pythons in the Pilbara (Pearson et al. 2013).

13.9.4. Important Populations and Critical Habitat

13.9.4.1. Important Populations

Currently, there are no species-specific policy guidelines on what an important population is or defining habitat critical for the survival of this python.

There are currently 190 records of the Pilbara Olive Python across the Pilbara region (DBCA 2021), including populations at Pannawonica, Millstream, Tom Price, and the Burrup Peninsula. The Development Envelope is located within the modelled distribution of Pilbara Olive Python.

The species also occurs within the Rangelands (Western Australia) Natural Resource Management Region, and part of its habitat is conserved in Karijini National Park, approximately 32 km west of the Development Envelope.

13.9.4.2. Critical Habitat

For this assessment, Critical habitat for the Pilbara Olive Python has been defined as rocky areas and gorges, especially when rocky areas are near water sources. Critical habitat within the Development Envelope comprises Gorge/Gully and Breakaway habitat types. Supporting foraging and dispersal habitat comprises Minor Drainage within 1 km of Pilbara Olive Python records within the Development Envelope (Astron 2020b).

13.9.5. Occurrence in the Development Envelope

13.9.5.1. Recorded Occurrences

The Pilbara Olive Python was not recorded during the targeted MNES survey (Astron 2020b) or during the Level 2 Fauna Survey (Astron 2019b).

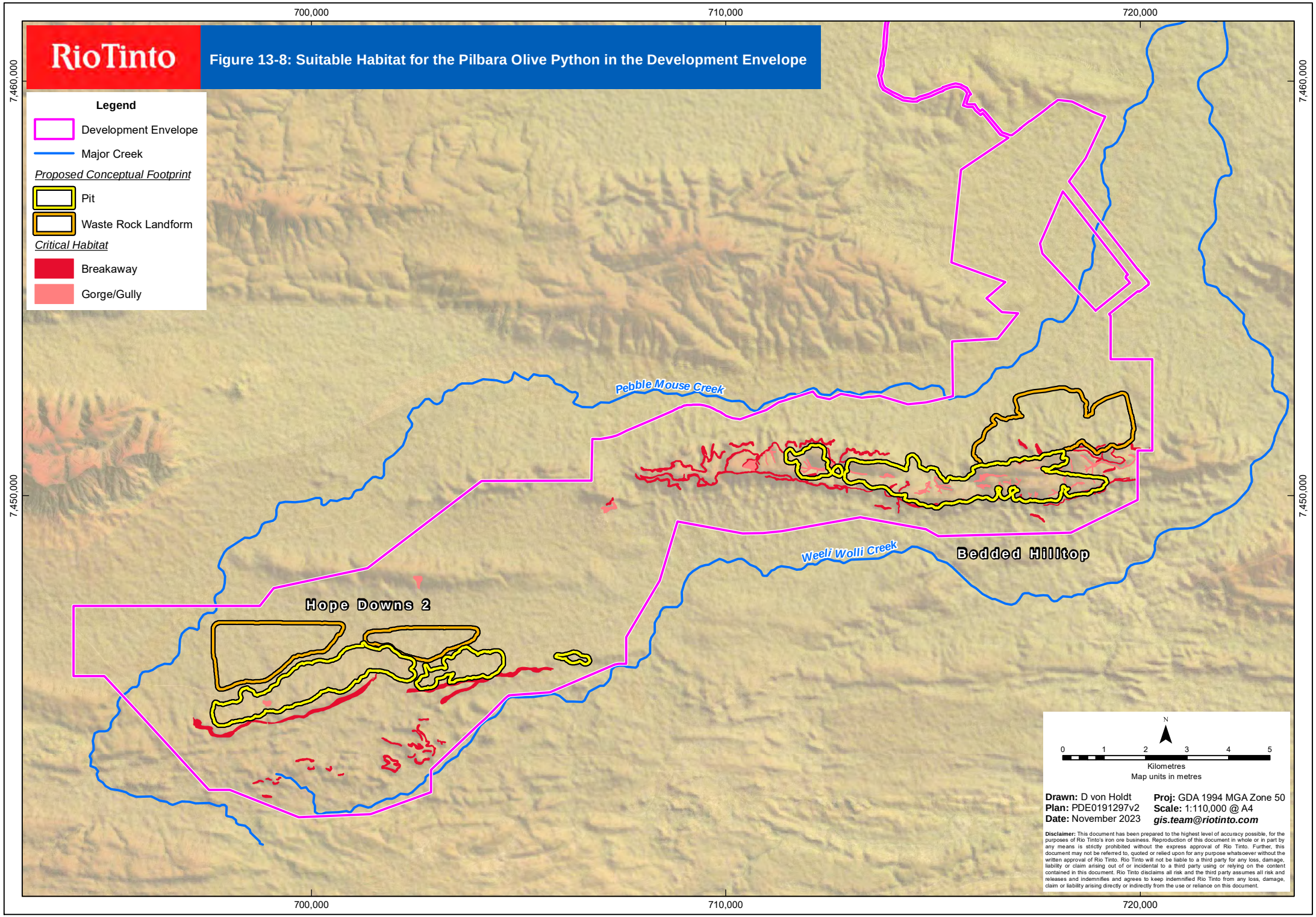
The lack of sightings does not directly indicate the absence of the species from the Development Envelope. The species is notoriously difficult to sight directly due to its cryptic, elusive, and nocturnal nature (DEWHA 2008a).

Fourteen historical records of the species have been made within 40 km of the Development Envelope. Most of these records (10) occur along Weeli Wolli Creek, which provides an abundance of suitable habitat for the species. It is noted that the Proponent has removed all but a small extent of Weeli Wolli Creek from the Proposed Action Development Envelope, reducing the likelihood of the Proposed Action impacting the species. The Development Envelope is located between Weeli Wolli Creek and Pebble Mouse Creek, as such contains suitable habitat in which the species can forage and disperse.

13.9.5.2. Habitat

Critical habitat within the Development Envelope comprises Gorge/Gully and Breakaway habitat types. Supporting foraging and dispersal habitat comprises Minor Drainage within 1 km of Critical habitat occurrences, providing connectivity between Gorge/Gully and Breakaway habitats (Figure 13-8).

Key surface water features have been minimised, with the Development Envelope being reduced to exclude areas of Weeli Wolli Creek and Pebble Mouse Creek.


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Figure 13-8: Suitable Habitat for the Pilbara Olive Python in the Development Envelope
Legend
Development Envelope
Major Creek
Proposed Conceptual Footprint
Pit
Waste Rock Landform
Critical Habitat
Breakaway
Gorge/Gully
700,000
710,000
720,000
7,460,000
7,450,000
Pebble Mouse Creek
Weeli Wolli Creek
Bedded Hilltop
Hope Downs 2
N
0 1 2 3 4 5
Kilometres
Map units in metres
Drawn: D von Holdt
Plan: PDE0191297v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:110,000 @ A4
gis.team@riotinto.com
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13.9.6. Assessment of Impacts

13.9.6.1. Loss/Reduction of Fauna Habitat as a Result of Clearing and Habitat Fragmentation

The Proposed Action will result in clearing approximately 105 ha of Critical habitat within Gorge/Gully and Breakaway habitats. The Proposed Action will also result in the clearing of approximately 334 ha of Supporting habitat being Minor Drainage habitat. The clearing of Critical and Supporting habitat is considered to be a significant residual impact and is proposed to be offset (Chapter 12).

Intact Pilbara Olive Python habitat will remain within and surrounding the Development Envelope. Significant corridors in Gorge/Gully, Breakaway and Minor Drainage habitats will allow movement around the mining area and through the landscape. Most notably, the Proposal has minimised impacts to Weeli Wolli Creek and Pebble Mouse Creek (only infrastructure crossings), the location of the majority of historical records of the Pilbara Olive Python. As such, habitat fragmentation caused by the Proposed Action is not expected to have significantly detrimental overall effects on Pilbara Olive Python habitat or movement.

13.9.6.2. Loss of Pilbara Olive Python Individuals

The Pilbara Olive Python is slow-moving and nocturnal and is vulnerable to injury or mortality from vehicle and machinery movements, mainly when foraging at night, basking, or during mating season when movements are more frequent. Construction of the Proposed Action will occur predominantly during daylight hours, minimising the potential for interaction with this species. The Proponent will implement management measures to mitigate the loss of fauna individuals, as detailed in Table 13-10 and Section 13.5, such as:

- Progressive clearing to allow fauna to migrate away from clearing activities or machinery movements
- Awareness training to identify conservation significant fauna and habitat, relevant management measures, personnel/contractor responsibilities, and incident reporting requirements (i.e., reporting of fauna observations and incidents)
- Vehicle speed limits.

By implementing mitigation and management measures, the loss of Pilbara Olive Python individuals associated with the Proposed Action is not expected to cause significant impacts to the species.

