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Environmental Review Document

Brockman Syncline Proposal

Hamersley Iron Pty Limited

Assessment Number: 2219

August 2023

Hamersley Iron Pty Limited

152-158 St Georges Terrace, Perth WA 6000

RTIO-0213320

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Disclaimer and Limitation

This report has been prepared by Rio Tinto's Iron Ore Group (Rio Tinto), on behalf of Hamersley Iron Pty Limited (the Proponent), specifically for the Brockman Syncline Iron Ore Project. Neither the report nor its contents may be referred to without the express approval of Rio Tinto unless the report has been released for referral and assessment.

Document Status						
Rev	**Author**	**Reviewer/s**	**Date**	**Approved for Issue**		
				To Whom	**GM Signature**	**Date**
A	ELA	Rio Tinto	October 2012	EPA Services		12.10.2022
B	Rio Tinto	Rio Tinto	May 2023	EPA Services		25.05.2023
C	Rio Tinto	Rio Tinto	August 2023	EPA Services		25.08.2023

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Invitation to make a submission

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

Hamersley Iron Pty Limited (the Proponent) proposes to develop the Brockman Syncline Proposal (the Proposal). The Proposal includes the extension and development of new above and below water table deposits and associated activities to extend the life of existing iron ore operations at Brockman Syncline 2, Brockman Syncline 4 and Nammuldi-Silvergrass. The Proposal is located approximately 60 km west-northwest of Tom Price in the central Pilbara region of Western Australia. The Proposal is located within the Native Title Determination Areas of the Puutu Kunti Kurrama and Pinikura People and the Eastern Guruma People.

The 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 which describes this proposal and its likely effects on the environment.

The ERD is available for a public review period of 8 weeks from 18 September 2023, closing on 13 November 2023.

Information on the Proposal from the public may assist the EPA to prepare 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.

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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 13 November 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

Other matters required by Schedule 4 of the EPBC Regulations is at Appendix A.1.

Task No.	Required work	Section and Page No.
Flora and Vegetation		
1	Identify and characterise the flora and vegetation of areas that may be directly or indirectly impacted by the proposal in accordance with the requirements of the EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (2016). This should include sampling more broadly to inform local and regional context. Demonstrate how surveys are relevant and consistent with current EPA policy and guidance. Ensure database searches and taxonomic identifications are up to date.	Section 7.3, pg. 171
2	Identify and describe the significant vegetation and significant flora species present and likely to be present within the conceptual footprint and wider development envelope and any areas that may be indirectly impacted by the proposal beyond the development envelope. Include an analysis of the significance of flora and vegetation in local, regional and State contexts as appropriate in accordance with the relevant guidance set out below.	Section 7.3, pg. 171
3	Provide maps depicting the recorded locations of the significant flora, listed ecological communities and significant vegetation in relation to the development envelope in accordance with the relevant guidelines set out below.	Section 7.3, pg. 171
4	Map weed occurrences in areas likely to be directly and indirectly impacted by the Proposal.	Section 7.3, pg. 171
5	Assess the potential direct and indirect impacts of the construction and operational elements of the proposal on identified environmental values, including the Brockman Iron cracking clay Priority Ecological Community (PEC) and Themeda grasslands on cracking clay Threatened Ecological Community (TEC). Include an assessment of impacts to groundwater/surface water dependent vegetation, including riparian vegetation. Include a quantitative assessment of levels of impact on significant flora, listed ecological communities and all vegetation units. Describe and assess the extent of any cumulative impacts within local, regional and State contexts as appropriate.	Section 7.4, pg. 251
6	Describe and justify any proposed mitigation to reduce the potential impacts of construction and operation of the proposal. Include any proposed management and/or monitoring plans that will be implemented pre- and post-construction to ensure residual impacts to identified environmental values (direct and indirect) are not greater than predicted.	Section 7.5, pg. 292
7	Identify, describe and quantify the potential residual impacts to identified environmental values (direct, indirect and cumulative) that may occur following implementation of the proposal after considering and applying avoidance and minimisation measures.	Section 7.6, pg. 310
8	Prepare a Mine Closure Plan, consistent with DMIRS Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (March 2020) and DMIRS Statutory Guidelines for Mine Closure Plans (March 2020), which includes methodologies to ensure progressive rehabilitation of disturbed land meets closure objectives, including vegetation composed of native species of local provenance.	Appendix B.4

Task No.	Required work	Section and Page No.
9	Provide a report that details the likely success of future Proponent rehabilitation activities in establishing self-sustaining areas of rehabilitation, taking into account: a. Evidence of success of rehabilitation undertaken by the Proponent to date in the region b. Relevant contemporary scientific evidence c. The types of area to be rehabilitated d. The scale of rehabilitation activities.	Appendix D.8
10	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Environmental Offset Guideline (2014, or any subsequent revisions).	Section 13.3, pg. 811
11	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 13.3, pg. 811
12	Where a contribution to the Pilbara Environmental Offsets Fund is proposed to offset 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 J.2
13	Maps and spatial data should be provided which defines the following areas across the entire development envelope for the Proposal and any other areas where impacts (direct and indirect) are predicted to occur: • Existing and/or already disturbed approved clearing (attributed with the relevant approval, such as Ministerial Statement number or native vegetation clearing permits). • Vegetation condition (e.g., completely degraded, degraded, poor, good, very good, excellent). • Specific flora/vegetation types proposed to be offset (e.g., riparian vegetation, priority ecological community, etc.). • Previous or existing offsets, if relevant.	Section 7.3, pg. 171 Section 13.4, pg. 822
14	Demonstrate in the ERD how the Proponent proposes to ensure the EPA objectives for this factor can be met.	Section 7.7, pg. 338 Section 15.2, pg. 1041
Terrestrial Fauna		
15	In accordance with the requirements of EPA Technical Guidance: a. Conduct a desktop study, incorporating existing regional terrestrial fauna surveys (including SRE invertebrate species) and databases; and b. Undertake terrestrial fauna (including short-range endemic (SRE) invertebrate species) surveys, in accordance with relevant EPA Technical Guidance, in all areas of impact, to identify and characterise terrestrial fauna and fauna habitat, at a local and regional scale, that may be impacted directly and indirectly by the implementation of the Proposal. This should	Section 8.2, pg. 340 Section 8.3, pg. 342

Task No.	Required work	Section and Page No.
	include sampling inside and outside the impact areas and consider cumulative impacts.	
16	Describe the values and significance of fauna and fauna habitat, including MNES fauna and MNES habitat, that may be impacted directly and indirectly by implementation of the Proposal during both construction and operations and describe the significance of these values in a local and regional context. Identify important or restricted habitats (e.g., breeding habitat, foraging/ feeding/ dispersal habitat).	Section 8.3, pg. 342
17	Provide figures and maps illustrating the recorded locations of conservation or other significant species and SRE invertebrate species in relation to the Proposal impact areas and fauna habitats.	Section 8.3, pg. 342
18	Describe and assess the extent of direct and indirect impacts as a result of implementation of the Proposal during both construction and operations to terrestrial fauna and MNES (Pilbara Leaf-nosed Bat {*Rhinonicteris aurantia* [Pilbara Form]}; Ghost Bat {*Macroderma gigas*}; Pilbara Olive Python {*Liasis olivaceus barroni*}; and Northern Quoll {*Dasyurus hallucatus*}) taking into consideration cumulative impacts and the significance of fauna and fauna habitat.	Section 8.4, pg. 468 Section 8.6, pg. 531 Section 14.5, pg. 937 Section 14.6, pg. 941 Section 14.7, pg. 965 Section 14.8, pg. 990
19	Quantify the extent of direct, indirect and cumulative impacts, including percentages of habitat types to be disturbed or otherwise impacted.	Section 8.4, pg. 468
20	Discuss known existing threats to any significant species, whether or not attributable to the Proposal, with reference to relevant impacts from the Proposal.	Section 14.5, pg. 937 Section 14.6, pg. 941 Section 14.7, pg. 965 Section 14.8, pg. 990
21	Describe and justify any proposed mitigation to reduce the potential impacts of construction and operation of the Proposal on significant terrestrial fauna. Include 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. Including for example, consideration of appropriate buffer zones around Pilbara Leaf-nosed Bat and Ghost Bat roost sites based on: • Discussion of the buffer zones around key/critical roost based on characteristics of the geology between the proposed disturbance and identified caves and the caves itself (i.e., fractures, sound transmissions, cave length, cave humidity/temperature (microclimate), direction). • Evaluation of the appropriateness of the proposed buffer width/distance based on the characteristics above.	Section 8.5, pg. 509 Section 14.9, pg. 1026
22	Demonstrate how the Proposal is consistent with relevant statutory recovery plans and threat abatement plans.	Section 14.2, pg. 842
23	Prepare a Mine Closure Plan consistent with DMIRS Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines for Mine Closure Plans (March 2020) which includes methodologies to ensure progressive rehabilitation of disturbed land meets closure objectives.	Appendix B.4
24	Provide a report that details the likely success of future Proponent rehabilitation activities in establishing self-sustaining areas of rehabilitation, taking into account:	Appendix D.8

Task No.	Required work	Section and Page No.
	a. Evidence of success of rehabilitation undertaken by the Proponent to date in the region b. Relevant contemporary scientific evidence c. The types of areas to be rehabilitated d. The scale of rehabilitation activities.	
25	Identify, describe and quantify the potential residual impacts (direct, indirect and cumulative) that may occur following implementation of the Proposal after considering and applying avoidance and minimisation measures.	Section 8.6, pg. 531 Section 14.10, pg. 1039
26	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Environmental Offsets Guidelines (2014, or any subsequent revisions).	Section 13.3, pg. 811
27	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 13.3, pg. 811
28	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 J.2
29	Maps and spatial data should be provided which defines the following areas across the entire development envelope for the Proposal and any other areas where impacts (direct and indirect) are predicted to occur: • Existing and/or already approved clearing (attributed with the relevant approval, such as Ministerial Statement number or native vegetation clearing permits). • Habitat condition (e.g., completely degraded, degraded, poor, good, very good, excellent). • Specific fauna habitats of the species proposed to be offset (attributed with the habitat type, e.g., denning, roosting, foraging etc.). • Previous or existing offsets, if relevant.	Section 8.3, pg. 342 Section 13.4, pg. 822
30	In the circumstances that offsetting of residual significant impacts on MNES is a requirement, and the WA State Environmental Offset Fund is not yet endorsed by DAWE, include discussion of the consideration of the EPBC *Environmental Offsets Policy* including, but not limited to: • The extent to which the proposed offset correlated to the residual significant impacts on MNES. The conservation gains to be achieved by the proposed offset, i.e., averting future loss, degradation or damage to the protected matter.	Not applicable as the Pilbara Environmental Offset Fund contributed by the industry, as environmental offset monies, is collected and deployed under both State and Commonwealth environmental legislation.
31	Demonstrate in the ERD how the Proponent proposed to ensure the EPA objective for this factor can be met.	Section 8.7, pg. 561 Section 15.2, pg. 1041

Task No.	Required work	Section and Page No.
Subterranean Fauna		
32	In accordance with EPA Technical Guidance: a. Conduct a desktop study, incorporating existing regional subterranean fauna surveys and databases b. Undertake surveys, in accordance with the requirements of relevant EPA Technical Guidance, in all areas of impact, to identify and characterise subterranean fauna and subterranean fauna habitat, at a local and regional scale that may be impacted directly and indirectly by the implementation of the Proposal. This should include sampling inside and outside the impact areas and consider cumulative impacts.	Section 9.2, pg. 563 Section 9.2, pg. 563
33	Describe the characteristics of subterranean fauna habitat that may be impacted directly and indirectly by implementation of the Proposal during both construction and operations and describe the significance of these values in a local and regional context. Include relevant geological and hydrological information to determine habitat suitability and connectivity, including inside and outside the impact areas.	Section 9.2, pg. 563
34	Provide figures and maps showing the extent of subterranean fauna habitat in relation to the Proposal and species distributions.	Section 9.2, pg. 563
35	Describe and assess the extent of direct, indirect and cumulative impacts as a result of implementation of the Proposal during both construction and operations to subterranean fauna, taking into consideration the significance of fauna and fauna habitat.	Section 9.4, pg. 632 Section 9.5, pg. 649
36	Quantify the extent of direct, indirect and cumulative impacts, including where feasible, percentages of habitat types to be disturbed or otherwise impacted.	Section 9.4, pg. 632 Section 9.5, pg. 649
37	Describe and justify any proposed mitigation to reduce the potential impacts of construction and operation of the Proposal. Include 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 predicated.	Section 9.6, pg. 653
38	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Environmental Offsets Guidelines (2014, or any subsequent revisions).	Section 13.3, pg. 811
39	Where significant residual impacts remain, propose an appropriate draft offsets package that is with due consideration to the WA Environmental Offsets Policy and Guidelines (or any subsequent revisions).	Section 13.3, pg. 811
40	Prepare a Mine Closure Plan, consistent with DMIRS Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (March 2020) and DMIRS Statutory Guidelines for Mine Closure Plans (March 2020) which includes consideration of backfilling mine pits, final landforms and rehabilitation of disturbed areas.	Appendix B.4
41	Demonstrate in the ERD how the Proponent proposes to ensure the EPA objective for this factor be met.	Section 9.7, pg. 653

Task No.	Required work	Section and Page No.
Inland Waters		
42	Characterise the baseline hydrological and hydrogeological regimes, ecological values and water quality, both in a local and regional context, including, but not limited to, catchment boundaries, creek flows, flood patterns, groundwater levels, aquatic fauna assemblages and water quality.	Section 6.3, pg. 74
43	Provide a hydrogeological assessment for the Proposal (including drillings, test pumping and groundwater modelling).	Section 6.3, pg. 74
44	Describe and map water dependent ecosystems which may be impacted by changes to hydrological/hydrogeological regimes. Describe/map the area of potential impact, including areas that are downstream and outside of the development envelope.	Section 6.3, pg. 74
45	Provide a detailed description of the design and location of the Proposal (including maps/figures where appropriate) as it relates to potential impact surface or groundwater.	Section 6.4, pg. 127
46	Provide a numerical groundwater model and surplus water discharge model for the Proposal.	Section 6.3, pg. 74
47	Provide a conceptual site water balance model over the life of the Proposal and provide an assessment of water management options and discuss the capacity to reuse surplus mine dewater. Demonstrate application of the waste hierarchy to minimise discharge of surplus mine dewater to mine pits, surface water and via aquifer reinjection.	Section 6.3, pg. 74
48	If surplus discharge is required, include predictions of the extent of the wetting front and assess any environmental impacts from changes flow regimes.	Section 6.4, pg. 127
49	If aquifer reinjection is required, undertake groundwater modelling to demonstrate potential impacts.	Section 6.4, pg. 127
50	Where pit lakes are proposed to be retained include details on the pit lake characteristics (e.g., flow-through or sink) to inform further studies and closure objectives, completion criteria and preliminary management measures for the Mine Closure Plan.	Section 6.4, pg. 127
51	Assess the nature, extent and duration of potential impacts of groundwater abstraction with a focus on possible impacts to groundwater dependent ecosystems.	Section 6.4, pg. 127
52	Characterise geochemical and physical properties of waste rock and waste fines to allow an assessment of the potential risk from waste rock dumps and waste fines storage facilities, including consideration of neutral mine drainage.	Section 6.3, pg. 74
53	Analyse, discuss and assess potential groundwater and surface water impacts (direct, indirect and cumulative). This analysis should include, but not be limited to: • Changes in groundwater levels and surface water flows associated with the proposal • Presence of PAF materials and risks associated with Acid Mine Drainage (AMD) • Changes in groundwater and surface water chemistry • Assessment of the function, reliance and potential impacts to groundwater dependent vegetation • Assessment and description of direct and indirect impacts to aquatic fauna through drawdown, discharge or changes to hydrological regimes	Section 6.4, pg. 127

Task No.	Required work	Section and Page No.
	• The nature, extent and duration of the potential impacts • Impacts to the environmental values of significant receptors. Impacts associated with the post-closure formation of permanent pit lakes.	
54	Apply the mitigation hierarchy and discuss proposed objectives/outcomes, monitoring, management and mitigation measures where necessary to be implemented to appropriately avoid and minimise impacts to inland waters.	Section 6.5, pg. 145
55	Prepare a Closure Plan consistent with DMIRS Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (March 2020) and DMIRS Statutory Guidelines for Mine Closure Plans (Match 2020), which includes criteria to ensure hydrological regimes and the quality of groundwater and surface water resources are suitable so that any dependent environmental values are maintained post closure.	Appendix B.4
56	Demonstrate in the ERD how the Proponent proposes to ensure the EPA objective for this factor can be met.	Section 6.7, pg. 168
Social Surroundings		
57	Characterise and describe the social, cultural and heritage values within the Development Envelope and any sensitive receptors that may be directly or indirectly impacted as a result of this Proposal to identify sites of social significance and their significance within a regional context, in consultation with the Traditional Owners.	Section 12.3, pg. 729
58	Conduct investigations, including ethnographic and archaeological surveys in consultation with the Traditional Owners, to determine the significance of potential impacts (direct, indirect and cumulative) to social surroundings as a result of this Proposal.	Section 12.2, pg. 728
59	Describe and assess the potential impacts (direct, indirect and cumulative) 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 12.4, pg. 753
60	Prepare a Social, Cultural and Heritage Management Plan which provides evidence of consultation with relevant stakeholders and specifies how the Proponent will minimise impacts to social, cultural and heritage values within the Development Envelope.	Appendix I.1
61	Apply the mitigation hierarchy and discuss proposed objectives/outcomes, monitoring, management and mitigation measures where necessary to be implemented to appropriately avoid and minimise impacts to social surroundings.	Section 12.5, pg. 772
62	Prepare a Mine Closure Plan consistent with DMIRS Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (March 2020) and DMIRS Statutory Guidelines for Mine Closure Plans (March 2020), which considers social surroundings.	Appendix B.4
63	Demonstrate in the ERD how the Proponent proposes to ensure the EPA objective for this factor can be met.	Section 12.7, pg. 806 Section 15.2, pg. 1041

Task No.	Required work	Section and Page No.
Air Quality		
64	Describe the environmental setting of the Proposal in relation to proximity to sensitive receptors.	Section 10.3, pg. 692
65	Describe the scale and nature of power generation/combustion activities associated with the Proposal.	Section 11.3, pg. 712
66	Characterisation of greenhouse gas emission sources from the Proposal.	Section 11.3, pg. 712
67	Estimation of expected Scope 1 (direct) and Scope 2 (indirect) greenhouse gas emissions in accordance with the National Greenhouse and Energy Reporting Act 2007 (NGER Act) and analysis of greenhouse gas intensity (i.e., quantity of CO2-e generated per tonne of product produced) and comparison with published benchmarked practices.	Section 11.3, pg. 712
68	Demonstrate application of hierarchy to avoid and minimise impacts to air quality (including greenhouse gases)	Section 10.5, pg. 700 Section 11.5, pg. 716
69	Prepare a Greenhouse Gas Management Plan which predicts the extent, severity, and duration of any residual impacts associated with greenhouse gas emissions from the project that may be expected after implementing the proposed management and mitigation measures.	Appendix H.1
70	Demonstrate in the ERD how the Proponent proposes to ensure the EPA objectives for this factor can be met.	Section 10.6.4.1, pg. 708 Section 11.7, pg. 727 Section 15.2, pg. 1041

EXECUTIVE SUMMARY

Overview

Hamersley Iron Pty Limited (the Proponent) proposes to develop the Brockman Syncline Proposal (the Proposal).

The Proposal includes a proposed consolidation and modernisation of the Ministerial Statements (MS) for three existing operations, namely:

- Brockman Syncline 2 (BS2) – authorised under MS 131 and MS 867
- Brockman Syncline 4 (BS4) – authorised under MS 1000
- Nammuldi-Silvergrass – authorised under MS 925.

Mining by the Proponent commenced in 1998, and this project maximises the utilisation of existing infrastructure in this iron ore hub.

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 to report on the Proposal's potential environmental impacts and their mitigation. It will be made available for public comment.

The Proposal is located approximately 60 km west north-west of Tom Price, in the central Pilbara region of Western Australia (WA). The Proposal is located within the Native Title Determination Areas of the Puutu Kunti Kurrama and Pinikura People and the Eastern Guruma People (Figure ES1). Extensive consultation with the Traditional Owners has resulted in substantial changes to the Proposal's design and improved social and environmental outcomes.

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

ES Table 1: General Description of the Proposal

General Proposal Description	
Proposal Title	Brockman Syncline Proposal
Proponent Name	Hamersley Iron Pty Ltd (Australian Company Number 004 558 276)

Short Description	The Brockman Syncline Proposal (the Proposal) is located approximately 60 km west-northwest of Tom Price in the central Pilbara region of Western Australia (Figure ES1). The Proposal is located within the Native Title Determination Areas of the Puutu Kunti Kurrama and Pinikura People and the Eastern Guruma People.
	
	The Proposal includes the extension and development of new above and below water table deposits and associated activities to extend the life of existing iron ore operations at Brockman Syncline 2, Brockman Syncline 4 and Nammuldi-Silvergrass (Figure ES2).
	
	The Proposal also includes, but is not limited to the following:
	• Development of new deposits and extensions of existing operations, including above the water table and below the water table mining
	• Ore processing, transport and handling infrastructure
	• Ore, topsoil and subsoil stockpiles
	• Mineral waste management, including but not limited to:
	  ○ Waste rock landforms
	  ○ In-pit storage of waste fines
	  ○ Land bridges
	  ○ Low-grade ore dumps

General Proposal Description	

	• Surface water management infrastructure, including but not limited to:
	  ○ Diversion drains
	  ○ Levees
	  ○ Culverts
	• Infrastructure for groundwater abstraction and utilisation
	• Dewatering and surplus water management, including but not limited to:
	  ○ Use in ore processing
	  ○ On-site use, including discharge to disused pits
	  ○ Use at the Nammuldi irrigated agriculture project
	  ○ Injection to the aquifer
	  ○ Provision to other users
	  ○ Discharge to creek lines
	• Other associated mine infrastructure and support facilities and upgrades, including but not limited to:
	  ○ Workshops
	  ○ Hydrocarbon and ANFO storage
	  ○ Laydown areas, offices and accommodation facilities
	  ○ Linear infrastructure, including but not limited to:
	  - Heavy and light vehicle access roads
	  - Conveyors
	  - Pipe and power lines (including sub-stations)
	  - Utilities and Communications distribution networks
	  - Rail and associated infrastructure
	  - Renewable energy infrastructure.

ES Table 2: Proposal Elements

Element	Location	Approved Proposal Extent (MS 131, 867, 925 and 1000)	Proposal	Amended Proposal
Physical Elements				
Mine and associated infrastructure	Figure ES2	• MS 131 and 867: No clearing limit specified (estimated at 1,106 ha) • MS 925: Clearing of up to 6,300 ha of native vegetation within the Nammuldi-Silvergrass Development Envelope • MS 1000: Clearing of no more than 4,503 ha within the Brockman 4 Development Envelope	Additional clearing of 7,896 ha within a 63,343 ha Development Envelope	Clearing of up to 19,805[1] ha within a 63,343 ha Development Envelope
Irrigated Infrastructure	Figure 2-2	Clearing of up to 2,500 ha within the Nammuldi Irrigated Area within the Development Envelope	No change	Clearing of up to 2,500 ha within the Nammuldi Irrigated Area within the 63,343 ha Development Envelope
Operational Elements				
Groundwater abstraction for water supply and mine dewatering	N/A	• MS 925: Groundwater abstraction of 51 GL/a at Nammuldi and 68 GL/a at Silvergrass • Undefined for MS 131, 867 and 1000	Abstraction of up to 50 GL/a	Abstraction of up to 50 GL/a
Management of Surplus Water	Figure 2-4	• MS 131 and MS 867: Discharge of excess water to Pit 5 at 950 ML/a • MS 925: Transfer for offsite use; transfer to the Irrigated Agriculture Area and periodic discharge to Duck Creek	• Surplus water management options include: • Use on site • Discharge to disused pits • Irrigated agriculture at Nammuldi	• Surplus water management options include: • Use on site • Discharge to disused pits • Irrigated agriculture at Nammuldi

[1] The Proposed Action, under the EPBC Act, includes the extension and development of new above and below water table deposits and associated activities to extend the life of Existing Operations with a total clearing of 7,896 ha. The Proposed Action does not include the Existing Operations.

Element	Location	Approved Proposal Extent (MS 131, 867, 925 and 1000)	Proposal	Amended Proposal
		• MS 1000: Dewatering disposal through controlled discharge to surface drainage of Boolgeeda Creek. Dewater discharge to extend no further than 37 km along Boolgeeda Creek from the discharge point under natural no-flow conditions	• Injection to the aquifer • Provision to other users • Controlled discharge to the environment via Duck and Boolgeeda Creek with a wetting front not exceeding 67 and 37 km respectively, under natural no-flow conditions.	• Injection to the aquifer • Provision to other users • Controlled discharge to the environment via Duck and Boolgeeda Creek with a wetting front not exceeding 67 and 37 km respectively, under natural no-flow conditions.
Backfill of Pits	N/A	• Partial backfill of Pits 1, 4, 4 extension, 5 and 6 at BS2[2] • Backfill of BS2 pit to sufficient depth to ensure that, following mine closure and backfilling, the groundwater water table will permanently remain at least 3 metres below the lowest point of the pit floor[3] • All open cut Marra Mamba pits in the Silvergrass area to be backfilled to above the post-mining water table levels[4]	• Backfill of BS3 Extension Deposits (MMJ and Creekside)	• Partial backfill of Pits 1, 4, 4 extension, 5 and 6 at BS2[2] • Backfill of BS2 pit to sufficient depth to ensure that, following mine closure and backfilling, the groundwater water table will permanently remain at least 3 metres below the lowest point of the pit floor[3] • All open cut Marra Mamba pits in the Silvergrass area to be backfilled to above the post-mining water table levels[4]

[2] Previous condition required under MS 131

[3] Previous condition required under MS 867

[4] Previous condition required under MS 925

Element	Location	Approved Proposal Extent (MS 131, 867, 925 and 1000)	Proposal	Amended Proposal
		• BS4 Mine Pits are to be backfilled so that the final surface levels are at a higher elevation than the pre-mining groundwater level to prevent the formation of pit lakes (Pits 2, 3, 4, 5, 6, 7, 10, 11, 12, 15, 16, 17 and 18)[5]		• BS4 Mine Pits are to be backfilled so that the final surface levels are at a higher elevation than the pre-mining groundwater level to prevent the formation of pit lakes (Pits 2, 3, 4, 5, 6, 7, 10, 11, 12, 15, 16, 17 and 18)[5] • Backfill of BS3 Extension Deposits (MMJ and Creekside) to above post mining recovered water levels
Proposal Elements with Greenhouse Gas Emissions				
Scope 1[6]		Diesel and land clearing – no more than 497,046 t CO_2-e p/a		
Scope 2[6]		Electricity – no more than 84,080 t CO_2-e p/a		
Scope 3[7]		1,014 Mt CO_2-e		
Rehabilitation and Closure				
• The key closure outcome is to rehabilitate the site to create a safe, stable and non-polluting landscape consistent with the post-mining land use and to maintain environmental and cultural heritage values. • Rehabilitation and closure activities will be carried out in accordance with the approved Mine Closure Plan (MCP).				
Other Elements which Affect the Extent of Effects on the Environment				
Proposal Time		Maximum project life	Operational phase is estimated at 25 years (not including construction and closure implementation phases).	

[5] Previous condition required under MS 1000

[6] Predicted peak annual emissions associated with the Amended Proposal

[7] Attributable to this Proposal

Figure ES1
Location of the Brockman Syncline Proposal

Drawn: GIS Team
Plan: PDE0182233v1
Date: June 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:1,250,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Rio Tinto Port
- Town
- Development Envelope
- Native Title Determination Area
- National Park
- Rio Tinto Railway
- Conveyor
- Highway
- Major Road
- Minor Road
- Site Access Road

Enlargement

Mount Brockman Road
Eastern Guruma
Silvergrass
Nammuldi
Brockman 2
Brockman Syncline
Brockman 4
Puutu Kunti Kurrama and Pinikura
White Quartz Road
Western Turner Syncline
0 5 10 15 20 Kilometres

See Enlargement

Murujuga National Park
Cape Lambert
Dampier
Wickham
Karratha
Roebourne
North West Coastal Highway
Millstream-Chichester National Park
Pannawonica
Mesa A
Mesa J
Great Northern Highway
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Eastern Guruma
Puutu Kunti Kurrama and Pinikura
Brockman Syncline
Western Turner Syncline
Tom Price
Mount Tom Price
Marandoo
Karijini National Park
Gudai-Darri
Yandicoogina
Hope Downs 1
Hope Downs 4
West Angelas
Paraburdoo
Eastern Range
Channar
Newman

400,000 450,000 500,000 550,000 600,000 650,000 700,000 750,000
7,750,000 7,700,000 7,650,000 7,600,000 7,550,000 7,500,000 7,450,000



N

0 15 30 45 60
Kilometres
Map units in metres

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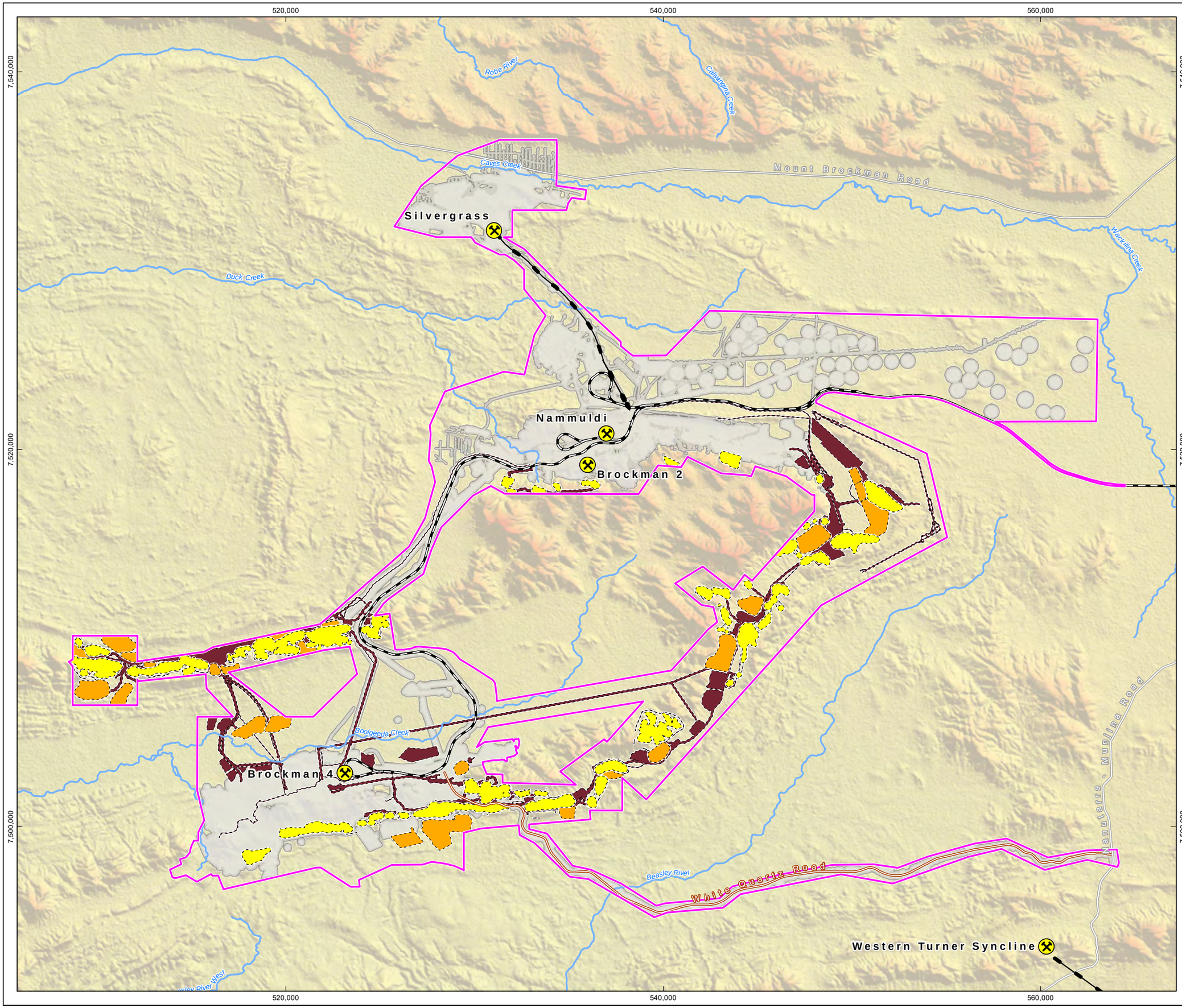

RioTinto

Figure ES2 Development Envelope and Indicative Location of Key Proposal Elements

Drawn: L.Fuentes
Plan: PDE0182235v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8
Kilometres

Map units in metres

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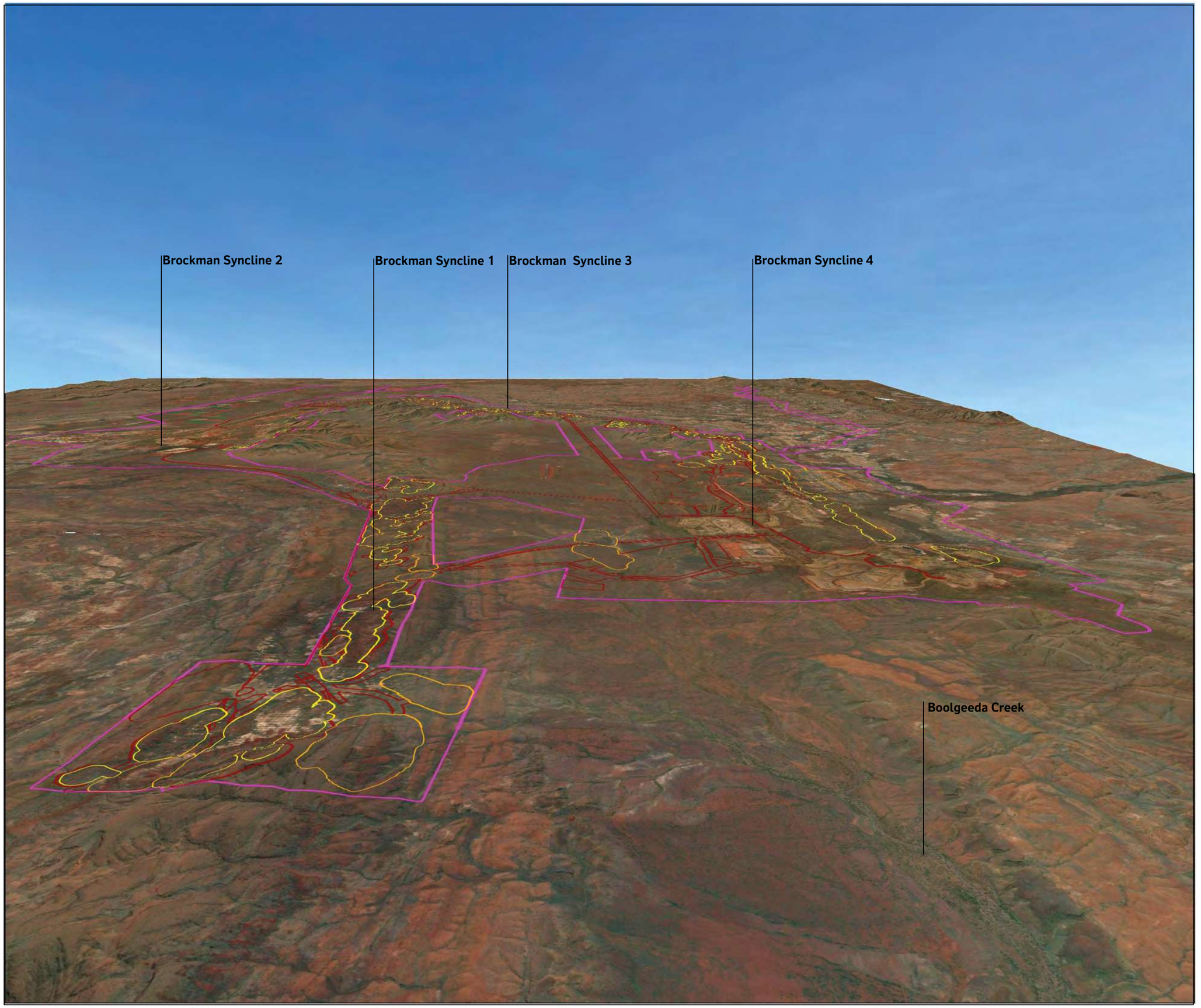

RioTinto

Figure ES2a Development Envelope and Indicative Location of Key Proposal Elements Looking East