13.9.6.3. Disturbance from Light, Noise and/or Vibration Resulting in the Displacement of Fauna Associated with the Construction and Mining Operations

Snakes use the inner ear to identify prey and avoid predators by detecting ground vibrations. Noise and vibration from blasting associated with the Proposed Action will be intermittent and of short duration. The sporadic and brief blasting means that related vibrations are not expected to interfere with the Pilbara Olive Python's ability to detect prey and avoid predators. It is not expected to impact individuals that may utilise nearby habitats significantly.

No significant impacts on Pilbara Olive Python are expected from increased light, noise, and vibration disturbance.

13.9.7. Significance of Impacts

An assessment of the Proposed Action on Pilbara Olive Python is detailed in Table 13-19, based on the Significant Impact Guidelines (DoE 2013).

Table 13-19: Assessment of the Significance of Impacts on Pilbara Olive Python

Significant Impact Criteria	Assessment of Significance of Impacts to Pilbara Olive Python
Lead to the long-term decrease in the size of an important population of the species.	There were no recorded sightings of the Pilbara Olive Python, however the lack of sightings does not directly indicate the absence of the species from the Development Envelope. 14 historical records of the species have been made within 40 km of the Development Envelope. The majority of these records (10) occur along Weeli Wolli Creek, which provides an abundance of suitable habitat for the species. The Proposed Action will remove up to 105 ha of Critical Gorge/Gully and Breakaway (shelter and breeding) from the Development Envelope. At least 182 ha (63.4%) of Critical habitat will remain available in the Development Envelope. An additional 634 ha of Gorge/Gully and Breakaway habitats have been mapped within the extrapolated survey area outside the Development Envelope. Any individuals displaced by the clearing of this habitat can disperse and forage in the surrounding habitat and more broadly in the low significance habitats. Given the retention of Critical shelter, denning and Supporting foraging habitat and the widespread availability of suitable foraging and dispersal habitat beyond the Development Envelope, the Proposed Action is not expected to cause a long-term decrease in the size of an important population.
Potential to reduce the area of occupancy of an important population of the species	The Pilbara Olive Python is known from ranges within the Pilbara region. The Proposed Action has the potential to reduce the area of occupancy of the species in a local context through the loss of Critical habitat; however, the species is expected to continue to exist within and surrounding the Development Envelope given the retention of Critical and Supporting habitat within the Development Envelope and surrounding area.
Potential for fragmentation of an existing population into two or more populations	The Pilbara Olive Python is a mobile species and is likely to move through the retained Critical habitat within the Development Envelope. At least 182 ha (63.4%) of Critical habitat will remain available in the Development Envelope. An additional 634 ha of Gorge/Gully and Breakaway habitats have been mapped within the extrapolated survey area. Most notably, the Proposal has minimised impacts to Weeli Wolli Creek, the location of the majority of the Pilbara Olive Python historical records. As such, habitat fragmentation caused by the Proposed Action is not expected to have significantly detrimental overall effects on Pilbara Olive Python habitat or movement.
Potential to adversely affect habitat critical to the survival of the species	The Pilbara Olive Python is known from the Pilbara region of Western Australia. Suitable habitat within its modelled distribution is likely to be Critical habitat for the species. The Proposed Action will result in a loss of up to 105 ha (36.6%) of Critical habitat for the Pilbara Olive Python within the Development Envelope comprising Gorge/Gully and Breakaway habitat types. The remaining habitats do not represent Critical or Supporting habitat for the species and are considered of low significance. At least 182 ha (63.4%) of Critical habitat will remain available in the Development Envelope. An additional 634 ha of Gorge/Gully and Breakaway habitats have been mapped within the extrapolated survey area. The clearing of Critical Gorge/Gully and Breakawayhabitat is considered a significant residual impact and is proposed to be offset (see Chapter 12).
Potential to disrupt the breeding cycle of a population	Given lack of records of this species in the Development Envelope and minimal impact to Weeli Wolli Creek (the location of the nearest records),

Significant Impact Criteria	Assessment of Significance of Impacts to Pilbara Olive Python
	the Proposed Action is not expected to disrupt the breeding cycle of the population.
Potential to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Proposed Action will impact up to 105 ha (36.6%) of Critical habitat for the species. However, 182 ha (63.4%) of Critical habitat within the Development Envelope will be retained. In addition, there will be no impacts from groundwater drawdown, minimal impact to Weeli Wolli Creek and Pebble Mouse Creek, and no impact to the nearest permanent pools (Weeli Wolli Spring and Ben's Oasis). Based on this, Pilbara Olive Pythons are expected to remain in the Development Envelope and are unlikely to decline.
Potential for an invasive species that are harmful to a vulnerable species becoming established in the species habitat	Foxes (and feral cats) are known threats to the Pilbara Olive Python (especially juveniles). Foxes have not been recorded in the survey area, and the Proposed Action is unlikely to increase its potential to become established in the area. The potential impacts of predation from feral cats because of the Proposed Action is considered low. The Proponent will undertake feral animal control in accordance with an annual plan or in response to significant increases in feral animal sightings.
Potential for the introduction of disease that may cause the species to decline	There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species to decline.
Potential interference with the recovery of the species	Regional and local priority actions have been identified for Pilbara Olive Python, including ensuring that development in areas where the species occurs does not impact known populations, managing changes to hydrology, and implementing TAPs to control and eradicate foxes and cats. The Proposed Action will result in a loss of up to 105 ha (36.6%) of Critical habitat for the Pilbara Olive Python within the Development Envelope, comprising Gorge/Gully, Breakaway (Critical) and Minor Drainage (Supporting) habitat types. The remaining habitats do not represent Critical or Supporting habitat for the species and are considered of low significance. At least 182 ha (63.4%) of Critical habitat and 229 ha (40.7%) Supporting habitat will remain available in the Development Envelope. An additional 634 ha of Gorge/Gully and Breakaway habitats have been mapped within the extrapolated survey area. The mitigation measures are not considered at variance with the recovery actions on the conservation advice and TAPs, and therefore, the Proposed Action is not expected to interfere with the recovery of the species.

13.9.8. Consistency with Relevant Recovery Plans and Guidance

13.9.8.1. Recovery Plan

There are no recovery plans for the Pilbara Olive Python.

13.9.8.2. Threat Abatement Plans

Feral cats have been recorded within the Development Envelope (Astron 2019b). Mine sites can attract/increase the abundance of introduced fauna due to the additional resources (food scraps, water, shelter). The Proponent will record all introduced fauna sightings and undertake feral cat control within the Development Envelope. As such, the Proposed Action will align with the TAP for predation by feral Cats (DoE 2015a).

13.9.8.3. Conservation Advice

The primary conservation actions from the approved Conservation Advice for the Pilbara Olive Python are outlined in Table 13-1. The Proposed Action has contributed to / will contribute to the following primary conservation actions:

- Identification of populations of high conservation priority
- Managing changes to hydrological regimes
- Implementation of control and eradication of feral animals in the local region
- Raise awareness with the community
- Implementation of road signage to raise awareness with road users on nearby roads.

13.9.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.9.9.1. Predicted Residual Impact

After application of mitigation measures the following significant residual impacts are predicted to the Pilbara Olive Python:

- Clearing up to 38 and 67 ha (60 and 30%) of Critical Gorge/Gully and Breakaway (denning and breeding) habitats, respectively for the Pilbara Olive Python. This clearing is proposed to be managed via upper limits of clearing as per Table 13-8 and will be offset as per Chapter 12

13.9.9.2. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposed Action, the anticipated environmental outcomes that apply to the Pilbara Olive Python are set out below.

- The Proponent shall not clear more than:
  - 38 ha of Gorge/Gully habitat within the Development Envelope
  - 67 ha of Breakaway habitat with the Development Envelope

- Minimise direct and indirect impacts from the Proposed Action to Pilbara Olive Python habitat in accordance with the EMP.

The proponent will implement the EMP as per Appendix A7 to achieve these outcomes.

13.9.10. Conclusion

Clearing up to 105 ha of Critical habitat for the Pilbara Olive Python will be offset. Environmental offsets are proposed for this clearing and are discussed in Chapter 12. Subject to conditions and implementation of offsets (Chapter 12), the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the species' survival.

13.10. Summary of Significant Residual Impacts of Offset Requirements for MNES

13.10.1. Significant Residual Impact

Significant residual impacts which remain post mitigation are presented in Table 13-20 and include:

- Clearing of up to 105 ha of potential Critical (potential denning, roosting, breeding and shelter) habitat for the Northern Quoll, Ghost Bat and Pilbara Olive Python (Breakaway and Gorge/Gully habitat types), of which 287 ha has been recorded in the Development Envelope and a further 634 ha within the wider Hope Downs Hub (Astron 2020d)
- Clearing of Supporting (foraging and dispersal) habitat for the following MNES species:
    - Northern Quoll (up to 297 ha of Minor Drainage and Rocky Hills within 1 km of Northern Quoll record)
    - Ghost Bat (up to 2,659 ha of all habitat types within 12 km of the Category 2 roost (Cave 10) within the Development Envelope, other than Critical habitat)
    - Pilbara Leaf-nosed Bat (up to two Category 4 Pilbara Leaf-nosed Bat roosts within the Development Envelope).