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

Development Envelope

Conceptual Footprint

Pit

Waste Rock Landform

Infrastructure

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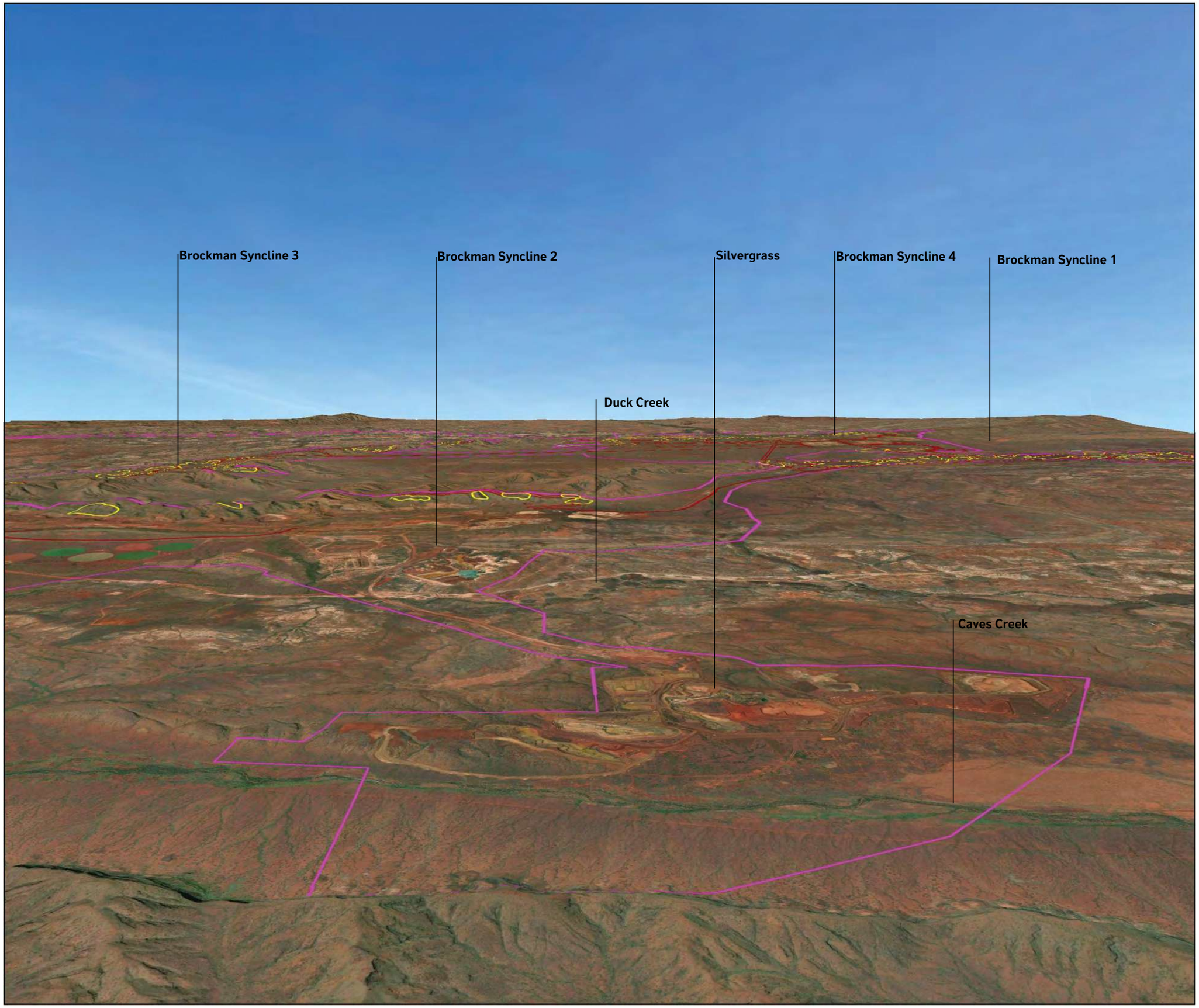

RioTinto

Figure ES2b
Development Envelope and Indicative Location of Key Proposal Elements Looking South

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
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Legend

- Development Envelope

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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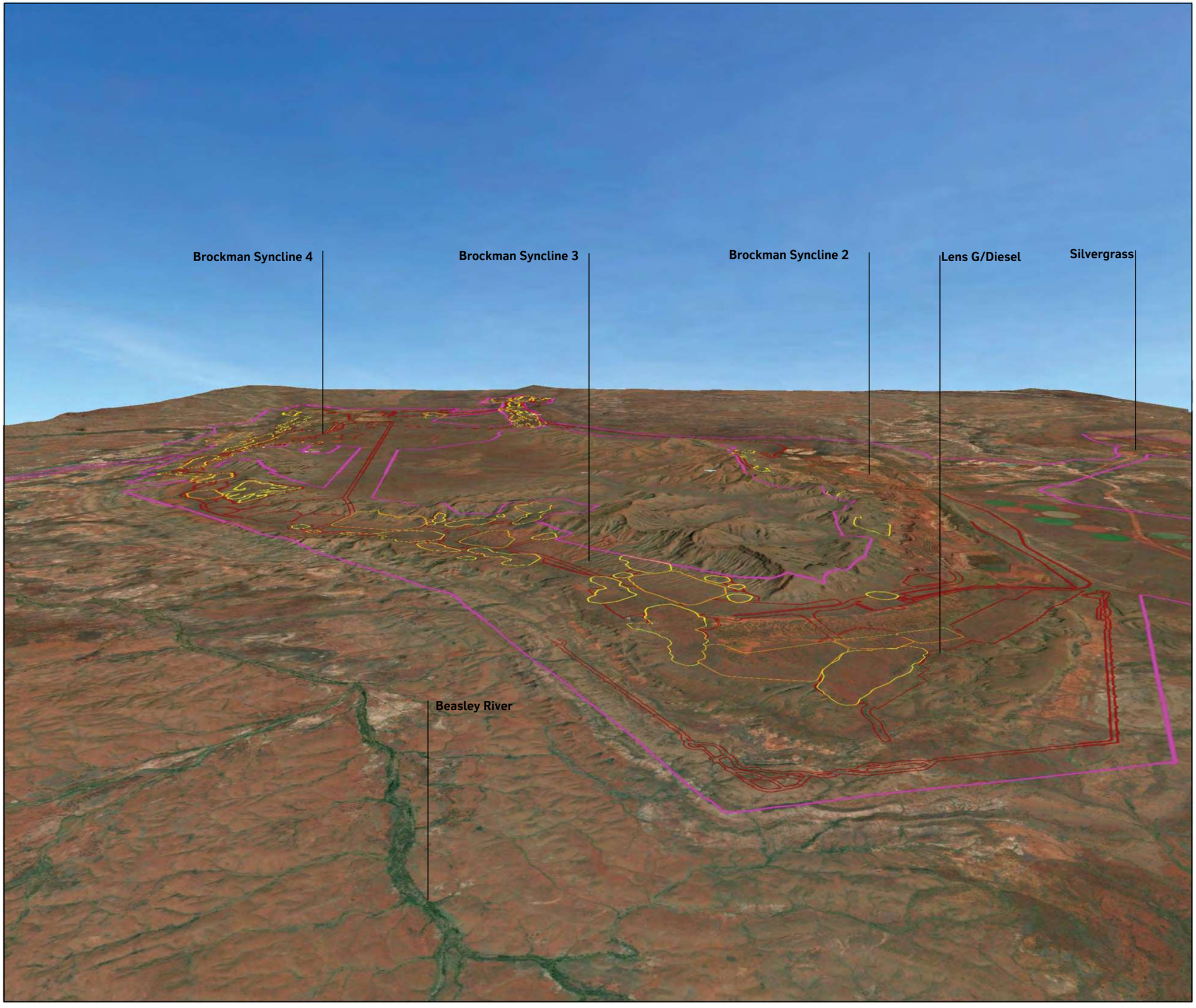

RioTinto

Figure ES2c
Development Envelope and Indicative Location of Key Proposal Elements Looking West

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

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Legend

- Development Envelope

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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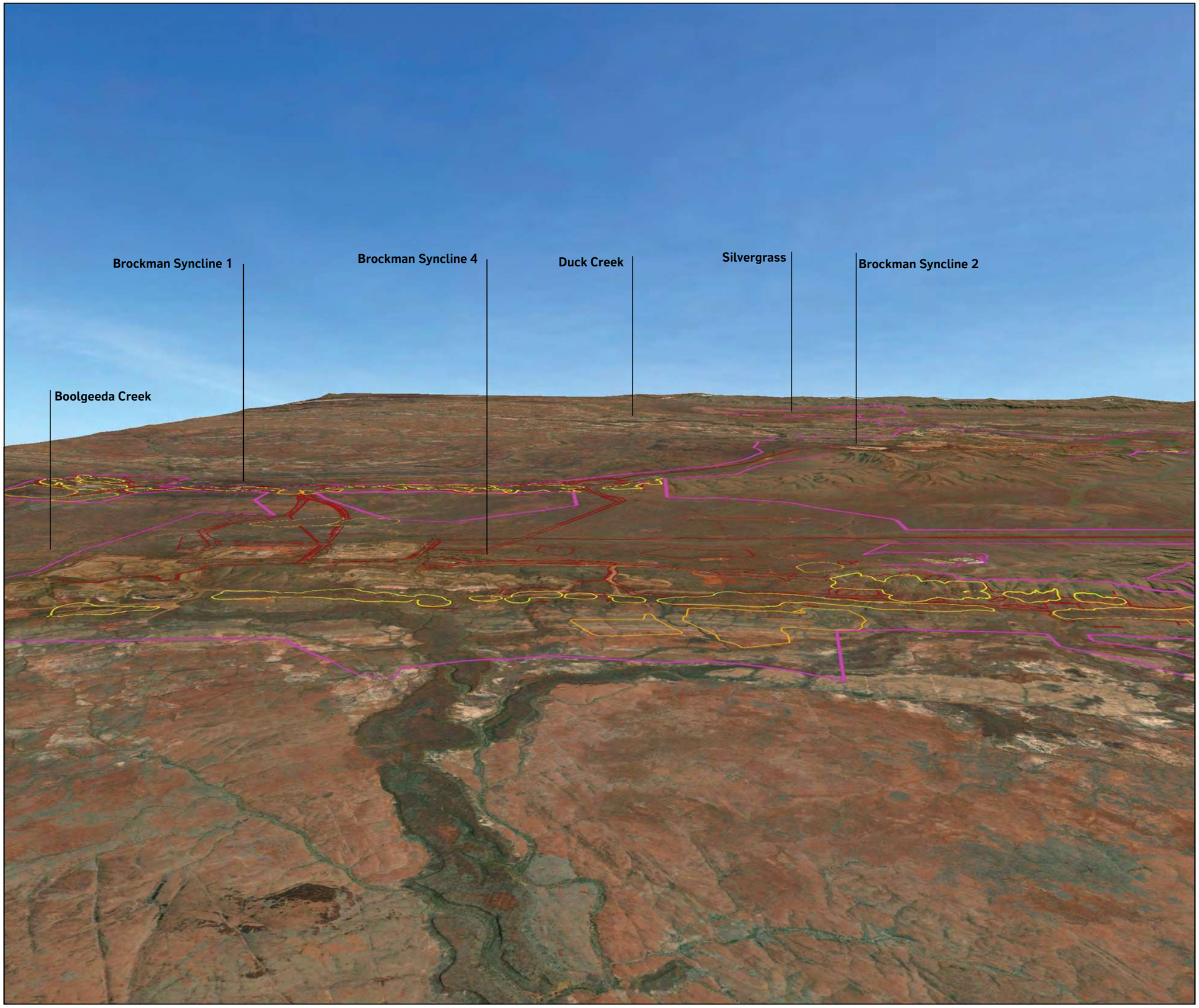

RioTinto

Figure ES2d Development Envelope and Indicative Location of Key Proposal Elements Looking North

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

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Legend

Development Envelope

Conceptual Footprint

Pit

Waste Rock Landform

Infrastructure

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Key Environmental Factors

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

- Inland Waters (Section 6)
- Flora and Vegetation (Section 7)
- Terrestrial Fauna (Section 8)
- Subterranean Fauna (Section 9)
- Air Quality (Section 10)
- Greenhouse Gas Emissions (Section 11)
- Social Surroundings (Section 12).

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 Section 14.

Cumulative Impacts

The Proposal is located within the Pilbara bioregion and the Hamersley subregion, both subject to pressure 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 six major iron ore projects within 100 km of the Proposal, in addition to the Proponent’s existing iron ore operations at Nammuldi-Silvergrass, Brockman 2 and Brockman 4. Therefore, the Proponent has considered the Proposal's potential to impact further environmental values already affected by 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 on surface and groundwater regimes might change outcomes for environmental values. The review of social and cultural values has identified concern amongst Traditional Owner groups about cumulative dust impacts, and the Proponent is committed to working innovatively to minimise dust emissions.

Environmental Outcomes, Objectives and Management Plans

The mitigation hierarchy has been applied to the Proposal concerning the key environmental values. The key outcomes and objectives include:

- Protect groundwater levels at Plunge Pool
- Establish Mine Restriction Zones (MRZs) and Mine Exclusion Zones (MEZs) around:
    - Category 2 Ghost Bat caves and associated apartment block caves
    - Critical habitat for MNES fauna species
    - Tetratheca butcheriana
    - Plunge Pool
- Limit the extent of disturbance on potential critical habitats for MNES fauna species:
    - Gorge/Gully
    - Debris Slope/Rocky Outcrop

The full list of anticipated outcomes and objectives is included in ES Table 3, and further detail is provided in the Environmental Outcomes Section.

The Proponent has prepared several draft management plans that address the expected environmental outcomes and objectives. 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 below:

An **Environmental Management Plan** (EMP; Appendix B.3) focuses on mitigating potential impacts on key fauna species and hydrological regimes associated with the Proposal and monitoring and reporting key performance indicators.

A **Social and Cultural Heritage Management Plan** (SCHMP; Appendix I.1 and I.2) for each Traditional Owner Group have been prepared in consultation with the Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma People and sets the principles and protocols in plain English under which the Proponent will continue to engage and work with the Traditional Owner groups.

A **Greenhouse Gas Management Plan** (GHGMP; Appendix H.1) demonstrates the Proponents' contribution toward Western Australia's aspiration of net zero emissions by 2050 and the interim emission reduction targets for the Proposal.

A **Mine Closure Plan** (MCP; Appendix B.4) 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 plans for achieving those outcomes.

These 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 thoroughly applying the mitigation hierarchy. These impacts are principally related to the Proposal's contribution to the cumulative loss of vegetation in the Pilbara Bioregion and the removal of habitat for several significant fauna species.

In line with government policies, the Proponent will offset these residual impacts through contributions to the Pilbara Environmental Offsets Fund (PEOF). The PEOF aims to deliver 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 ES3 outlines each key environmental factor's potential impacts, proposed mitigation, and proposed environmental outcomes.

Table ES3: Summary of Potential Impacts, Proposed Mitigation and Proposed Environmental Outcomes

Key Environmental Factor 1: Inland Waters	
Potential Impacts	**Direct Impacts** • Lowering of groundwater levels as a result of mine pit dewatering and closure • Groundwater mounding from surplus water storage in disused mine pits • Changes to surface hydrological regimes of Boolgeeda Creek and Duck Creek from the continued discharge of surplus water • Changes to surface water catchments, flow paths, flooding and sheet flows from mine pits and infrastructure placement. **Indirect Impacts** • Change to surface water quality within pools downstream from surplus water discharge points • Impacts to ground and/or surface water quality due to mineral waste management, Waste Rock Landforms (WRLs) and Waste Fines Storage Facilities (WFSFs) • Post closure formation of pit lakes resulting in impacts to groundwater • Increased sediments in runoff from infrastructure and drainage resulting in adverse impacts to Plunge Pool • Contamination of surface water due to accidental spills of hazardous materials and waste. **Cumulative Impacts** • Cumulative catchment loss • Cumulative groundwater drawdown

Mitigation Hierarchy	**Avoid**
	• Groundwater drawdown at Plunge Pool will be avoided as no below water table (BWT) mining being permitted at the BS3 deposit
	• Groundwater drawdown at Plunge Pool will be avoided by fulfilling operational water demand with dewatering abstraction, therefore avoiding separate water supply borefield
	• Groundwater mounding from surplus water discharge will be avoided by limiting the amount of water discharged to pits to only occur where pit lakes would not be expected to cause mounding in areas of shallow watertable (i.e., <20 m bgl)
	• Changes to surface hydrological regimes as a result of surplus water discharge will be avoided by discharging surplus water discharge to complete mine pits, when they become available
	• Impacts to surface water quality at Duck Creek and Boolgeeda Creek will be avoided by preventing any discharge to creeks which is not compatible with the receiving environment.
	Minimise
	• Changes to surface hydrological regime will be minimised by:
	  ○ Discharging to surface water systems via alternative discharge methods, including discharge to the Nammuldi Agricultural Project (NAP) (as approved under MS 925) and completed mine pits, where practicable.
	  ○ Restricting surface water discharge to the early stages of the mine life, before mine pits become available.

Key Environmental Factor 1: Inland Waters	

	• Altered surface waterflows due to installation of project infrastructure by:
	  ○ Minimising catchment losses by implementing diversions in Plunge Pool catchment
	  ○ Designing all linear infrastructure to convey high frequency flood events (up to 1 in 10 Annual Exceedance Probability (AEP)) through culverts or similar. The infrastructure may also be designed to allow overtopping in low frequency events, if practicable.
	  ○ Designing the Lens G haul road to have major culverts to maintain flows within the broad valley between Lens G and Diesel deposits.
	• A reduction in the surface water quality of Duck and Boolgeeda Creek will be minimised through the implementation of the surplus use hierarchy, including preferential discharge to the mine pits and NAP (as approved under MS 925).
	• Increased sedimentation in Plunge Pool will be minimised by:
	  ○ Constructing water management structures in key risk areas thus reducing the discharge of sediment-laden runoff from the site (e.g., banks, sediment traps, catch bunds)
	  ○ Implementing leaky weir sediment traps or similar within the Plunge Pool catchment to minimise sediment contributions to Plunge Pool.
	Rehabilitate
	• Implement a mine closure strategy that includes backfilling of the BS3 Extension deposits (MM-J and Creekside) to recovered post-mining water levels to minimise the long-term drawdown in aquifers that are 9 km upgradient of Plunge Pool
	• Implement the water management strategy, which includes the preferential discharge of surplus water to mine pits when available. This strategy will result in recharge at those locations and minimise the total export of water and groundwater drawdown within the Brockman Syncline aquifers
	• Remove all linear infrastructure at closure unless required for future use identified through the mine closure planning process.
	• Effective management of PAF materials requires progressive waste characterisation, closure planning and monitoring. These aspects will continue to be addressed through the mine closure planning process.

Residual Impacts, including Assessment of Significance	**Non-Significant Residual Impacts**
	• No other third-party bores exist within the Brockman Syncline aquifers. As groundwater drawdown is constrained within the syncline, there will be no predicted impact on other users beyond the syncline
	• Groundwater levels that support the base water level in Plunge Pool (which has been placed in a MEZ) will be maintained by:
	  ○ Limiting mining at the BS3 deposits (1 km north of Plunge Pool) to above water table (AWT)
	  ○ Backfill of the BS3 Extension deposits (MM-J and Creekside, 9 km northeast of Plunge Pool) to above post mining recovered water levels to minimise long-term drawdown in the upstream aquifer; and minimise any potential for a reduction in groundwater contribution to the Plunge Pool aquifer compartment.
	  ○ A catchment area of no less than 7 km^2 will be maintained within the catchment that supports Plunge Pool to ensure flushing of the pool.
	• Discharge to Boolgeeda Creek will be limited to within a 37 km wetting front as previously approved (MS 1000)
	• Discharge to Duck Creek will be limited to within a 67 km wetting front (previously assessed under MS 925), noting that a formal wetting front is being proposed as part of a modernisation to conditions

Key Environmental Factor 1: Inland Waters	
	• Infrastructure will be placed in a manner that will allow natural low flow paths and functioning of Boolgeeda and Duck Creek will be maintained within the Development Envelope • Five pit lakes are expected to form from the Proposal (seven as a result of the Amendment Proposal) and are likely to be groundwater sinks. Backfill will be prioritised in the remaining pits should PAF be predicted to be of a high risk to environmental receptors. • Pits utilised for the surplus storage of water will be selected on the basis of pits where this would not expect to cause groundwater mounding in areas of shallow watertables • The waste fines solids are likely to be non-acid forming (NAF) and considered low risk given the neutral pH of the supernatant and NAF solids • There are no known sensitive receptors within the immediate vicinity of Lens A, Pit 8 and Pit 5, thus making them suitable for in-pit WFSFs.
Proposed Environmental Outcomes and Objectives	In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes and objectives that apply to Inland Waters are set out below. **Plunge Pool** The following environmental outcomes are proposed in relation to Plunge Pool: • No measurable drawdown of groundwater levels at Plunge Pool as a result of mine dewatering attributable to the Proposal. • Minimise changes to the hydrological regime of Plunge Pool to ensure environmental and cultural heritage values are maintained. The following environmental objective are proposed in relation to Plunge Pool: • Avoid, where possible and otherwise minimise impacts to water quality and sedimentation in Plunge Pool as a result of the Proposal **Inland Waters and Vegetation – Dewatering and Discharge** The following environmental outcomes are predicted in relation to dewatering and discharge: • Discharge of surplus water as a result of mining does not cause long term impacts on the environmental values of the Boolgeeda and Duck Creek systems • Ensure water discharged to Boolgeeda and Duck Creek meets specified agreed water quality requirements developed in accordance with the Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG 2018) framework or its revisions. To meet the above outcomes, the Proponent shall ensure that: • Discharge to Boolgeeda Creek under natural no flow conditions (wetting front) does not extend further than 37 km downstream of the discharge location • Discharge to Duck Creek under natural no flow conditions (wetting front) does not extend further than 67 km downstream of the discharge location.

Key Environmental Factor 2: Flora and Vegetation	
Potential Impacts	**Direct impacts** • Clearing of native vegetation (including riparian vegetation) • Clearing of individuals of Priority flora species. **Indirect impacts** • Degradation/alteration of surface water dependent ecosystems as a result of altered surface catchments • Impacts to groundwater dependent ecosystems as a result of groundwater drawdown • Impacts to riparian vegetation as a result of surplus water discharge to surface water systems • Degradation of vegetation condition due to increased abundance and diversity of weeds • Degradation of vegetation from dust deposition and the potential increase in bushfire risk. **Cumulative impacts** • Clearing of native vegetation • Clearing of Priority Flora.
Mitigation Hierarchy	**Avoid** • No clearing of the P33 vegetation type, which is representative of the Priority 1 Priority Ecological Community (PEC) – Brockman Cracking Clay Communities of the Hamersley Range • No clearing of any *Tetratheca butcheriana* (P1) individuals through the establishment of MEZs • Impacts to riparian vegetation within Boolgeeda Creek and Duck Creek from surplus water discharge will be limited to the prescribed wetting fronts • Prevent the introduction of new weed species entering the Development Envelope through implementing the Iron Ore (WA) Pilbara Weed Management Strategy • Prevent vegetation degradation through the potential increase in bushfire risk by avoiding clearing activities when severe or high fire risks are present. **Minimise** • Reduce the loss of native vegetation from 9,977 ha to 7,896 ha • Implement upper clearing limits for all Priority 1 and 2 flora species within the Development Envelope • Conduct genetic studies on *Tetratheca butcheriana* to inform future management of the species • Reduce the potential impact to riparian vegetation by minimising the amount of water discharged along creeklines as practicable by using abstracted water for on-site operational, environmental and management purposes • Implement the Iron Ore (WA) Pilbara Weed Management Strategy to manage the spread of existing weed species through the existing management strategy • Manage the degradation of vegetation through dust deposition:

Key Environmental Factor 2: Flora and Vegetation	
	○ Adopt dust suppression techniques, such as water carts with water sourced from dewatering activities ○ Limit the amount of disturbed land at one time ○ The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Manage the degradation of vegetation through the potential increase in fire: ○ Manage and monitor hot works, vehicle movement and disposal of fire-starting waste ○ Ensure firefighting equipment is available in vehicles and around the site ○ Ensure all personnel on-site have been adequately trained on fire prevention and management. **Rehabilitate** The Proponent will: • Undertake progressive rehabilitation to minimise cleared areas and revegetate using local native species • Develop an MCP which includes Closure Objectives 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 the disturbed area. • Spray weeds during progressive rehabilitation over the life of the mine • Include indicative closure completion criteria to ensure that the only weed species recorded within rehabilitation areas are also present within the local uncleared area.
Residual Impacts, including Assessment of Significance	**Non-Significant Residual Impacts** • The proposed avoidance and management measures associated with the Proposal, the demonstrate non-significant residual impact to Flora and Vegetation include: • The closest Threatened Ecological Community (TEC) is the Themeda grasslands on cracking clays (Hamersley Station, Pilbara), located approximately 1.2 km west of the Development Envelope. This TEC will not be directly or indirectly impacted by the Proposal • One vegetation type (P33) was considered to represent the Brockman Iron Cracking Clay Priority Ecological Community (PEC) of the Hamersley Ranges (P1). This vegetation type occurs within the Silvergrass area and will not be impacted by the Proposal • Based upon upper limits of clearing and proposed conditions for high local significance vegetation units, which are also considered riparian as defined in Table 7 11, post implementation of the Proposal it is predicted that 5.1 ha (20%) of the vegetation type C3 (DkCk) will be impacted within the Development Envelope • Based upon upper limits of clearing and proposed conditions for high local significance vegetation units as defined in Table 7 11, post implementation of the Proposal it is predicted that:

Key Environmental Factor 2: Flora and Vegetation	
	○ 124.5 ha (30%) of the vegetation type G3 will be impacted within the Development Envelope ○ 111.5 ha (50%) of the vegetation type H35 will be impacted within the Development Envelope ○ 216.3 ha (30%) of the vegetation type H36 will be impacted within the Development Envelope • No Groundwater Dependent Ecosystems (GDEs) (Table 7 8) are considered to be of regional or high local significance • Direct impacts to potential GDE feature 355 (of high potential groundwater dependence) and Vegetation type C28 (of high local significance and riparian) and which are associated with Plunge Pool will be avoided as Plunge Pool has been placed within a MEZ and will not be impacted from groundwater drawdown (Section 6.6) • Given only small scale, moderate local significance potential GDEs will be impacted and the number and extent of GDEs that will remain undisturbed by the Proposal in and around the Development Envelope, the Proponent considers that overall impacts to GDEs are not significant • No surface water dependent vegetation has been identified within the survey area • Direct impacts will avoid the Priority 1 flora species *Tetratheca butcheriana* which has been placed within a 100 m MEZ within the Development Envelope. Indirect impacts from dust are considered unlikely and are addressed in the EMP • Based upon upper limits of clearing and proposed conditions for Priority flora species as defined in Table 7 16, post implementation of the Proposal it is predicted that: ○ 750 (51.9%) of known individuals of *Hibiscus sp. Mt Brockman* (E. thoma ET 1354) (P1) will be impacted within the Development Envelope. Taking into consideration cumulative impacts this represent a total loss of 862 (11.5%) of known individuals outside of the Development Envelope. ○ 64 (30%) of known individuals of *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) will be impacted within the Development Envelope. This represents an impact of 18% of known individuals outside the Development Envelope. ○ 102 (51.5%) of known individuals of *Ipomoea racemigera* (P2) will be impacted within the Development Envelope. Taking into consideration cumulative impacts this represents a total loss of 1,001 (20.5%) of known individuals outside of the Development Envelope. ○ 54 (100%) of known individuals of *Oxalis* sp. Pilbara (M.E. Trudgen MET 1570) (P2) will be impacted within the Development Envelope. This represents an impact of 10.1% of known individuals outside of the Development Envelope ○ 3 (100%) of known individuals of *Pentalepis trichodesmoides* subsp. hispida (P2) will be impacted within the Development Envelope. Taking into consideration cumulative impacts this represents an impact of 2% of known individuals outside of the Development Envelope. • The riparian environments in Duck and Boolgeeda Creeks within the discharge wetting fronts will continue to be modified in the short term but are not expected to be permanently affected. Therefore, the impacts are not anticipated to be significant. • The Proposal is not expected to significantly impact the condition of native vegetation through the spread or introduction of weed species **Significant Residual Impacts** • Clearing up to 7,716 ha of native vegetation in good to excellent condition. This clearing is proposed to be offset. • Clearing up to 5.1 ha of vegetation type C3 (DkCk) considered to be of high local significance as a vegetation type and as a potential GDE (note this occurs within the 7,716 ha of native vegetation in good to excellent condition discussed above). This clearing is proposed to be offset.

Key Environmental Factor 2: Flora and Vegetation	

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 Flora and Vegetation are set out below:
	• The Proponent shall not clear the Priority 1 PEC (Brockman Cracking Clays) or vegetation type P33 mapped within the Development Envelope
	• The Proponent shall not clear more than:
	  ○ 5.1 ha of vegetation unit C3 (DkCk)
	  ○ 124.5 ha of vegetation unit G3
	  ○ 111.5 ha of vegetation unit H35
	  ○ 216.3 ha of vegetation unit H36
	• The Proponent shall not clear more than:
	  ○ 10% of known individuals in the State of the P1 flora species *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)
	  ○ 18% of known individuals in the State of the P2 flora species *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trugden MET 15708)
	  ○ 11% of known individuals in the State of the P2 flora species *Ipomoea racemigera*
	  ○ 12% of known individuals in the State of the P2 flora species *Oxalis* sp. Pilbara (M.E Trudgen 12725)
	• No direct impacts to the known individuals of *Tetratheca butcheriana* within the Development Envelope
	• No measurable change in the presence or condition of the known *Tetratheca butcheriana* individuals within the Development Envelope as a result of implementing the Proposal.

Assessment of Offsets (if relevant)	Following application of the mitigation hierarchy, the following residual environmental impacts are considered significant impacts and therefore require an offset: • Clearing up to 7,896.3 ha of native vegetation in good to excellent condition will be offset at a rate of approximately $890/ha • Clearing up to 6 ha of high value riparian vegetation will be offset at a rate of $1,780/ha The offsets are in line with the State and National offset guidelines and are expected to counterbalance the significant residual impacts.

Key Environmental Factor 3: Terrestrial Fauna	
Potential Impacts	**Direct impacts** • Loss of habitat as a result of clearing and habitat fragmentation • Loss of fauna individuals • Loss of SRE individuals and supporting SRE habitat as a result of clearing.

Key Environmental Factor 3: Terrestrial Fauna	
	Indirect impacts • Degradation or alteration of habitat as a result of altered hydrological regimes • Habitat degradation 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 pest species **Cumulative impacts** • Cumulative regional impacts on fauna habitats • Cumulative regional impacts on terrestrial fauna species present in the Development Envelope
Mitigation Hierarchy	**Avoid** • Ensure all clearing occurs in approved ground disturbance areas by implementing the Proponent's Approval Request system • Establish MEZs and MRZ around 106 significant caves, critical cave clusters and the significant Plunge Pool water features within the Development Envelope • Maintain habitat connectivity by ensuring the landform corridors such as drainage lines remain intact • Avoid known MRZs and MEZs by including them in the Proponent's GIS system • Ensure clearing occurs only in approved ground disturbance areas • Undertake pre-clearance surveys for significant fauna • Clearing activities will not be undertaken when the fire danger rating is severe or high • Habitat degradation associated with construction operation activity, including dust and altered fire regime by avoiding clearing activities when fire danger ratings are high. • Displacement of fauna due to the disturbance from light, noise, and/or vibration through the application of vibration limits to apartment block and isolated category 2 and 3 roosts within the Development Envelope. **Minimise** • Design the Development Envelope and Conceptual Footprint to minimise practicable disturbance of high significance Gorge/Gully and Debris Slope/Rocky Outcrop habitats • Restrict clearing of high significance habitat to authorised extents • Minimise impacts to significant habitat types by including the known locations of significant fauna habitat types in the Proponent's GIS system • Ensure clearing occurs in the approved ground disturbance through continuous implementation of the Proponents Approvals Request system • Undertake progressive clearing to allow fauna to migrate away from clearing activities or machinery movement • Clearing will commence, where possible, from a disturbed vegetation edge to an undisturbed area (to encourage mobile fauna to relocate to adjacent areas naturally).

Key Environmental Factor 3: Terrestrial Fauna	

	• Limit light vehicle movements outside of operating mine areas to daylight hours
	• The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna.
	• Confine vehicle traffic to defined roads and tracks
	• Remove any roadkill from trafficable areas to reduce the risk of an increase in predators
	• Barbed wire fences will be avoided in most instances. If barbed wire fencing is required (due to legislative, safety or pastoral requirements), the top strand will be replaced with plain wire, and reflectors will be placed on the top wire to help prevent the entanglement of bats.
	• Provide site induction programs on significant fauna, including their appearance and habitats, as well as standard operating procedures in the event of fauna interactions
	• Place egress points at artificial water sources (e.g., turkeys nest)
	• The top edges of artificial water source, trenches and borrow pits will be sloped to enable fauna egress.
	• Reduce habitat degradation associated with construction and operation activity, including dust and altered fire regimes:
	  ○ Restrict topsoil and overburden stripping and other high dust generating activities if risk-based assessment measures determine that dust cannot be adequately controlled
	  ○ Restrict vehicles from accessing rehabilitated surfaces 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 personnel training
	• Reduce displacement of fauna due to disturbances from light, noise and/or vibration:
	  ○ Minimise light overspill by directing lighting in mining areas towards mining activities
	  ○ Ensure equipment design is specified to be within Australian standard noise limits
	• Minimise an increase in abundance and diversity of pest species:
	  ○ Fence the landfills and cover the putrescible wastes
	  ○ Design and construct the 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 the Traditional Owners.
	Rehabilitation:
	• Prepare and regularly update an MCP, which includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms are stable and consider ecological and hydrological factors.
	• The habitat elements considered during the rehabilitation design includes:
	  ○ Vegetation is known to provide preferred food or shelter preference
	  ○ Retaining and replacing woody debris

Key Environmental Factor 3: Terrestrial Fauna	
	○ Managing feral predators and herbivores across both reference and rehabilitated areas. ○ Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore 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. • Borrow pits would be designed, constructed, and rehabilitated to minimise surface water ponding.
Residual Impacts, including Assessment of Significance	**Non-Significant Residual Impacts** • The significant category 2 (Upper Beasley River Roost) and category 3 Pilbara Leaf-nosed Bat roosts are located outside of the Development Envelope and will not be directly impacted by the Proposal, indirect impacts are considered unlikely. • Of the 131 non-significant (category 4) Pilbara Leaf-nosed Bat roosts within the Development Envelope, post implementation of the Proposal it is predicted that 106 Pilbara Leaf-nosed bat roosts will remain due to overlap with Ghost Bat roosts and placed in MRZs/MEZs and managed via an EMP. A total of 25 category 4 roost which are not considered critical habitat will be impacted by the Proposal • All significant Ghost Bat roosts (isolated category 2 roosts and apartment block roosts) will be retained within the Development Envelope and placed in MRZs/MEZs (Figure 8 27) and managed via the EMP. • Of the 66 non-significant (category 3) and 42 non-significant (category 4) Ghost Bat roosts within the Development Envelope, post implementation of the Proposal it is predicted that 14 and 11 will be impacted by the Proposal. These roosts are not considered critical habitat for the species. • Of the 25 water features known within the Development Envelope, 13 have been placed in MRZs/MEZs, including the permanent groundwater sustained Plunge Pool and managed via the EMP. Four ephemeral water features will be impacted by the Proposal. These water features are not considered critical habitat for the species. • No potential SRE species are considered to have a high risk from the Proposal or were recorded from isolated/restricted habitat types within the Development Envelope. **Significant Residual Impacts** • Clearing of up to 264 ha and 67 ha (28% and 13%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and denning) habitats for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python within the Development Envelope. This clearing is proposed to be managed via upper limits of clearing and will be offset. • Clearing of approximately 25 ha and 114 ha (4% and 15%) of supporting Major and Minor (foraging and dispersal) Creekline habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, when within the species home range. This clearing is proposed to be offset • Clearing of approximately 65 ha, 2,638 ha and 104 ha (3%, 12% and 9%) of supporting Alluvial, Colluvial and Hardpan Plain habitat for the Pilbara Leaf-nosed and Ghost Bat, when within the species home range. This clearing is proposed to be offset.

Key Environmental Factor 3: Terrestrial Fauna	

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 Terrestrial Fauna are set out below:
	• The Proponent shall not clear more than:
	  ○ 264 ha of Gorge/Gully habitat within the Development Envelope
	  ○ 67 ha of Debris Slope/Rocky Outcrop habitat with the Development Envelope
	• No direct or indirect impacts from the Proposal to Ghost Bat or Pilbara Leaf-nosed Bat roosts retained within MRZs and MEZs
	• Minimise direct and indirect impacts from the Proposal to the Northern Quoll and Pilbara Olive Python habitat in accordance with the EMP.

Assessment of offsets (if relevant)	Following application of the mitigation hierarchy, the following residual environmental impacts are considered significant impacts and therefore require an offset: • Clearing of up to 264 ha and 67 ha (28% and 13%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and denning) habitats for Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python at a rate of $3,306/ha • Clearing of approximately 25 ha and 114 ha (4% and 15%) of supporting Major and Minor (foraging and dispersal) Creekline habitat within the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Pythons home range at a rate of $1,653/ha • Clearing of approximately 65 ha, 2,638 ha and 104 ha (3%, 12% and 9%) of supporting Alluvial, Colluvial and Hardpan Plain habitat within the Pilbara Leaf-nosed Bat and Ghost Bats breeding home range at a rate of $1,653/ha The offsets align with the State and National offset guidelines and are expected to counterbalance the significant residual impacts. It is noted that different offset rates are used for the Commonwealth and Western Australia Government

Key Environmental Factor 4: Subterranean Fauna	

Potential Impacts	**Direct Impacts**
	• Loss of individuals or reduction in stygofauna habitat through mining and/or groundwater drawdown
	• Loss of individuals or reduction in troglofauna habitat as a result of mining.
	Indirect Impacts
	• Changes to surface inputs of flow/volume of water, nutrients and oxygen from:
	  ○ Construction of waste landforms, stockpiles and WFSFs
	  ○ Vegetation clearing
	  ○ Changed hydrological regime.
	• Changes to the structure and presence of underground voids from:
	  ○ Sedimentation and fill (beneath waste landforms, stockpiles and WFSFs)

Key Environmental Factor 4: Subterranean Fauna	
	○ Compaction, blasting/shock and vibration. • Desiccation of subterranean habitat from: ○ Groundwater drawdown ○ Changes to surface infiltration • Fragmentation of previously connected/contiguous habitat by excavation • Contamination from spills, leaching and environmental incidents. **Cumulative Impacts** • Cumulative loss of habitat within connected habitat.
Mitigation Hierarchy	**Minimise** • Pit dewatering will be minimised to that required to safely access below water table resources • The water management strategy includes the preferential discharge of surplus water to mine pits when they are available. This strategy will result in recharge at those locations and minimise the total export of water and groundwater drawdown within the Brockman syncline aquifers. Should pits not be available for water storage the Proponent will continue to discharge water to Duck and Boolgeeda creek. • Groundwater will be abstracted compliant with an approved Groundwater Licence and Operating Strategy, which will include the development of trigger and threshold levels for groundwater quality and levels • Updating/recalibration of groundwater models at least annually for the first five years reducing to tri-annually should no difference be observed between predicted and actual modelling. • Clearing and/or disturbance to remain within the approved Development Envelope • Appropriate design of waste landforms specifically encapsulation of potential acid-forming (PAF) waste rock and minimisation of oxidation to prevent changes to groundwater quality • Appropriate design of hazardous material storages in accordance with relevant guidelines and Australian Standards • Construction and maintenance of surface water drainage systems to control and contain runoff from mining areas and divert clean stormwater away from pits and other mining disturbance areas • Construction of WFSFs as per approved designs to minimise seepage • Monitoring of groundwater quality discharge during operations as per the requirements of the EMP. • Provision of spill kits and implementation of spill management procedures. **Rehabilitate** • Backfill of pits to reduce the potential drawdown extent post closure • Backfill of pits with moderate or high risk of forming acidic pit lakes Preparation and regular update of a Mine Closure Plan consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020b).

Key Environmental Factor 4: Subterranean Fauna	
Residual Impacts, including Assessment of Significance	**Non-Significant Residual Impacts** • Approximately 55% of BWT habitat be impacted across the syncline for stygofauna, with 42 to 65% impacted within individual assessment areas under the modelled cumulative impact scenario • Three stygofauna taxon (Paramelitidae `sp. Biologic-AMPH012`, Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003`) are considered at a high risk under the modelled cumulative impact scenario, however suitable habitats remain within and surrounding the syncline such that it is likely that these species will persist in the surrounding environments • Approximately 10% of AWT habitat will be impacted across the syncline for troglofauna, with between 7 and 28% impacted within individual assessment areas under the modelled cumulative impact scenario • Troglofauna species recorded from the Development Envelope are expected to persist following the implementation of the Proposal.
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 Subterranean Fauna are set out below: • Minimise direct and indirect impacts to subterranean fauna, where possible To meet the above environmental outcome the Proponent shall: • Limit the Proposals groundwater abstraction of up to 50 GL/a.

Key Environmental Factor 5: Air Quality	
Potential Impacts	**Indirect Impacts** • Increased dust particulates through construction and operation - affecting human health and amenity at sensitive receptors • Exposure of fibrous materials - affecting human health. **Cumulative Impacts** • Additional future emissions of approximately 45 kt PM10 particulates per annum from FMG Eliwana Iron Ore Project (yet to be developed)
Mitigation Hierarchy	**Avoid** • Ensure all uncovered fibrous materials are encapsulated during mining to avoid the risk of respirable fibrous materials becoming airborne. **Minimise** • Minimise clearing as far as possible • Clearing will occur in approved ground disturbance areas through the continued implementation of the Proponents Approval Request System • Use dust suppressants or water on roads, working surfaces and stockpiles as required • Use dust collection systems and enclosed screenhouses

Key Environmental Factor 5: Air Quality	

	• Restrict vehicles to designated roads and tracks
	• The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna.
	• Cover the overland conveyor at BS1 to reduce dust generation
	• Seal low volume access road to BS1
	• Explore opportunities to minimise dust emissions, including:
	  ○ Program trialling products to improve product efficiency
	  ○ Dust reduction through technological innovation
	• Train all personnel who may be required to work in 'potentially fibrous; or 'fibrous' areas
	• Ensure appropriate respiratory protection will be carried by all personnel entering 'potentially fibrous, or 'fibrous' areas
	• Implement signs and demarcation at the entrance to 'potentially fibrous; or 'fibrous' areas
	• Implement the following controls in 'potentially fibrous; or 'fibrous' areas:
	  ○ Respiratory protection shall be worn when not in a pressurised cab (i.e., on foot). Based on risk assessment, disposable overalls can be worn within a 'fibrous' area if deemed necessary.
	  ○ Upon exit, equipment and personnel will be inspected and cleated if required.
	  ○ Haul trucks shall be loaded to minimise spillage while transporting fibrous material.
	• Cap fibrous materials in situ or encapsulate it in non-fibrous (i.e., inert) mineral waste within a designated waste dump.
	• Mitigate the risk of accidental public access through:
	  ○ Establishing abandonment bunds around pits to limit public access
	  ○ Ensuring other closure landforms provide for safe access on accordance with the outcomes agreed through the mine closure planning process
	Rehabilitate
	• Undertake progressive rehabilitation on areas that are no longer in use to reduce wind erosion on exposed surfaces
	• Rehabilitate tracks that are not required for monitoring or maintenance to reduce the risk of inadvertent public access
	• Rehabilitate all access roads prior to relinquishment and install physical barriers (earthen bunds) unless the State wishes the road to remain accessible for whatever reason
	• Install locked gates on the access roads for the duration of the post-closure monitoring and maintenance period
	• Review the potential visitors access the site, and install additional control measures, including abandonment bunding around pits, where appropriate.

Key Environmental Factor 5: Air Quality	
Residual Impacts, including Assessment of Significance	**Non-Significant Residual Impacts** • Dust concentrations attributable to the Proposal are predicted to be low outside the Proposal operational areas at all sensitive receptors, and well below dust air quality assessment criteria • The risk of exposure to fibrous minerals from the Proposal is low due to its remote location and the measures taken to prevent accidental public access. The Proponent will continue to implement its FMMP to ensure occupational limits are not exceeded for fibrous materials.
Proposed Environmental Outcomes	No environmental outcomes are proposed as standard business practices are considered sufficient to manage the Air Quality factor to meet the EPA's objective.

Key Environmental Factor 6: Greenhouse Gas Emissions	
Potential Impacts	**Direct Impacts** • 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 generated from the Proponent's Pilbara Power Generation Network (Scope 2 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. **Cumulative Impacts** • The Amended Proposal is expected to contribute approximately 554,000 t CO2-e per annum (average), as follows: • Scope 1 emissions: 492,369 t CO2-e per annum (including land clearing) • Scope 2 emissions: 61,631 t CO2-e per annum.
Mitigation Hierarchy	**Avoid** • Minimise land clearing • Minimise haulage distances and inclines for trucks • Utilise fuel-efficient vehicles, plant and equipment • Use of variable speed drives to improve efficiency • Use of high efficiency electrical motors • Reduce ancillary vehicle movements, e.g. Using buses to transport personnel between site and accommodation

Key Environmental Factor 6: Greenhouse Gas Emissions	
	• Progressive backfilling of the pits as far as practicable to reduce the amount of total material moved (TMM) and truck operating hours • Installation of high efficiency LED lighting across the majority of plant infrastructure • The use of natural gas as a fuel source for electricity generation, as opposed to diesel fuel • The installation of rooftop solar and remote solar panels to power borefield pumps. **Reduce** • Solar PV power generation is being studied as part of the Pilbara Wide emissions reduction strategy. The Greater Brockman Revised Proposal has two locations being assessed for the second development of Solar PV in the Pilbara, to be connected to the existing Pilbara Power network. The installation will offset a significant portion of emissions from the Greater Brockman region • Opportunities to continuously improve productivity and minimise Scope 1 emissions during the construction and operation of Greater Brockman Revised Proposal (including the Proposal) include: o Increasing effective utilisation through reducing idle time/ queue time and parking up equipment wherever possible o Reducing double handling material to reduce TMM o Increasing the efficiency of operations (including waste and ore haulage) through mine planning, design and scheduling. o Regular maintenance and servicing of equipment. **Offset** • The Proponent will offset GHG Emissions where abatement is insufficient against the interim and long-term targets by retiring credible offset units in 2025, 2030, 2035, 2040, 2045 and 2050.
Residual Impacts, including Assessment of Significance	**Non-Significant Residual Impacts** • Five yearly interim reduction of emissions from 2025 to 2050 based on targets outlined in the GHG MP, including but not limited to: o Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 GHG emissions o Commitment to offset if the targets are not met o Five yearly progress reporting o 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 MP (currently estimated at 354,215 t CO2-e).
Proposed Environmental Outcomes	• The Proponent shall take measures to ensure that net GHG emissions associated with the Proposal do not exceed: o 1,540 t Co2-e for the period between 1 January 2024 and 31 December 2025 o 976,119 t Co2-e for the period between 1 January 2026 and 31 December 2030 o 732,089 t Co2-e for the period between 1 January 2031 and 31 December 2035 o 488,149 t Co2-e for the period between 1 January 2036 and 31 December 2040 o 244,029 t Co2-e for the period between 1 January 2041 and 31 December 2045

Key Environmental Factor 6: Greenhouse Gas Emissions	
	○ Zero t Co2-e for every five-year period from 1 January 2046.
Assessment of Offsets (if relevant)	• The Proponent will apply the integrity principles of the International Carbon Reduction and Offset Alliance (ICROA) in relation to the sourcing and use of credible offset units for carbon offsetting. Credible offset units sourced will be based on the principles outlined in ICROA's Technical Specification; real, measurable, permanent, additional, independently verified, and unique. • Rio Tinto will only use 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. • The Proponent may also use other offset units that meet integrity principles and are based on clear, enforceable and accountable standards.

Key Environmental Factor 7: Social Surroundings	
Potential Impacts	**Direct impacts** • Destruction of Aboriginal Heritage sites • Alteration of water – direct impact to creek or pool tributaries, changes to surface water flow regimes, changes in water quality via sedimentation and alteration of groundwater levels and regimes • Restriction of access to Country, places and sites of social, cultural and heritage significance • Disturbance to sites and places of social, cultural and heritage significance as a result of mining • Clearing of identified populations of culturally significant flora and/or fauna • Changes to landforms which may result in altered visual landscapes within the region and at specific areas supporting social cultural heritage values • Cumulative impacts. **Indirect impacts** • Alteration of the experience and enjoyment of Country due to dust and noise

Key Environmental Factor 7: Social Surroundings	
	• Disturbance of animals that are used socially or culturally, or which have cultural associations due to habitat clearing, dust, noise and vibration • Impacts for Pastoralists associated with surplus water discharge to creeks, namely attraction of feral animals and issues with retention of cattle on stations.
Mitigation Hierarchy	The Proponent will apply 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** Engagement and consultation, including in-field consultation, with Traditional Owner groups and stakeholders will inform the Proposal design, with the aim of avoiding impacts to sites, places and values of social and cultural significance wherever practicable. **Minimise** The Proponent 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. **Mitigate (Rehabilitate)** Rehabilitation and final closure landform design will consider stakeholder and Traditional Owner views regarding visual amenity, post-closure access to sites and places of social and cultural significance, remediation of impacts arising during the operational phase and inclusion of culturally significant flora species to the extent practicable. Rehabilitation activities will be undertaken progressively over the life of the mine, and opportunities to involve Traditional Owner groups in the rehabilitation of their country will be explored. The Proponent has prepared and will implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020b) for the Proposal in this regard.
Residual Impacts, including Assessment of Significance	**Non-Significant Residual Impacts** • Pastoral activities (Hamersley and Rocklea Station) across the Development Envelope are managed by the Proponent. The Proponent is in the process of purchasing the portion of the Cheela Plains Pastoral station upon which the Proposal is located. Indirect impacts to Cheela Plains Pastoral Station will not be significantly different to those already authorised under MS 1000 • There are no predicted significant impacts predicted to the general public. The Development Envelope is not frequented by member of the public for recreational activities • No European heritage sites have been documented within the Development Envelope. **Significant Residual Impacts** • Direct and indirect impacts to Aboriginal Heritage, cultural values and the traditional usage of the land for the Puutu Kunti Kurrama and Pinikura People. These impacts will be managed through a co-developed SCHMP • Direct and indirect impacts to Aboriginal Heritage, cultural values and the traditional usage of the land for the Eastern Guruma People. These impacts will be managed through a co-developed SCHMP.

Key Environmental Factor 7: Social Surroundings	
Social Surroundings Outcomes	In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated outcomes that apply to Social Surroundings are set out below: • Subject to reasonable health and safety requirements, the Proponent will allow the Puutu Kunti Kurrama and Pinikura People ongoing access and connection to Country within the Development Envelope. • Subject to reasonable health and safety requirements, the Proponent will allow the Muntulgura Guruma People ongoing access and connection to Country within the Development Envelope. In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated objectives that apply to Social Surroundings are set out below: • Avoid, where practicable, and otherwise minimise direct and indirect impacts as a result of implementation of the Proposal to Puutu Kunti Kurrama and Pinikura cultural heritage values in accordance with the SCHMP • Avoid, where practicable, and otherwise minimise direct and indirect impacts as a result of implementation of the Proposal to Eastern Guruma cultural heritage values in accordance with the SCHMP.

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 with the Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma People.

Many of the significant environmental values within the Development Envelope were identified in multiple environmental factors. As such, they have already been the focus of mitigation actions across these environmental factors and require no additional or different mitigation to be applied. This includes Plunge Pool, Boolgeeda and Duck Creeks, rocky habitats and caves, which were identified in the Inland Waters, Flora and Vegetation, Terrestrial Fauna and Social Surroundings environmental factors.

One impact which was identified as a potential holistic impact was dust. However, the impact assessment identified that no significant impacts to the environment as a whole are expected due to the Proposals emission of dust. The Proponent does note that dust, in the context of cumulative emissions in the Pilbara, can potentially have a significant impact. The Proponent is committed to investigating ways to improve dust emission management within the bioregion.

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Abbreviations

Abbreviation	Description
AEP	Annual Exceedance Probability
ACH Act	*Aboriginal Cultural Heritage Act 2021*
AH Act	*Aboriginal Heritage Act (WA) 1972*
AMD	Acid Mine Drainage
ANFO	Ammonium nitrate/fuel oil
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASR	Aquifer Storage and Recovery
AWT	Above Water Table
BAM Act	*Biosecurity and Agricultural Management Act 2007*
BC Act	*Biodiversity Conservation Act (WA) 2016*
BIF	Banded Iron Formation
BS1	Brockman Syncline 1
BS2	Brockman Syncline 2
BS3	Brockman Syncline 3
BS4	Brockman Syncline 4
BWT	Below Water Table
CO_2-e	Carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4)
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DBCA	Department of Biodiversity, Conservation and Attractions
DCD	Duck Creek Downstream
DCT	Duck Creek Tributaries
DCU	Duck Creek Upstream
DG Safety Act	*Dangerous Goods Safety Act 2004*
DMA	Decision-making Authorities
DMIRS	Department of Mines, Industry Regulation and Safety
DotEE	Department of the Environment and Energy
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EAR	Ecosystem At Risk
EC	Electrical Conductivity

Abbreviation	Description
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
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
ESD	Environmental Scoping Document
FMG	Fortescue Metals Group
FMMP	Fibrous Materials Management Plan
GDE	Groundwater Dependent Ecosystem
GDV	Groundwater Dependent Vegetation
GHG	Greenhouse gas
GL	Gigalitres
GL/a	Gigalitres per annum
GWL	Groundwater Licence
IBRA	Interim Biogeographic Regionalisation for Australia
IHMP	Integrated Heritage Management Program
ILUA	Indigenous Land Use Agreement
IUCN	International Union for Conservation of Nature
km	kilometre
LAP	Land Access Protocol
LOESS	locally estimated scatterplot smoothing
LOM	Life of Mine
m	metre
mAHD	metres Australian Height Datum
MAR	Managed Aquifer Recharge
mbgl	metres below ground level
MCP	Mine Closure Plan
MEZ	Mining Exclusion Zone
mg/L	Milligrams per Litre

Abbreviation	Description
Mining Act	*Mining Act 1978*
ML/a	Megalitres per annum
ML/d	Megalitres per day
MNES	Matters of National Environmental Significance
MP	Management Plan
mRL	minimum reporting level
MS	Ministerial Statement
Mtpa	Million tonnes per annum
NAF	Non-Acid Forming
NAP	Nammuldi Agricultural Project
NDVI	Normalised Difference Vegetation Index
NDWI	Normalised Difference Water Index
NEPM	National Environment Protection Measures
NTD	Native Title Determinations
NVCP	Native Vegetation Clearing Permit
P	Priority
PAF	Potentially acid forming
PCD	Proposal Content Document
PEC	Priority Ecological Communities
PKKP AC	Puutu Kunti Kurrama and Pinikura Aboriginal Corporation
PMST	Protected Matters Search Tool
PPV	Peak Particle Velocity
RNTBC	Registered Native Title Body Corporate
Rio Tinto	Rio Tinto Group
RISM	Residual Impact Significant Model
RiWI Act	*Rights in Water and Irrigation Act 1914*
ROM	Run of Mine
SCARD	Spontaneous Combustion and Acid Rock Drainage
SCHMP	Social and Cultural Heritage Management Plan
SILO	Scientific Information for Land Owners
SRE	Short Range Endemic
TAP	Threat Abatement Plan
TDS	Total Dissolved Solids

Abbreviation	Description
TEC	Threatened Ecological Communities
TMM	Total material moved
TSP	Total Suspended Particulates
TSSC	Threatened Species Scientific Committee
UCL	Unallocated Crown Land
µm	micrometres
VU	Vulnerable
WA	Western Australia
WFSF	Waste Fines Storage Facility
WGAC	Wintawari Guruma Aboriginal Corporation
WoNS	Weeds of National Significance
WRL	Waste Rock Landform

1. INTRODUCTION

Hamersley Iron Pty Limited (the Proponent) is proposing to develop the Brockman Syncline Proposal (the Proposal). The Proposal includes a proposed consolidation and modernisation of the Ministerial Statements (MS) for three existing operations, namely:

- Brockman Syncline 2 (BS2) – authorised under MS 131 and MS 867
- Brockman Syncline 4 (BS4) – authorised under MS 1000
- Nammuldi-Silvergrass – authorised under MS 925.

The Proposal is located approximately 60 km west north-west of Tom Price, in the central Pilbara region of Western Australia (WA). The Proposal is located within the Native Title Determination Areas of the Puutu Kunti Kurrama and Pinikura People and the Eastern Guruma People (Figure 1-1).

1.1. Purpose and Scope

The purpose of this Environmental Review Document (ERD) is to provide the necessary information to allow the assessment of the Proposal under Part IV of the *Environmental Protection Act 1986* (EP Act) (Section 3). This ERD has been prepared in accordance with an Environmental Scoping Document (ESD), which was approved by the Western Australian Environmental Protection Authority (EPA) on 20 March 2020 (Appendix B.1).

Since the approval of the ESD additional technical studies undertaken have provided greater clarity on project design and significant environmental and social aspects. The Proponent subsequently submitted a request to change the relevant key characteristics of the Proposal under s.43A of the EP Act to the EPA. The EPA deemed these changes to be unlikely to increase any environmental impacts of the Proposal. As such, this ERD relates to the Proposal as described in the referral and modified in accordance with s.43A. Updates have been made to incorporate these changes into the Environmental Impact Assessment (EIA) in this ERD.

The ERD content, format and environmental assessment has considered and applies relevant EPA guidance and policy.

This ERD presents detailed information on each environmental factor nominated by the EPA as a potential 'key' environmental factor related to the Proposal.

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, drawing upon proposal specific biological and other technical studies
- 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 adverse impacts.

This ERD also satisfies the requirements for an accredited assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and includes an assessment of potential significant impacts of the Proposal on Matters of National Environmental Significance (MNES) (Section 14) and a checklist of requirements outlined in Schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations) against the ESD (Appendix A.1).

The ERD considers all phases of Proposal implementation, including construction, commissioning, operation and closure in the context of existing approved operations. Cumulative impacts with other projects are also addressed. The potential impacts to key environmental factors are described in detail

and assessed using relevant studies specific to the Proposal. This ERD summarises and describes the proposal specific environmental studies conducted for the Proposal as relevant to the EIA. Technical reports used in preparing the ERD are provided as appendices.

1.2. Proponent

Hamersley Iron Pty Limited (the Proponent) is a wholly owned subsidiary of Rio Tinto Limited (Rio Tinto). The Proponent details are provided in Table 1-1.

Table 1-1: Proponent Details

Item	Detail
Company	Hamersley Iron Pty Limited
ACN	004558276
Address	152–158 St Georges Terrace, Perth WA 6000

The key contact for the Proposal is:

Jonathon Barker

Senior Advisor, Environmental Approvals

152-158 St Georges Terrace, Perth WA 6000

+61 8 9327 2000

Jonathon.Barker@riotinto.com

1.3. Proposal Terminology

The following terminology is used throughout this document:

- **Development Envelope**: Refers to the area in which the Existing Operations and the new mine areas and associated facilities of the Proposal are located. All direct impacts associated with the Amended Proposal will be contained within the Development Envelope
- **Proposal**: The Proposal is the significant amendment to the Approved Proposals and includes the extension and development of new above and below water table deposits and associated activities to extend the life of the Existing Operations. The Proposal is the subject of this assessment and does not include the Existing Operations
- **Proposed Action**: The Proposed Action, under the EPBC Act, includes the extension and development of new above and below water table deposits and associated activities to extend the life of the Existing Operations. The Proposed Action is the subject of this assessment and does not include the Existing Operations
- **Existing Operations**: Refers to the existing iron ore operations that form the Approved Proposals (BS2, BS4 and Nammuldi-Silvergrass as approved under MS 131, 867, 1000 and 925) and includes components of the Approved Proposals that have and those that are yet to be implemented
- **Amended Proposal**: The Amended Proposal incorporates both the Existing Operations and the Proposal
- **Conceptual Footprint**: Refers to the current indicative layout of the direct disturbance footprint of the Proposal, which includes key elements such as mine pits and waste rock landforms (WRLs), as well as infrastructure. This footprint is indicative only, and therefore, the final location of key elements and infrastructure may occur outside of 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 Restriction Zone (MRZ)**: Refers to a demarcated zone where no mining excavation will occur, and only low impact activities associated with environmental monitoring and management may be implemented. No more than 5% of the MRZ can be cleared for low impact activities
- **Mining Exclusion Zone (MEZ)**: Refers to an area within the Development Envelope where no direct disturbance is permitted unless in response to a contingency action associated with monitoring and management
- **Assessment Area**: As the Development Envelope is large, seven assessment areas have been defined to aid the reader to understand the location of environmental values and impacts. These assessment areas are for providing context for assessment information only and are not referred to in the Proposal definition and/or Proposal Content Document (PCD) (Appendix B.2)

Figure 1-1
Location of the Brockman Syncline Proposal

Drawn: GIS Team
Plan: PDE0182233v1
Date: June 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:1,250,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Rio Tinto Port
- Town
- Development Envelope
- Native Title Determination Area
- National Park
- Rio Tinto Railway
- Conveyor
- Highway
- Major Road
- Minor Road
- Site Access Road

Enlargement

Mount Brockman Road
Eastern Guruma
Silvergrass
Nammuldi
Brockman 2
Brockman Syncline
Brockman 4
White Quartz Road
Puutu Kunti Kurrama and Pinikura
Western Turner Syncline
0 5 10 15 20 Kilometres

Cape Lambert
Murujuga National Park
Dampier
Wickham
Karratha
Roebourne
North West Coastal Highway
Millstream-Chichester National Park
Pannawonica
Mesa A
Mesa J
See Enlargement
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Eastern Guruma
Puutu Kunti Kurrama and Pinikura
Brockman Syncline
Western Turner Syncline
Tom Price
Mount Tom Price
Marandoo
Gudai-Darri
Yandicoogina
Great Northern Highway
Karijini National Park
Hope Downs 1
Hope Downs 4
West Angelas
Paraburdoo
Eastern Range
Channar
Newman

Karratha
PILBARA
AUSTRALIA
Perth

N
0 15 30 45 60 Kilometres
Map units in metres

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2. PROPOSAL

2.1. Proposal Content

The Brockman Syncline Proposal includes the extension and development of new above and below water table deposits and associated activities to extend the life of the Existing Operations.

In accordance with s. 40AA of the EP Act, the Proposal represents a significant amendment to the Approved Proposals and will be assessed in the context of the Existing Operations. Accordingly, this ERD details the Existing Operations and the Proposal in order to have regard to the combined effect that implementing the Existing Operations and this Proposal (collectively the 'Amended Proposal'), may have on the environment.

The Proponent proposes that subject to approval of the Proposal, a new consolidated MS for the Amended Proposal will be published with implementation conditions that supersede, consolidate and modernise those currently applicable to the Existing Operations (Appendix B.3).

2.1.1. Existing Operations

The Approved Proposals for the Existing Operations together provide an approved disturbance footprint of 11,759 ha. The Approved Development Envelopes for each Approved Proposal are shown in Figure 2-1.

2.1.1.1. Brockman Syncline 2 and Nammuldi-Silvergrass

BS2 and Nammuldi-Silvergrass are currently managed as one site. Operations commenced at BS2 and Nammuldi above water table (AWT) in 1998 and 2006, respectively, followed by Nammuldi and Silvergrass below water table (BWT) in 2014 and 2017. BS2 and Nammuldi-Silvergrass operations utilise three processing plants:

- BS2 dry processing plant
- Nammuldi AWT dry processing plant
- Nammuldi BWT wet processing plant.

Brockman Syncline 2 (MS 131 and 867)

BS2 includes AWT mining of pits 1 to 3 and AWT and BWT mining of pits 4 to 7 and associated infrastructure, including rail spur, surplus water discharge to Pit 5 and potential acid-forming (PAF) material waste dump.

Although some components are subject to limits, no overall clearing limits are specified within MS 131 or MS 867. As part of this Proposal, clearing limits on BS2 will be defined within the context of the amalgamated and contemporised new MS.

Along with various mine design, ore transport, infrastructure, water and power supply parameters, as well as mining rates and stockpiles. MS 131 and MS 867 authorises:

- Dewatering of Pit 4-6 orebody aquifer of not more than 950 megalitres per annum (ML/a) (0.95 gigalitres per annum [GL/a]) to maintain groundwater level at a depth not greater than 570 mRL
- Discharge of excess water to Pit 5 for passive recharge (includes water quality discharge requirements)
- Mineral waste management and closure requirements including partial backfills of pits (Pits 1, 4, 4 Extension, 5, 6 and BS2).

Nammuldi-Silvergrass (MS 925)

Nammuldi-Silvergrass operations include AWT and BWT mining, permanent re-alignment of 3 km of Narraminju (Caves Creek)[8] and associated infrastructure, including an external waste fines storage facility (WFSF), irrigated agriculture at Nammuldi and periodic discharge to Kartajirri (Duck Creek). MS 925 authorises:

- Mining up to 225 m BWT at Nammuldi Marra Mamba and Brockman pits
- Mining up to 150 m BWT at Silvergrass Marra Mamba pits, with all pits to be backfilled above the post-mining water table levels
- Clearing of up to 6,300 ha for mining, waste dumps, WFSF and associated infrastructure and 2,500 ha for the Nammuldi Agricultural Project (NAP) (also termed the Irrigated Agriculture Area)
- Groundwater abstraction of 51 GL/a at Nammuldi and 68 GL/a at Silvergrass.

The Proponent has agreed in consultation with Traditional Owners not to proceed with the diversion of the main creekline for the Silvergrass East pit 1 operations at Caves Creek currently permitted under MS 925; this change will be reflected in the Proposal Content Document of the Amended Proposal.

2.1.1.2. Brockman Syncline 4 (MS 1000)

Operations commenced at BS4 in 2010, with the most recent addition being the Brockman 4 Marra Mamba AWT deposits (Q and R). The BS4 deposits consist of the Brockman and Marra Mamba mineralised formations along the southern limb of the Brockman Syncline.

BS4 operations include a dry crushing and screening processing plant. MS 1000 authorises:

- Clearing of no more than 4,503 ha with the Development Envelope
- Dewater disposal through controlled discharge to Pulykati Wuntu (Boolgeeda Creek) with a maximum wetting footprint to extend no further than 37 km from the discharge outlet under natural no-flow conditions.

The existing BS4 operation was referred under the EPBC Act in 2005 based on the potential presence of MNES fauna species (and their habitat), specifically Northern Quoll, Night Parrot and Pilbara Olive Python. The existing BS4 operation was determined to be ‘not a controlled action’, not requiring EPBC Act assessment and approval.

2.1.1.3. Shared Infrastructure

Existing operations at BS2, BS4 and Nammuldi-Silvergrass share the following infrastructure, including but not limited to:

- Boolgeeda airport
- Brockman rail fuel hub and rail spur
- Haul roads and light vehicle roads
- Water transfer infrastructure Jerriwah, BS2, BS4, Nammuldi and West Pilbara Village accommodation camps
- Nammuldi WFSF
- Water management infrastructure, including the NAP
- Power infrastructure, including a 220 kV transmission network and BS2 regional substation

[8] The Proponent has agreed in consultation with Traditional Owners to not implement the permanent realignment at Caves Creek currently permitted under MS 925, this will be reflected in the new consolidated MS to be issued.

- Administration buildings
- Mobile and fixed plant equipment workshops
- Warehouses
- Hydrocarbon storage facilities
- Ammonium nitrate/ fuel oil (ANFO) explosives storage facilities
- Power distribution network
- Dewatering infrastructure and water supply borefields
- Wastewater treatment plants
- Laydown yards.

The above infrastructure will continue to be operated under the Amended Proposal.

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Figure 2-1
Existing Operations - Development Envelopes

Drawn: A.Coulson
Plan: PDE0182234v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:180,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Part IV Indicative Approved Footprint
- Brockman 2 - MS 131/867
- Nammuldi Silvergrass - MS 925
- Brockman 4 - MS 1000
- Conveyor
- Rio Tinto Railway
- Major Road
- Minor Road
- Site Access Road
- Major Creek

510,000 520,000 530,000 540,000 550,000 560,000

7,530,000 7,520,000 7,510,000 7,500,000 7,490,000

Robe River
Calivingina Creek
Cayes Creek
Mount Brockman Road
Duck Creek
Silvergrass
Nammuldi
Brockman 2
Wackina Creek
Boolgeeda Creek
Brockman 4
Beasley River
White Quartz Road
Nanutarra - Munjina Road
Western Turner Syncline
Beasley River West

N

0 2 4 6 8 10
Kilometres

Map units in metres

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2.1.2. General Proposal Description

A summary of the Proposal and its key elements, which have the potential to significantly affect the environment, are shown in Table 2-1 and Table 2-2. The Development Envelope for the Proposal is 63,343 ha and a total indicative disturbance of up to 7,896 ha has been defined for the Proposal as shown in Figure 2-2. Oblique views of the Development Envelope and Conceptual Footprint are provided in Figure 2-2 a to d.

The PCD for the Proposal under assessment (as modified under s.43A of the EP Act) is attached as Appendix B.2.

Table 2-1: General Proposal Description

General Proposal Description	
Proposal Title	Brockman Syncline Proposal
Proponent Name	Hamersley Iron Pty Limited (ACN 004 558 276)

Short description	The Brockman Syncline Proposal (the Proposal) is located approximately 60 km west-northwest of Tom Price in the central Pilbara region of Western Australia. The Proposal is located within the Native Title Determination Areas of the Puutu Kunti Kurrama and Pinikura People and the Eastern Guruma People.
	
	The Proposal includes the extension and development of new above and below water table deposits and associated activities to extend the life of existing iron ore operations at Brockman Syncline 2, Brockman Syncline 4 and Nammuldi-Silvergrass.
	
	The Proposal also includes, but is not limited to the following:
	• Development of new deposits and extensions of existing operations, including above water table and below water table mining
	• Ore processing, transport and handling infrastructure
	• Ore, topsoil and subsoil stockpiles
	• Mineral waste management, including but not limited to:
	  ○ Waste rock dumps
	  ○ Storage of waste fines
	  ○ Land bridges
	  ○ Low-grade ore dumps
	• Surface water management infrastructure, including but not limited to:
	  ○ Diversion drains
	  ○ Levees
	  ○ Culverts
	• Infrastructure for groundwater abstraction and utilisation
	• Dewatering and surplus water management, including but not limited to:
	  ○ Use in ore processing
	  ○ On-site use, including discharge to disused pits
	  ○ Use at the Nammuldi irrigated agriculture project
	  ○ Infiltration to the aquifer
	  ○ Provision to other users
	  ○ Discharge to creek lines
	• Other associated mine infrastructure and support facilities and upgrades, including but not limited to:
	  ○ Accommodation Camps
	  ○ Workshops
	  ○ Hydrocarbon and ANFO storage

General Proposal Description	
	○ Laydown areas, offices and accommodation facilities ○ Linear infrastructure including but not limited to: - Heavy and light vehicle access roads - Crushing and conveying systems - Pipe and power lines (including sub-stations) - Utilities and communications distribution networks - Rail and associated infrastructure - Renewable energy infrastructure.

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

Element	Location	Approved Proposal Extent (MS 131, 867, 925 and 1000)	Proposal	Amended Proposal
Physical Elements				
Mine and associated infrastructure	Figure 2-2	• MS 131 and 867: No clearing limit specified (estimated at 1,106 ha) • MS 925: Clearing of up to 6,300 ha of native vegetation within the Nammuldi-Silvergrass Development Envelope • MS 1000: Clearing of no more than 4,503 ha within the Brockman 4 Development Envelope	Additional clearing of 7,896 ha within a 63,343 ha Development Envelope	Clearing of up to 19,805[9] ha within a 63,343 ha Development Envelope
Irrigated Infrastructure	Figure 2-2	Clearing of up to 2,500 ha within the Nammuldi Irrigated Area within the Development Envelope	No change	Clearing of up to 2,500 ha within the Nammuldi Irrigated Area within the 63,343 ha Development Envelope
Operational Elements				
Groundwater abstraction for water supply and mine dewatering	Figure 2-6	• MS 925: Groundwater abstraction of 51 GL/a at Nammuldi and 68 GL/a at Silvergrass • Undefined for MS 131, 867 and 1000	Abstraction of up to 50 GL/a	Abstraction of up to 50 GL/a
Management of Surplus Water	Figure 2-4	• MS 131 and MS 867: Discharge of excess water to Pit 5 at 950 ML/a • MS 925: Transfer for offsite use; transfer to the Irrigated Agriculture Area and periodic discharge to Duck Creek	Surplus water management options include: • Use on site • Discharge to disused pits • Irrigated agriculture at Nammuldi	Surplus water management options include: • Use on site • Discharge to disused pits • Irrigated agriculture at Nammuldi

[9] The Proposed Action, under the EPBC Act, includes the extension and development of new above and below water table deposits and associated activities to extend the life of Existing Operations with a total clearing of 7,896 ha. The Proposed Action does not include the Existing Operations.

Element	Location	Approved Proposal Extent (MS 131, 867, 925 and 1000)	Proposal	Amended Proposal
		• MS 1000: Dewatering disposal through controlled discharge to surface drainage of Boolgeeda Creek. Dewater discharge to extend no further than 37 km along Boolgeeda Creek from the discharge point under natural no-flow conditions.	• Injection to the aquifer • Provision to other users • Controlled discharge to the environment via Duck and Boolgeeda Creek with a wetting front not exceeding 67 and 37 km respectively, under natural no-flow conditions.	• Injection to the aquifer • Provision to other users • Controlled discharge to the environment via Duck and Boolgeeda Creek with a wetting front not exceeding 67 and 37 km respectively, under natural no-flow conditions.
Backfill of Pits	Figure 2-2	• Partial backfill of Pits 1, 4, 4 extension, 5 and 6 at BS2[10] • Backfill of BS2 pit to sufficient depth to ensure that, following mine closure and backfilling, the groundwater water table will permanently remain at least 3 metres below the lowest point of the pit floor[11] • All open cut Marra Mamba pits in the Silvergrass area to be backfilled to above the post-mining water table levels[12]	• Backfill of BS3 Extension Deposits (MMJ and Creekside)	• Partial backfill of Pits 1, 4, 4 extension, 5 and 6 at BS2[10] • Backfill of BS2 pit to sufficient depth to ensure that, following mine closure and backfilling, the groundwater water table will permanently remain at least 3 metres below the lowest point of the pit floor[11] • All open cut Marra Mamba pits in the Silvergrass area to be backfilled to above the post-mining water table levels[12]

[10] Previous condition required under MS 131

[11] Previous condition required under MS 867

[12] Previous condition required under MS 925

Element	Location	Approved Proposal Extent (MS 131, 867, 925 and 1000)	Proposal	Amended Proposal
		• BS4 Mine Pits are to be backfilled so that the final surface levels are at a higher elevation than the pre-mining groundwater level to prevent the formation of pit lakes (Pits 2, 3, 4, 5, 6, 7, 10, 11, 12, 15, 16, 17 and 18)[13]		• BS4 Mine Pits are to be backfilled so that the final surface levels are at a higher elevation than the pre-mining groundwater level to prevent the formation of pit lakes (Pits 2, 3, 4, 5, 6, 7, 10, 11, 12, 15, 16, 17 and 18)[13] • Backfill of BS3 Extension Deposits (MMJ and Creekside) to above post mining recovered water levels.
Proposal Elements with Greenhouse Gas Emissions				
Scope 1[14]	Diesel and land clearing – no more than 497,046 t CO_2-e pa			
Scope 2[14]	Electricity – no more than 84,080 t CO_2-e pa			
Scope 3[15]	1,014 Mt CO_2-e			
Rehabilitation and Closure				
• The key closure outcome is to rehabilitate the site to create a safe, stable and non-polluting landscape consistent with the post-mining land use and to maintain environmental and cultural heritage values. • Rehabilitation and closure activities will be carried out in accordance with the approved Mine Closure Plan (MCP).				
Other Elements which Affect the Extent of Effects on the Environment				
Proposal Time	Maximum project life	Operational phase estimated at 25 years (not including construction and closure implementation phases).		