No other potential impacts to MNES fauna (either singly or collectively) are considered as likely to be significant.

Table 13-20: Significant Residual Impact Resulting from the Clearing of Critical and Supporting MNES Habitats within the Development Envelope

Habitat Type	Clearing within Development Envelope (ha)
Critical Habitat - upper limit	
Gorge/Gully	38
Breakaway	67
Supporting Habitat - approximate clearing	
Alluvial Plain	70
Low Hills and Slopes	917
Minor Drainage	412
Mulga Woodland	601
Rocky Hill	369
Stony Plain	433
Total	2,907

The MNES fauna species home range is defined as:

- Northern Quoll – 1 km from recorded locations of Northern Quoll, within the Development Envelope
- Pilbara Leaf-nosed Bat – 10 km from Category 1, 2 and 3 roosts
- Ghost Bat – 12 km from Category 1 and 2 roosts or Category 3 (associated within an apartment block)
- Pilbara Olive Python – 1 km from recorded locations of Pilbara Olive Python, within the Development Envelope.

13.10.2. Offset Requirements

BHT and HD2 deposits have different habitat characteristics. BHT deposit area has a concentration of the MNES values, both habitats and records of key species, and for this reason a large MEZ has been proposed to provide for broad habitat protection for all of the MNES species. The HD2 deposit area has a low concentration of MNES values and recorded records of key MNES species.

Based on significant survey work and advice from Pilbara subject matter experts, the offsets proposed are specific to these characteristics of the HD2 Proposal.

Offsets are proposed to counterbalance the significant residual impacts on MNES fauna caused by the clearing of up to:

- 105 ha of Critical habitat (Northern Quoll, Ghost Bat and Pilbara Olive Python)
- 2,659 ha of Supporting habitat (Northern Quoll and Ghost Bat).

The appropriateness of these offsets to achieve the counterbalancing objective is discussed in Chapter 12.

14. HOLISTIC IMPACT ASSESSMENT

This ERD provides a detailed assessment of the potential environmental impacts associated with the Proposal and the application of the mitigation hierarchy to each environmental factor. However, the environment is a complex dynamic of connections and interactions, and while an effect on a particular factor(s) may be minor in isolation, its impact across these interconnections may result in a significant impact.

The EPA defines the holistic impacts as the "*Connections and interactions between impacts, and the overall impact of the proposal on the environment as a whole".* The Proponent has sought to understand the environment as a whole, using information derived from technical surveys and investigations on the environmental, and the views and concerns raised through consultation with relevant stakeholders, including the Nyiyaparli, Banjima and Ngarlawangga People. The inputs and perspectives of the Traditional Owners continues to be vital in growing this understanding of the whole environment and the balance between its many interconnected elements.

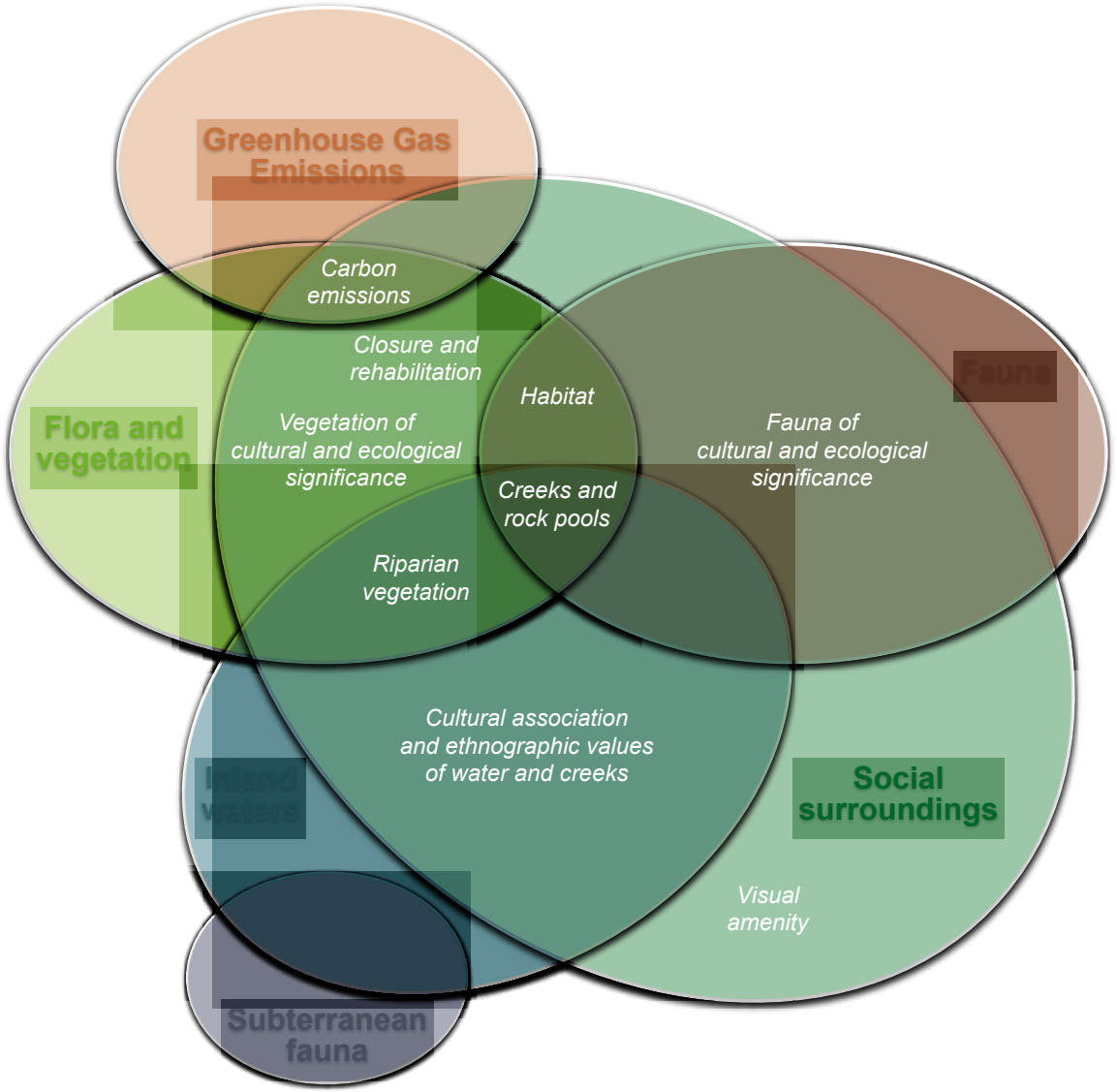
14.1. Connections and Interactions Between Environmental Factors

The environmental surveys and studies undertaken for the Proposal have considered and assessed potential impacts at both a local and regional scale. The results of these surveys and studies have informed the Proposal impact assessment and mitigation measures. While the Proposal's predicted outcomes have been considered independently in relation to the environmental principles and the EPA's environmental objectives for each preliminary environmental factor, the Proponent recognises the complex linkages between Flora and Vegetation, Terrestrial Fauna, Inland Waters and Social Surroundings.

In the Pilbara, the most important cultural values often coincide with elements of the landscape with high visual amenity, botanical diversity and fauna habitat values; therefore, additional combined environmental effects may become significant and require additional mitigation. The high level of connectivity between the environmental factors: Inland Waters, Flora and Vegetation, Terrestrial Fauna and Social Surroundings is illustrated in Figure 14-1. A further detailed understanding informs the environmental values and processes and the holistic views and concerns raised through consultation relevant stakeholders, including the Nyiyaparli, Banjima and Ngarlawangga People. The inputs and perspectives of the Traditional Owners continues to be vital in growing this understanding of the whole environment and the balance between its many interconnected elements. A conceptual model of these fundamental elements and their many interconnections is represented in Figure 14-1.

The key impacts that have little interaction across factors, when viewed at the timescale of the life of the mine, are GHG emissions and the loss of subterranean fauna habitat associated with mine pits. These impacts are assessed in detail in the factor assessments and require no further holistic considerations.