[13] Previous condition required under MS 1000

[14] Predicted peak annual emissions associated with the Amended Proposal

[15] Attributable to this Proposal

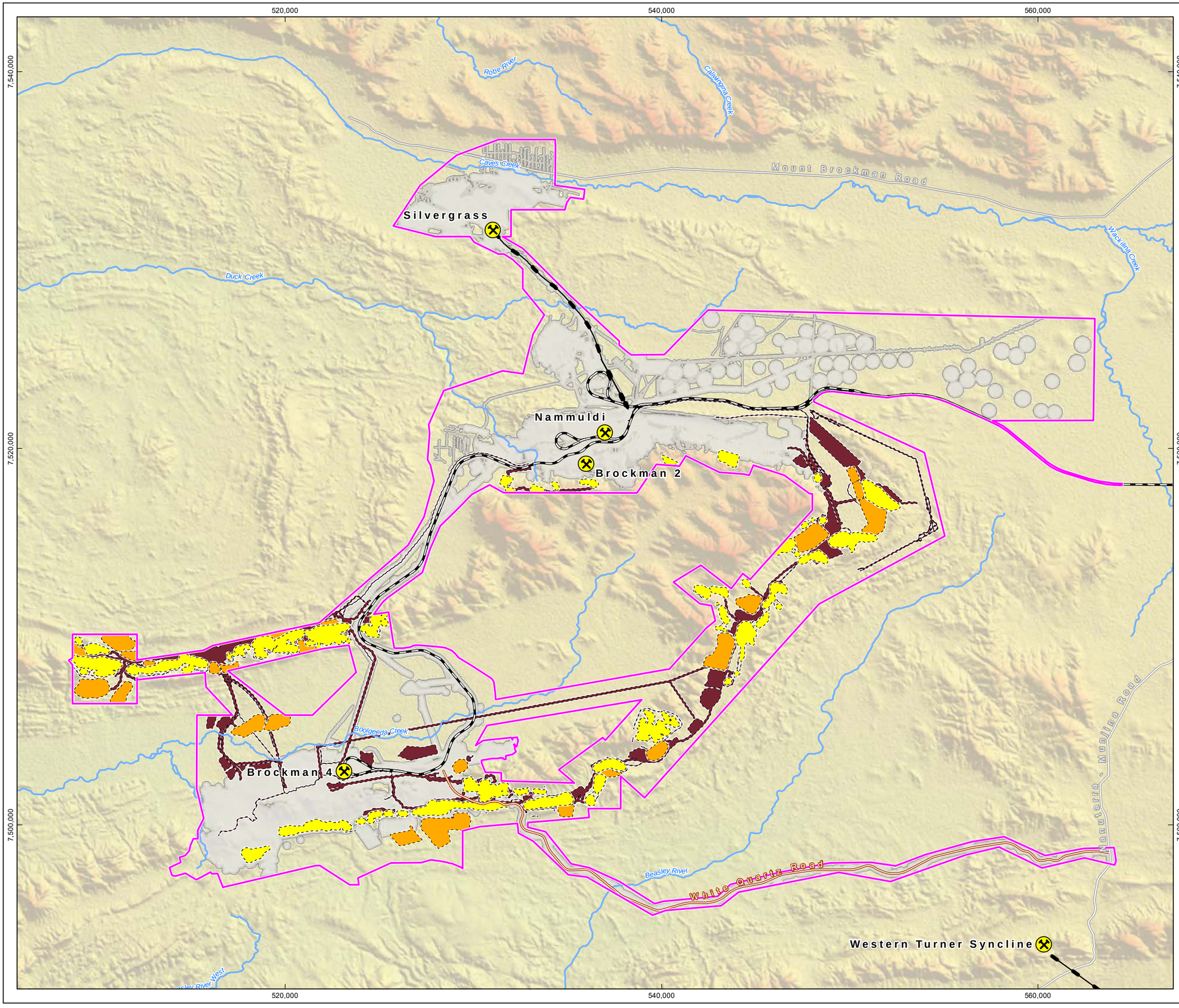

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Figure 2-2
Development Envelope and Indicative Location of Key Proposal Elements

Drawn: L.Fuentes
Plan: PDE0182235v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8
Kilometres

Map units in metres

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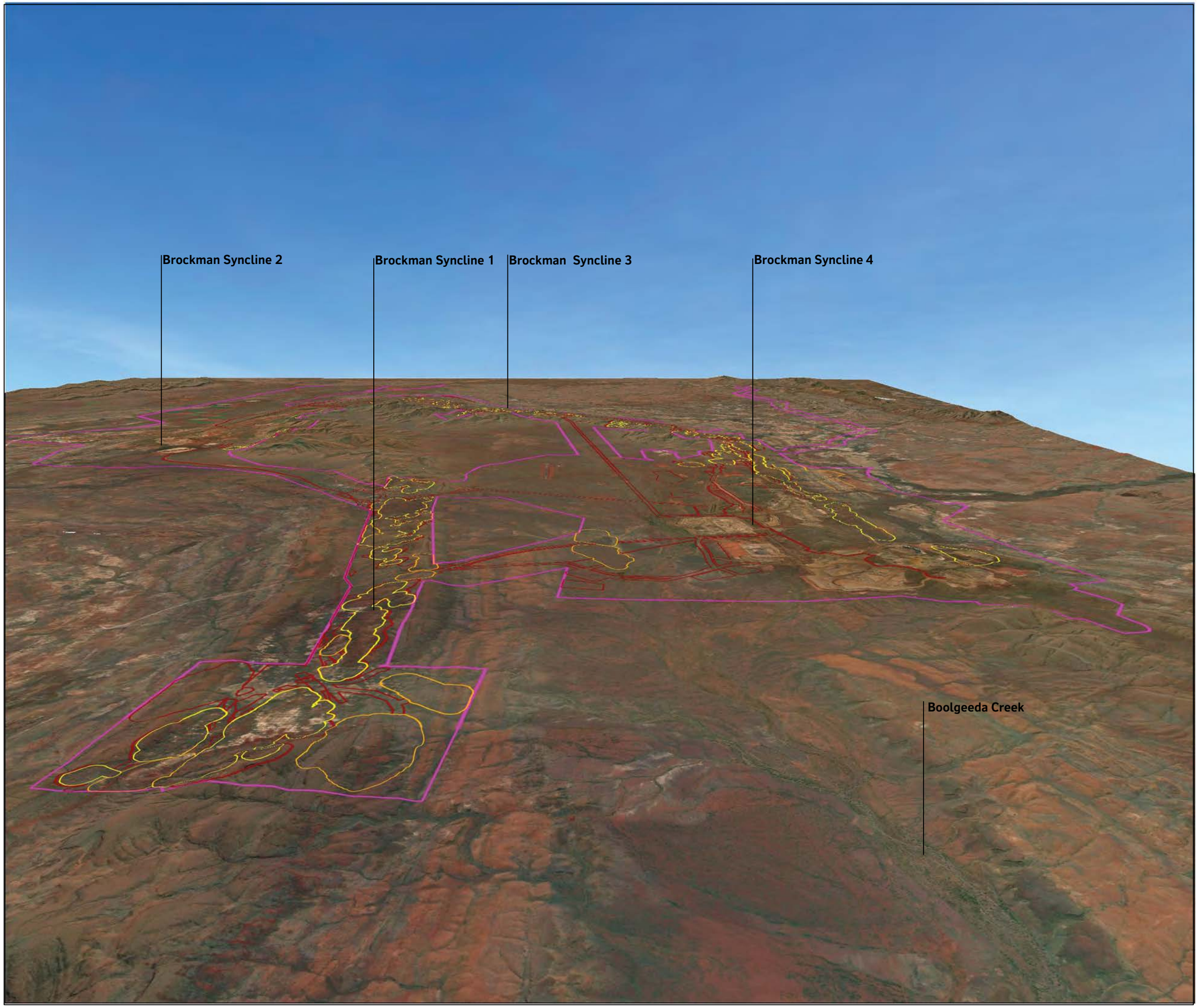

RioTinto

Figure 2-2a
Development Envelope and Indicative Location of Key Proposal Elements Looking East

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

Development Envelope

Conceptual Footprint

Pit
Waste Rock Landform
Infrastructure

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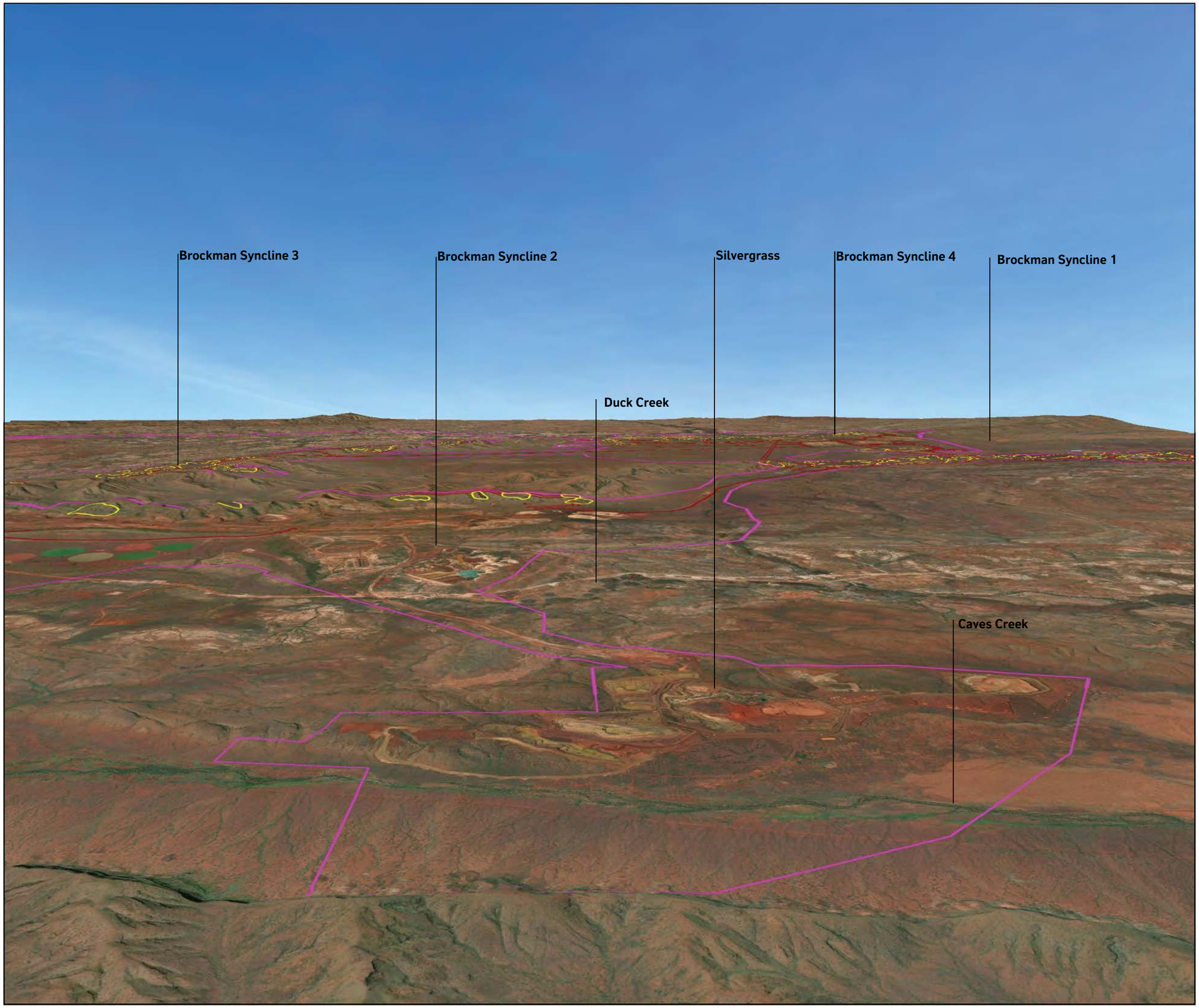

RioTinto

Figure 2-2b
Development Envelope and Indicative Location of Key Proposal Elements Looking South

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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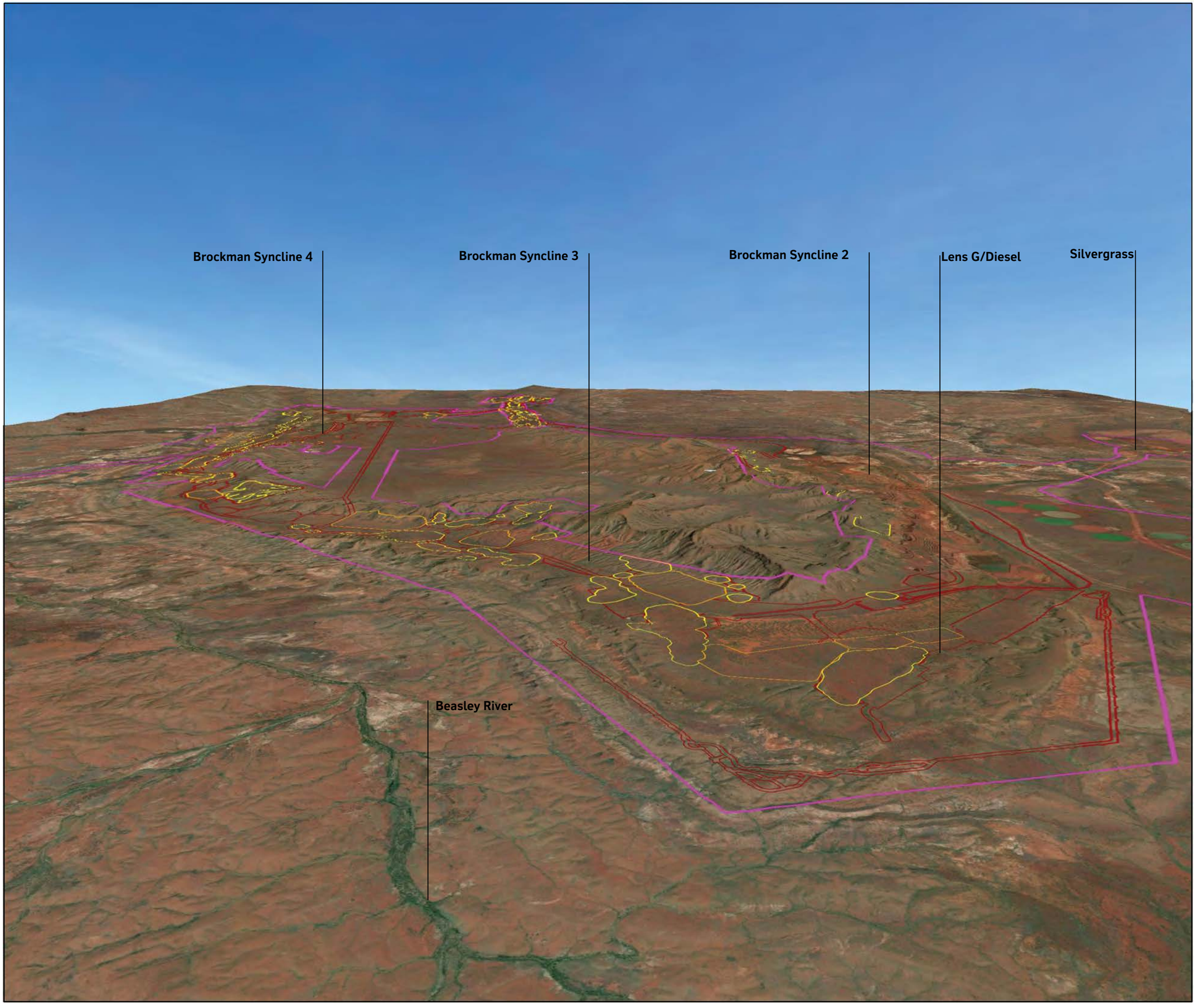

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Figure 2-2c
Development Envelope and Indicative Location of Key Proposal Elements Looking West

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

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Legend

Development Envelope

Conceptual Footprint

Pit
Waste Rock Landform
Infrastructure

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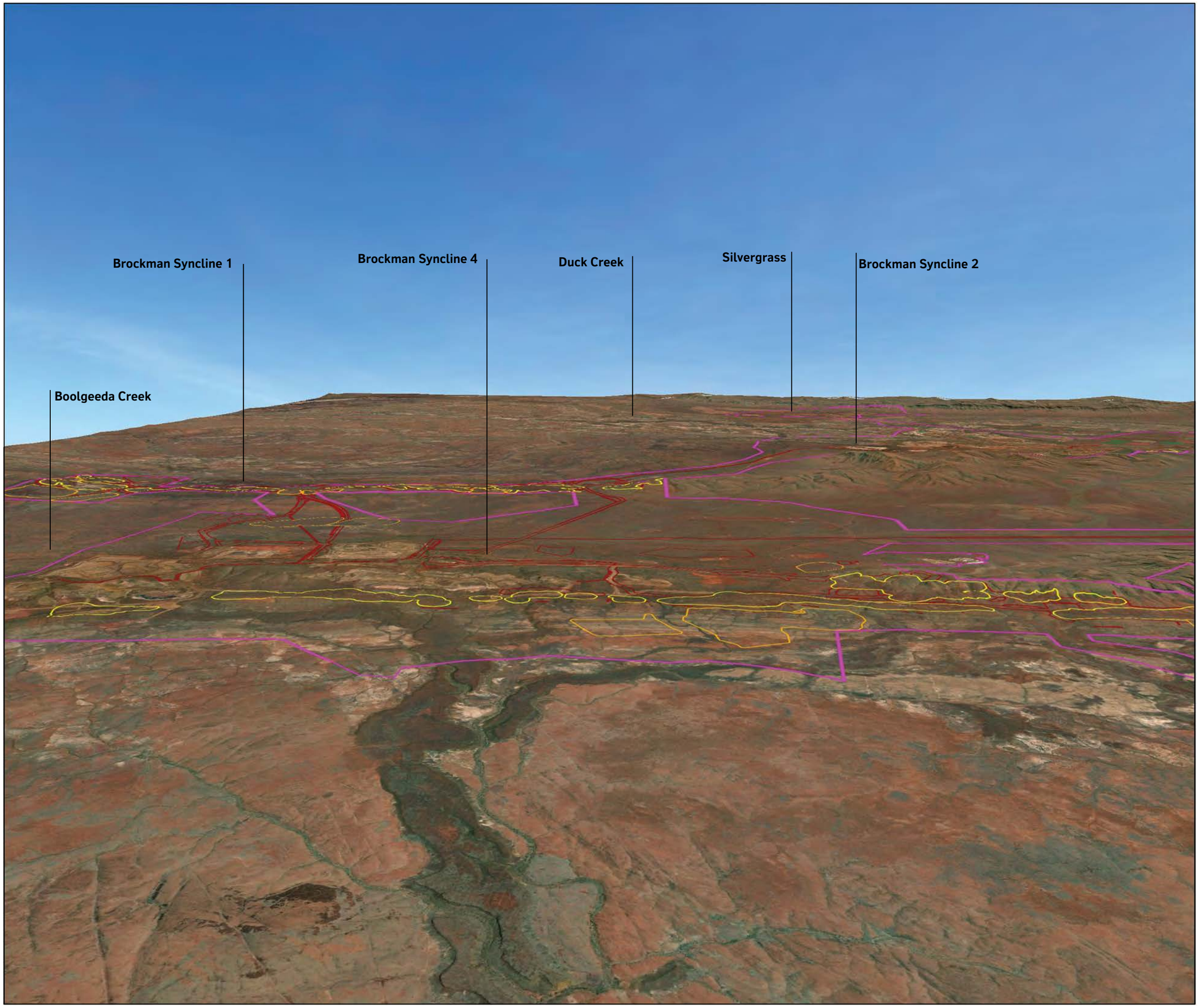

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Figure 2-2d
Development Envelope and Indicative Location of Key Proposal Elements Looking North

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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2.1.3. Detailed Proposal Description

2.1.3.1. Native Vegetation Clearing and Topsoil Removal

Clearing of up to 7,896 ha of additional native vegetation is proposed within the 63,343 ha Development Envelope. Clearing of vegetation occurs through all phases of the Proposal due to the long timeframe of iron ore operations.

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. Mining

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 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, dozers, water trucks, service trucks and graders. In line with relevant Australian standards, explosives magazines would store explosives for open pit blasting activities.

Approved and proposed AWT and BWT pits within the Development Envelope are detailed in Table 2-3 and shown in Figure 2-3.

Table 2-3: Approved and Proposed Pits within the Development Envelope

Type	Approved Pits/Deposits	Proposed Pits*/Deposits
AWT Only	• BS2 pits 1, 2 and 3 • BS4 Marra Mamba Pits Q and R	• BS1 East 3 • Pit 9c, Pit 14c, B2ED South, Pit 1a, 1d, 2b, 3a and 3b • Sandleford 1, 2 and 3 • Monkey 1, 2 and 3 • Creekside 1 • Orbe 1 and 2 • Lauriston • Brokenwood • Marra Mamba J2 (MM-J2) • BS3 • Marra Mamba M1 (MM-M1) • Endeavour 2
AWT and BWT	• BS2 pits 4, 5, 6 and 7 • BS4 pits • Nammuldi Marra Mamba and Brockman Pits – up to 250 m BWT • Silvergrass Marra Mamba Pits – up to 150 m BWT • BS4 Brockman Pits 2, 3, 4, 5, 6, 7, 10, 11, 12, 15, 16, 17 and 18)	• BS1 East 1 and 2 • BS1 West 1, 2 and 3 • Lens G • Diesel • Creekside 2 • Marra Mamba J1 (MM-J1) and J3 (MM-J3) • Marra Mamba M2 (MM-M2) • Marra Mamba N1 (MM-N1) and N2 (MM-N2) • Endeavour 1

Type	Approved Pits/Deposits	Proposed Pits*/Deposits
		• Marra Mamba O1 (MM-O1), O2 (MM-O2) and O3 (MM-O3) • Marra Mamba Q • Marra Mamba R

**Pit naming indicative*

2.1.3.3. Waste Rock Management

The ultimate design slopes of WRLs will be to ensure final landform slopes that are geotechnically stable and safe over the long term.

Several factors are taken into consideration for the locations of permanent WRLs; these include but are not limited to:

- Minimising the potential impact on known environmental and social values
- Waste rock characterisation, including erosion and acid and/or metalliferous drainage (AMD) potential and their proximity to sensitive environmental and social values
- Minimising the economic haul distance
- Avoiding the areas with potential future economic resource potential
- Allowing for future battering to achieve ultimate landform stability at closure
- Allowing for contingency mine pit cutbacks in the event pit wall stability is compromised.

2.1.3.4. Mineral Waste Management

Rio Tinto operations in the Pilbara manage and reduce the risk of AMD through implementation of provisions included in the Mine Closure Plan (MCP) (Appendix B.4).

Current operations manage PAF material on-site by encapsulating it with inert material within in-pit and ex-pit WRL's and monitoring water quality surrounding these facilities. Any future operation encountering PAF material will utilise existing encapsulation areas or identify new storage areas that minimise the potential for long-term environmental impacts. Selection and design criteria for new PAF material storage areas are detailed in the MCP and may include encapsulation within ex-pit WRLs, or in-pit as backfill to either above or below the predicted recovered groundwater level to avoid repeated inundation and exposure to oxygen.

At closure, WRLs containing PAF material are likely to require store and release covers, as implemented at other Rio Tinto operations in the Pilbara. Further detailed designs will be undertaken to support subsequent revisions of the MCP (Appendix B.4).

Initial mapping of PAF material exposures on final pit walls has been completed to assess the AMD risk from this material at closure. BWT pits with moderate to high AMD risk will be backfilled to prevent a permanent pit lake forming at closure. Pit designs will be refined throughout the life of mine (LOM) and opportunities to reduce the AMD risk will be identified and the AMD risk re-assessed as part of the mine closure planning process.

Non-acid forming (NAF) mineral waste may be utilised for construction. Alternatively, mineralised stockpiles (in and ex pit) may be used temporarily or permanently to store materials that do not meet current product strategy specifications. This material may be processed where strategies change over time.

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Figure 2-3
Development Envelope and Indicative Pit Locations

Drawn: L.Fuentes
Plan: PDE0190113v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:180,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Indicative Pit Outlines

- Above Water Table Pit (AWT)
- Above/Below Water Table Pit (AWT/BWT)
- Below Water Table Pit (BWT)

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000 540,000 560,000
7,540,000 7,520,000 7,500,000

Robe River
Caiwarrina Creek
Caves Creek
Mount Brockman Road
Wackiinta Creek
Duck Creek
Boolgeeda Creek
Beasley River
Beasley River West
White Quartz Road
Nanutarra - Munjina Road

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

Pit 14c
Lens G
B2ED South
Pit 9c
Pit 3a
Pit 3b
Pit 2b
Pit 1a
Pit 1d
Monkey 2
Sandleford (1,2 and 3)
Diesel
Lauriston
Brokenwood
Monkey 1
Orbe 2
Orbe 1
Creekside 2
Creekside 1
MM-J-2
MM-J-1
MM-J-3
BS1 East 1
BS1 East 3
BS1 East 2
BS1 West 2
BS1 West 3
BS1 West 1
M1
Endeavour 2
BS3
Endeavour 1
Pit Q
Pit R
Pit O-2
Pit O-1
Pit O-3
M2
N2
N1

2.1.3.5. Processing Facilities

In addition to utilising existing ore handling and processing infrastructure at BS2, BS4 and Nammuldi-Silvergrass, the Proposal includes the following facilities:

- Run of mine (ROM) pads and blending stockpiles
- Primary and in-pit crushing facilities
- Concentrators
- Overland conveying systems
- Modifications to the existing processing facilities.

2.1.3.6. Waste Fines Management

The existing WFSF at Nammuldi is expected to reach capacity in 2027. Additional in-pit WFSFs are proposed to be developed in the Lens A pit, Pit 5 and Pit 8 (Figure 2-4). These pits are part of the approved mine at BS2-Nammuldi and are due for mining completion by 2026.

2.1.3.7. Waste Management

The Proponent has existing systems and procedures in place 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.

2.1.3.8. Water Management Strategy

Rio Tinto's overarching water management strategy and surplus use hierarchy is outlined in Figure 2-5. The hierarchy shows that surplus water will be used for any required mitigation demand before operational use. Any further surplus will be stored in completed pits or via Aquifer Storage and Recovery (ASR) into suitable formations as the preferred surplus water management option.

The Proposal includes BWT mining which requires dewatering to access ore safely. Predicted dewatering volumes initially exceed operational water demand; however, as mining progresses into later years of the Proposal, water demand exceeds dewatering volumes. Effective groundwater management can manage this supply and demand, including access to stored water in pits. Water is also required for the Managed Aquifer Recharge (MAR) scheme that will be implemented in Narraminju (Caves Creek), subject to receiving all relevant approvals and in consultation with Traditional Owners. Work is ongoing from a closure planning process to identify appropriate water sources to continue to support the MAR scheme in consultation with Traditional Owners. This MAR scheme does not form part of this Proposal under assessment.

As such, a surplus water management strategy is required in which surplus water is initially discharged to creeks and/or the full extent of the NAP as (approved under MS 925 and MS 1000) until such time as mined out pits become available for storage. Significant storage capacity in completed pits is anticipated by 2030 based on the current indicative mine sequence.

Figure 2-6 provides a spatial overview of the key elements of the Proposal water management strategy. Water is currently managed with a hub-based approach with BS2 and Nammuldi-Silvergrass being managed separately to BS4. However, under the Proposal, it is proposed that all mining areas be connected by pipelines to enable flexibility in water management across the Development Envelope. This flexibility will be key to the reduction of surplus water discharge and result in better environmental outcomes.

The key elements of the water management strategy are:

- Reduce surpluses where practicable with mine scheduling and efficient dewatering design
- Water supply to the Caves Creek MAR Scheme
- Preferential use of water for operational purposes such as processing and dust suppression
- Include flexibility to transfer water between mining areas, including the potential to connect BS2-Nammuldi-Silvergrass and BS4 water management hubs. This large water management network connecting separate mining areas allows more efficient use of dewatering to meet operational demands
- Preferential storage within completed mine pits and ASR to minimise surplus water discharge to the environment
- Use of water surplus for irrigation of the NAP (as approved under MS 925)
- Utilise the existing Duck Creek discharge point for periodic discharge when NAP has lower capacity or is not fully operational. Periodic discharge to Duck Creek is anticipated to be required until around 2030
- Continued discharge within the approved 37 km wetting front at Boolgeeda Creek to address surpluses at BS4 until in-pit storage becomes available around 2030.

This water management strategy includes the following mitigation measures:

- Avoids discharge to creeks not previously used for discharge
- Utilises existing discharge locations
- Avoids continuous discharge to Duck Creek
- Minimises water losses during period of surplus through using pit voids and suitable aquifer formations (i.e., ASR) for storage where appropriate.

The environmental impact assessment undertaken for the Proposal indicates that aquifer reinjection will not be required, accordingly no modelling has been undertaken, consistent with the ESD, however should monitoring and/or management during implementation of the Proposal indicate the potential for impacts that require mitigation through aquifer reinjection be required, groundwater modelling to demonstrate potential impacts associated with the specific proposed aquifer reinjection program will be undertaken to support appropriate revisions to the EMP for approval.

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7,500,000

Robe River
Callawirrina Creek
Caves Creek
Mount Brockman Road
Duck Creek
Boolgeeda Creek
Beasley River
White Quartz Road

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

SEE INSET A
SEE INSET B
SEE INSET C

INSET A
WFSF
0 1 2 3
Kilometres

INSET B
Lens A
0 1 2 3
Kilometres

INSET C
Nammuldi
Pit 08
Pit 05
0 1 2 3
Kilometres

RioTinto

Figure 2-4
Proposed In-Pit
Waste Fines Storage Facilities

Drawn: L.Fuentes
Plan: PDE0191425v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Approved Waste Fines Storage
- Proposed In-Pit Waste Fines Storage Facilities
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access
- Major Creek

N
0 2 4 6 8 10
Kilometres

Map units in metres

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Overarching strategy

- Management of operational water surplus and deficits
- Reduce surpluses where possible with mine scheduling and efficient dewatering
- Adopt a hierarchy of use
- Protection of heritage and environmental values.
- Minimise closure obligations, including meeting stakeholder expectations around impact mitigation

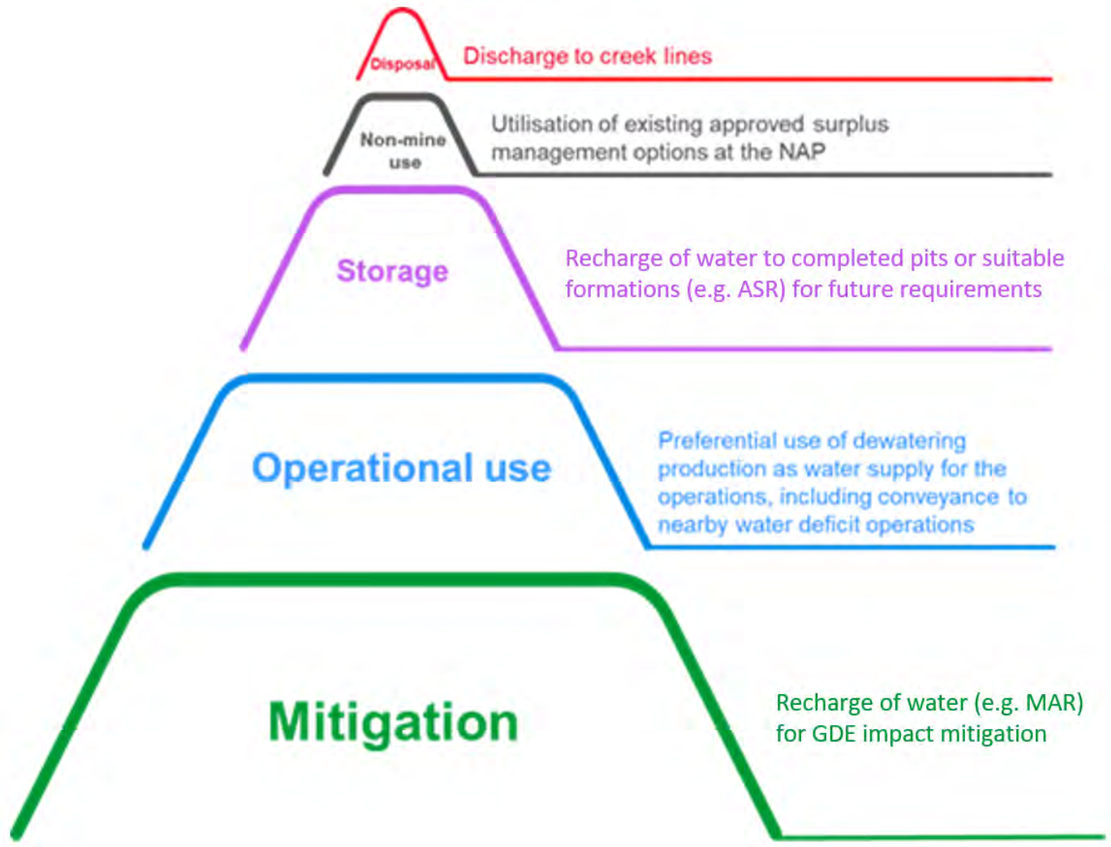

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Figure 2-5
Water Management Strategy and Surplus Hierachy

Drawn: A.Coulson
Plan: PDE0182237v1
Date: May 2022
GIS.Team@riotinto.com

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Figure 2-6
Water Management Infrastructure Schematic including Existing and Proposed Elements

Drawn: L.Fuentes
Plan: PDE0182238v1
Date: May 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:210,000 @A3
GIS.Team@riotinto.com

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Riparian Vegetation

Mallu Mallu Springs

NARRAMINJU MAR

SGE

CAVES CREEK

DUCK CREEK

Proposed 67 km discharge extent limit

NAMMULDI AGRICULTURAL PROJECT

EXISTING DUCK CREEK DISCHARGE

B2N

LENS G

DIESEL

CREEKSIDE

BS1

EXISTING BOOLGEEDA CREEK DISCHARGE

BS3

BOOLGEEDA CREEK

Existing 37 km discharge extent limit

Plunge Pool

BS4/BSM/T-O

BSM/M-N

Legend

- ORE PROCESSING PLANT
- AQUIFER OUTLINE
- BWT DEPOSIT
- AWT DEPOSIT
- PIT VOID STORAGE

N

0 2 4 6 8 10

Kilometres

Map units in metres

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2.1.3.9. Surface Water Management

Most infrastructure will be located beyond the floodplains of the creeks within the Development Envelope. Operational diversions are proposed to maintain flows where mining encroaches on the 1:100 AEP floodplain. At closure, operational diversions 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.

2.1.3.10. Linear Infrastructure

Ore will be transported to existing processing facilities at BS2, BS4 and Nammuldi-Silvergrass via conveyor, haul trucks and/or road trains. New infrastructure is required to connect the new deposits to the existing infrastructure, including but not limited to:

- Heavy vehicle and light vehicle access roads
- Crush and conveying systems
- Powerline realignments, installation and associated power distribution network, including substations
- Water supply pipelines
- Communications infrastructure.

2.1.3.11. Support Facilities

The Proposal will largely utilise existing supporting facilities at BS2, BS4 and Nammuldi-Silvergrass, which may be upgraded as required. However, the Proposal does include, but is not limited to, the following additional facilities at the new deposits:

- Heavy and light vehicle workshops
- Fixed plant workshops
- Hydrocarbon storage
- Refuelling facilities
- Oily water treatment facilities
- Park-up areas
- Administration and crib facilities
- Emergency fire services.

2.1.3.12. Accommodation

The operational workforce will be accommodated in the existing accommodation villages, including but not limited to BS2, BS4, Nammuldi and Jerriwah. Temporary construction accommodation may be required to accommodate the construction workforce. This will be located on existing disturbed areas, where practicable, to minimise clearing of native vegetation.

2.1.3.13. Power Supply

Power will be supplied by existing 33 kV transmission lines and additional substations. Transformers and switchgear equipment will be required to support new crush, convey and dewatering infrastructures. Overhead power lines will be extended and re-aligned to support mine operations, including the 220 kV transmission line to Tom Price. Diesel generators may be required to power dewatering bores. Power may also be supplied through renewables including through the construction of new renewable power projects and associated infrastructure.

2.1.3.14. Railway Corridor

The Development Envelope has been amended to address a historical gap applicable to the railway corridor between the NAP area and the West Angelas Iron Ore Project Linear Infrastructure Development Envelope as outlined in MS 1113.

2.1.4. Proposal Exclusions

The Proposal excludes the following activities to the extent they are required during the assessment of the Proposal:

- Low impact activities required to inform Part IV assessment of the Proposal, including drilling and associated activities for resource evaluation, geotechnical assessment and hydrogeological investigations. These activities will be subject to relevant provisions under Part V of the EP Act and the Rights in Water and Irrigation Act 1914 (RiWI Act)
- Activities that are part of, or required for continuation of, the existing mining operations at BS2, BS4 and Nammuldi-Silvergrass (as approved under MS 131, MS 867, MS 1000 and MS 925)
- Construction camp and associated activities (currently authorised under Clearing Permits issued under Part V of the EP Act)
- Environmental heritage and other studies/ investigations involving fieldwork.

Current operational activities are authorised via statutory environmental approvals under Part IV and V of the EP Act, the RiWI Act and the *Mining Act 1978* (Mining Act). The Proponent notes that whilst the Proposal is under assessment, additional approvals or amendments to existing approvals may be required to support these activities and the continuation of existing operations that do not relate to the implementation of this Proposal. Therefore, the above exclusions are not limited to only approved activities.

2.1.5. Approach to Impact Assessment

For this Proposal, the Proponent has defined the Development Envelope, which contains all of the Proposal's construction and operational activities and full scope of predicted direct impacts. The Proposal's final footprint will be located within the Development Envelope.

A Conceptual Footprint has been created which represents the approximate location of the Proposal's maximum amount of disturbance.

Iron ore mines can operate over many years, and pits, WRLs and infrastructure requirements can change over time as they are subject to market influences/conditions, the overarching portfolios of other mines, the desired ore blend, business requirements, legal agreements, customer demand and the need for flexibility to take into account environmental and heritage information for adaptive management and optimal environmental and social outcomes. Also, new technology and advances occur, enabling improved mining and infrastructure practices.

In order to allow for a full environmental impact assessment of the Proposal and enable the flexibility to implement the Proposal, the entire Development Envelope has been assessed for mining activities and surveys undertaken following EPA guidance. Where significant environmental or cultural heritage areas are within the Development Envelope, MRZs and/or MEZs have achieved the EPA's objectives, including outcome or management-based conditions or management plans.

Therefore, the activities of this Proposal can occur at any location within the Development Envelope up to the authorised extents, subject to the proposed MEZ and/or MRZ and other disturbance or other limits as proposed in conditions or management plans.

For the purposes of this assessment, the Development Envelope has been conceptually split into seven areas with four including Proposal elements that are under assessment as shown in Table 2-4 and Figure 2-7. Three of the areas within the Development Envelope relate to approved projects only. The

assessment areas are used only for ease of discussing the location of environmental values and impacts in the large Development Envelope.

Table 2-4: Environmental Impact Assessment Areas and Associated Deposits

Environmental Impact Assessment Area	Associated Proposal Deposit
Silvergrass (approved)	N/A
Brockman Syncline 1 Assessment Area	• BS1 East Deposit (1,2 and 3) • BS1 West Deposit (1, 2 and 3)
Brockman Syncline 2 Assessment Area	• Pit 9c • Pit 14c • B2ED South • Pit 1a, 1d, 2b, 3a and 3b • Lens G • Diesel
Brockman Syncline 3 Assessment Area	• Sandleford (1, 2 and 3) • Monkey (1, 2 and 3) • Creekside (1, 2 and 3) • Orbe • Lauriston • Brokenwood • MM-J (1, 2 and 3) • BS3
Brockman Syncline 4 Assessment Area	• Endeavour (1 and 2) • MM-M (1 and 2) • MM-N (1 and 2) • MM O (1, 2 and 3) • MM-R • MM-Q
NAP (approved)	N/A
MS 1000 Corridor (approved)	N/A

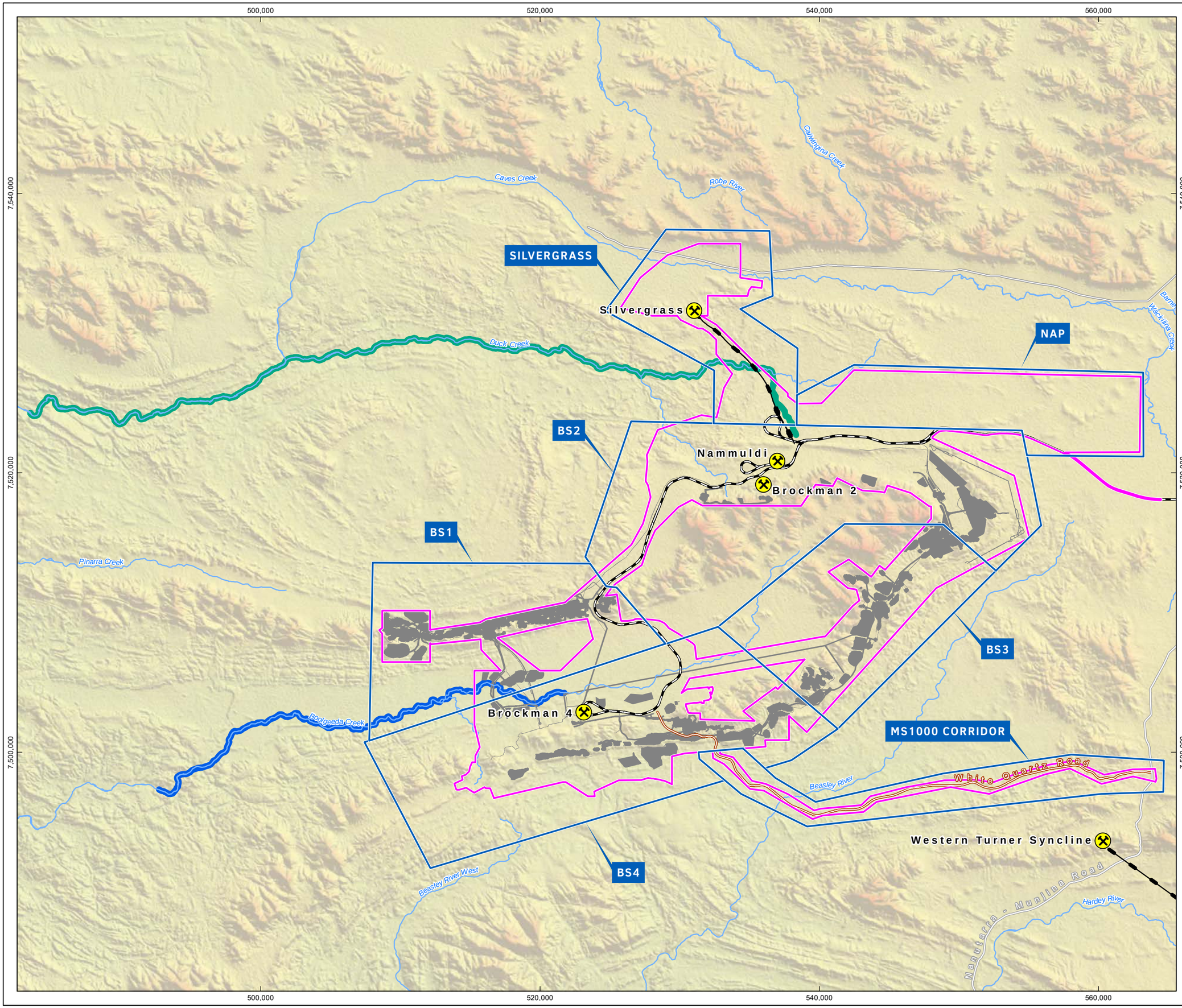

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Figure 2-7
General Environmental Impact Assessment Areas

Drawn: L.Fuentes
Plan: PDE0182236v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Assessment Areas
- Approved Indicative Site Layout
- Boolgeeda Creek Discharge Extent
- Duck Creek Discharge Extent
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

N

0 2 4 6 8 10
Kilometres
Map units in metres

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2.2. Proposal Alternatives

2.2.1. Justification of the Proposal

The Proponent supplies the global market with iron ore from the Pilbara and progressively seeks to develop resources within tenure, environmental and social constraints. This Proposal is required as part of the long-term plan to sustain iron ore production from Rio Tinto's Pilbara operations.

The Proposal is the most suitable option to sustain the current iron ore production from the BS2, BS4 and Nammuldi-Silvergrass operations whilst also utilising existing infrastructure and processing facilities. The Proposal will extend the life of the existing operations by up to 25 years. Production from the new deposits is strategically important for optimising Rio Tinto's 'Pilbara Blend' iron ore product. They contain a mix of Marra Mamba and High Phosphorus Brockman ore bodies. The Proposal includes one of the shortest mines to port cycle times in the Rio Tinto iron ore rail network for favourable rail capacity and comparative greenhouse gas emissions.

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

- Contribution to the value of mineral exports
- Royalties and taxation payments
- Development and ongoing sustaining capital investment
- Sustaining direct and indirect employment opportunities in the Pilbara and other regions of WA
- Sustaining demand for goods and services supporting the national, state and local 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
- Continued funding for a range of organisations in the region, 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. Location Alternative and Project Optimisation

The location of the economic orebodies defines the location of the Proposal. However, the Proposal design and scope has been optimised to minimise environmental and social impacts through various considerations such as design, layout, sequence, technologies and mitigation strategies. These considerations are described throughout this ERD. The approach to avoiding and mitigating impacts through the development of the final Development Envelope is described below.

2.2.2.1. Modifications to Development Envelope

The proposed Development Envelope has been reduced from 73,707 ha to 63,343 ha. The Development Envelope was adjusted (where possible) to avoid significant impacts on known environmental and cultural values and to allow more time for consultation and assessment of some of the removed areas from an environmental and cultural perspective. The following provides examples of where the Proponent has designed the Proposal to avoid or mitigate potentially significant or irreversible environmental impact and/or impacts to cultural values.

Tetratheca butcheriana

Tetratheca butcheriana is a Priority 1 flora species listed by the Department of Biodiversity, Conservation and Attractions (DBCA). There are 3,787 known individuals in seven populations, restricted to the Brockman Syncline landform (Rio Tinto 2021a). Under the relevant International Union for Conservation of Nature (IUCN) definition, this species would be listed as Critically Endangered. The Proponent has avoided one population of this species (2,057 individuals) by re-designing the Development Envelope to exclude this area (Figure 2-8). The two populations within the Development Envelope will be avoided by applying a 100 m MEZ buffer around the mapped population extent. Plant health monitoring will also be established as a precaution to check that there are no unforeseen indirect impacts. Further research, including genetic studies and pollination studies, are underway to increase further knowledge of this species (see Section 7).

Wona Land Systems PEC

The Wona Land System is a system of basalt upland gilgai plains supporting tussock grasslands and minor hard spinifex grasslands and supports several Priority flora species. An area that intersected early iterations of the Development Envelope had for a time been identified as potentially to be listed as the 'Four plant assemblages of the Wona Land System' Priority Ecological Community (PEC), and the Development Envelope was therefore amended to avoid this area. However, since then, DBCA determined that the relevant area near the Proposal no longer warrants consideration to be listed as the PEC (DBCA 2017). Nevertheless, the Development Envelope has been designed to avoid this area (Figure 2-8).

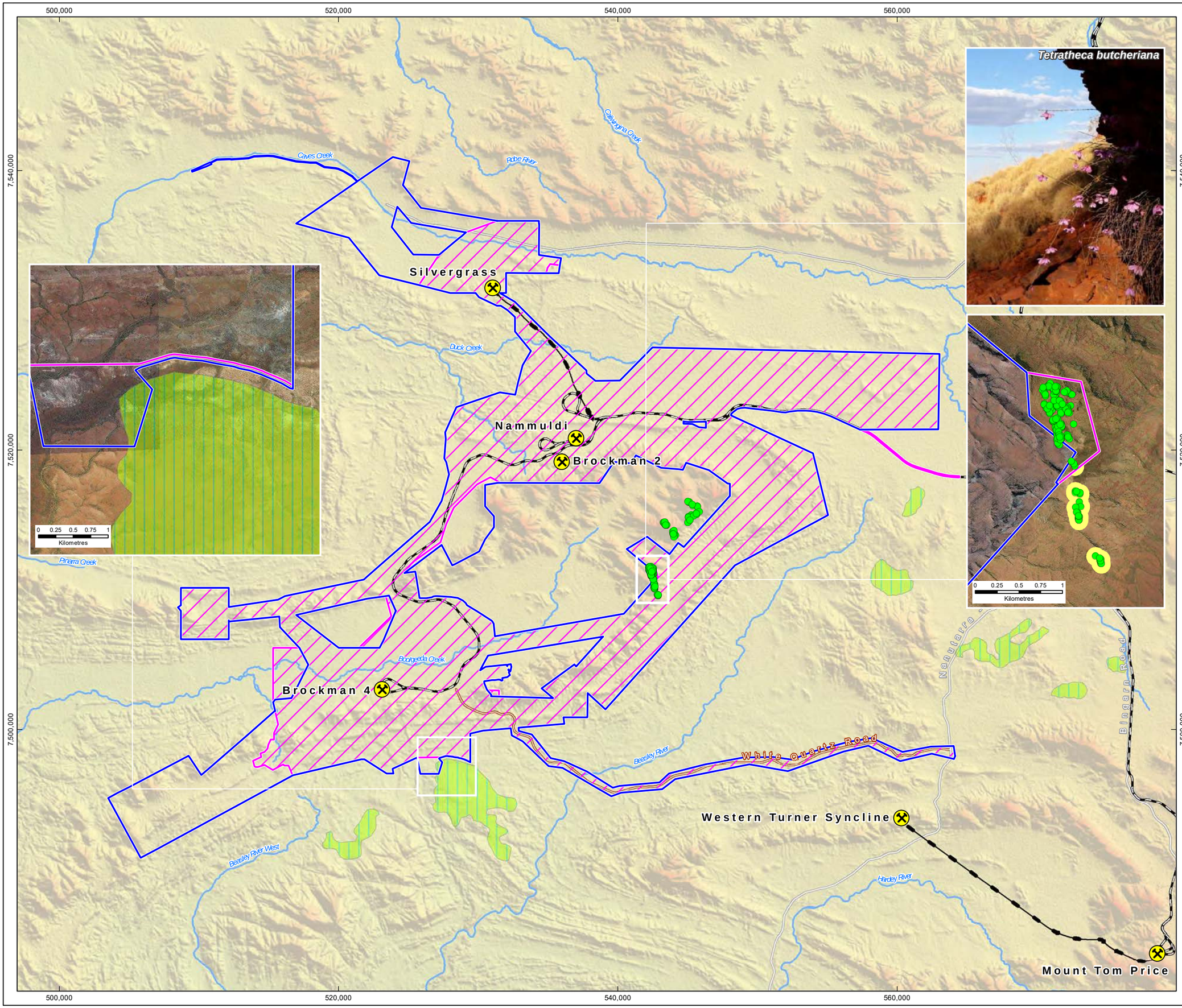

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Figure 2-8
Changes to the Development Envelope to Avoid *Tetratheca butcheriana* (P1) and the Wona Land System

Drawn: L.Fuentes
Plan: PDE0182239v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Original Development Envelope
- *Tetratheca butcheriana* (P1)
- Mine Exclusion Zone (*Tetratheca butcheriana*)
- Wona Land System
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Culturally Significant Sites

Based on current information and ongoing technical work and consultation, Rio Tinto has removed the below areas from the scope of the Proposal through a s.43A application and deferred them for further consideration. Deferral of operations in and around these areas recognises the need for further planning and extensive consultation with Traditional Owners as part of any potential future proposal. Any related future proposal would be subject to separate EP Act and EPBC Act referral and environmental impact assessment, along with assessment and approvals under other legislation such as, most prominently, the *Aboriginal Cultural Heritage Act 2021* (ACH Act).

- BS2 South West (BS2W) – The B2SW area is located south-west of the existing BS2 operation on Muntulgura Guruma Country outside of the revised Development Envelope. It is on a predominantly flat area adjacent to Jawunpa (Mt. Brockman) and is an ethnographic site of mythological significance with cultural associations and links to stories from the Dreamtime
- Vivash – The Vivash area is located outside of the revised Development Envelope, on Puutu Kunti Kurrama and Pinikura Country, southwest of existing BS4 operations. Purlykuti Creek intersects the Vivash area. Purlykuti Creek is an ethnographic site considered a strategic travel route and the "gateway" to the important places on Puutu Kunti Kurrama and Pinikura Country. The entire creek is considered culturally significant, extending beyond the currently listed heritage site boundary and sits within a Moratorium area which has been agreed between the Proponent and the Puutu Kunti Kurrama and Pinikura People
- Silvergrass West – Silvergrass West is located west of existing Silvergrass operations outside of the revised Development Envelope. Caves Creek intersects the Silvergrass West area. Caves Creek is a Registered site under the ACH Act, comprising main channel and tributaries. It extends across Muntulgura Guruma country with a smaller portion located on Robe River Kuruma Country. Along the creek are several sites of additional significance, including Mallu Mallu/Marlumarlunha (Palm Springs), which is a traditional meeting place for the three Kuruma (Guruma) groups.

2.2.2.2. Modifications to Project Layout

Similar to the Development Envelope, a series of conceptual footprint options were assessed to minimise potential significant impacts to environmental and cultural values. The following provides examples where the Proponent has used avoidance or mitigation measures to avoid potential significant or irreversible impact to known environmental or cultural heritage values and placed these within MEZ/MRZs. Opportunities to minimise environmental, cultural, and heritage impacts will continue to be explored during Proposal implementation and as part of ongoing closure planning processes.

Significant Ghost Bat Caves

The Proponent has designed the Proposal to strategically avoid all important Ghost Bat caves (either as part of an 'apartment block' around category 2 (maternity or day) caves or isolated category 2 caves). These caves are considered significant habitat for the Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) throughout the Development Envelope. Most significantly, this includes the removal of portions of satellite ore deposits from the mine plan at Lens G in order to avoid potential direct and indirect impacts to three 'apartment block' caves within the general location of the deposit. These caves have been placed in MRZs and MEZs (Figure 2-9).

In addition, the Proponent recognises that the range at Brockman Syncline 1 (BS1) likely acts as an east-west corridor for the movement of the Ghost Bat in the region as there is no known suitable roosting habitat to the north or south of the deposit (flats extend north and south). As such, the mine plan has been amended to exclude a cluster of seven caves along the range to ensure the east-west connection is maintained along the range and between any caves in surrounding areas. These caves have been placed in MRZs and MEZs (Figure 2-9).

In order to protect significant Ghost Bat caves within the Development Envelope, the Proponent has further defined MRZs for 92 caves, with buffers ranging from 150 m for significant caves (maternity and day roosts) and 75 or 20 m for less significant caves (night roosts used during foraging). Further detail is provided in Sections 8 and 14. In some instances, MRZs surrounding caves may also align with significant social and/or heritage sites.

Plunge Pool

Plunge Pool is a permanent water body at the base of a small gorge on Muntulgura Guruma Country, within the Development Envelope. The Pool has ecological importance to fauna, including MNES species and cultural significance to the Muntulgura Guruma Traditional Owners.

The pool is fed by surface water runoff from an approximately 20 km^2 sub-catchment of the Hardey River catchment. The pool is also supported by groundwater connected to the aquifer in the underlying unmineralised Marra Mamba Iron Formation (MMIF).

Plunge Pool is approximately 20 km east of current BS4 mining operations, 1 km south of BS3 pit, within the BS3 assessment area and is downgradient of two deposits referred to as Marra Mamba – J (MM-J) and Creekside (CRK).

The referred Proposal included BWT mining of the BS3 deposit; however, the Proponent has subsequently removed this from the Proposal via s.43A to ensure no impacts to groundwater levels in the vicinity of Plunge Pool. In addition, the Proponent is committed to partially backfilling MM-J and CRK pits which are upgradient of the pool to above the post-mining water levels. This will prevent a permanent pit lake from forming and reduce long term evaporation which could otherwise continue to impact groundwater levels in the long term.

In addition, the Proponent will implement surface water management controls upstream of Plunge Pool to reduce the potential for sedimentation of the pool during operations (Figure 2-10).

Plunge Pool has been placed within a MEZ.

Kurwillinha/Ephemeral Pool

Kurwillinha Pool, also known as Ephemeral Pool, is a small pool within the BS4 assessment area, approximately 1 km south-east of the Endeavour resource within the Development Envelope. In recognition of its cultural importance to the Muntulgura Guruma People and its likely role as a key fauna resource, the Proponent has amended the adjacent Marra Mamba Pit O's mine design to avoid directly impacting the pool (Figure 2-10). Surface water studies have demonstrated that the modelled catchment reduction for the pool is unlikely to affect the hydrological regime (Section 6).

Ephemeral Pool has been placed in a MEZ.

2.2.2.3. Other Project Alternatives Considered

The Proponent has considered a range of further Proposal options/alternatives. Some of the key options identified and their justification for inclusion or exclusion are summarised in Table 2-5.

Table 2-5: Consideration of Alternatives

Proposal Element	Options/Alternatives	Environmental Impact	Rationale for Option Chosen
Mine pit depths	Limit mining to AWT only	Limiting mining to AWT only would avoid the need to dewater pits and manage and/or discharge surplus water	The Proponent has considered limiting mining to AWT only; however, BWT mining maximises ore production for the disturbance required. BWT mining also minimises the potential for double handling of waste rock and/or re-mining of rehabilitated areas to access un-mined resources in the future. The Proponent has undertaken an assessment of potential impacts related to dewatering to facilitate BWT mining and will implement dewatering controls/management measures, where required, to ensure environmental outcomes are achieved. This will include either backfilling pits to above water table recovery level once mining is completed or limiting mining to AWT in defined areas. The implementation of these measures will be based on the environmental and/or cultural significance of an area and the risk of impact to these areas from dewatering.
Mine pit closure	Backfill	Backfill reduces the volume of permanent waste rock landforms at closure. This minimises long term changes to visual amenity and surface runoff. Backfill can reduce the formation of, or size of, pit lakes, including acidic lakes. Re-handling of the material for backfill increases greenhouse gas emissions and potential re-exposure of PAF or fibrous materials.	Partial backfill of BWT pits to prevent the formation of pit lakes will be undertaken where the presence of PAF materials is likely to form acidic pit lakes or where a pit lake is likely to result in a significant impact to a downstream environmental or cultural value. Partial backfill of some pits with tailings will also occur to avoid additional clearing for a new WFSF and address PAF exposure. AWT pits and pits that will form non-acid pit lakes or where no pathway from pit lake to a known receptor is identified will not be backfilled. The impacts of a permanent pit lake in these conditions are considered environmentally acceptable, and the materials handling is minimised.

Proposal Element	Options/Alternatives	Environmental Impact	Rationale for Option Chosen
	No backfill	Pits are made safe and stable but are not vegetated where the pit floor is more than 10 m below the ground surface. Modelling predicts that the proposed permanent pit lakes that will form in some pits will act as groundwater sinks, with continued propagation of drawdown towards the pit. Access is permanently restricted via abandonment bunds. No re-handling of waste material.	
Operational water supply	Development of a separate water supply borefield	Groundwater drawdown due to abstraction.	The Proponent has undertaken a water balance assessment and determined that developing a separate water supply borefield will not be required. In line with Rio Tinto's water use hierarchy, the Proponent will store water for operational use in mined-out pits for future operational use when demand exceeds supply.
WFSF	The Proposal, as referred, included the disposal of processing tailings into a dedicated above ground WFSF.	Additional clearing required for the construction of an above ground WFSF and changes to the visual landscape.	An options assessment for tailings disposal was completed, including raising to the existing above ground WFSF, in-pit tailings disposal, and a combination of above ground and in-pit tailings storage to accommodate the LOM tailings. In-pit tailings deposition was selected as the preferred option based on the criteria identified. Undertaking in-pit tailings disposal minimises the footprint (including clearing) and height of the finished WFSF and eliminates the requirement for the construction of an additional above ground WFSF. The proposed waste fines levels in BS2 Pits 5 and 8 are modelled to be above the recovered groundwater level, therefore, preventing the formation of permanent pit lakes at closure in this area (as per current approved closure strategies). In-pit WFSFs will be capped with 2 m of inert mineral waste material. In addition, Lens A will be filled and capped to the surface to mitigate impacts from Duck Creek capture and avoid the need to implement a significant permanent diversion drain around the pit.

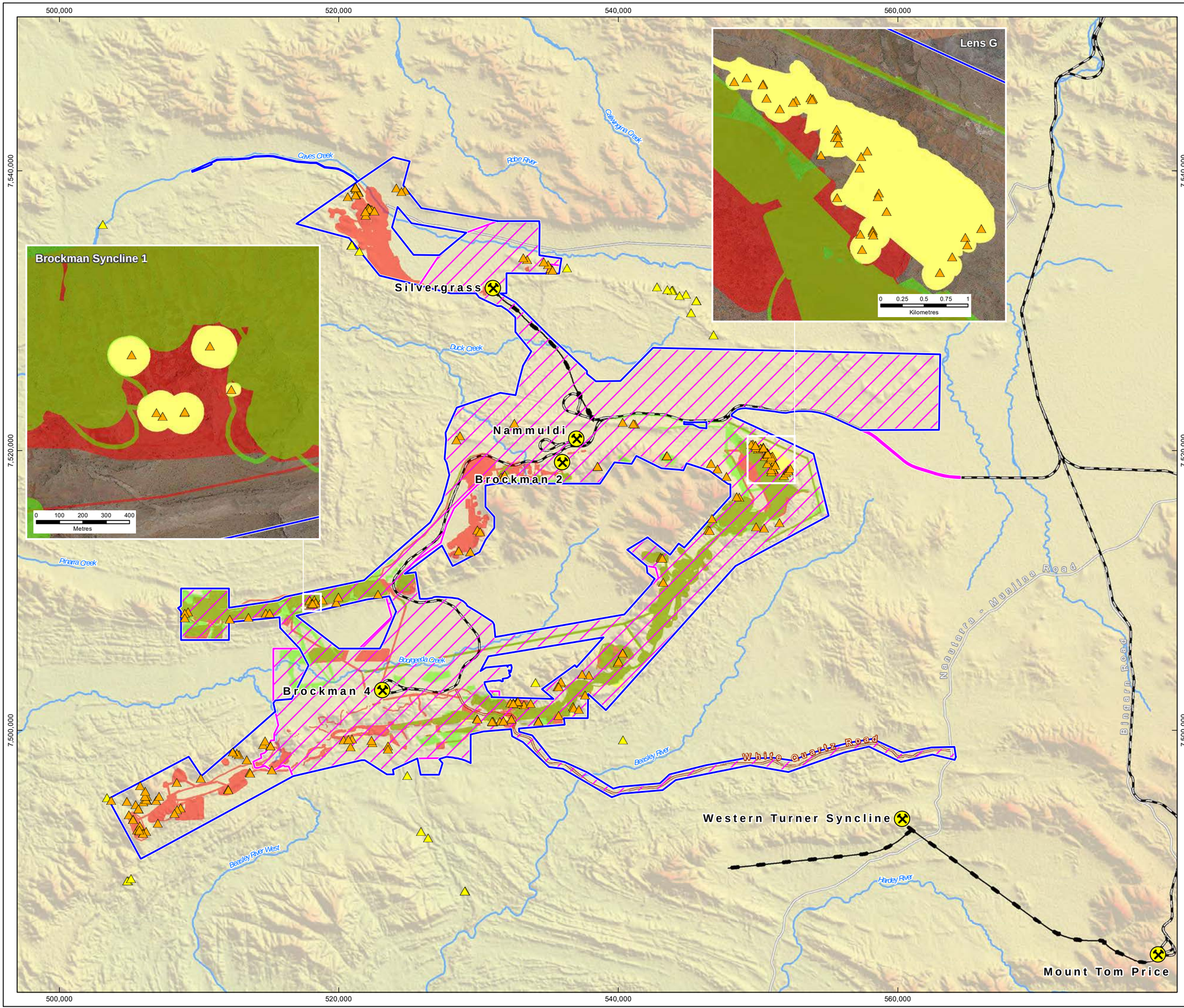

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Figure 2-9
Change to Conceptual Layout to Avoid Significant Caves

Drawn: L.Fuentes
Plan: PDE0182240v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Original Development Envelope
- Current Conceptual Footprint
- Original Conceptual Footprint
- Bat Cave and MNES Critical Habitat Mine Exclusion Zones
- Cave Location - Survey Area
- Cave Location - Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 2-10
Change to Conceptual Layout and Mining Strategy to Avoid Significant Pools

Drawn: L.Fuentes
Plan: PDE0182241v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- BS3 Pit - Above Water Table Only
- MMJ and Creekside Pit Backfilled at Closure
- Mine Exclusion Zone
- Brockman Syncline Pools
- Rio Tinto Mine
- Major Creek
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access

0 2 4 6 8 10
Kilometres

Map units in metres

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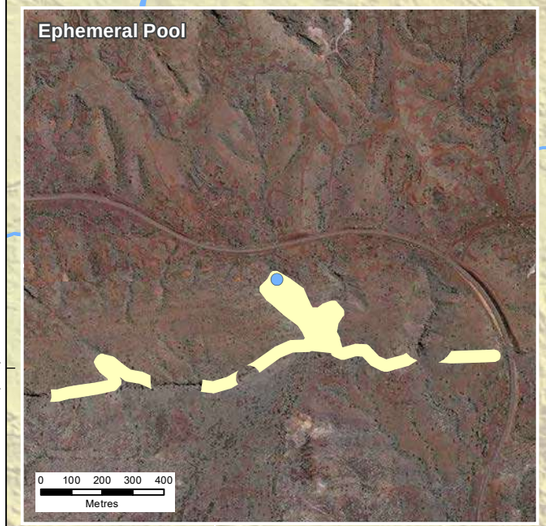



2.3. Local and Regional Context

2.3.1. Environmental Setting

2.3.1.1. Climate

The Proposal is located in the Pilbara, with a hot and persistently dry climate. With the absence of long-term nearby rainfall records, gridded rainfall data for the centroid of the Proposal were obtained from the Scientific Information for Land Owners (SILO) database.

The long-term mean annual rainfall is 325 mm with a range of 90 mm to 800 mm, illustrating the high inter-annual variability (Figure 2-11). The highest average rainfall period is the most recent 30 years, with the lowest period being the 30 years preceding the 1952-53 water year. Since this low point in 1952-53, there has been a steady increase in annual rainfall, with the average annual rainfall for the last 30 years being 365 mm. However, eight of the last 12 years have returned less rainfall than the recent mean, including the last three consecutive years, potentially indicating a reversal in the long-term increasing trend, as suggested by the trend (described as locally estimated scatterplot smoothing [LOESS]) in Figure 2-11.

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.

Rainfall is also highly seasonal, with approximately 75% of the annual total occurring between December and April. Rainfall is typically associated with tropical low-pressure systems and thunderstorm activity from the monsoonal trough in northern Australia during summer. While winters are typically dry, mild unseasonal rainfall can occur owing to tropical cloud bands that intermittently affect the area. The daily rainfall data analysis indicates infrequent rain events and low rainfall totals.

2.3.1.2. Geology

The Proposal is situated in the west part 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, with the Hamersley Group forming the majority of outcropping. The Hamersley Group is a thick sedimentary sequence comprising banded iron formations (BIF), shales and dolomites, with minor felsic volcanic and extensive dolerite dykes and sills. The group contains the Brockman Iron Formation and the Marra Mamba Iron Formation (MMIF), which together host most of the known major iron ore deposits in the Pilbara.

The Brockman Syncline refers to a folded band of geological units with high-grade mineralisation in Marra Mamba and Brockman Iron Formation deposits. The MMIF is generally associated with low rounded hills, whereas the Brockman Iron Formation is associated with the steep rocky hills. These geological units have been intruded by low permeability dolerite dykes, forming hydraulic barriers between deposits and compartmentalising aquifers within the syncline. The Brockman Syncline aquifer system is primarily closed with little connection with the surrounding lithologies.

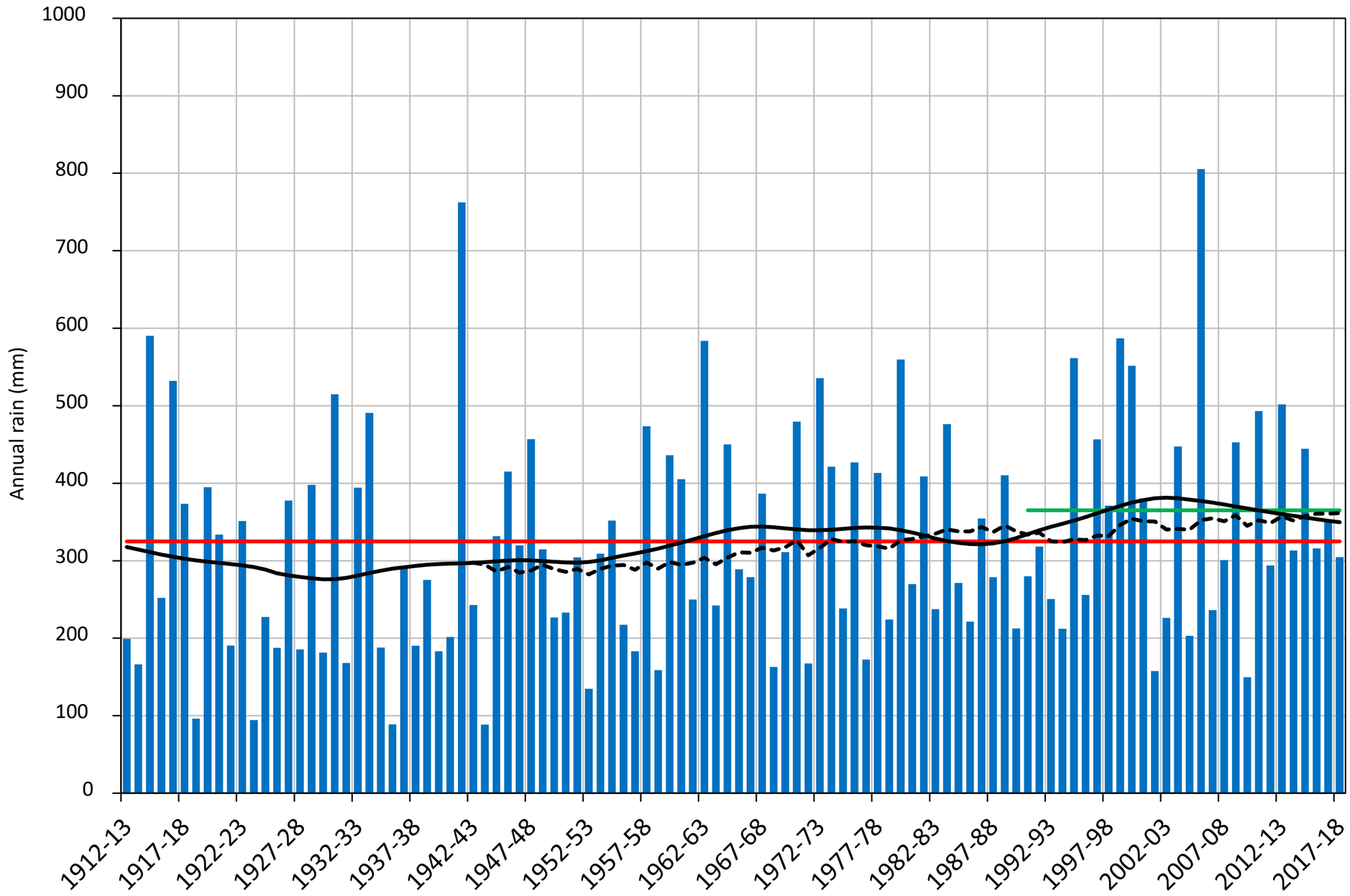

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Figure 2-11
Long-term Annual Rainfall

Drawn: L.Fuentes
Plan: PDE0182242v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:750,000 @A3
GIS.Team@riotinto.com

Legend

- Annual rainfall (October-September)
- Long-term mean (325mm)
- 1990-91 to 2017-18 mean (365mm)
- Annual rainfall trend (LOESS)
- Annual rainfall trend (30y Moving Average)

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2.3.1.3. Bioregion

The Proposal is located within the Pilbara Bioregion (PIL) under the Interim Biogeographic Regionalisation of Australia (IBRA) (Figure 2-12). The Pilbara bioregion is divided into four sub-regions: Chichester (PIL1), Fortescue Plains (PIL2), Hamersley (PIL3) and Roebourne (PIL4). The Proposal is entirely within the Hamersley (PIL3) subregion (6,215,092 ha), which has significant mineral resources associated with the ranges and is described by Kendrick (2001) 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".

2.3.1.4. Topography and Major Watercourse

The Proposal sits within the western end of the Hamersley Ranges on the southern side of the divide between the Ashburton and Robe rivers (Figure 2-13). The Hamersley Ranges escarpment above Caves Creek rises steeply to around 300–400 m from the valley floor. The highest peak in the vicinity of the Development Envelope is Jawunpa/Mt Brockman (elevation 1,127 m) which sits south of the BS2 operation and is a dominant landscape feature. Like the escarpment to the north, the syncline ridgelines extend either side of that peak and typically reach around 300–400 m above the valley floor. These steep areas are characterised by rough, rocky features such as cliffs, gorges, rock outcrops and the Hamersley Range signature 'Brunos Band' or 'tram tracks', which typically run horizontally along the slopes. Broad flat to undulating plains extend from the edges of the steep hills and escarpments throughout the Development Envelope, including between the limbs of the syncline and the expanse of the NAP.

The Brockman Syncline encloses the BS4 rail loop, and the Proposal is located on a large floodplain area where elevation can occur up to 150 m above the adjacent valley floors. In the northern portion of the Nammuldi-Silvergrass and BS2 assessment area, the land consists of low undulating hills separated from the steep Brockman Iron Formation escarpments by the valley floors.

Duck Creek, Boolgeeda Creek and Caves Creek are the three major creeklines intersecting the Development Envelope. Duck Creek and Boolgeeda Creek are the main watercourses that divide the Development Envelope. Caves Creek intersects the northern part of the Development Envelope, including the approved Silvergrass mine. None of the Proposal elements are within the Caves Creek catchment. The southeast portion of the Development Envelope is located in the Beasley River catchment, a major sub-catchment of the Hardey River catchment.

2.3.1.5. Land Systems

The Proposal intersects 15 land systems, of which the Newman and Boolgeeda cover almost two-thirds of the Development Envelope (approximately 61%) (Table 2-6 and Figure 2-14). These two land systems are defined by plateaux, ridges and mountains progressing to stony lower slopes and plains.