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HOPE DOWNS 2 PROPOSAL

FIGURE 14-1

Holistic View of Links between Environmental Factors and Values

Prepared by: ELA/TtCOF_RH | Doc: \\tt.local\coh\S772\S\GRAPHICS\20278_ELA_RioTinto_HopeDowns\20278_ELA-RT_GRA001_VENN.ai_1 | Date: 06.12.2022

14.2. Consideration of Holistic Effects

This section provides information on the Proposal's effects on the environment as a whole to determine whether any additional considerations for assessment arise. For this holistic assessment, the following considerations have been applied:

1. Where an impact(s) has been completely avoided, it will not contribute to holistic environmental effects and does not require consideration
2. Where an impact is already considered potentially significant and the mitigation hierarchy applied in relation to one factor, additional mitigation measures to address combined environmental effects are unlikely to be required
3. Where an impact(s) has been considered to likely result in a significant impact across two or more factors, and the mitigation hierarchy has been applied in isolation per factor, consideration will be given if further measures are required to mitigate this combined impact
4. Where there are multiple overlapping minor impacts, or a minor impact affects multiple values and has been assessed as insignificant in the context of an individual factor, these may require further holistic consideration
5. The environmental principles of intergenerational equity, and conservation of biological diversity and ecological integrity are considered the most relevant and have been a foundation when considering potential significance of the holistic effect of the Proposal.

Where holistic effects on the environment have been identified, their potential impacts on the environment as a whole have been considered in accordance with Section 4.1 of the *Environmental Impact Assessment Procedures Manual* (EPA, 2021). The following section outlines and discusses these holistic effects as it relates to the implementation of the Proposal.

A summary of this assessment is provided in Table 14-1.

14.2.1. Land Disturbance

As discussed in previous sections, the Proposal will directly disturb 4,900 ha of land, all of which contains native vegetation. The combined impacts associated with this land disturbance include:

- Loss of priority flora and supporting habitat
- Loss of conservation significant fauna species and supporting habitat
- Direct fauna mortality
- Altered surface water regimes resulting in a potential increase in flooding and erosion events, loss in catchment area
- Long-term localised loss in ecological diversity and values of cultural significance (including culturally significant plants and animals), due to the creation of permanent pit voids and waste rock landforms which will limit the ability to rehabilitate land to return it to pre-mining condition post closure.

While the above effects will result in localised impacts, these impacts can also influence the dynamics of the environment in a regional context when considered against other similar activities. It has been demonstrated that cumulatively, the Proposal will not result in a significant increase in the combined impacts within the regional area. The Proposal's implementation will not contribute to the reduction in regional vegetation extent by more than 4.9%, and all regional vegetation associations will remain above 80% when combined with other significant projects.

The clearing of vegetation, when assessed at a regional scale, will not lead to compounding impacts, resulting in significant effects on the identified environmental values and their connections, including the provision of habitat for conservation and culturally significant flora and fauna species.

The longer-term effects of the Proposal to the identified environmental values will be largely counterbalanced through progressive and post-mining rehabilitation works, which will seek to restore environmental values impacted through the implementation of the Proposal. Subject to the completion of successful rehabilitation, the Proposal will not result in a significant long-term effect on the identified environmental values of the local area.

Based on significant survey work and advice from Pilbara subject matter experts, the avoidance, mitigation, MEZ and offsets proposed across each relevant environmental factor also work together to reduce the combined impact of the holistic effects. These measures include:

- Reduction in overall Development Envelope to limit the extent of potential land disturbance and impacts to Weeli Wolli Creek, Pebble Mouse Creek, which has minimised potential impacts on sites of significant cultural value, in particular, Weeli Wolli Creek
- No below water table mining (no dewatering of the aquifer, no surplus water discharge) and limited impacts to water courses (no diversions of named creeks, no creek capture), and no expected impacts to regionally significant pools (located outside the Development Envelope)
- Water sourced from surplus water from HD1 or a borefield will not impact groundwater-dependent ecosystems, creeklines or pools/habitats supporting riparian vegetation, MNES and stygofauna values
- Reduction in the proposed Conceptual Footprint in areas that impact environmental or cultural values, including removing a waste rock landform south-east of HD2, ensuring the proposed Conceptual Footprint is limited to minimise impacts to the southern façade at BHT, avoiding impact to areas of Breakaway and Gorge/Gully landforms and habitats (that contain caves, a higher concentration of significant plant and animal species and preserves corridors of high value / Critical habitat for conservation significant fauna)
- Establishment of Mining Exclusion Zones to preserve significant biological and cultural values within the Development Envelope which recognises that the BHT deposit area has a concentration of the MNES values, both habitats and records of key species, and for this reason a large MEZ has been proposed to provide for broad habitat protection for all of the MNES species.
- Identification of culturally important and ecological areas within the Development Envelope to be recorded on the Rio Tinto GIS database as special places to influence final mine design
- Culturally important plants to be incorporated into closure and rehabilitation planning, including but not limited to, inclusion in revegetation seed mixes where suitable species are identified.

In consideration of the scale of the Proposal (4,900 ha of native vegetation clearing), the broader distribution of biological values across the local area and surrounds, the application of the mitigation hierarchy to minimise effects, and the established framework of EMPs and environmental offsets, when the separate environmental factors for the Proposal are considered together, the effects of the Proposal to the biological values are not considered to be environmentally significant nor inconsistent with the EPA's objectives.

14.2.2. Social Surroundings

The mining activities associated with the Proposal lie with the traditional lands of the Nyiyaparli People, and it is acknowledged that through their connection to Country, the link between the Traditional Owners and the environment is highly valued.

It is also acknowledged that permanent water sources and associated rock holes are of high ecological and cultural significance in the area, as they are indicators of the health of Country. This in turn reflects the health of culture. These reliable water sources and sand soaks were focal points within the landscape around which traditional daily activities and travel occurred. Further, flora and vegetation are

also considered to have cultural significance, and vegetation serves a variety of purposes for the Nyiyaparli People who utilised the area, serving as tools, food, and its association with spiritual and cultural beliefs. The knowledge and use of various plants by the Nyiyaparli People are indicative of the inherent ongoing connection Nyiyaparli People have to Country.

Reflecting their importance to the health and survival of the Nyiyaparli People, plants form part of the order of all forms of Nyiyaparli cultural life.

In noting the interconnections between the flora and vegetation, terrestrial fauna, inland waters and their importance to the Nyiyaparli People, there is potential that the Proposal may result in impacts to local sites of importance to the Nyiyaparli People through:

- Increased dust, noise and vibration levels as a result of mining and associated activities
- Changes to local landforms (including creation of pit voids and waste rock landforms) which will result in altered visual landscapes within the region and at specific areas supporting social, cultural and heritage values
- Disturbance of Country, places and sites of social, cultural and heritage significance
- Changes to Country, places and sites of social, cultural and heritage significance
- Altered social activities, relationships or cultural practices due to changes to special places.

As outlined in Section 11.5, impacts to cultural sites and values within and adjacent to the Proposal will be mitigated through:

- Avoidance of known significant areas, such as Weeli Wolli Creek
- Identification and recording of ‘Special Places’ including relevant exclusion zones
- Implementation of the HD2 Nyiyaparli SCHMP and the ACHMP (required under the ACH Act)
- Cultural awareness training of workforce
- Restrictions on workforce access to non-working areas of the Development Envelope
- Ongoing consultation and collaboration with the Nyiyaparli People on relevant aspects of mine planning and closure and rehabilitation planning
- Identification of areas to which the Nyiyaparli People wish to retain access during operations and/or post-closure to inform mine planning
- Facilitating access for Nyiyaparli People during operations and post-closure
- Mitigation measures if known special places or any other locations confirmed through consultation that are being maintained in-situ cannot be safely accessible to Traditional Owners.

In considering the above and noting the outcomes presented in Table 14-1 following the implementation of management and mitigation measures, the combined effects of the Proposal as a whole are no greater than the effects on individual factors when considered.

14.3. Conclusion

A holistic assessment of the Proposal’s impact on environmental factors, Flora and Vegetation, Terrestrial Fauna, Inland Waters and Social Surroundings has been considered in relation to the environmental principles and the EPA’s environmental objectives for each key environmental factor.

In considering the connections and interactions between environmental factors, including the broader distribution of biological values across the local area and surrounds, the application of the mitigation hierarchy to minimise effects, and the established framework of EMPs and environmental offsets, when the separate environmental factors for the Proposal are considered together, the effects of the Proposal

to the biological values are not considered to be environmentally significant nor inconsistent with the EPA's objectives.

The Proponent considers that the EPA objectives can be met for all six environmental factors by applying appropriate mitigation and management actions where relevant and through the provision of funding into the PEOF.