Table 2-6: Land System Units within the Development Envelope

Land System	Description	Current Extent in Subregion		Extent in Development Envelope[#]	
		ha	%	ha*	%
Newman	Rugged, jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	1,856,685	47.0	14,042	32.2
Boolgeeda	Stony lower slopes and plains below hill systems and supporting hard and soft spinifex grasslands or mulga shrublands.	607,323	15.4	14,430	33.1
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard (and occasionally soft spinifex) grasslands.	711,724	18.0	4,923	11.3
Platform	Dissected slopes and raised plains supporting hard spinifex grasslands	217,768	5.5	3,303	7.6
Robe	Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grassland.	102,677	2.6	2,133	4.9
McKay	Hills, ridges, plateaux remnants and breakaways of meta sedimentary rocks supporting hard spinifex grasslands	80,855	2.7	1,761	4.0
River	Active floodplains and major rivers supporting grassy Eucalyptus woodlands, tussock grasslands and soft spinifex grasslands.	72,468	1.8	830	1.9
Wannamunna	Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally Eucalyptus woodlands)	62,357	1.6	667	1.5
Table	Low calcrete plateaus, mesas and lower plains supporting mulga and cassia shrublands and minor spinifex grasslands.	20,653	0.5	400	0.9
Hooley	Alluvial clay plains supporting a mosaic of snakewood shrublands and tussock grasslands.	22,089	18.9	314	0.7
Nooingnin	Hardpan plains with very large groves supporting mulga shrublands.	21,802	0.6	277	0.6
Paraburdoo	Basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex and tussock grasses.	106,979	2.7	275	0.6

Land System	Description	Current Extent in Subregion		Extent in Development Envelope[#]	
		ha	%	ha*	%
Brockman	Alluvial plains with cracking clay soils supporting tussock grasslands.	21,670	0.5	200	0.5
Jurrawarrina	Hardpan plains and alluvial tracts supporting mulga shrublands with tussock and spinifex grasses.	17,908	0.5	56	0.1
Pindering	Gravelly hardpan plains supporting grooved mulga shrublands with hard and soft spinifex.	26,322	0.7	23	0.1

** Area has been rounded up to the nearest ha. Source: van Vreeswyk et al. 2004; #Excludes Approved Footprint*

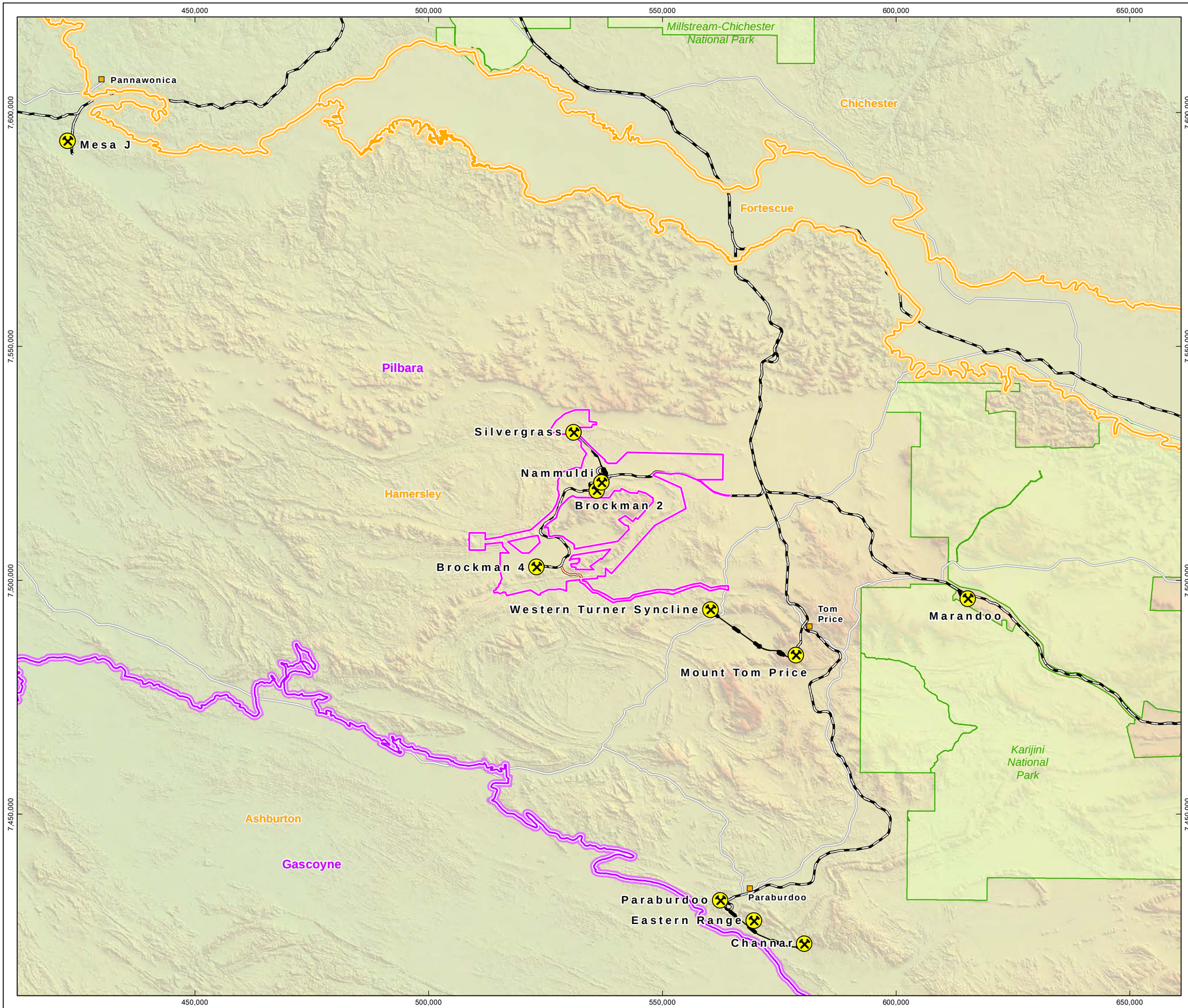

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Figure 2-12
IBRA Regions and Subregions

Drawn: L.Fuentes
Plan: PDE0182243v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:750,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- IBRA Region
- IBRA Subregion
- Rio Tinto Mine
- Town
- Rio Tinto Railway
- Conveyor
- Major Road
- Site Access Road

N

0 10 20 30 40

Kilometres

Map units in metres

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Figure 2-13
Key Topographic Features

Drawn: A.Coulson
Plan: PDE0182246v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:300,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Topographic Feature
- Town
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

Regional Elevation (mAHD)

1200

200

N

0 5 10 15

Kilometres

Map units in metres

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500,000 520,000 540,000 560,000 580,000

7,540,000 7,520,000 7,500,000 7,480,000

Hamersley Range
Caves Creek
Robe River
Calwingina Creek
Mount Sheila
Mount Jack
Mount McRae
Mount Sylvia
Silvergrass
Duck Creek
Wackina Creek
Nammuldi
Brockman 2
Mount Brockman
Pinarra Creek
Boolgeeda Creek
Brockman 4
Beasley River
White Quartz Road
Western Turner Syncline
Beasley River West
Nanutarra - Munjina Road
Tom Price
Mount Tom Price
Hardey River
Barnett Creek
Bingarra Road
Paraburdoo - Tom Price Road
Wyeelmurra Creek
Kanyeenarma Creek

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Figure 2-14
Land System Distribution

Drawn: L.Fuentes
Plan: PDE0182244v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

Land System

- Boolgeeda Land System
- Brockman Land System
- Hooley Land System
- Jurrawarrina Land System
- McKay Land System
- Newman Land System
- Nooingnin Land System
- Paraburdoo Land System
- Pindering Land System
- Platform Land System
- River Land System
- Robe Land System
- Rocklea Land System
- Spearhole Land System
- Table Land System
- Wannamunna Land System
- Wona Land System

N

0 2 4 6 8
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Brockman Land System
Jurrawarrina Land System
Mount Brockman Road
Hooley Land System
Silvergrass
Rocklea Land System
Nammuldi
Brockman 2
McKay Land System
Nooingnin Land System
Wannamunna Land System
Spearhole Land System
Pindering Land System
Newman Land System
Platform Land System
Boolgeeda Land System
River Land System
Brockman 4
Paraburdoo Land System
Nanutarra - Munjina Road
Table Land System
White Quartz Road
Robe Land System
Wona Land System
Western Turner Syncline

2.3.2. Social Setting

The Proposal is in the Shire of Ashburton, which encompasses an area of approximately 105,647 km^2 and is located approximately 60 km west-north-west of Tom Price and 1,400 km north of Perth. The administrative centre for the shire is Tom Price.

In the 2021 ABS Census, the Shire of Ashburton had an estimated residential population of 7,391 people, comprising 58% male and 42% female. Most of these people live in either mining towns or nearby mining camps. Aboriginal and Torres Strait Islander people make up approximately 10% of the population.

European settlement dates from the 1860s, with land used mainly for pastoral purposes. Significant development did not occur until the late 1960s, when iron ore deposits were discovered, and offshore gas and oil production commenced.

Iron ore mining and oil and gas production are the main industries. Rural land is characterised by open-cut mines, large pastoral leases and cattle stations.

The Proposal is located entirely within the Native Title Determination Areas of the Puutu Kunti Kurrama and Pinikura, and the Eastern Guruma People.

The traditional lands and waters of the Puutu Kunti Kurrama People and the Pinikura People cover approximately 10,888 km^2 of WA's Pilbara region, between Onslow and Tom Price. These two Groups are related but distinctly separate language groups, who each speak for their own country and collectively over a shared area. The two groups observe common laws and customs that facilitate the protection and sharing of resources. The groups are represented by the Puutu Kunti Kurrama and Pinikura Aboriginal Corporation (PKKP AC), a Registered Native Title Body Corporate (RNTBC).

Wintawari Guruma Aboriginal Corporation is the RNTBC that represents the interest of the Muntulgura Guruma People over traditional lands that cover approximately 6,500 km^2 around Tom Price and Karijini National Park in the Eastern Pilbara region of WA.

In and around the Development Envelope, many archaeological, ethnographic and cultural heritage values are associated with the Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma, and neighbouring Robe River Kuruma, peoples' continuing use of and connection with the area, established over many generations. These values include numerous recorded heritage sites and objects readily recognisable as having archaeological and anthropological value. Other less visible values exist in the area that are more complex, relating to interdependent connections between land, place and cultural practice, such as hunting, resource collection, learning, stories, rituals and religion. Cultural heritage values are often associated with ridge lines and water, including major drainage lines, springs, pools, rock holes, soaks, windmills, and wells. However, cultural values can occur throughout the landscape, such as areas supporting medicinal or food plants or preferred hunting grounds.

2.3.2.1. Land Use and Existing Development

The current land use is dominated by iron ore mining, given the Proposal forms an extension of the existing BS2, BS4 and Nammuldi-Silvergrass operations. Other iron ore mines are located nearby (Section 2.3.4). Additional land use includes pastoral grazing, with the proposed Development Envelope intersecting portions of the following pastoral stations:

- Rocklea and Hamersley Stations (Proponent-owned)
- Cheela Plains Station (third party-owned).

Other land uses include:

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

2.3.3. Conservation Reserves and Environmentally Sensitive Areas

The closest conservation reserve to the Proposal is Karijini National Park. This is located approximately 42 km east of the Development Envelope. Karijini National Park protects 627,400 ha of land within the Pilbara bioregion and is also considered an environmentally sensitive area (ESA) (Figure 2-15).

The closest ESAs to the Proposal are (Figure 2-15):

- 'Themeda grasslands on cracking clays (Hamersley Station, Pilbara)' Threatened Ecological Community (TEC), located approximately 1.2 km West of the Silvergrass mine, outside the Development Envelope (DBCA 2019a, b)
- Woongarra Gorge Area, approximately 20 km south of the Proposal (DBCA 2019a, b).

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

2.3.4. Reasonably Foreseeable Projects

There are no reasonably foreseeable projects within 100 km of the Proposal, however there are several existing projects. Table 2-7 lists existing projects that are either operational or have been recently approved within the Hamersley Subregion; these projects are also shown in Figure 2-16.

Table 2-7: Existing Projects within 100 km of the Proposal

Project*	Status	Location
Rio Tinto Existing Brockman Operations (BS2, BS4 and Nammuldi-Silvergrass) (MS 131, 867, 925 and 1000)	Operational	The approved footprint is within the Development Envelope
Fortescue Metals Group (FMG) Eliwana Iron Ore Project (MS 1109)	Commenced	Adjacent to the north of the Development Envelope
FMG Eliwana Railway (MS 1108)	Commenced	Adjacent to the north of the Development Envelope
Flinders Mine Pilbara Iron Ore Project (MS 1014)	Approved	15 km to the north of the Development Envelope
Rio Tinto Western Turner Syncline (MS 1031)	Operational	15 km to the south-east of the Development Envelope
FMG Solomon Expansion (MS 1062)	Operational	70 km to the north-east of the Development Envelope
Rio Tinto Greater Paraburdoo Iron Ore Hub (MS 1195)	Approved	85 km to the south-east of the Development Envelope

**Includes projects that have been approved but are yet to be implemented.*

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Figure 2-15 Conservation Reserves, TECs and PECs within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0182247v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:650,000 @A3
GIS.Team@riotinto.com

Legend

- Development
- National Park
- Rio Tinto Mine
- Town

Threatened and Priority Ecological Communities

- Priority 1 PEC
- Priority 2 PEC
- Priority 3 PEC
- Priority 4 PEC
- TEC

Millstream-Chichester National Park

Pannawonica

Mesa J

Silvergrass

Nammuldi

Brockman 2

Brockman 4

Western Turner Syncline

Tom Price

Mount Tom Price

Marandoo

Karijini National Park

Brockman Iron cracking clay communities of the Hamersley Range

Themeda grasslands on cracking clays (Hamersley Station, Pilbara)

Brockman Iron cracking clay communities of the Hamersley Range

Brockman Iron cracking clay communities of the Hamersley Range

0 1 2 3 4
Kilometres

450,000 500,000 550,000 600,000

7,600,000 7,550,000 7,500,000 7,450,000

N

0 10 20 30 40
Kilometres

Map units in metres

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Figure 2-16
Existing and Reasonably Foreseeable Projects within the Hamersley Subregion

Drawn: A.Coulson
Plan: PDE0182248v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:525,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- National Park

Existing Rio Tinto Projects

- Brockman 4
- Brockman 2 and Nammuldi-Silvergrass
- Western Turner Syncline
- Rio Tinto Greater Paraburdoo Iron Ore Hub

Existing Competitor Projects

- FMG Eliwana Iron Ore Project
- FMG Solomon Iron Ore Project - Expansion
- Flinders Mine Pilbara Iron Ore Project

- Rio Tinto Mine
- FMG Mine
- Town
- Conveyor
- Rio Tinto Railway
- FMG Railway

N

0 5 10 15 20 25
Kilometres

Map units in metres

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3. LEGISLATIVE CONTEXT

3.1. Environmental Impact Assessment Process

The Proposal is subject to assessment under the Commonwealth EPBC Act and Western Australian (WA) EP Act. The Proposal will undergo an accredited assessment in which the Commonwealth Minister will rely on the assessment outcomes prepared by the WA EPA to inform an approval decision in respect of the Proposal 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 (GoWA 2021) (Administrative Procedures)
- Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2021a) (Procedures Manual)
- Statement of Environmental Principles, Factors and Objectives and Aims of EIA (EPA 2021b)
- Instructions – How to Identify the Content of a Proposal (EPA 2021c)
- Instructions – How to Prepare an Environmental Review Document (EPA 2021d)
- Interim Guidance – Environmental Outcomes and Outcomes-based Conditions (EPA 2021e)
- Instructions - How to Prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EMPs) (EPA 2021f)
- Interim Guidance – Taking Decision Making Processes into Account in EIA (EPA 2021g).

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 affect the environment. The EPA Services division within the Department of Water and Environmental Regulation (DWER) administers the environmental impact assessment process in accordance with the relevant policies and guidelines, including those listed above.

The Proposal was referred to the EPA on 23 July 2019. On 28 August 2019, the EPA determined that the Proposal would be assessed under Part IV of the EP Act. The level of assessment was set at Environmental Review – with public consultation required (eight-week period). The EPA identified the key environmental factors as Inland Waters (Section 6), Flora and Vegetation (Section 7), Terrestrial Fauna (Section 8), Subterranean Fauna (Section 9), Air Quality (Section 10), Greenhouse Gas Emissions (Section 11) and Social Surroundings (Section 12). The Proponent prepared an ESD to define the form, content, timing and procedure of the ERD (Appendix B.1), and the EPA approved the ESD on 31 March 2020. 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 s.43A of the EP Act.

This ERD has been prepared in accordance with the ESD (Appendix B.1) and the EPA guidance listed above to meet the requirements of s 40(2)(b) of the EP Act. This ERD is now published for eight 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 ERD 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 through consideration of the ERD, any submissions received, and the Proponent's responses to any submissions received. The EPA also considers applicable policies and guidelines and may seek advice from relevant government agencies. The EPA will then prepare an assessment report recommending whether the Proposal should be approved and, if so, any implementation conditions that should apply. The EPA Assessment Report and Recommendations (EPA Report) will be made public. The EPA Report will be provided to the Minister

for the Environment, who will 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 MNES and is administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

Referral of the Proposal to DCCEEW under the EPBC Act occurred on 26 August 2019. The Commonwealth Minister for the Environment determined the Proposal to be a Controlled Action under s 75 of the EPBC Act on 31 October 2019; therefore, it will require further assessment and approval under the EPBC Act to determine if it can proceed. The relevant Matter (the controlling provision) is 'Listed threatened species and communities' (sections 18 and 18A of the EPBC Act). MNES with the potential to be significantly impacted by the Proposal include the following fauna species:

- Northern Quoll (*Dasyurus hallucatus*)
- Ghost Bat (*Macroderma gigas*)
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)
- Pilbara Olive Python (*Liasis olivaceus*).

The assessment of the significance of potential impacts from the Proposal on MNES has been carried out as per relevant EPBC Act guidance and addressed specifically in Section 14 of this ERD.

3.1.3. Accredited Assessment

The EPA will assess the Proposal as an accredited assessment on behalf of the Commonwealth under s 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 report will be provided to the Commonwealth Minister for their approval decision.

3.1.4. State Agreement

The Proposal is located within an area covered by the *Iron Ore (Hamersley Range) Agreement Act 1963* (WA). A State Agreement is a legal contract between the Western Australian Government and a Proponent of a major project within State boundaries. A State Agreement details the rights, obligations, terms and conditions for developing a specific project. Elements of the Proposal located outside of the State Agreement tenure are supported by various tenures granted under the Mining Act and *Land Administration Act 1997* (WA).

3.2. Other Approvals and Regulation

3.2.1. Native Title

The Proposal is located within the boundaries of the recognised Native Title Determination Areas of two Traditional Owner groups of the Pilbara region: the Puutu Kunti Kurrama and Pinikura People (WAD126/2005) and the Eastern Guruma People (WAD6208/1998) (refer to Section 12 for further detail). Rio Tinto has negotiated and executed claim-wide Native Title Agreements with both Traditional Owner groups which include Indigenous Land Use Agreements (ILUAs) and Cultural Heritage Protocols.

These agreements are currently being reviewed and modernised by the Proponent and the Traditional Owner Groups.

The Robe River Kuruma People (WAD6090/1998) hold Native Title over land approximately 20 km west of the Development Envelope. Although their Native Title area does not directly overlap the Development Envelope, the Robe River Kuruma People have a cultural attachment to the area around

the Development Envelope. This attachment associates with the interest in specific heritage places and other intangible cultural heritage values (Section 12).

3.2.2. Land Tenure

The Proposal and existing operations at BS2, BS4 and Nammuldi-Silvergrass are located on State Agreement Mineral leases ML4SA and ML272SA and other general-purpose and miscellaneous leases all held by the Proponent and its related companies (Table 3-1). The Development Envelope is within the Shire of Ashburton and intersects Cheela Plains, Rocklea and Hamersley Pastoral Stations, the latter two held and managed by the Proponent. Mount Stuart Pastoral Station is located approximately 5 km to the west. Land tenure is present in Table 3-1 and Figure 3-1.

Table 3-1: Summary of Tenement Information

Tenement	Status	Holder
General Purpose Lease		
G47/1225	Live	Hamersley Iron Pty Ltd
G47/1226	Live	Hamersley Iron Pty Ltd
G47/1227	Live	Hamersley Iron Pty Ltd
G47/1232	Live	Hamersley Iron Pty Ltd
G47/1242	Live	Hamersley Iron Pty Ltd
Miscellaneous Licences		
L47/139	Live	Hamersley Iron Pty Ltd
L47/140	Live	Hamersley Iron Pty Ltd
L47/141	Live	Hamersley Iron Pty Ltd
L47/151	Live	Hamersley Iron Pty Ltd
L47/153	Live	Hamersley Iron Pty Ltd
L47/160	Live	Hamersley Iron Pty Ltd
L47/161	Live	Hamersley Iron Pty Ltd
L47/647	Live	Hamersley Iron Pty Ltd
Mineral Lease		
ML4SA	Live	Hamersley Iron Pty Ltd
ML272SA	Live	Hamersley Iron Pty Ltd
Pastoral Lease		
L3114/1166	Live	Rocklea Pastoral Station
L3114/1277	Live	Hamersley Pastoral Station

3.2.4. Decision-making Authorities and Other Approvals

In addition to the EPA assessment of the Proposal under Part IV of the EP Act, numerous other environment-related assessments and authorisations will be required before the Proposal can be implemented, with these listed in Table 3-2. The authorities listed in Table 3-2 have been identified as decision-making authorities (DMAs) for this Proposal.

Table 3-2: Decision-making Authorities Identified for the Proposal and Other Approvals Required

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, Department of Water and Environmental Regulation (DWER)	*Rights in Water and Irrigation Act 1914* (RiWI Act)	**Section 26D licence** required to construct dewatering and water supply bores **Section 5C licence** required for the abstraction of groundwater	Yes EPA Inland Waters factor and objective considered in decision-making. RiWI Act processes regulate the extraction of water associated with mine dewatering, but not disposal. 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 appeals 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 • 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. Surface water impacts may be considered in the assessment but are not essential. Impacts on stygofauna are not further assessed (although related results may be included in groundwater monitoring reporting required by the licence).
Minister for Water, DWER	RiWI Act	**Groundwater Licence required** to manage significant volumes of water proposed to be taken from several sources and multiple bores	Yes EPA Inland Waters factor and objective considered in decision-making. The Groundwater Operating Strategy supplements a section 5C licence detailing how the licensee will manage its operations to address broader management issues associated with taking and using water (DWER 2020b). The operating strategy must include:

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)
			• Details of the water source to be used • Land use, water abstraction regime and methods and infrastructure used to abstract and distribute water • Monitoring and reporting requirements • Methods to manage impacts on the aquifer, the environment and other water users • Contingency plans • Water efficiency measures.
Minister for Water, DWER	RiWI Act	**Section 11/17/21A Permit** required to interfere or obstruct bed or banks (i.e., creek diversion)	Yes EPA Inland Waters factor and objective considered in decision-making. Permit applications consider the effect of the alteration to existing surface water catchments, surface water flow paths and sheetflows. Key principles considered include (DoW 2012): • Avoiding interference or obstruction of water, bed or banks, wherever practicable • Discouraging dams where viable alternatives exist • Reduce watercourse crossings to a minimum and consolidate crossings with other infrastructure, where practicable • Avoid permanent pools, bends or high velocity sections of watercourses • Minimise disturbance to riparian vegetation, riparian zones and floodplains • Mitigate risks or impacts from site disturbance including erosion, sedimentation, weed introduction, vegetation clearing, loss of habitat and change to ecological values • Prevent the discharge of pollutants and materials into watercourses • Rehabilitate or revegetate the site following construction to maintain or improve riparian zone function.
Chief Executive Officer, DWER	EP Act Part V	**Works Approval* and Licence** Activities and prescribed premise categories	Yes 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.

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)
		applicable to the Proposal include, but are not limited to: • 5 – Processing of ore • 6 – Mine dewatering • 12 – Screening, etc. of materials • 64 – Class II Putrescible landfill • 73 – Bulk storage of chemicals etc.	Assessments consider the 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 (DG) Licence** is required for the storage and handling of hazardous materials during construction	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. 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).
Minister for Aboriginal Affairs, Department of Planning, Lands and Heritage (DPLH)	*Aboriginal Heritage Act 1972* (AH Act) *Aboriginal Cultural Heritage Act 2021* (ACH Act)	**Section 16 Authorisation** is required to enter, excavate, examine or remove anything on an Aboriginal site **Section 18 Notices** from the Minister is required where the impact on an Aboriginal site is unavoidable	No s.16 and 18 authorisations are predominately related to authorisations to impact heritage sites and therefore not expected to regulate impacts to the environment.

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 Environment and Chief Executive Officer, Department of Biodiversity, Conservation and Attractions (DBCA)	*Biodiversity Conservation Act 2016* (BC Act)	**Section 40 Authorisation** is required from the Minister to take and/or disturb threatened flora and/or fauna 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.
Minister for Mines and Petroleum (DMIRS)	*Mining Act 1978* (Mining Act)	**Mining Proposal** is required for any mining-related disturbance within tenements (i.e., all works apart from road intersection works) outside of the State Agreement area	Yes DMIRS has developed its own environmental objectives, which approximate EPA factor objectives for Terrestrial Fauna, Flora and Vegetation, Inland Water and Terrestrial Environmental Quality in relation to Mining Proposals only. Mining Proposals address all Proposal elements and activities and consider the likely environmental impacts within an 'Environmental Group Site' (a grouping of mining tenements that make up a mining operation). DMIRS aims to focus its assessment on factors not regulated elsewhere (e.g., such as key environmental factors assessed under Part IV of the EP Act). Environmental factors assessed include: • Land and soils (including subsurface materials) – geochemical and physical characteristics • Biodiversity (e.g., flora, vegetation, terrestrial fauna) • Water resources (surface water and groundwater) • Rehabilitation and mine closure – a mining proposal must contain a mine closure plan. Stakeholder engagement will occur during preparation but there is no provision for public comment or appeal on a mining proposal. Approved mining proposals will typically be made available to the public on the DMIRS website. Approval of a mining proposal will usually include environmental monitoring and reporting requirements.

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 Mines and Petroleum, DMIRS	Mining Act	**Programme of Work (PoW) Application** is required to undertake ground disturbing activities with mechanised equipment on mining tenement (i.e., Exploration activities)	Yes PoW include requirements to rehabilitate disturbed areas.
Local Government – Shire of Ashburton	*Building Act 2011* *Planning and Development Act 2005* *Health Act 1911*	**Building and Health approvals** is required.	No
Minister for State Department of Jobs, Tourism, Science and Innovation (JTSI)	*State Agreement Act* *Iron Ore (Hamersley Range) Agreement Act 1963*	**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.*

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Figure 3-1
Land Tenure

Drawn: L.Fuentes
Plan: PDE0182249v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:225,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Live Mining Act Tenure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

Pastoral Station - Rio Tinto

- Hamersley Station
- Rocklea Station

Pastoral Station - Competitor

- Cheela Plains Station
- Mt Stuart Station

N

0 2 4 6 8 10

Kilometres

Map units in metres

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M272SA Sec 002
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E47/00892
ML4SA Sec 264
ML4SA Sec 266
M272SA Sec 003
ML4SA Sec 265
Silvergrass
L47/00647
G47/01243
N050438 Hamersley Station
G47/01242
L47/00159
L47/00140
ML4SA Sec 241
L47/00152
ML4SA Sec 107
ML4SA Sec 239
ML4SA Sec 110
Brockman 2
L47/00141
ML4SA Sec 106
ML4SA Sec 105
L47/00143
G47/01226
ML4SA Sec 104
ML4SA Sec 102
E47/01038
ML4SA Sec 103
P47/01948
L47/00153
L47/00185
G47/01227
ML4SA Sec 279
G47/01225
G47/01232
E47/03593
Brockman 4
ML4SA Sec 245
ML4SA Sec 124
ML4SA Sec 125
ML4SA Sec 126
ML4SA Sec 246
ML4SA Sec 280
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ML4SA Sec 166
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P47/01943
ML4SA Sec 282
ML4SA Sec 123
ML4SA Sec 122
ML4SA Sec 121
ML4SA Sec 120
ML4SA Sec 119
ML4SA Sec 283
ML4SA Sec 244
Mt Stuart Station
Cheela Plains Station
E47/01788
ML4SA Sec 127
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E47/01277
ML4SA Sec 167
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ML4SA Sec 171
ML4SA Sec 172
ML4SA Sec 173
Mount Brockman Road
ML4SA Sec 267
L47/00127
E47/00661
L47/00128
L47/00280
E47/00047
E47/04473
E47/01054
M47/00371
M47/00372
M47/00370
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E47/04220
L47/00151
L47/00178
E47/04219
P47/01971
E47/04049
ML4SA Sec 243
ML4SA Sec 115
E47/00031
E47/04221
ML4SA Sec 116
ML4SA Sec 117
L47/00184
ML4SA Sec 118
N050372 Rocklea Station
Nanutarra - Munjina Road
L47/00161
White Quartz Road
ML4SA Sec 257
ML4SA Sec 258
L47/00668
E47/02951
Western Turner Syncline
ML4SA Sec 010
ML4SA Sec 009
ML4SA Sec 012
L47/00210
L47/00745
L47/00721
L47/00744
L47/00646
L47/00645
L47/00824
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G47/01258
G47/01260
L47/00552
L47/00698
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ML4SA Sec 019
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4. STAKEHOLDER ENGAGEMENT

The Proponent recognises the value of building positive relationships with key stakeholders and the communities in which we are active. The Proponent seeks to build sustainable partnerships with business partners, governments, non-government organisations, host communities and other stakeholders to support mutually beneficial outcomes. The Proponent strives to engage early, openly, honestly and regularly with the communities impacted by our operations and consider their views in our decision-making with respect to key planning, operational and closure aspects.

Ongoing consultation has been an important part of the Proponent's approach to continued operations. This has involved:

- Identification of stakeholders associated with the Proposal
- Delineation of a plan of communications and engagement with stakeholders
- Incorporation of stakeholder feedback into project planning
- In undertaking consultation, the Proponent has incorporated feedback from stakeholders into its planning to ensure the Proposal can be implemented in a manner that does not compromise the environmental and social values of the area or the interests of key stakeholders in an unacceptable way.

4.1. Stakeholder Identification

Relevant stakeholders identified and consulted with for the Proposal are listed in Table 4-1.

Table 4-1: Key and Interested Stakeholders for the Brockman Syncline Proposal

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

Stakeholder Sector	Organisation	Key Interest/s
	Department of Jobs, Tourism, Science and Innovation	• Administers State Agreement Acts • Major Projects • Future Battery Mineral Strategy • Jobs • Renewable energy initiatives
	• Department of Primary Industries and Regional Development • Department of Communities	• Regional and community development
	Department of Biodiversity, Conservation and Attractions	• 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	• 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 • 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 Ashburton	• 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	• Muntulgura Guruma People • Puutu Kunti Kurrama and Pinikura People • Robe River Kuruma 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 • Impacts to sites and social and cultural heritage values of significance / heritage protection, either directly or indirectly • Change of rights to land access • Land access agreement • Operational interactions (e.g., traffic, road condition, noise, and other amenity issues)
Pastoralists	• Cheela Plains Pastoral Station	• Access to and use of pastoral land

Stakeholder Sector	Organisation	Key Interest/s
	• Mt Stuart Pastoral Station	• 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
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 proposed project, including likely impacts and benefits that may be derived from the Proposal
- Communicate the project vision to promote confidence in Rio Tinto as an organisation, and the proposed project, by ensuring open and transparent communication of the Proposals 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 Engagement Summary

4.3.1. Traditional Owner Groups

The Proponent has undertaken ongoing consultation with the Puutu Kunti Kurrama and Pinikura People, Muntulgura Guruma People and the Robe River Kuruma and their Registered Native Title Body Corporate representatives, the Puutu Kunti Kurrama and Pinikura Aboriginal Corporation, the Wintawari Guruma Aboriginal Corporation and the Robe River Kuruma Aboriginal Corporation relating to the Proposal. This consultation has helped the Proponent to understand the Traditional Owners 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 B.5 and Appendix B.6. 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 an imperative requirement throughout the Proposal LOM.

As the Proposal progresses, the Proponent looks forward to continued collaboration with the Puutu Kunti Kurrama and Pinikura, Muntulgura Guruma People and the Robe River Kuruma People.

4.3.2. Pastoral Stations

The Proponent has undertaken regular and ongoing consultation with Cheela Plains Pastoral Station and Mount Stuart Pastoral Station since 2018. The Mount Stuart Pastoral Station have raised questions regarding the management of any increase in surplus water discharge and Cheela Plains Pastoral Station have raised concerns in relation to water management and the footprint. In more recent updates, no questions or issues have been raised (Appendix B.5).

4.3.3. Government and Special Interest Groups

Consultation with several State and Commonwealth Departments and Agencies commenced in 2018/2019, 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 (16 – 22 August 2019). The EPA received five separate submissions with the common theme recommending use of the Public Environmental Review (PER) rather than the Assessment on Referral Information (ARI) process for project impact assessment
- Comment on Controlled Action Status of the Proposal under the EPBC Act (September 2019). 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 proposed project. 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 B.5. Consultation relevant to closure planning for the Proposal is reflected within the MCP (Appendix B.4

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, Rio Tinto 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
The Precautionary Principle Where there are threats of serious or irreversible damage, a 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 more than 50 studies to understand the social and environmental values within the Development Envelope and the potential risks to these from the Proposal. These studies have informed the detailed design of the Proposal, and modifications to the Proposal have been made to avoid and minimise impacts, where practicable. All applicable studies have been conducted to conform with EPA's Environmental Factors Guidelines, technical guidance documents, and other best practice guidelines to ensure the robust collection of data to make predictions on the effect or impact of the Proposal on environmental and social values. • Any uncertainties within the studies have been addressed in the impact assessment using conservative assumptions, scenario modelling and proposed outcome-based conditions. Uncertainties that have been addressed throughout the ERD include: • Twelve taxa are considered to represent potential short-range endemic (SRE) species due to the lack of data available and the inability to identify beyond the genus level, until more information is known they will be treated in this precautionary manner (Section 8) • Due to the lack of pump testing between the BS3 deposit aquifer and Plunge Pool, and noting the significance of Plunge Pool from an environmental and social perspective, the Proponent has followed the precautionary principle and limited mining to AWT at the BS3 deposit (Section 6) • The sensitivity and response of aquatic fauna to potential changes to water quality. As a result, it has been assumed that habitat modification will occur within the discharge extent, and since no species are limited to the impact area, the Proposal is not expected to cause any loss in aquatic diversity as a result of surface water discharge impacts (Section 6) • Modelling of the effect of increased water availability for Duck Creek is based on an assumed constant discharge regime (i.e. a precautionary approach to assessment), and hence it has been assumed that shallow groundwater levels will result in Duck Creek over the period in which discharge will occur (Section 6) • No Northern Quoll dens were recorded in the Development Envelope, although it is assumed that they occur to meet the requirements of this Precautionary Principle (Section 14). The Development Envelope supports several significant values, including records of high significance habitat for Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python. The Proposal will impact some Priority flora species; however, no flora species or ecological communities listed as Threatened are present within the Development Envelope. The Proponent has set out some key mitigation measures to prevent significant environmental impacts and demonstrate application of the precautionary principle. These include: • Mining of the BS3 deposit will be limited to AWT to avoid the need to dewater close to Plunge Pool (Section 6)

Principle	Consideration
	• The surface water catchment which flows into Plunge Pool will be maintained at a minimum of 7 km2 to ensure that the pool will flush multiple times per year (Section 6) • Discharge of water to pits will only occur where pit lakes would not be expected to cause mounding in areas of shallow watertable (i.e., <20 m bgl) (Section 6) • Surface water management to minimise erosion and downstream sedimentation risk to catchments outside of the Development Envelope (Section 6) • Water will only be discharged to creeks where the water quality is compatible with the receiving environment (Section 6) • Avoid known locations of significant vegetation (TECs and PECs) and vegetation associated with Plunge Pool (vegetation type C28) (Section 7) • Avoid known locations of the significant flora species (Tetratheca butcheriana) (Section 7) • Restore vegetation using recovered topsoil and seed of local provenance to promote successful rehabilitation (Section 7) • Minimise direct impacts to high significance fauna habitat for vertebrate and SRE fauna through the implementation of upper clearing limits (Section 8) • Avoiding 106 significant Ghost Bat roosts and 18 surface water features through the implementation of MEZs and MRZs (Section 8). The Proponent will monitor all significant environmental issues to provide assurance that anticipated environmental outcomes are achieved, and that mitigation measures are effective. The Proponent has consulted with and continues to engage extensively with the Traditional Owner groups. The Traditional Owner Groups land either intersects the Development Envelope (Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma) or are neighbouring (Robe River Guruma) and have an interest in the Proposal regarding the potential impacts on social and cultural heritage values from the Proposal. In recognition of the known or likely occurrence of significant social and cultural heritage values in the originally proposed Development Envelope, the Development Envelope was redesigned and reduced within the scope of the current assessment to avoid those areas under s.43A of the EP Act. The Proponent has applied the mitigation hierarchy of avoid, minimise and mitigate environmental, social and cultural heritage impacts too as low as reasonably practicable. The environmental risks associated with the Proposal have been assessed and are detailed in this ERD.

Principle	Consideration
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 maintenance of biological diversity and natural resources and reducing greenhouse gas emissions are of particular importance in relation to this principle. The Proponent has prepared a Greenhouse Gas Management Plan that outlines the emissions targets and process to reduce emissions over time, consistent with the net-zero by 2050 commitment by the Australian Government. The Proponent has also set medium-term (2-10 years) targets for greenhouse gas (GHG) emission reductions against a 2018 baseline: • Reduce Scope 1 & Scope 2 emissions by 15% by 2025 (approximately 4.9M t CO2-e) • Reduce Scope 1 & Scope 2 emissions by 50% by 2030 (approximately 16.3 M t CO2-e). The Proponent commits to providing offsets as a contingency if reduction targets are not met over the life of mine. The Proponent has and will continue to work collaboratively with the Traditional Owners to ensure the maintenance of Indigenous social and cultural heritage values and the future enjoyment of the land (Section 12). The Proponent will implement mining exclusion zones and mining restriction zones (MEZ and MRZ) to protect significant bat caves (Section 8 and Section 14). The Proponent will implement offsets for significant residual impacts to vegetation in 'good to excellent' condition and high significance habitat (Gorge/Gully, Debris Slope/Rocky Outcrop) for Northern Quoll, Pilbara Leaf-nosed Bats, Ghost Bats, and Pilbara Olive Python (Section 13 and 14). 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.
The Principle of Conservation of Biological Diversity and Ecological Integrity	The Proponent has considered the relevant environmental factors and has modified the mine and infrastructure design to avoid/minimise impacts to significant environmental values associated with flora and vegetation, terrestrial fauna and subterranean fauna, where practicable. This includes: • The total clearing required for the Proposal was revised from 13,793 ha to 7,896 ha • Avoid direct and indirect disturbance to Plunge Pool, Ephemeral Pool and surrounding groundwater dependent vegetation (GDV) (Section 6) • Avoid direct disturbance to all known populations of Priority 1 flora species *Tetratheca butcheriana* within the Development Envelope (Section 7) • Avoid direct disturbance to 106 significant caves, including no impacts to maternity Ghost Bat (category 2) roosts (Section 8 and 14) • Retention of 18 surface water bodies out of 22 recorded within the Development Envelope (Section 6)

Principle	Consideration
	• Retention of at least 70% of high local significance vegetation within the Development Envelope (Section 7) • Retention of at least 89% of riparian vegetation within the Development Envelope (Section 7) • Retention of at least 94% of mapped groundwater dependent ecosystems (GDEs) within the Development Envelope (Section 7) • Retention of at least 85% of the known state population of Priority 1 and Priority 2 flora species within the Development Envelope (Section 7) • Retention of at least 65% of the known state population of Priority 3 and Priority 3 flora species within the Development Envelope (Section 7) • Retention of at least 75% of high significance fauna habitat within the Development Envelope (Section 8). The Proponent will implement an Environmental Management Plan (EMP) (Appendix B.3) to manage potential impacts to environmental values within the Development Envelope and implement an MCP (Appendix B.4). The conservation of biological diversity and ecological integrity has been a fundamental consideration in developing the Proposal and applying the mitigation hierarchy.
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 significant environmental values. The Proponent will bear all costs of monitoring, mitigation provisions, offsets and closure, which has been included in the financial provisioning for the Proposal. The Proponent has prepared an MCP for the Proposal (Appendix B.4). This will be further developed through ongoing consultation. The Proponent will prepare a Mining Proposal and MCP under the Mining Act, incorporating appropriate environmental management/mitigation, rehabilitation, and closure planning costs.

Principle	Consideration
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 considered 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. Key measures for waste minimisation in this Proposal include: • Strategic management of surplus water via surplus use hierarchy to minimise the overall loss of water from this system (Section 6) • Mineral Waste Management Plan to ensure waste material is adequately geochemically characterised and appropriately managed • Waste to be collected and removed for treatment by licensed contractors. Rio Tinto has set an ambition to reach net zero emissions by 2050 across all its operations, including the Pilbara, and has committed to interim emissions reduction targets of 15% by 2025 and 50% by 2030, relative to the 2018 baseline (equity basis) (Section 11).

6. INLAND WATERS

6.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021b) 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 2018). 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.

6.2. Relevant Policy and Guidance

Table 6-1 presents relevant policy and guidance for Inland Waters and demonstrates how this has been considered for the Proposal.

Table 6-1: 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 2021b)	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 2018)	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 2021d)	This document forms the basis of the headings and content provided in this ERD.
Inland Waters of the Pilbara Western Australia Part 1 (EPA 1988) Inland Waters of the Pilbara Western Australia Part 2 (EPA 1989)	The values and potential issues associated with mining identified in these documents have informed the development of policy and scoping of this EIA.
Other State or Commonwealth	
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 Inland Waters.
Statutory Guidelines for Mine Closure Plans (DMIRS 2020b)	
Use of Mine Dewatering Surplus (DWER 2020a)	The water management strategy has been developed with consideration of this guidance, and surplus water will be preferentially stored within mine pits once operational and environmental needs have been met.

Policy and Guidance	Explain How the Policy and Guidance has been Considered
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 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). Water licence conditions may be applied to any groundwater abstraction licence to reduce and, where possible, eliminate risks and require monitoring, management and mitigation.
Pilbara Water in Mining Guidelines (DoW 2009a)	The water management strategy has been prepared with consideration of this guidance.
Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (DoW 2009b)	Groundwater abstraction will be licenced, and monitoring is undertaken in accordance with an operating strategy. This provides confidence that this aspect of the Proposal will be regulated by DWER. DWER's requirements include monitoring and review of aquifer performance.
Use of operating strategies in the water licencing process (DWER 2020b)	
Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG 2018)	Australia's National Water Quality Management Strategy 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)	

6.3. Receiving Environment

6.3.1. Studies and Survey Effort

Groundwater investigations across the Brockman Syncline originally commenced in the 1970's as part of iron ore mineral investigations. Major geological and hydrogeological drilling and testing programmes across the Brockman Syncline deposits commenced in the 1980's and have been ongoing since this time.

Groundwater monitoring over a network of 200 monitoring bores and vibrating wire piezometers has been occurring across the Brockman Syncline since operations commenced in the 1990's, with regular monitoring programs since 2004.

Data gathered from these monitoring programs has been used to determine the extent and quality of groundwater resources within the region and to develop dewatering strategies for BWT deposits. As part of the above, monitoring of aquifer response to dewatering at the existing BS2, BS4 and Nammuldi BWT mines has allowed for a significant database of groundwater knowledge to be developed to support ongoing refinement and calibration of the hydrogeological conceptualisation across the Syncline.

Similarly, the hydrological studies and ongoing operations in the areas have enabled the characterisation of surface water systems have been characterised using geomorphological assessments, flow monitoring and hydrological modelling.

Table 6-2 summarises the studies for the Inland Waters undertaken for the Proposal. Key Inland Waters studies are provided in Appendix C.1 to C.8.

Table 6-2: Summary of Studies

Survey/Studies/Prepared for	Survey Area, Type and Timing	Consistency with Guidance
Hydrology (Surface Water)		
Brockman Syncline Proposal Hydrology & Hydraulics Study (Rio Tinto 2021b; Appendix C.1 Prepared by Rio Tinto	**Study/Survey area:** Brockman Syncline region, specifically Duck Creek and Hardey River catchments. **Type:** impact assessment based on hydrological and hydraulic models. **Timing:** Modelling undertaken 2020/2021.	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.
Hazard Analysis and Risk Assessment for Dewatering Discharge to Duck Creek and Boolgeeda Creek (WRM 2020; Appendix C.2)	**Study/Survey area:** Brockman Syncline region, specifically Duck Creek and Boolgeeda Creek. **Type:** Hazard analysis and risk assessment for dewatering discharge to Duck Creek and Boolgeeda Creek. **Timing:** Water sampling undertaken between 2016 and 2019, with aquatic ecosystem surveys undertaken between 2009 and 2019.	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.
Duck Creek Surplus Water Discharge (Rio Tinto 2019a)	**Study/Survey area:** Duck Creek catchment. **Type:** Modelling and assessment of proposed discharge of surplus water to Duck Creek during proposed operations. **Timing:** Results presented November 2019.	Prepared in accordance with the requirements in the EPA Inland Water factor guideline.
Boolgeeda Creek - Surplus Water Discharge (Rio Tinto 2019b)	**Study/Survey area:** Boolgeeda Creek, Brockman Syncline region. **Type:** Impact assessment of surplus discharge to Boolgeeda Creek. **Timing:** Assessment undertaken October 2019.	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.
Plunge Pool – Hydrological impact assessment (Rio Tinto 2021c)	Study/Survey area: Plunge Pool. **Type:** Impact assessment of Plunge Pool catchment reduction. **Timing:** Assessment undertaken 2021.	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.
Plunge Pool – Sedimentation Assessment (Rio Tinto 2022a)	Study/Survey area: Plunge Pool. **Type:** Impact assessment of sediment transport in Plunge Pool catchment. **Timing:** Assessment undertaken 2022.	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.

Survey/Studies/Prepared for	Survey Area, Type and Timing	Consistency with Guidance
The Mode of Occurrence for Plunge Pool (Rio Tinto 2022b; Appendix C.3).	Study/Survey area: Plunge Pool. **Type:** Summary of the hydrology and hydrogeology of Plunge Pool and recommendations for its ongoing protection. **Timing:** Assessment undertaken January 2022	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.
Hydrogeological (Groundwater)		
Brockman Syncline Regional Groundwater Model – Cumulative Impact Assessment (RPS 2021a; Appendix C.4) Prepared for Rio Tinto	**Study/Survey area:** Brockman Syncline deposits region (including current B2N and BS4 operations). **Type:** Groundwater modelling study to assess cumulative impacts arising from proposed Brockman Syncline mining. **Timing:** Assessment undertaken November 2021.	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.
Greater Brockman Operations – Detailed water balance assessment (EMM 2021; Appendix C.5)	**Study/Survey area:** BS2, BS4, Nammuldi and satellite deposits **Type:** Detailed water balance assessment. **Timing:** Data current as of March 2021.	N/A
Brockman Syncline Pit Lake Modelling (RPS 2021b; Appendix C.6) Prepared for Rio Tinto	**Study/Survey area:** Brockman Syncline deposits within the Development Envelope **Type:** Assessment of pit lake formation potential. **Timing:** Assessment undertaken February 2021.	Prepared in accordance with information requirements in the EPA Inland Water factor guideline.
Brockman Syncline: Hydrogeological Assessment (Rio Tinto 2022c; Appendix C.7)	**Study/Survey area:** Brockman Syncline deposits (including BS2, BS4 and Nammuldi operations). **Type:** Hydrogeological Assessment of the Brockman Syncline region with conceptual hydrogeological modelling, groundwater flow modelling and assessment of impacts. **Timing:** Data and results presented as of 2022.	Prepared in accordance with information requirements in the EPA Inland Water factor guideline and the DWER Operational policy no. 5.12 – Hydrogeological reporting associated with a groundwater well licence.
Geochemistry/waste rock characterisation/tailings storage facility		
Greater Brockman AMD Risk Assessment (Rio Tinto 2021d; Appendix C.8)	**Study/Survey area:** Brockman Syncline deposits within the Development Envelope	Prepared in accordance with information requirements in the EPA Inland Water factor guideline and the DMIRS Mining Proposal guidance.

Survey/Studies/Prepared for	Survey Area, Type and Timing	Consistency with Guidance
	Type: Acid and metalliferous drainage risk assessment for the deposits within the proposed development envelope. **Timing:** Assessment undertaken March 2021.	
Assessment of In-Pit LOM Waste Fines Disposal (Klohn Crippen Berger KCB 2021)	**Study/Survey area:** BS2 assessment area (Lens A, Pit 5 and Pit 8). **Type:** Assessment of the suitability of these pits for waste fines storage including consideration of storage volumes and water quality. **Timing:** Assessment undertaken in 2021.	
Water quality assessment for the in-pit TSF pond at Pit 8 (Rio Tinto 2021e)	**Study/Survey area:** BS2 assessment area **Type:** Qualitative estimate of the potential water quality of TSF pond water informed by geochemistry. **Timing:** Assessment undertaken in 2021.	
Aquatic fauna		
Brockman Syncline Proposal Aquatic Ecological Values Desktop Review Final (WRM 2019a)	**Study/Survey area:** Caves Creek, Duck Creek and Boolgeeda Creek. **Type:** Summary of known aquatic ecological values collated from historic baseline and other monitoring associated with the Brockman Syncline Development Proposal. **Timing:** Presentation of data collected since 2009.	There is no specific guidance on aquatic fauna sampling. In accordance with the Water Quality Management Framework, water quality (physical and chemical stressors and toxicants) and several aquatic fauna receptors (hyporheos fauna, macroinvertebrates, and fish) are currently used to characterise and monitor ecosystem health condition.
Brockman Baseline Aquatic Fauna Water Quality Survey Dry-19 Tech Report Final (WRM 2019b)	**Study/Survey area:** Caves Creek, Duck Creek and Boolgeeda Creek. **Type:** Summarises results of the dry season 2019 (dry-19) baseline sampling of aquatic ecosystems in the Brockman Syncline Proposal. **Timing:** Presentation of data collected during sampling round in 2019.	
Greater Brockman 'Plunge Pool' Aquatic Biota Values Assessment (WRM 2019c)	Study/Survey area: Plunge Pool **Type:** Summarises results of the dry season 2019 (dry-19) baseline sampling of aquatic ecosystems in the Brockman Syncline Proposal. **Timing:** Assessment undertaken in 2019	

6.3.2. Regional Context

The Brockman Syncline refers to a folded band of geological units with high grade mineralisation in both Marra Mamba and Brockman Iron Formation deposits. The Brockman Syncline represents a large horseshoe shaped topographic feature with its central apex trending roughly east-west for approximately 60 km. High ridges of Brockman Iron Formation standing 300 – 400 m above the syncline valley floor occur along the northern and southern limbs with a maximum elevation of 1,132 m Relative Level (mRL) on the northern limb at Mount Brockman. The highest elevations correspond with the younger Brockman Iron Formation, separated from an outer, lower lying ridge of the older Marra Mamba Iron Formation by valleys of softer dolomite metasedimentary rock of more recent Tertiary infill sediments.

Marra Mamba Iron Formation is generally associated with low rounded hills whereas the Brockman Iron Formation is associated with steep rocky hills. Brockman Iron Formation and Marra Mamba Iron Formation both contain aquifers associated with deposits as the mineralisation process has increased permeability and porosity. These geological units have been more recently intruded by low permeability dolerite dykes, which form hydraulic barriers between deposits and 'compartmentalise' aquifers within the syncline. The Brockman Syncline aquifer system is primarily a closed system with little connection with the surrounding lithologies (Rio Tinto 2022c).

The Proposal occurs within the Hamersley fractured rock aquifer of the Pilbara Groundwater Allocation Plan area. There are no allocation limits prescribed for this area.

The Proposal is located within the Ashburton River catchment. Boolgeeda Creek and Duck Creek flow east to west within the Development Envelope and Caves Creek intersects Silvergrass in the northern section of the Development Envelope before joining Duck Creek. These creeks are all tributaries of the Ashburton River.

6.3.3. Groundwater

The Proposal deposits are broadly considered as part of the Brockman Syncline Hydrogeological Zone (Figure 6-1). The existing Silvergrass mine is within the Caves Creek Hydrogeological Zone. No new elements of the Proposal will be implemented in this latter zone, so it is considered only in the context of being part of the connected water management strategy.

6.3.3.1. Conceptual Hydrogeological Model

Based on the substantial hydrogeological data and investigations since the 1990's and in order to identify and assess potential impacts associated with the proposed abstraction of groundwater to facilitate the Proposal, the hydrogeological model was updated to include the new mining areas (RPS 2021a). A summary of the key features of the model are described below.

Groundwater in the Brockman Syncline is hosted within several different formations of varying hydraulic characteristics, a summary is detailed in Table 6-3.

The Brockman Syncline aquifer system is primarily a closed system with little connection with the surrounding lithologies (Figure 6-2). Relatively low permeability shales of the Mount McRae Shale and Mount Sylvia Formation act as an aquitard between the Brockman Iron Formation orebody aquifer and the regional Wittenoom Formation aquifer. However, hydraulic connection between these units is observed where faulting occurred, particularly at BS4.

Tertiary detrital sediments associated with creeklines are permeable and host groundwater, with variable aquifer properties associated with the clays and pisolites in the sediments.

The Brockman Syncline is characterised by dolerite dykes trending northwest-southeast which post-date and intrude (effectively cross cutting) through the major formations and the deposits (Figure 6-1). The dykes have subsequently partially eroded before the deposition of Tertiary sediments (Rio Tinto 2022c). Additionally, differential groundwater levels have been observed across a major dolerite sill that

wraps around the syncline along strike of the Joffre Member of the Brockman Iron Formation. This sill forms a major hydraulic boundary on the inside of the syncline. However, several locations have been identified where the sill has been eroded below groundwater level (and subsequently infilled with detrital sediments), which will allow hydraulic connection between the Brockman Iron Formation and the overlying formations located within the centre of the syncline (Figure 6-2).

Due to the complex nature of the aquifer geometry, geological structures and hydraulic barriers around the Brockman Syncline, detailed hydrogeological conceptual models have also been developed at an individual deposit scale. Rio Tinto (2022 c) presents these conceptual models for Proposal deposits in detail (Appendix C.7).

Table 6-3: Summary of Hydraulic Characteristics of Geological Formations Found within the Brockman Syncline

Geology		Hydrogeology Characteristics	Description
	Detritals/Alluvials	Variable aquifer properties	Where saturated, Tertiary detrital sediments, may be permeable and host groundwater, with the heterogeneity of these sediments (i.e., pisolites, clays) reflected in variable aquifer properties. Primarily overlie the Wittenoom Formation.
	Dolerite Sills/Dykes	Low permeability	Network of dykes crosscut syncline and act as hydraulic barriers. A major sill also wraps around the syncline.
Boundary Formations	Wyloo Group	Low permeability Low storage	A sedimentary formation that includes sandstones, mudstones, conglomerates, and limited hydrogeological data exists.
	Weeli Wolli Formation	Low permeability Low storage	A succession of jasperlite, shale and dolerite sills. Although not tested within the Brockman region, the Weeli Wolli Formation is known to have relatively low permeability with low groundwater storage.
Brockman Syncline aquifers	Brockman Iron Formation	Fractured and mineralised rock aquifer	Groundwater is predominantly associated with secondary porosity developed through mineralisation within the Joffre and Dales Gorge Members.
	Mount McRae Shale/Mount Sylvia Formation	Aquitard	The shale bands are characteristically **low** permeability and often act as an aquitard. However, the upper units can have increased permeability where fractured.
	Wittenoom Formation	Fractured rock aquifer	Thick succession of chert, shale and dolomite. Groundwater associated with secondary porosity associated with faulting/fractures and subsequent karstic dissolution mostly within the Paraburdoo Member.
	Marra Mamba Iron Formation - Mineralised Mt Newman	High hydraulic conductivity Medium storage	Increased secondary porosity hosted within mineralisation.
	Marra Mamba Iron Formation • Mt Newman BIF • MacLeod Member • Nammuldi Member	Potential to act as an aquiclude	Succession of BIFs, Shales and Cherts, may acts as a no flow boundary, no hydraulic conductivity except when heavily fractured.

Geology		Hydrogeology Characteristics	Description
Boundary Formations	Jeerinah Formation Fortescue Group	Low Hydraulic conductivity Low storage	The Jeerinah Formation hosts interbedded chert, shale, dolomite and a high density of intruded dolerite sills (up to 50% of the formation). It underlies and therefore wraps around the syncline

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Figure 6-1
Brockman Syncline Hydrogeological Zone, Illustrating the Key Hydraulic Features and Aquifer Boundary

Drawn: L.Fuentes
Plan: PDE0182256v1
Date: August 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:150,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000 550,000

7,520,000 7,510,000 7,500,000 7,490,000

596mRL
575mRL
596mRL
574mRL
543mRL
520mRL
500mRL
437mRL
593mRL
Groundwater Divide
592mRL
530mRL
557mRL
535mRL
547mRL
523mRL
Plunge Pool Outflow
524mRL
502mRL
505mRL
495mRL
490mRL
?
484mRL
506mRL
516mRL

Legend

- Development Envelope
- Rio Tinto Pit Outlines
- Competitor Resource Outline

Hydrogeological Features

- Aquifer Boundary Formations
- Potential Aquatard
- Potential Hydraulic Barriers (Dolerite Dyke Sill)
- Groundwater Flow Compartment Overlapping Directions
- Groundwater Divide

N

0 2 4 6 8

Kilometres

Map units in metres

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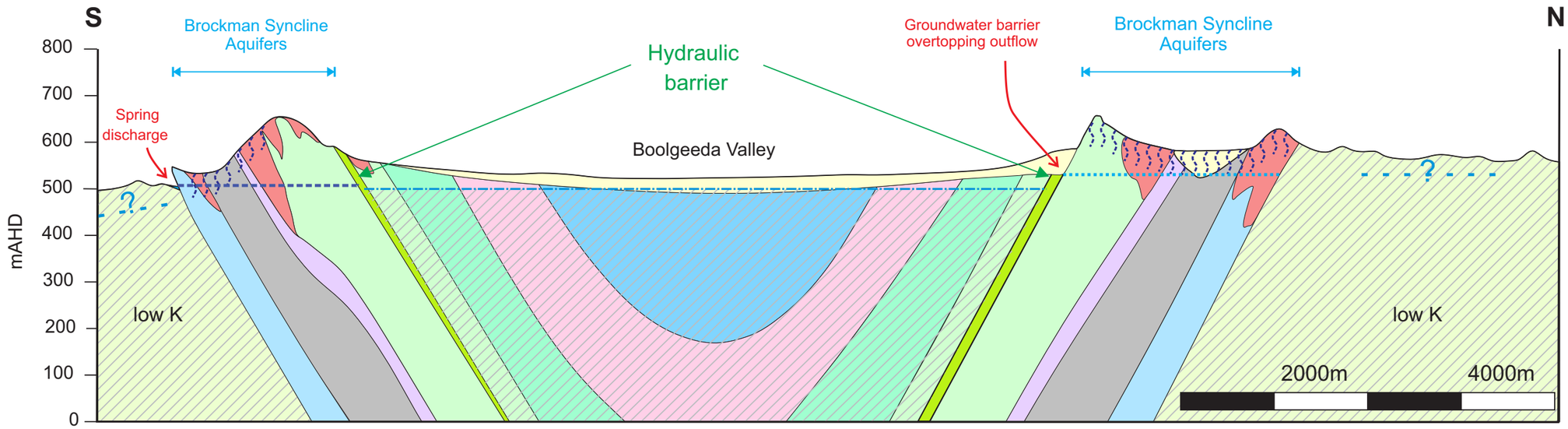

Geology

- Boolgeeda Formation
- Mt McRae Shale Mt Sylvia Formation
- Detritals
- Wongarra Volcanics
- Wittenoom Formation
- Mineralisation
- Weeli Wolli Formation
- Marra Mamba Formation
- Dolerite Sill
- Brockman Formation
- Jeerinah Formation

Hydrogeology

- Groundwater discharge/outflow Rainfall recharge
- Groundwater level (measured)
- Groundwater level (low confidence)
- Groundwater level (unknown) Aquifer boundary formations

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Figure 6-2
Hydrogeological Conceptual Section of the Brockman Syncline Aquifers, Boundary Formations and Key Hydraulic Features

Drawn: A.Coulson
Plan: PDE0182257v1
Date: May 2022
GIS.Team@riotinto.com

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6.3.3.2. Groundwater Levels

Groundwater levels across the Brockman Syncline are generally deep and beyond the typical depth of vegetation root systems (>20 m bgl). Pre-mining groundwater levels within the Development Envelope range from 593 to 495 mRL. The range in depth is a reflection of both the variation in surface elevations combined with the local groundwater gradient.

The highest groundwater level occurs in the BS3 assessment area and corresponds to an area of elevated topography. The regional groundwater level trends follow the broad surface topography. However, groundwater is compartmentalised at a local scale within sections of the Syncline, exhibiting very flat groundwater levels with sudden step changes (up to 50 m) over short distances. The compartmentalisation is a result of numerous NW-SE trending dolerite dykes that cut across the syncline. Hydraulic connection can occur across the dykes where they are eroded below the prevailing groundwater level (and subsequently infilled with detrital sediments), which will allow hydraulic connection between the Brockman Iron Formation and the overlying formations (Figure 6-3).

Groundwater levels have remained relatively consistent over time with little response to rainfall; however, there is a slight annual fluctuation (approximately 0.2 m), which may illustrate diffuse recharge following the wet season (Rio Tinto 2022c).

Figure 6-4 presents pre-mining depth to water contours (metres below ground level – m bgl) for the Brockman Syncline aquifer. Depth to groundwater is variable due to significant topographic variation. BS1, BS2 and BS3 (which includes Plunge Pool – refer to Section 6.3.5.2) assessment areas all include small areas where depth to water is less than 20 m bgl. This corresponds with the areas of potential Groundwater Dependent Ecosystems (GDE) mapped by Biologic (2021a) as presented in Section 7.

6.3.3.3. Existing Groundwater Use

The Proponent currently abstracts groundwater to enable BWT mine pit dewatering for existing mining operations and water supply.

There are no registered water supply bores within the Brockman Syncline that the Proponent does not operate. However, FMG holds several groundwater licences within the north-western limb of the syncline for a water supply borefield at FMG's Flying Fish deposit. Drawdown resulting from the abstraction of groundwater from the FMG, and the Proponents operations can overlap at the BS1 assessment area, which may affect the pit inflow and/or bore abstraction rates at both operations. The Proponent and FMG have engaged with regards to this matter.

Groundwater Level Response to Existing Dewatering Abstraction

Active dewatering for BWT mining currently occurs at BS2-Nammuldi and BS4 mining operations (Table 2-3 and Figure 2-3), with drawdown of the pre-mining groundwater level by up to 154 m bgl and 74 m bgl. Figure 6-5 illustrates the drawdown from existing operations in relation to the pre-mining water level in a vertical fence section, which also illustrates the aquifer compartmentalisation created by dolerite dykes.

The drawdown in BS2-Nammuldi and BS4 are shown in plan view in Figure 6-6 and Figure 6-7, respectively. The drawdown from BS2-Nammuldi has propagated around the Syncline to the Diesel deposit within the BS2 assessment area (Figure 6-6), whilst at BS4, drawdown extent has been observed to be truncated by dolerite dykes (Figure 6-7).

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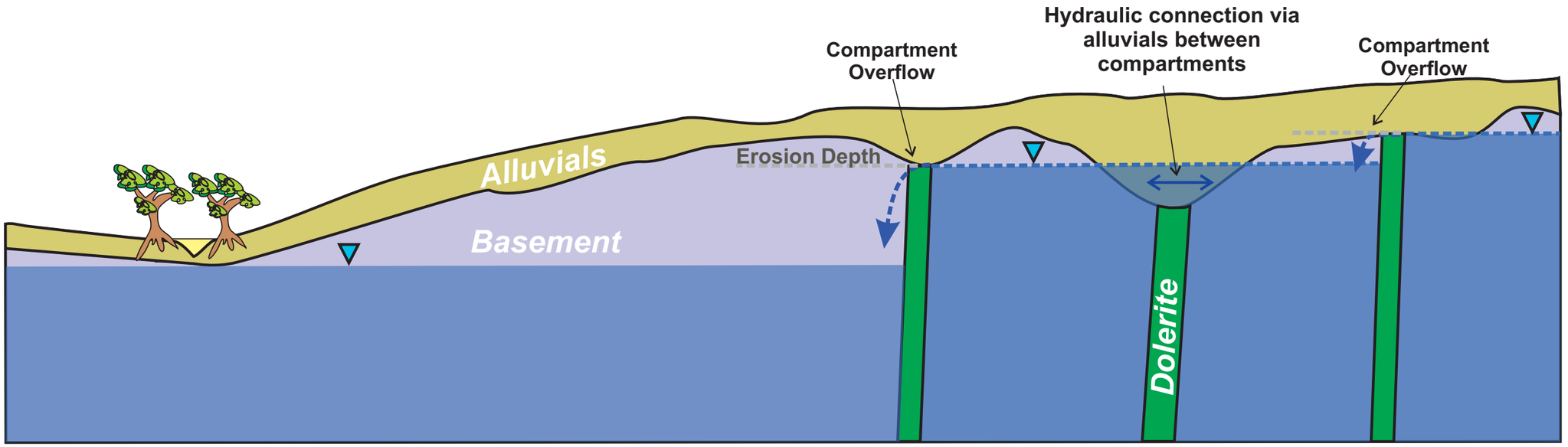
Figure 6-3
Schematic of the Effect of Dolerite Dykes on Groundwater Levels

Drawn: L.Fuentes
Plan: PDE0182258v1
Date: June 2022

GIS.Team@riotinto.com



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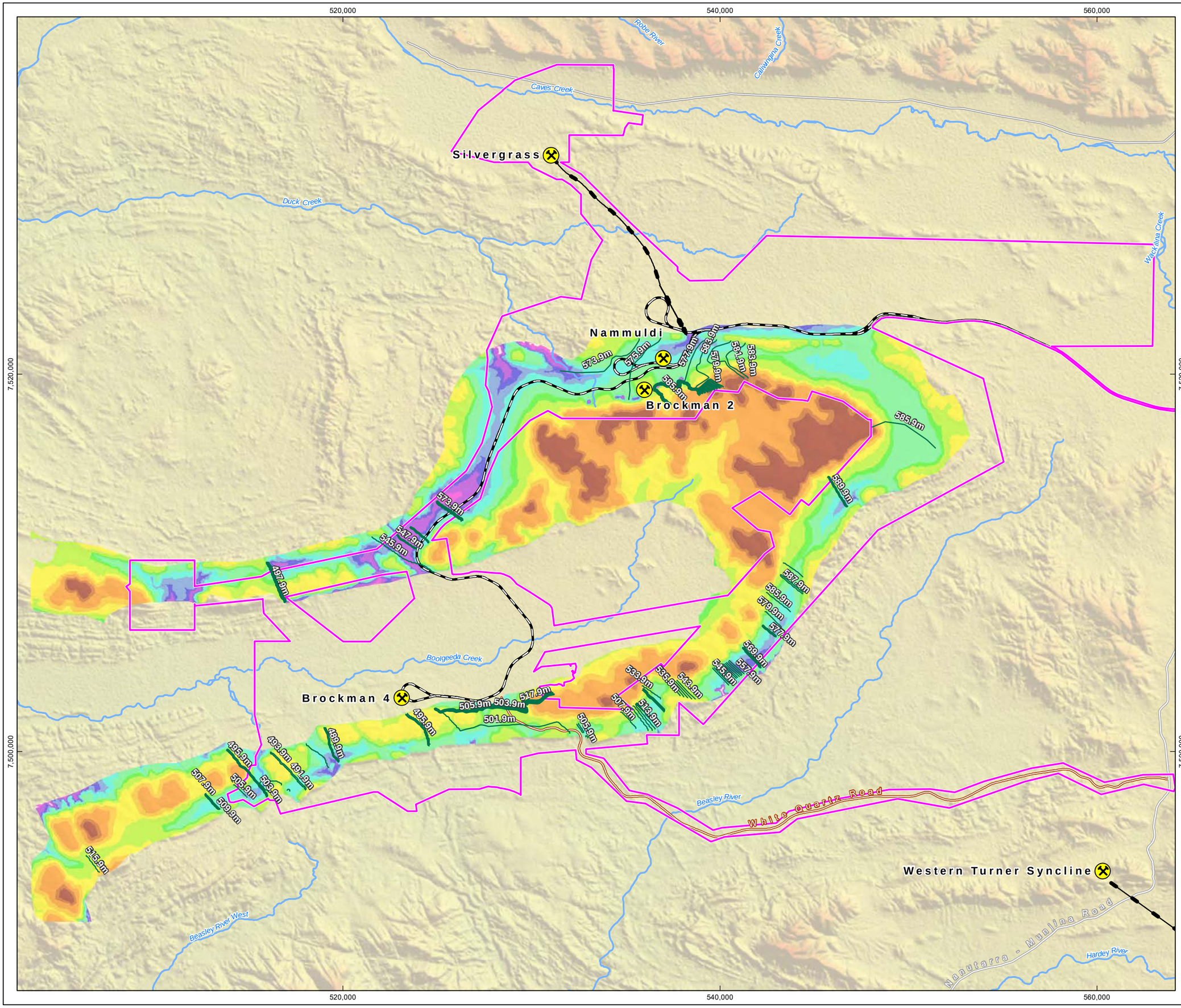

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Figure 6-4
Pre-mining Depth to Water in the Brockman Syncline Region

Drawn: L.Fuentes
Plan: PDE0182259v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Pre-mining Regional Water Levels
- Major Creek

Depth to Water (mbgl)

- 250 - 300
- 200 - 250
- 150 - 200
- 100 - 150
- 80 - 100
- 60 - 80
- 50 - 60
- 40 - 50
- 30 - 40
- 25 - 30
- 20 - 25
- 10 - 20
- 5 - 10
- 5
- <5

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

N

0 2 4 6 8 10
Kilometres
Map units in metres

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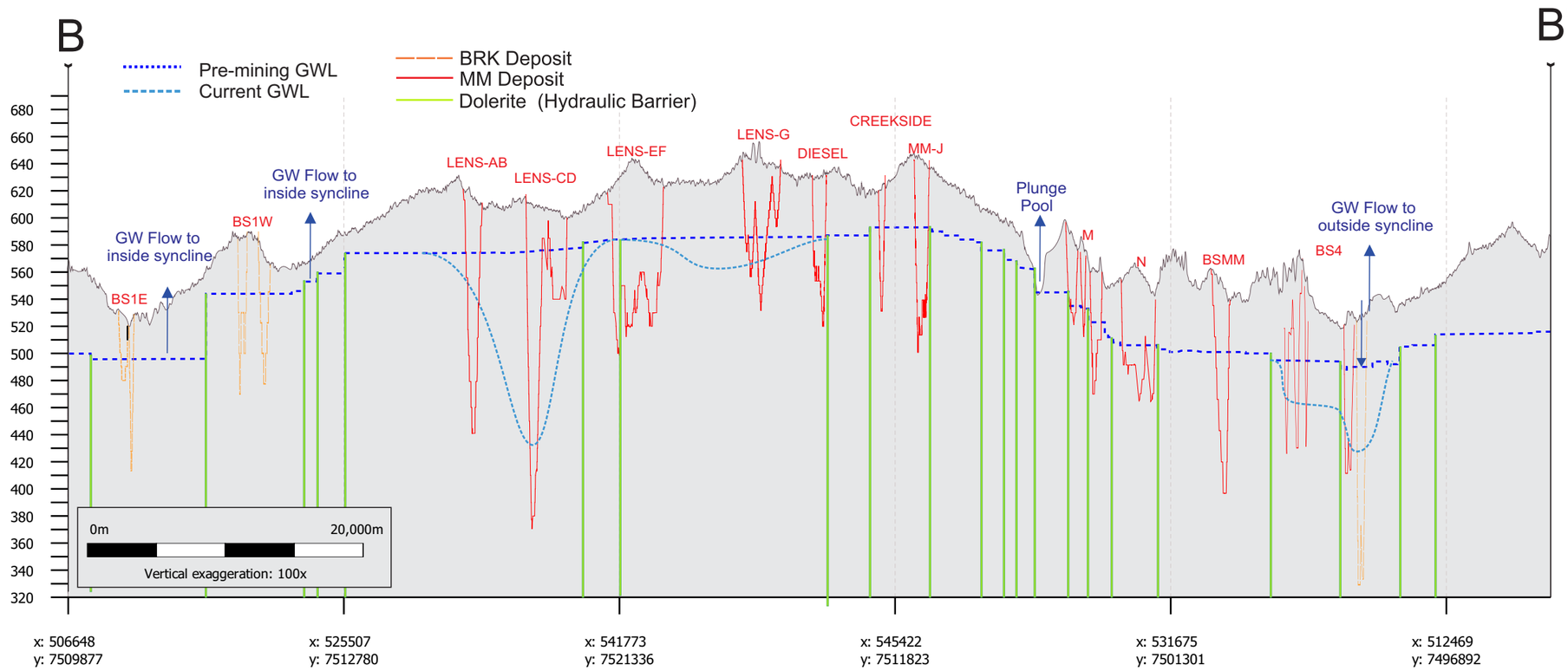

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Figure 6-5
Brockman Syncline Fence Section from BS1 to BS4 Assessment Area Showing Pre-mining and Current Groundwater Levels

Drawn: L.Fuentes
Plan: PDE0182260v1
Date: May 2022
GIS.Team@riotinto.com

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Figure 6-6
Groundwater Drawdown Contours from Pre-mining Levels in the BS2 and Nammuldi Area, Illustrating Propagation Around the Syncline (2016-2020)

Drawn: L.Fuentes
Plan: PDE0182261v1
Date: August 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Development Envelope
- Proposed Conceptual Pit
- Drawdown Contours
- Water Bores

Hydrogeology

- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)

N

0 1 2 3 4
Kilometres

Map units in metres

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530,000 535,000 540,000 545,000 550,000

7,525,000 7,520,000 7,515,000 7,510,000

Nammuldi

Brockman 2

120 m 130 m 110 m 100 m 90 m 80 m 70 m 60 m 50 m 40 m 30 m 20 m 10 m 5 m 1 m

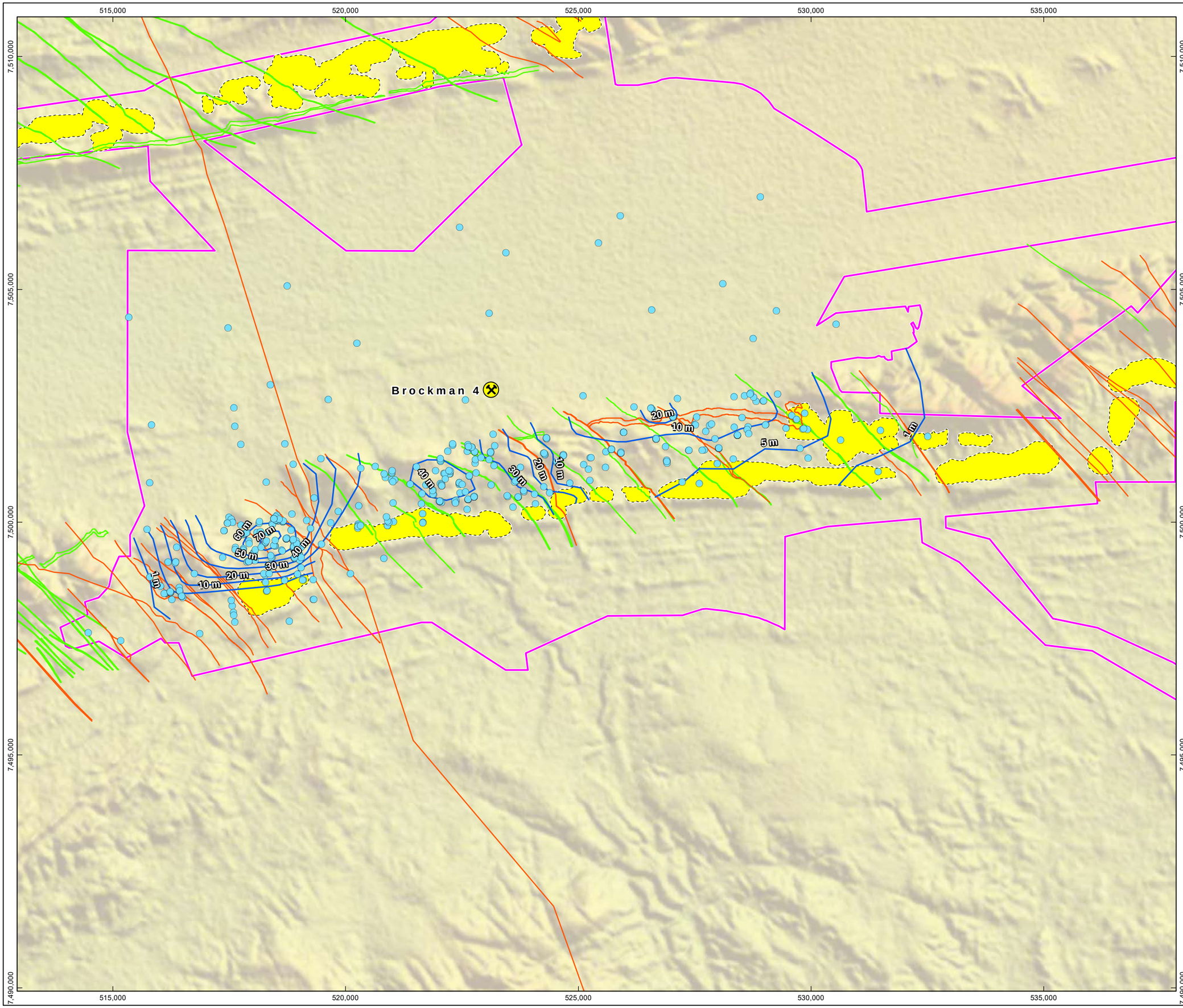

Figure 6-7
Groundwater Drawdown Contours from Pre-mining Levels in the BS4 Area (2013-2020)

Drawn: L.Fuentes
Plan: PDE0182262v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Development Envelope
- Proposed Conceptual Pit
- Drawdown Contours
- Water Bores

Hydrogeology

- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)

N

0 1 2 3 4

Kilometres

Map units in metres

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6.3.3.4. Groundwater Quality

Groundwater quality in the Brockman Syncline is typically classified as fresh (Table 6-4), with electrical conductivities varying between 500 and 1,500 µS/cm and pH values ranging from between 7.2 and 8.4 (Rio Tinto 2022 c). There are high carbonate concentrations in some areas associated with the presence of calcrete bands. Groundwater quality is generally within the Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000 guidelines for aquatic ecosystems, except for copper and zinc, which were recorded at elevated levels at some locations. Using these default guideline values for aquatic ecosystems to assess groundwater is consistent with the approaches outlined in ANZG (2018).

Groundwater has been sampled across all hydrostratigraphic units present within the syncline since operations began. Groundwater monitoring data collected in relation to operational facilities are typically reported in Annual Environmental Reports, submitted as part of licence conditions and compliance obligations. Additional groundwater quality data is collected by Rio Tinto outside of compliance purposes as part of regional monitoring and is aimed at monitoring regional aquifer conditions that mining operations may potentially impact. Groundwater major ion data suggest a relatively consistent water quality, with the largest variability found in chloride ion concentrations. Chloride concentrations ranged from 6 to 3,320 mg/L, with a regional average of 194 mg/L. Spatially, chloride concentration is highly variable, with changes in concentration of approximately 300 mg/L recorded over several hundred metres (Rio Tinto 2022 c). Chloride is a conservative ion in the Pilbara, therefore, its concentration in groundwater is generally influenced by evaporation or dilution. Hence it is used as an indicator analyte to help develop the groundwater model conceptualisation, in particular to help understand and conceptualise rainfall recharge processes. These chloride signatures vary between aquifer compartments across the syncline which supports the hydrogeological conceptualisation that mixing between the aquifer compartments is limited.