Table 14-1: Holistic Impact Assessment Summary

Environmental Effect	Holistic Impact	Mitigation and Management Measures	Offsets Relevant (Y/N)	Relevant EP Act Principles Considered	EPA Objective Achieved (Y/N)	Additional Mitigation Measures Required (Y/N)
Land disturbance	• Loss of priority flora individuals and supporting habitat • Clearing of habitat supporting conservation significant fauna species • Altered surface water regimes resulting in a potential increase in flooding and erosion events • Disturbance of plants and fauna of cultural significance (including culturally significant plants and animals) and their habitats due to the creation of permanent pit voids and waste rock landforms which will limit the ability to rehabilitate land to return it to pre-mining condition post closure	• Establishment of Mining Exclusion Zones to protect significant environmental and cultural areas and features, including avoiding impact to areas of Breakaway and Gorge/Gully landforms and habitats (that contain caves and a higher concentration of significant plant and animal species) • Reduction in the Development Envelope to exclude the area of Weeli Wolli Creek adjacent to HD2, which avoids disturbance within the modelled 1:100 AEP flood extent of Weeli Wolli Creek and to increase the separation distance of mining activities from the creek • Develop maps of culturally important ethnobotanical / ecological areas within the Development Envelope to be recorded on the Rio Tinto GIS database as special places • Culturally important plants to be considered in closure and rehabilitation planning,	Yes - monetary contribution will be made into the Pilbara Environmental Offset Fund.	• The principle of intergenerational equity • The principle of the conservation of biological diversity and ecological integrity	Yes – When considered holistically, the likely environmental effects from the Proposal will not result in combined environmental effects that significantly impact the environment as a whole	No

Environmental Effect	Holistic Impact	Mitigation and Management Measures	Offsets Relevant (Y/N)	Relevant EP Act Principles Considered	EPA Objective Achieved (Y/N)	Additional Mitigation Measures Required (Y/N)
		including but not limited to, inclusion in revegetation seed mixes where suitable species are identified • The proposed Conceptual Footprint has been amended to remove the waste rock landform near the HOPE4-07 heritage complex to avoid direct impacts to visual amenity in this area, and from Weeli Wolli Creek				
Sense of place (Social Surrounds)	• Increased dust, noise and vibration levels as a result of mining and associated activities • Alterations to surface water features of cultural value, through the construction of new crossings, diversions, and loss of catchment area • Disturbance of country, places and sites of social, cultural and heritage significance • Altered social activities, relationships or cultural practices due to changes to special places. • Changes to local landforms (including creation of pit voids and	• Identification and recording of 'Special Places' including relevant exclusion zones • Ongoing consultation and collaboration with Nyiyaparli Traditional Owners on relevant aspects of mine planning and closure and rehabilitation planning • Identification of areas to which Nyiyaparli Traditional Owners wish to retain access during operations and/or post-closure to inform mine planning • Facilitating access for Nyiyaparli People during operations and post-closure	• Not applicable	• The principle of intergenerational equity • The principle of the conservation of biological diversity and ecological integrity	Yes - When considered holistically, the likely environmental effects from the Proposal will not result in combined environmental effects that significantly impact the environment as a whole.	No

Environmental Effect	Holistic Impact	Mitigation and Management Measures	Offsets Relevant (Y/N)	Relevant EP Act Principles Considered	EPA Objective Achieved (Y/N)	Additional Mitigation Measures Required (Y/N)
	waste rock landforms) which will result in altered visual landscapes within the region and at specific areas supporting social, cultural and heritage values	• Mitigation measures if known special places or any other locations confirmed through consultation that are being maintained in-situ are unable to be kept safely accessible to Traditional Owners • Reduction in the proposed Conceptual Footprint to minimise impacts to access to culturally significant areas including any areas on which traditional practices are conducted and resources are collected • A 100 m buffer will apply to significant heritage site BDH16-03, within which all direct disturbance will be avoided (MEZ3) The Mine Closure Plan includes the following requirements: • Minimise dust accumulating on culturally important areas (including areas inhabited by important plants and animals) as designated by the Nyiyaparli People • Pebble Mouse Creek crossings and all linear infrastructure will be removed and rehabilitated				

Environmental Effect	Holistic Impact	Mitigation and Management Measures	Offsets Relevant (Y/N)	Relevant EP Act Principles Considered	EPA Objective Achieved (Y/N)	Additional Mitigation Measures Required (Y/N)
		at closure if no longer required for a future use				

15. CUMULATIVE IMPACT ASSESSMENT

Cumulative environmental impacts are the successive, incremental, and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities (EPA 2021[223]). The EPA (2021[223]) defines reasonably foreseeable future activities as:

“Third party (or proponent) activities which are already approved, are in a government approvals process, or are otherwise reasonably likely to proceed:

- For proposals assessed at the level of environmental review – at the time an Environmental Review Document for a proposal is accepted
- For proposals assessed at the level of assessment on referral information - at the time the final referral or required additional information is accepted
- Existing activities that are reasonably expected to be ongoing”.

15.1. Reasonably Foreseeable Projects

There are several existing and reasonably foreseeable iron ore mining projects within the Proposal region and, more broadly, within the Hamersley subregion of the Pilbara bioregion. Those projects in the Hamersley sub-region within 50 km of the Proposal are listed and described in Table 15-1 and shown in Figure 15-1. The projects within the Hamersley subregion occupy similar positions in the landscape and, therefore, encompass areas with fauna and flora assemblages that are comparable to the Proposal.

Table 15-1: Current and Forecast Mining Proposals within 50 km of the Proposal and in the Hamersley Subregion

Project	Status	Location
Rio Tinto Managed Operations		
Hope Downs 1 (including Baby Hope)	Existing	Adjacent
Hope Downs 4	Existing	42 km
West Angelas Iron Ore Mine (including deposits C, D and G)	Existing	28 km
West Angelas Iron Ore Mine (Revised Proposal)	Proposed	28 km
Yandicoogina Iron Ore Project	Existing	29 km
Koodaideri Iron Ore Mine and Infrastructure Project (now referred to as Gudai-Darri Project)	Existing	36 km
Third-party Operations		
Mining Area C (including Southern Flank) – BHP Billiton Iron Ore Pty Ltd (BHP)	Existing	15 km
Marillana Creek – Yandi – BHP	Existing	37 km
Central Marra Mamba – Wonmunna Iron	Existing	10 km
Iron Valley – Mineral Resources Limited	Existing	49 km

Further details of these projects are provided in Section 2.3.2.3.

RioTinto

Figure 15-1: Existing and Reasonably Foreseeable Projects within the Hamersley Subregion

Legend

- Development Envelope
- Airport
- Rio Tinto Mine
- Third Party Mine
- Rio Tinto Camp
- Third Party Camp
- Highway
- Major Road
- Minor Road
- Site Access Road
- Rio Tinto Railway
- Major Creek

Ministerial Statement

- 1020
- 1025
- 1038
- 1113
- 584
- 854
- 999

Land Administration Act Tenure

- General Lease
- Rio Tinto - Pastoral Lease
- Third Party - Pastoral Lease
- National Park
- Reserve

N

0 5 10 15

Kilometres

Map units in metres

Drawn: D von Holdt **Proj:** GDA 1994 MGA Zone 50
Plan: RTIO-0955969v1 **Scale:** 1:380,000 @ A3
Date: February 2023 ***gis.team@riotinto.com***

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650,000 700,000 750,000

7,500,000 7,450,000

Karijini National Park

Gudai-Darri

Gudai-Darri Exploration Camp

Gudai-Darri

Gudai-Darri Village

MARILLANA CREEK

N050471 Juna Downs Station

Spinifex Camp

Yandicoogina Barimunya

Yandi Camp (BHPBIO)

Iron Valley

Nyidinghu Camp

Yandi

Yandi Village

Yandicoogina

N050471 Juna Downs Station

N050368 Marillana Station

Karijini National Park

Packsaddle Camp

Mining Area C

Mulla Mulla Camp

Coondawanna

South Flank

Hope Downs 1

COONDINER CREEK

Hope Downs 1 Village

Great Northern Highway

Wonmunna

West Angelas Village

West Angelas

Wintamarra Village

West Angelas

Hope Downs 4

Hope Downs 4 Village

N050676 Turee Creek Station

Angelo River Camp

15.2. Summary of Cumulative Assessment for Key Environmental Factors

Cumulative environmental impacts have been assessed for each environmental factor. A summary of the cumulative impacts is provided below.

15.2.1. Flora and Vegetation

Cumulative impacts refer to the effect of the Proposal in addition to the combined, incremental effects of surrounding disturbing land uses to the environment resulting from other iron ore mining projects within the bounds of the Hamersley subregion and within 50 km of the Proposal. This section outlines the potential cumulative impacts to flora and vegetation values as a result of the Proposed Amendment and other surrounding mining activities either approved or currently under assessment.

Cumulative impacts have been considered against the following flora and vegetation aspects:

- Beard Vegetation Associations (Beard 1975)[8]
- Conservation Significant Flora

In undertaking a cumulative impact assessment, the following assumptions have been made:

- Cumulative impacts have been considered against both third-party operations and other Rio Tinto managed regional operations (Table 6-14),
- Cumulative impacts to flora and vegetation resulting from third-party operations are based on information available in the public domain for third party operators and does not encapsulate impacts for all third-party operations in the Pilbara.
- Cumulative impact calculations do not take into consideration areas outside of those assessed under Part IV of the EP Act for each relevant proposal.
- Priority flora taxa considered has been reduced to only those taxa that are identified as being impacted by this Proposal and in third-party approval documents
- The accuracy of data from external sources has not been verified and it is assumed that data publicly available is accurate and collected in accordance with standard industry guidelines
- Survey effort within the Pilbara is largely undertaken within mining tenure and there will be a resultant bias in the occurrence of species on mining and exploration tenements due to the increased survey effort taking place within mining tenure
- Cumulative impact calculations do not take into consideration areas outside of those assessed by each relevant proposal.

15.2.1.1. Native Vegetation

The Proposal will contribute to the following cumulative impacts at a regional scale:

- Clearing of native vegetation
- Removal of individuals of Priority flora species

Cumulative impacts have been considered within the bounds of the Hamersley subregion, based on an assessment of all major mining projects (current and foreseeable future projects) located within the same pre-European vegetation associations as the Development Envelope. There are ten projects within the bounds of the Hamersley subregion and within 50 km of the Proposal that had publicly accessible data on which the cumulative impact assessment could be based.

[8] Based on being the only regionally consistent and comparable vegetation dataset

Regional vegetation mapping at the scale completed for the Development Envelope is not available or in a format that is consistent and comparable across the Pilbara bioregion more broadly. Therefore, identifying and assessing potential cumulative impacts on vegetation types is limited to regional vegetation datasets, e.g. Beard's Vegetation Associations (Section 6.3.2.1).

The Proposal will necessitate the clearing of 4,900 ha of native vegetation, the majority of which is considered to be in Good to Excellent condition. Vegetation within the Development Envelope comprises two vegetation associations: Hamersley 18 and Hamersley 82 (Table 15-2). Implementation of the Proposal will not result in significant cumulative impacts to regional vegetation associations, with approximately 93% of pre-European extent for vegetation association Hamersley 82 remaining within the subregion and approximately 85% of vegetation association Hamersley 18 remaining.

Table 15-2: Pre-European Vegetation Associations within the Development Envelope (based on Beard 1975)

Vegetation Association and Description	Extent within the Hamersley Subregion			Formal Protection	Extent within the Development Envelope	
	Pre-European (ha)	Current (ha)	Percent Remaining	Percentage in Reserves	Hectares (ha)	Percentage of Current Extent
Hamersley_18 – low woodland, open low woodland or sparse woodland; mulga (*Acacia aneura*).	580,512	576,389	99.3%	29.6%	7,874	1.4%
Hamersley_82 – hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	2,168,702	2,156,558	99.4%	13.7%	4,535	0.2%

The cumulative effect iron ore mining operations on clearing of native vegetation at a regional scale (i.e. within the Hamersley sub-region) is presented in Table 15-3. The current extent of vegetation within the Hamersley subregion is 2,156,547 ha for vegetation association Hamersley 82 and 575,808 ha for vegetation association Hamersley 18.

It is noted that there is no publicly available data of impacts resulting from pastoral and/or grazing activities and, therefore, is not able to be included in cumulative impacts calculations.

The National Objectives and Targets for Biodiversity Conservation include avoiding clearance of existing vegetation with a pre-European extent of below 30% (Commonwealth of Australia 2001). Following the implementation of the Proposal and cumulative impacts from reasonably foreseeable projects, approximately 93% or more of pre-European extent for vegetation association Hamersley 82 will remain within the subregion and approximately 84% for vegetation association Hamersley 18.

Table 15-3: Cumulative Impacts on Beard (Beard 1975) Vegetation Associations within the Hamersley Subregion

Vegetation Association	Pre-European Extents (ha)	Current Extent (ha)	Clearing from this Proposal (ha (%))	Other Regional Projects	Cumulative Impact		Proposal Contribution (%)	Vegetation Remaining (%)
			Extent (ha)	Disturbance (ha)	Total Cumulative Disturbance (ha)	Cumulative Reduction in Current Extent (%)		
Hamersley 18 - low woodland, open low woodland or sparse woodland; mulga (*Acacia aneura*).	580,513	575,808	3,067	84,454	87,521	15.2	3.5	84.8
Hamersley 82 - hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	2,168,703	2,156,547	1,790	138,738	140,528	6.5	1.3	93.5

**Areas proposed to be cleared for each vegetation association are based on the area of the Development Footprints for reasonably foreseeable projects listed in Section 2.3.2.2 and 2.3.2.3.*

15.2.1.2. Significant Flora

Ten Priority flora species have the potential to be impacted cumulatively by the Proposal when considering other major projects within the Hamersley sub-region (Table 15-4). The estimate of the number of plants potentially impacted by other projects includes all individuals within their respective Proposal development envelopes, not the disturbance footprint as indicated by publicly available information. Several projects, such as the Flinders Pilbara Iron Ore Project (MS 924), do indicate the potential to disturb Priority species that occur within their development envelopes, but an estimated number of individuals is not provided. Due to this lack of data, these projects have been excluded from this cumulative assessment.

The Proposal does not significantly contribute to the cumulative impacts to most of the Priority flora species, as the proportion on individuals impacted as a result of implementation of the Proposal is less than 6% of the total known population (Table 15-4). The only exception is the Priority 4 species: *Lepidium catapycnon* (22%) of the known population could potentially be impacted by the Proposal.

Table 15-4: Cumulative Impacts on Significant Flora Species within the Hamersley IBRA Subregion

Taxon	Proposal – Total number of Individual Taxa Impacted	Other Regional Projects - Total Number of Individual Taxa Impacted	Total Cumulative Impact – Individuals	No. of Known Individuals	Proportion of Known Individuals Impacted by the Proposal (%)
Priority 2					
Aristida lazaridis (P2)	395	1,502	1,897	10,641	4
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	301	770	1,071	5,563	5
Priority 3					
Acacia subtiliformis	1	695	696	179,099	0
Eremophila naaykensii	182	6,163	6,345	13,628	1
Grevillea saxicola	143	351	494	4,929	3
Rhagodia sp. Hamersley (M. Trudgen 17794)	56	1,843	1,899	100,000	0.1
Triodia sp. Mt Ella (M.E. Trudgen 12739)	3,877	91,802	95,679	142,995	3
Priority 4					
Acacia bromilowiana	202	240	442	3,612	6
Lepidium catapycnon	8,494	219	8,713	38,156	22
Ptilotus mollis	284	1	285	6,495	4

As a result of the implementation of the Proposal, the cumulative impacts to most of the Priority flora species, as the proportion on individuals impacted as a result of implementation of the Proposal is less than 6% of the total known population (Table 15-4). The only exception is the Priority 4 species:

Lepidium catapycnon (22%) of the known (recorded) population could be impacted by the Proposal, leaving the majority of the population undisturbed by the Proposal and thus not considered to be a significant impact. *Lepidium catapycnon*'s preferred habitat includes shale like soils on hill slopes, this habitat is relatively common in the Development Envelope and the surrounding area and is a disturbance opportunist, being quick to recolonise areas impacted by minor disturbance such as tracks, ripping and fire. The species was delisted by DCCEEW in 2017.

Cumulative impacts of conservation significant flora species within the Development Envelope that occur across multiple nearby projects are not likely to alter the conservation status for any of the Priority flora species within the Development Envelope. Therefore, cumulative impacts to Priority flora are not expected to be significant.

15.2.2. Terrestrial Fauna

15.2.2.1. Significant Fauna

All significant fauna species that occur or are likely to occur within the Development Envelope may be affected by cumulative impacts from existing and foreseeable projects. Existing and reasonably foreseeable projects within the region that may contribute to cumulative impacts along with the Proposal are described in Chapter 2. Table 15-5 identifies the occurrence of conservation species within other project areas within 50 km of the Proposal.

All significant fauna species that occur or are likely to occur within the Development Envelope may be affected by cumulative impacts from existing or foreseeable projects. However, these species occur widely in the Hamersley sub-region (Table 15-5) and can move throughout the local landscapes. The retention of high value habitat will help maintain the significant fauna species within the sub-region.

The loss of high significance habitats for MNES is considered a significant residual impact for this and other projects and will be offset through the PEOF. Projects under the PEOF will be designed to provide conservation benefits for these species in the Hamersley sub-region.

15.2.2.2. Fauna Habitat

Detailed fauna habitat mapping has been completed in the Development Envelope; however, detailed mapping at the same scale and using consistent descriptors is not available for the Pilbara region. Land System mapping at a regional level by DPIRD provides an opportunity to assess cumulative impacts on broad landscape units, as a surrogate for fauna habitat.

A total of nine land systems are present within the Development Envelope. However, two of the systems, Egerton and McKay, have been removed from the assessment as neither will be impacted directly by the implementation of the Proposal. The cumulative losses on each of the land systems from current and foreseeable future operations within a 50 km radius of the Proposal are shown in Table 15-6.

Following the implementation of the Proposal the direct impact on each of the land systems will not exceed 1% of their extent in the wider Hamersley subregion, with the exception of the Pindering Land System which will have a 2.5% reduction. The cumulative impacts of this Proposal as well as current/future operations are not predicted to exceed 6.0% for most of the Land Systems. The exceptions being the Wannamunna, Pindering and Boolgeeda Land Systems which will have a reduction ranging between 11.2 and 12.6%.

The estimated cumulative impacts from this Proposal and reasonably foreseeable projects within the Hamersley subregion are anticipated to be 205,938 ha (5.7%; Table 15-6). The cumulative impacts on land systems are considered small (the highest loss is 12.6%) within the Pindering land system with 3,307 ha. Therefore, the full range of habitat types associated with these land systems will remain within the Hamersley subregion. Given that the habitat types will remain throughout the sub-region and that the species associated with the Proposal are known to occur throughout the region, the cumulative impact of these species are not expected to be significant.

The cumulative loss of vegetation and fauna habitat as a result of mining in the Hamersley sub-region is recognised as a potentially significant residual impact and therefore is proposed to be offset via the PEOF.

Table 15-5: Occurrence of Significant Fauna Species within Approved and Reasonably Foreseeable Projects within 50 km of the Proposal

Significant Fauna Recorded	Christmas Creek (30 km)	Hope Downs 4 (2 km)	West Angelas Deposits J, F and H (1 km)	Koodaideri Iron Ore Mine* (40 km)	Mining Area C Southern Flank (20 km)	Pilbara Expansion Strategic Proposal: Jinidi Iron Ore Mine (20 km)	West Angelas Deposits C, D and G (1 km)	Pilbara Expansion Strategic Proposal: Jinidi Iron Ore Mine (35 km)
Birds								
Grey Falcon	×	✓	✓	✓	✓	✓	✓	✓
Letter Wing Kite	×	×	×	×	×	×	×	×
Night Parrot	✓	×	×	×	×	✓	×	✓
Reptiles								
Pilbara Olive Python	✓	✓	✓	✓	✓	✓	✓	✓
Pilbara Barking Gecko	×	×	✓	×	✓	✓	✓	×
Gane's Blind Snake	×	✓	✓	×	✓	×	✓	✓
Lerista macropisthopus remota	×	×	×	×	×	×	×	×
Mammals								
Northern Quoll	✓	✓	✓	✓	✓	✓	✓	✓
Ghost Bat	×	×	✓	✓	✓	✓	✓	✓
Pilbara Leaf-nosed Bat	✓	×	✓	✓	✓	✓	✓	✓
Western Pebble-mound Mouse	✓	✓	✓	✓	✓	✓	✓	✓

** now referred to as the Gudai-Darri Iron Ore Mine*

Table 15-6: Cumulative Impacts on Land Systems within the Pilbara Region

Land System	Current Extent in Hamersley Subregion	Extent of Loss within Development Envelope		Extent of Loss in Current and Reasonably Foreseeable Future Projects*		Cumulative Impact	
Unit	Area (ha)	Area (ha)	% of Current Extent	Area (ha)	% of Current Extent	Area (ha)	% of Current Extent
Boolgeeda	607,323	707	<0.1	67,467	11.1	68,174	11.2
Calcrete	134,834	26	<0.1	2436	1.8	2,462	1.8
Newman	1,856,685	1,485	<0.1	99,914	5.4	101,399	5.5
Pindering	26,322	647	2.5	2,660	10.1	3,307	12.6
Platform	217,768	1,983	0.9	7,808	3.6	9,791	4.5
Rocklea	711,724	4	<0.1	13,266	1.9	13,270	1.9
Wannamunna	62,357	6	<0.1	7,529	12.1	7,535	12.1

*Areas proposed to be cleared for each land system are based on the area of the Development Footprints for the following projects: BHP's Mining Area C, BHP's Pilbara Expansion Strategic Assessment, Koodaideri Iron Ore Mine and Yandicoogina Iron Ore Expansions

15.2.3. Subterranean Fauna

15.2.3.1. Stygofauna

The negligible potential for the Proposal to impact on local stygofauna species and habitats given that the Proposal involves AWT mining only, and that no significant groundwater abstraction will be occurring, as discussed further in Section 15.2.4.2 below. This renders it improbable that the Proposal would then cause or contribute to significant cumulative impacts to other stygofauna communities, including those at Weeli Wolli Spring.

Neither the direct nor the cumulative impacts of the Proposal are likely to completely remove suitable habitats or their connections for any of these stygofauna species; therefore, the stygofauna species recorded from the Development Envelope are expected to persist following the implementation of the Proposal.

15.2.3.2. Troglofauna

Consideration of cumulative impacts on troglofauna habitats within the modelled extent has included the proposed operations within the Development Envelope and the nearby existing Hope Downs 1 operations, West Angelas operations, and BHP's Mining Area 'C' Southern Flank. Cumulative impacts will only impact troglofauna taxa whose distribution extends across two or more projects, although the cumulative impact is difficult to quantify. However, any impacts will be moderated by the retention of substantive connected troglofauna habitat in the Development Envelope following pit excavation (Stantec 2022).

Although difficult to predict, the likelihood of the Proposal causing or contributing to cumulative regional impacts to troglofauna values is considered to be very low.

15.2.4. Inland Waters

The following section outlines the potential cumulative impacts to inland water environmental values as a result of the Proposal and other surrounding mining activities either approved or currently under assessment. Cumulative impacts have been considered against the following inland water aspects:

- Surface water catchment area
- Groundwater drawdown.

In undertaking a cumulative impact assessment, a number of assumptions need to be made. For this assessment it has been assumed that:

- Cumulative impacts have been considered against the following projects
  - Rio Tinto managed – Hope Downs 1 operations and West Angelas operations
  - BHP – Mining Area C (North and South Flank)
- Cumulative impacts to inland waters resulting from third-party operations have been quantified based on information obtained from the public domain and does not encapsulate impacts for all third-party operations in the East Pilbara
- Cumulative impact calculations do not take into consideration areas outside of those assessed under Part IV of the EP Act for each relevant proposal
- The accuracy of data from external sources has not been verified and it is assumed that data publicly available is accurate and collected in accordance with standard industry guidelines
- Cumulative impact calculations do not take into consideration areas outside of those assessed by each relevant proposal

- Cumulative impacts to catchment areas resulting from Third-Party operations are conservative and based on information available in the public domain and may not represent the most accurate levels of disturbance.

15.2.4.1. Surface Water – Catchment Area

In the context of surface water, a review of potential cumulative impacts centred on catchment area reduction. The Proposal, Rio Tinto's existing Hope Downs 1 operations and BHP's South Flank and North Flank (Mining Area C) all occur within the Weeli Wolli catchment area. Table 9-17 summarises the cumulative impact to the Weeli Wolli Creek.

The total cumulative area of the Weeli Wolli Creek catchment impacted by the Proposal and surrounding operations is 22.6%, representing approximately 2% of the Fortescue Marsh catchment.

It is important to note that a reduction in catchment area is not a direct link to reduced surface water flow or volume. In considering the impact of this reduction, current modelling results (Section 9.4.1), show no significant reductions in surface water flow and volume modelling during mining operations.

At the sensitive receptors of Ben's Oasis and Weeli Wolli Springs, the cumulative loss of catchment area will not significantly impact these sites as:

- The local catchment area supporting Ben's Oasis is only impacted by the Proposal, which will reduce the catchment area by 0.2%. Additionally, given Ben's Oasis is sustained by the groundwater aquifer, its functioning is not reliant on surface water flow.
- Weeli Wolli Springs will be supported by the continued supplementation of water to the spring (as conditioned in MS 893), effectively offsetting the cumulative reduction in surface water flow to this receptor to maintain the values of the spring.

With regards to Pebble Mouse Creek, the catchment supporting this drainage line extends west of the GNH and will continue to experience typical flows following significant rainfall events. No mining activities directly impact (e.g. divert) the natural flow path of the Pebble Mouse Creek and all linear infrastructure crossings have and will be designed to maintain the existing flow regime.

Considering the above, and that the Proposal does not substantially contribute to cumulative reduction of the Weeli Wolli Creek catchment, no significant residual impacts to the environmental values of Weeli Wolli Creek, including Ben's Oasis and Weeli Wolli Spring are predicted to occur.

In its report and recommendations, the EPA stated that the potential for cumulative impacts from mine sites and the successful deployment of closure commitments is an important consideration in ensuring the future of Weeli Wolli Spring. The requirements of Hope Downs 1 Ministerial Statement (MS 893) to ensure that supplementation of Weeli Wolli Spring protects dependent environmental values. In addition, following closure, there is a requirement for the aquifer supporting the Weeli Wolli Spring to be replenished and re-establish a self-sustaining environment. Monitoring and compliance measures required under MS 893 will ensure that the environmental and cultural values of Weeli Wolli Spring are maintained.

Pebble Mouse Creek

Cumulatively, the Proposal and Hope Downs 1 operations will reduce the total catchment area by 8%. Modelling show water depths in Pebble Mouse Creek directly downstream of the HD2 pits will be reduced by approximately 0.1 m. Noting the sporadic flow of this creek and the management measures to be implemented, this reduction is not considered significant and will not result in downstream residual impacts on the Weeli Wolli Spring.

No significant residual impacts from the loss of catchment area attributable to the Proposal are expected.

15.2.4.2. Groundwater Drawdown

The regional Wittenoom aquifer which underlays the HD2 deposit is also subject to dewatering from the West Angelas operations and BHP's Mining Area C (South Flank). Drawdown contours from these operations are expected to extend into the Development Envelope. It is therefore likely that the abstraction for the Proposal will interact with, and further extend this drawdown.

When considered in the context of sensitive environmental receptors (Ben's Oasis and Weeli Wolli Spring), the cumulative effect of the drawdown is not expected to result in significant residual impacts as:

- Ben's Oasis, a groundwater dependent surface water feature, is understood to be sustained by groundwater flow from the south. Current hydrogeological conceptualization suggests that Ben's Oasis is isolated from HD2 by a combination of lithological hydraulic barriers and groundwater compartmentalization (Rio Tinto 2022b)
- Weeli Wolli Spring is not considered to be connected to the groundwater systems that coincide with the Proposal due to the presence of a southeast trending dyke located to the east of the BHT (Rio Tinto 2022b). As such it is considered that abstraction poses no risk to the Weeli Wolli Spring pools, located downstream from the Hope Downs 1 operations and outside of the HD2 groundwater system.

The existing mining at Hope Downs 1 operations involve BWT mining with surplus water managed via discharge to Weeli Wolli Creek. As concluded in the EPA's assessment of Weeli Wolli Creek (2018c), there appears to be enough distance between the dewatering bores at the mining developments so that there are no obvious spatial or temporal cumulative effects to the groundwater of the catchment and its values.

Given that the Proposal involves AWT mining only, and that no significant groundwater abstraction will be occurring, the Proposal will have negligible contribution to the existing groundwater drawdown related effects on the Weeli Wolli Creek catchment and its values.

Cumulatively, drawdown from HD2 production bores is not expected to extend into or interact with the HD1 aquifer due to location of geological barriers. As a result, it is expected that there will be negligible additional effects, as a result of the Proposal, on either Hope Downs 1 operations or BHP's Mining Area C existing drawdown.

15.2.5. GHG Emissions

Ore production included in the Proposal will sustain rather than increase annual throughput associated with the existing adjacent Hope Downs 1 operations. The Proposal will increase the total operational life within Hope Downs Hub as the approved deposits (HD1N, HD1S and Baby Hope) reach the end of their productive life.

As a result, the Hope Downs Hub (including the Proposal) is expected to contribute cumulatively approximately 178,991 t CO_2-e per annum (average), as follows:

- Scope 1 emissions: 169,644 t CO_2-e
- Scope 1 emissions (land clearing): 2,441 t CO_2-e
- Scope 2 emissions (consumption of electricity): 6,906 t CO_2-e.

The Proponent is committed to delivering emissions reductions in a linear trajectory (based on five-yearly targets) to net zero GHG emissions by 2050, through the mitigation hierarchy.

Cumulative impacts, when considered in combination with the adjacent Hope Downs 1 operations, will, overall result in a cumulative reduction in net emissions. This will be achieved through the implementation of the GHG EMP.

15.2.6. Social Surroundings

Consultation outcomes with Traditional Owners have highlighted concerns regarding cumulative impacts in the vicinity of the Proposal, as discussed in further detail in Section 11.5. This concern extends more broadly across the areas of their native title determinations. This broader consideration is discussed in Section 14.2.2.

The Proposal has the potential to contribute to cumulative impacts to Social Surroundings values at a regional scale through:

- Traditional Owner water-related cultural obligations, and to other groups upstream and downstream of the diversion along the two main creek systems (Pebble Mouse Creek and Weeli Wolli Creek)
- Traditional Owners have expressed the desire to manage Country holistically and for the Proposal impacts to be considered as together. Any impacts to individual sites, whether archaeological or ethnographic, must be considered not only in relation to the impacts to that site but also in terms of the potential impact it may have to the entire cultural landscape.
- Dust accumulation in water features and along drainage lines – including ecological and water quality effects and with respect to the enjoyment of place
- Noise, visual amenity, and visual landscapes in the region, which already has a number of mining operations in close proximity
- Plants and animals in the region, particularly the loss of individuals or populations of plants or animal species, loss of biodiversity and impacts to animals as a result of loss and fragmentation of habitat and migration pathways and social and cultural impacts of loss of culturally significant plants and animals.

Importantly, Traditional Owners are concerned that the above examples of potential cumulative impacts will impede their ability to care for Country - with animals moving away, or waterholes becoming covered with a film of dust, or some parts of Country no longer being accessible. Section 14.2.2 discusses the holistic impacts to Social Surroundings values.

The Proponent recognises these concerns regarding cumulative impacts and will seek to address them through ongoing consultation and the co-development of SCHMPs, where relevant.

15.3. Predicted Cumulative Outcomes

On the basis of the above assessment, the Proponent does not consider that the Proposal presents a significant risk relative to current, proposed or cumulative impacts for each key environmental factor.

Further, as discussed throughout this document, it is considered that the existing obligations and commitments prescribed under a range of regulatory instruments and decision-making processes, are appropriate to manage potential cumulative impacts associated with the Proposal in addition to new conditions proposed for consideration by the EPA.

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APPENDIX A CHAPTERS 1 TO 5

A.1: Environmental Scoping Document

A.2: EPBC Checklist

A.3: Proposal Content Document

A.4: Hope Downs 2 Draft Mine Closure Plan

A.5: Hope Downs 2 Proposal Consultation Register

A.6: Draft Hope Downs 2 Greenhouse Gas Environmental Management Plan

A.7: Draft Hope Downs 2 Matters of National Environmental Significance (MNES) Fauna Environmental Management Plan

APPENDIX B FLORA AND VEGETATION

B.1: Hope Downs 2 Proposal Flora and Vegetation Survey Report

B.2: Hope Downs Development Envelope Consolidated Vegetation Mapping Report

B.3: Targeted Riparian Values Assessment of the Greater Hope Downs 1 Area

APPENDIX C TERRESTRIAL FAUNA

C.1: Hope Downs 2 Proposal Fauna Survey Report

C.2: Hope Downs Development Envelope Consolidated Fauna Habitat Mapping Report

C.3: Hope Downs 2 Proposal – Ghost Bat Cave Characteristics Report

C.4: Hope Downs 2 Proposal – Ghost Bat Memo

C.5: Hope Downs 2 Proposal Grey Falcon Assessment Report

C.6: Hope Downs 2 Proposal Matters of National Environmental Significance Fauna Assessment Report

C.7: Hope Downs 2 Proposal Matters of National Environmental Significance Northern Quoll Monitoring – Phase 3 of 3 Results (July – October 2022) and Phases 1 to 3 Summary Report

C.8: Hope Downs 2 Short-Range Endemic Invertebrate Fauna Preliminary Risk Assessment

C.9: Hope Downs 2 Proposal – Long Term Motion Cameras

APPENDIX D SUBTERRANEAN FAUNA

D.1: Hope Downs 2 Proposal Level 2 Troglofauna Survey

D.2: Hope Downs 2 Proposal Level 2 Stygofauna Survey

APPENDIX E INLAND WATERS

E.1: Assessment of Surface Water Impacts on Sensitive Receptors in the Weeli Wolli Creek Catchment

E.2: Hydrogeological Assessment of the Hope Downs 2 and Bedded Hilltop Deposits

E.3: Baby Hope Hydrology & Hydraulic Assessment

APPENDIX F CONFIDENTIAL

F.1: Heritage Values – Confidential

F.2: Hope Downs 2 Traditional Owner Consultation Summary – Confidential

F.3: Draft Nyiyaparli Social and Cultural Heritage Management Plan – Confidential

F.4: Banjima Social Surrounds HD2 Report – Confidential

F.5: Nyiyaparli HD2 Social Surrounds Report – Confidential

F.6: Ngarlawangga HD2 Social Surrounds Reports – Confidential

F.7: HD2 Air Quality Modelling Report – Confidential

F.8: HD2 Noise and Vibration Report – Confidential

APPENDIX G OFFSETS

G.1: Progressive Rehabilitation Summary

G.2: Draft Hope Downs 2 Impact Reconciliation Procedure