Sulfate is a naturally occurring ion found within rainwater, surface water and groundwater. Its concentration in groundwater is related to a range of different sources, including dissolution of rock minerals but it can also indicate impacts from mining operations. Sulfate concentrations were observed to vary between 1.0 – 2,600 mg/L in monitoring bores across the Brockman Syncline. This data suggests a large range of natural background conditions relating to sulfate, with the elevated concentration (2,600 mg/L) observed in a single bore (MB14NAN001), situated immediately north of Nammuldi and approximately 4.5 km southeast of the Nammuldi WFSF. The bore screen is situated within basalt of the Jeerinah Formation, which is typically characterised by naturally high concentrations of sulfate and as these concentrations are not reflected in adjacent groundwater monitoring bores it is considered to represent an outlier, reflecting localised elevations.

Table 6-4: Summary of Physical Chemistry and Major Ion Concentrations Across Brockman Syncline (Rio Tinto 2022c)

Groundwater Sampling Brockman Syncline											
(i) Pumping water bores											
Statistic	**Na mg/L**	**K mg/L**	**Ca mg/L**	**Mg mg/L**	**Fe mg/L**	**HCO_3 mg/L**	**SO_4 mg/L**	**Cl mg/L**	**pH**	**EC uS/cm**	**TDS* mg/L**
Mean	108	14	74	59	0.1	261	162	189	7.9	1,285	815
Minimum	36	3	24	23	0.0	63	2.0	69	7.2	553	314
Maximum	208	71	383	223	1.9	521	1,630	592	8.4	3,730	3,420

Groundwater Sampling Brockman Syncline											
(ii) Monitoring bores											
Statistic	**Na mg/L**	**K mg/L**	**Ca mg/L**	**Mg mg/L**	**-**	**HCO_3 mg/L**	**SO_4 mg/L**	**Cl mg/L**	**-**	**-**	**-**
Mean	95	15	61	52	-	230	111	186	-	-	-
Minimum	6	1	3	2	-	5	1	6	-	-	-
Maximum	1,110	939	560	365	-	610	2,600	3,320	-	-	-

**TDS = Total Dissolved Solids*

6.3.3.5. Groundwater Dependent Ecosystems

Ecosystems that rely on groundwater for some or all of their water requirements are classified as GDE (Biologic 2021a). Within inland Australia, there are three key types of GDEs:

- Aquatic ecosystems; that rely on the surface expression of groundwater – this includes surface water ecosystems that have a groundwater component, such as rivers, wetlands and springs.
- Terrestrial ecosystems; that rely on the subsurface presence and proximity of groundwater – this includes groundwater dependent vegetation (GDV).
- Subterranean ecosystems; stygofauna communities in aquifers.

These GDEs rely on either below ground access to watertables (via the capillary fringe) or surface water expression of groundwater to provide at least some of the community's environmental water needs. GDEs are often typified by the presence of GDV but can include aquatic ecosystems with a surface/groundwater component. These ecosystems can present in the form of creeks, rivers, pools, wetlands, springs (along with more hydrophytic or aquatic vegetation).

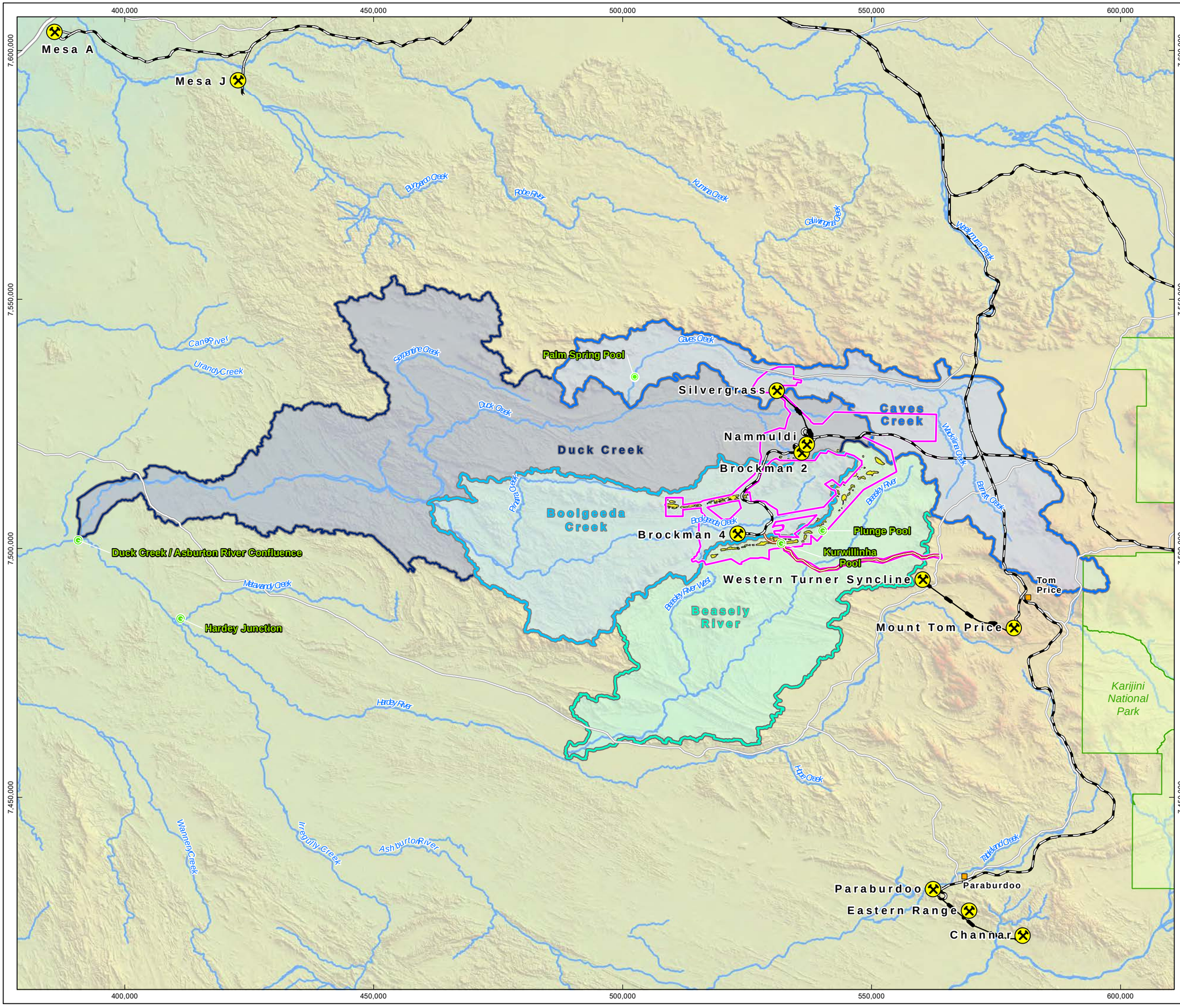
Isolated areas of shallow watertables along with restricted patches of vegetation indicative of GDV that may support GDEs have been identified in areas of the Brockman Syncline where there are topographical lows and shallow groundwater levels. Plunge Pool is a groundwater dependent pool and surface water feature that is described in Section 6.3.4.

Terrestrial GDEs are described in Section 7.3.2.6, and stygofauna values are described in Section 9. Aquatic fauna are described in Section 6.3.5

6.3.4. Surface Water

6.3.4.1. Regional Catchments

The Proposal is located in the northern reaches of the regional Ashburton River catchment and spans two major surface water sub-catchments: Duck Creek and Hardey River (Figure 6-8). These watercourses flow west. The Hardey River reaches its confluence point with the Ashburton River approximately 100 km west of the Proposal at Hardey Junction whereas Duck Creek enters the Ashburton River approximately 30 km downstream of Hardey Junction. Duck Creek and Hardey River catchment areas are approximately 6,400 km^2 and 6,300 km^2, respectively. Streamflow in both catchments are ephemeral, exhibiting high temporal variability, with flows generally occurring in response to high rainfall events. These creek systems tend to remain dry for most of the year.



RioTinto

Figure 6-8
Surface Water Catchments

Drawn: L.Fuentes
Plan: PDE0182250v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:700,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Proposed Conceptual Pit
- National Park

Catchments

- Beasely River
- Boolgeeda Creek
- Caves Creek
- Duck Creek

- Town
- Locality Reference
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Highway
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 10 20 30 40
Kilometres
Map units in metres

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6.3.4.2. Rivers, Creeks and Associated Pools

Duck Creek

The northern section of the Brockman Syncline (the BS2 assessment area) is largely within the Duck Creek catchment (Figure 6-8). Duck Creek is ephemeral; however, the following semi-permanent to permanent clear river pools persist along Duck Creek (outside and downstream of the Development Envelope, Figure 6-9):

- Duck Creek Upstream (DCU) 1, 2 and 3, which are located within Duck Creek, approximately 10 km downstream of the discharge location
- DCU 11, which is located within Duck Creek, approximately 40 km downstream of the discharge
- Duck Creek Downstream (DCD) 3, 5, 6, 7 and 8, located within Duck Creek (downstream of the confluence with Caves Creek), approximately 50 to 70 km downstream of the discharge.
- DCD T2, which is a rock pool on a tributary of Duck Creek
- DCD 11 and 15, which are located within Duck Creek (downstream of the confluence with Boolgeeda Creek), approximately 120 to 130 km downstream of the discharge location.

These pools are situated on bedrock structures that impede groundwater flow or against cliffs where high-flow events have scoured deep pools (WRM 2020). Such pool systems are likely to be at least partly groundwater dependent. Extensive ephemeral pools form along Duck Creek following significant wet season rainfall, establishing connectivity between the more persistent waterholes and aiding dispersal of aquatic biota throughout the system.

These pools play an important role in the creek's ecosystem by supporting a diverse range of aquatic fauna, terrestrial fauna and social surroundings. Ephemeral pools also form along Duck Creek following significant wet season rainfall, establishing connectivity between the more persistent waterholes (WRM 2020).

Shallow groundwater levels characterise Duck Creek, and the associated riparian vegetation is therefore considered GDV. The shallow groundwater levels (~2 m bgl)) limit tree rooting depths in the existing system (AQ2 2021).

Boolgeeda Creek

Boolgeeda Creek is an ephemeral creekline in the central valley of the Brockman Syncline between the BS1 and BS4 assessment areas and is a major tributary of Duck Creek (Figure 6-8). Boolgeeda Creek drains in a westerly to south-westerly direction to its point of confluence with Duck Creek. The Boolgeeda Creek catchment is relatively steep; therefore, it is expected that a relatively high proportion of rainfall will be converted into runoff.

Boolgeeda Creek is highly ephemeral and surface water expression generally persists for days to weeks following rainfall events. There is only one known deep semi-permanent pool on Boolgeeda Creek, located 9.6 km upstream of the confluence with Duck Creek (outside and downstream of the Development Envelope (WRM 2020, Figure 6-9).

During wetter years, this pool persists over the dry season but dries out completely during drought years. There is an existing surplus water discharge point located within Boolgeeda Creek as part of the existing operations.

Permanent and semi-permanent river pools are considered to be 'exceptionally important' refugia during drought periods, supporting diverse and abundant aquatic flora and fauna (WRM 2019a).

Beasley River

The southeast portion of the Development Envelope is located in the Beasley River catchment, a major sub-catchment of the Hardey River catchment. The Beasley River catchment covers an area of approximately 2,058 km^2 and drains from north to south through the Hamersley Ranges and discharges into the Hardey River, approximately 6 km upstream of Cheela Springs (Figure 6-8). Lens G, the easternmost ore deposit, is situated in an internally draining basin located in the upper catchment of the Beasley River. The basin captures local runoff and is subject to flooding after large rainfall events (Rio Tinto 2021b). The mulga communities in this broad valley have been identified as important to the Muntulgura Guruma people.

Two pools, Kurwillinha Pool and Plunge Pool, are located within the Development Envelope. These pools are within the Beasley River catchment in the BS4 and BS3 assessment areas (Figure 6-9) and are further described in Section 6.3.4.3. Another pool, Ridge Pool is outside the Development Envelope but is within the Beasley River catchment.

Caves Creek

The existing Silvergrass mine is within the Caves Creek catchment, which discharges into Duck Creek (Figure 6-8). The headwaters of the Caves Creek sub-catchment include Barnett Creek and Wackilina Creek, located in the high relief areas of the Hamersley Range (Figure 6-8). These creeks flow over wide, flat plains, producing a meandering channel, creating Caves Creek at their confluence. Caves Creek is largely ephemeral but supports permanent pools and an aquatic GDE downstream of the Silvergrass mine around Mallu (Palm Springs) (Figure 6-8).

Palm Springs is a regionally significant permanent pool approximately 30 km downstream from the Development Envelope at Silvergrass. Palm Springs occurs along an approximately 4 km stretch of Caves Creek where there is shallow groundwater and a series of permanent and semi-permanent pools. Palm Springs and the downstream pool site Wawuru Yinta are recognised as having particularly high cultural value and significance for Traditional Owners.

Palm Springs is environmentally significant as a Priority 2 PEC ‘Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara Region’, containing flora with restricted distributions or from highly disjunct populations; or are major range extensions from northern and eastern Australia. Palm Springs also supports several Priority flora species, including the Millstream palm (*Livistona alfredii*), which is limited to only a few locations in the Pilbara, with the largest populations occurring at Millstream.

As established in the conditions of approval in MS 925 (Nammuldi-Silvergrass) the Proponent is required to ensure no long-term impact on GDV communities in Caves Creek (including Palm Springs) beyond the Development Envelope.

The Proposal does not include any expansion of the MS 925 approved mining, mine pit dewatering or infrastructure in the Caves Creek catchment and therefore, the environmental setting of this system is not described in further detail.

RioTinto

Figure 6-9
Surface Water Pools Within the Discharge Extent

Drawn: L.Fuentes
Plan: PDE0191426v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:350,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Gorge and Rock Pool
- Semi-permanent/Permanent Water Feature
- Brockman 2 Discharge Point
- Brockman 4 Discharge Point
- Maximum Duck Creek Wetting Front
- Maximum Boolgeeda Creek Wetting Front
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access

N

0 2 4 6 8 10
Kilometres

Map units in metres

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6.3.4.3. Unnamed Pools

Within the Development Envelope, 21 ephemeral pools were recorded in various fauna surveys between 2005 and 2022 as summarised in Biologic (2022a) and shown in Figure 6-10. Ephemeral pools occur throughout the ranges following rainfall and can persist for a short time (days to weeks) in shaded rocky areas. These shorter-lived ephemeral features are not considered significant for fauna (Biologic 2022a) and therefore are not considered further in this assessment.

No other persistent semi-permanent to permanent surface water features have been identified in the Development Envelope.

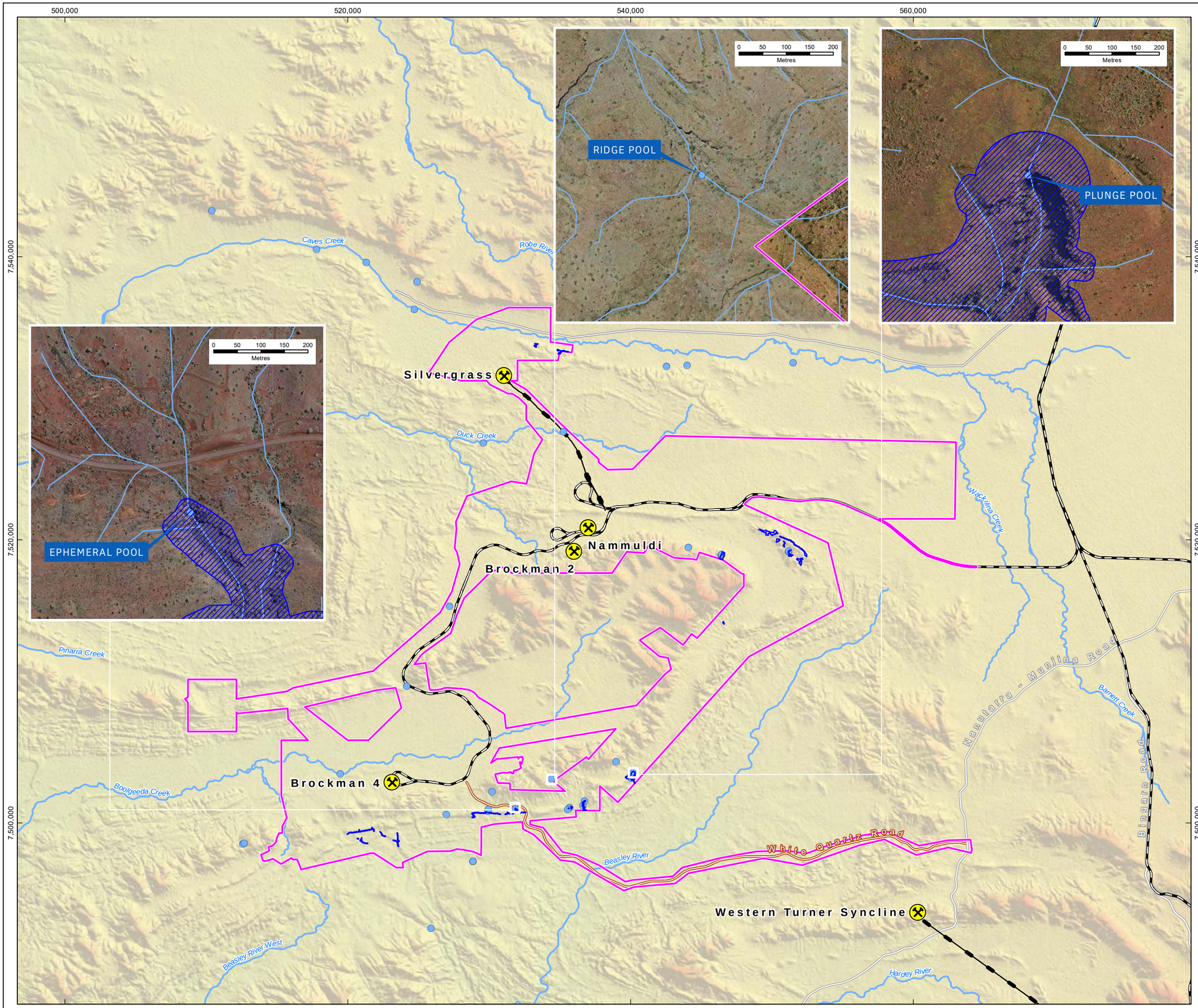
6.3.4.4. Named Pools

Three significant named pools have been identified within or near the Development Envelope, near the BS3 and BS4 assessment areas (Figure 6-10) that are relevant to this assessment:

- Plunge Pool (permanent groundwater dependent pool)
- Ridge Pool (outside the Development Envelope) (ephemeral surface water dependent gorge pool)
- Kurwillinha Pool (ephemeral surface water dependent gorge pool).

Plunge Pool is the largest of the pools in the Development Envelope and has significance for the Muntulgura Guruma People. Kurwillinha Pool is also culturally significant for the Muntulgura Guruma People (Section 12).

Ridge Pool and Plunge Pool are known water sources for conservation listed fauna such as the Pilbara Leaf-nosed Bat (Bat Call WA 2017) (Sections 8 and 14).



RioTinto

Figure 6-10
Surface Water Pools within the Development Envelope

Drawn: L.Fuentes
Plan: PDE0182251v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- MNES Critical Habitat Exclusion Zone
- Surface Water Pools
- Major Creek
- Minor Creek
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

N

0 2 4 6 8 10
Kilometres

Map units in metres

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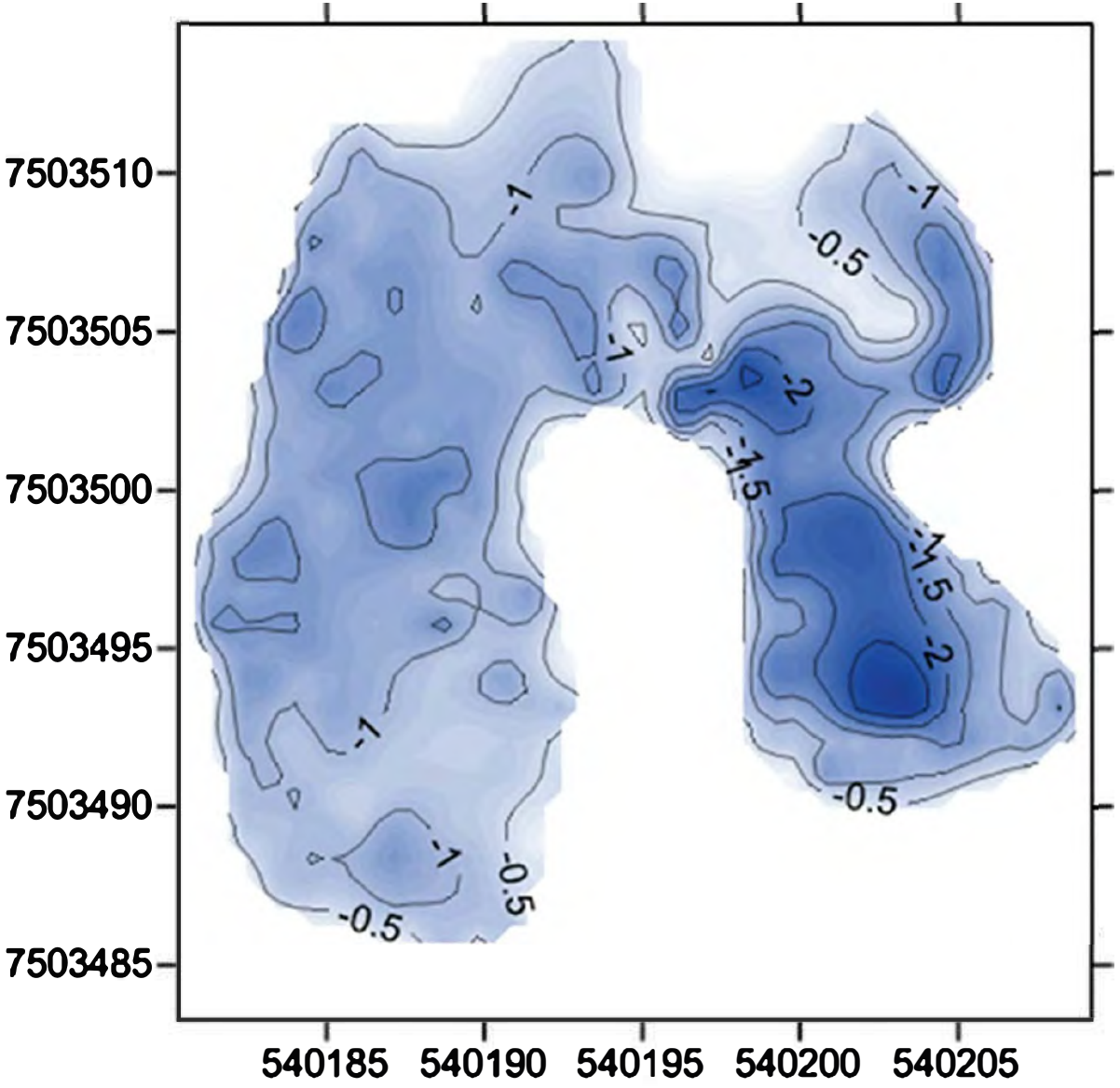
Plunge Pool – Permanent Groundwater Dependent Pool

Plunge Pool is the only permanent pool located within the Development Envelope. It occurs at the base of a small gorge within the BS3 assessment area adjacent to the BS3 deposit and supports significant environmental and cultural values. The pool is fed by groundwater and topped up by surface water flow from a 21 km^2 sub-catchment of the Hardey River regional catchment (Rio Tinto 2022b). Being a permanent groundwater fed pool, Plunge Pool supports Aquatic GDE.

Plunge Pool measures approximately 20 m by 15 m and 2.5 m deep, as determined in a bathymetry survey undertaken in November 2016 (Figure 6-11, Rio Tinto 2022b) and it is surrounded by gorge walls approximately 20 m high (Plate 6-1).



Plate 6-1: Plunge Pool *(Source: Rio Tinto 2022c)*



RioTinto

Figure 6-11
Plunge Pool Bathymetry (mbgl) (Based on November 2016 Water Levels)

Drawn: L.Fuentes
Plan: PDE0182252v1
Date: May 2022

GIS.Team@riotinto.com

Note: Bathymetry in metres

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Mode of Occurrence

Water levels within the pool have been recorded as reaching a maximum level of 542.6 mRL, which is the spilling point of the pool. The lowest recorded water level in the pool was 541 mRL in the monitoring period between 2017 and mid 2019 despite below average rainfall.

Extensive hydrogeological drilling has been undertaken in areas adjacent to Plunge Pool to understand its relationship and connection to surrounding aquifers (Rio Tinto 2022b). The measured groundwater levels indicate the aquifers are all compartmentalised in this area by cross-cutting dolerite dykes. The water levels decrease in step changes from 593 mRL to 546 mRL over an approximate 5 km distance. A conceptual model (Figure 6-12) of the relationship of Plunge Pool to both surface water and groundwater has been developed based on the monitoring and water balance described in Rio Tinto (2022b). This cross-section shows the water levels at two bores upstream of Plunge Pool, which have a 12 m head difference in monitored water levels.

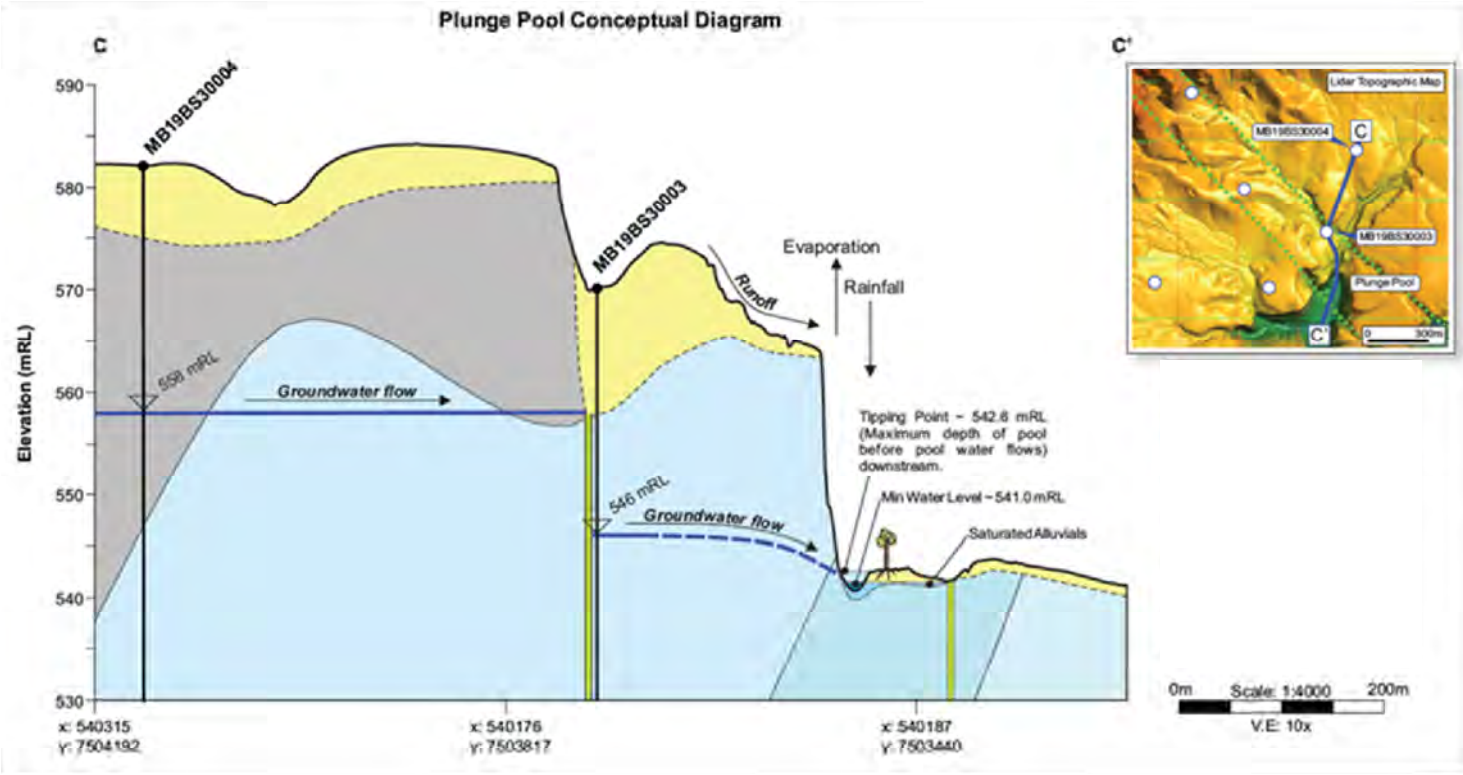
Pool Chemistry

The hydrochemistry of Plunge Pool and surrounding groundwater is consistent with the conceptualisation and monitoring data which supports that the pool is groundwater fed and 'topped up' by runoff during rainfall events. The electrical conductivity (EC) within the pool has been observed to immediately increase during high rainfall events at the start of the wet season due to runoff from the local catchment, collecting surface salts before flowing into the pool. This peak in EC is then followed by a sudden decrease, related to later runoff with a decreased salt load likely due to flushing from the first seasonal flows. Over time, the EC signature of the pool gradually equilibrates to an EC signature similar to adjacent groundwater until the next significant rainfall runoff event takes place (Rio Tinto 2022b, Appendix C.3).

Surface Water Flows

Plunge Pool has a contributing catchment of 21 km^2 and although the pool is a surface expression of groundwater, surface water flows are important to flush the pool periodically. The creek drains the catchment in a south-westerly direction and has a relatively flat uniform slope of 12 m/km before discharging into the pool via a waterfall.

The total storage volume of the pool is estimated as being 1,900 kL from the lowest point at 538.1 mRL to the spill point at 542.6 mRL. Approximately 700 kL of this volume is assumed to be permanent water sustained by groundwater inflow. The remaining 1,200 kL is active storage, replenished and depleted according to rainfall, catchment inflows, infiltration to groundwater and evaporation. Therefore, the pool requires a flow event of 1,900 kL or greater to replace storage completely. Modelling indicates that the pool would fill approximately seven days per year under 'average' conditions. Smaller flow events may have a freshening effect on the pool and may result in some flushing depending on the pool water level before the rainfall event (Rio Tinto 2021c). Figure 6-12 presents the conceptual model for Plunge Pool indicative of groundwater and surface water interactions.



RioTinto

Figure 6-12
Plunge Pool
Conceptual Cross Section

Drawn: L.Fuentes
Plan: PDE0182252v1
Date: May 2022

GIS.Team@riotinto.com

Legend

- Cenozoic Alluvials
- Wittenoom Formation
- Mt Newman Member
- Macleod Member
- Nammuldi Member
- Dolerite Dyke

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Ridge Pool – Ephemeral Surface Water Dependent Gorge Pool

Ridge Pool (Figure 6-10) is located in a gully high within the vicinity of the BS4 assessment areas but is outside the Development Envelope on Muntulgura Guruma Country. The pool measured approximately 8 m by 4 m and 1 m deep in November 2016 (Plate 6-2). The elevation of the pool is approximately 670 mRL, which is 160 m higher than the pre mining groundwater level (510 mRL) in the BS4 deposits to the south (Rio Tinto 2022c). This indicates that the pool is either not groundwater dependent or relies on perched groundwater not connected to the broader aquifer.

The pool has a catchment area of 0.5 km^2. It is understood to be fed by surface water that collects after rainfall events in a hollow in the low permeability Dales Gorge Member of the Brockman Iron Formation. The water in the pool is protected from evaporation by an overhanging rock shelf (Plate 6-2). The pool was observed to contain water from the end of 2016 and throughout 2017 (Rio Tinto 2022c).

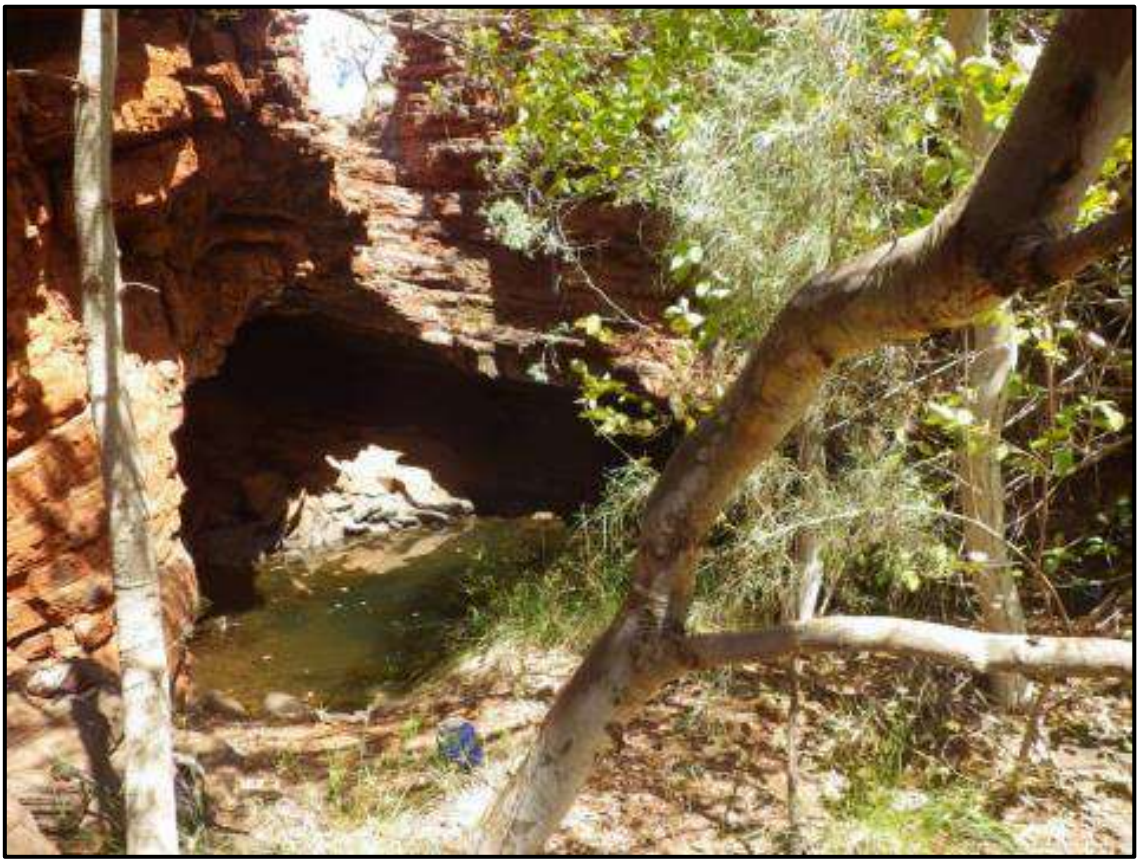

Plate 6-2: Ridge Pool *(Source: Rio Tinto 2022c)*

Kurwillinha Pool – Ephemeral Surface Water Dependent Gorge Pool

Kurwillinha Pool (also known as Ephemeral Pool) (Figure 6-10) is located at the upper end of a small gorge in the BS4 assessment area on Muntulgura Guruma Country (Plate 6-3). The pool has a 0.7 km^2 catchment that drains from north to south and is within the Beasley River catchment. The pool is located at an elevation of approximately 555 mRL, which is more than 50 m higher than the pre-mining groundwater table in the area. Therefore, the pool is not groundwater-dependent and is most likely fed by surface water that collects after rainfall events at the head of the gorge. The gorge is within the low permeability Marra Mamba Formation, with colluvium along the base.

This pool was observed to diminish between October 2016 and December 2016 until it was dry. The pool measured approximately 4 m by 1.5 m and 0.2 m deep in October 2016, equating to a volume of 1.2 m^3 at that time. Analysis of available LiDAR topographic data indicates that the volume of the pool when full could be as little as 6.6 m^3 (Rio Tinto 2021b).



Plate 6-3: Kurwillinha Pool *(Source: Rio Tinto 2021b)*

6.3.4.5. Surface Water Flooding and Flow Regime

Surface water flooding has been estimated for the pre-development landform to characterise the existing flow regime (Rio Tinto 2021b) under a range of flood scenarios. The level of flood event is described in terms of Annual Exceedance Probability (AEP), which is the probability of an event occurring or being exceeded within a year. For example, a 1 in 100 AEP event has a 1% probability of being equalled or exceeded in any year.

Baseline flood depths and flood velocities under different flood events have been estimated for defined sub-catchments of the Development Envelope, and a full set of baseline maps (40) is provided in Appendix E of Rio Tinto (2021b; Appendix C.1). These baseline maps show that surface flows are dominated by well-defined channel flow with narrow floodplains (Figure 6-13). The exception to this is the broad valley in the BS2 assessment area, where overland flow during flooding is evident. These deposits are within an internally draining basin in the upper catchment of the Beasley River. This basin captures local runoff and is subject to broad flooding in the relatively flat valley after large rainfall events (Figure 6-14). This effect occurs only occasionally after flooding. However, no sheetflow dependent vegetation has been identified in this area.

AECOM (2019) completed a geomorphology assessment within the region to understand erosion and sediment transport processes in the Development Envelope. The report found the following processes currently occurring:

- Occasional localised scour of channel banks (exposing tree roots in some locations)
- Infrequent sandbars
- Infrequent in-channel scour and bar formation (mainly in gorge sections)
- Infrequent small delta features at tributary confluences
- Deposition of fines on wash-slopes, floodplains and in-channel pools
- Boulder and cobble lags that show fines have been flushed away.

There are currently low rates of active sediment transport in the Development Envelope (AECOM 2019). Sediment is transferred in pulses in response to flood events along the channel bed as bedload, and localised storage occurs in channel and in floodplain pockets

RioTinto

Figure 6-13
Baseline Flood Mapping of Boolgeeda Creek; 1 in 100 AEP Flood Depths Showing Defined Channels and Narrow Flood Plains

Drawn: L.Fuentes
Plan: PDE0182254v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:122,500 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Assessment Area
- Proposed Conceptual Pit
- Haul Road
- Major Creek

Depth (mAHD)

- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- > 5.0

N

0 1 2 3 4 5
Kilometres

Map units in metres

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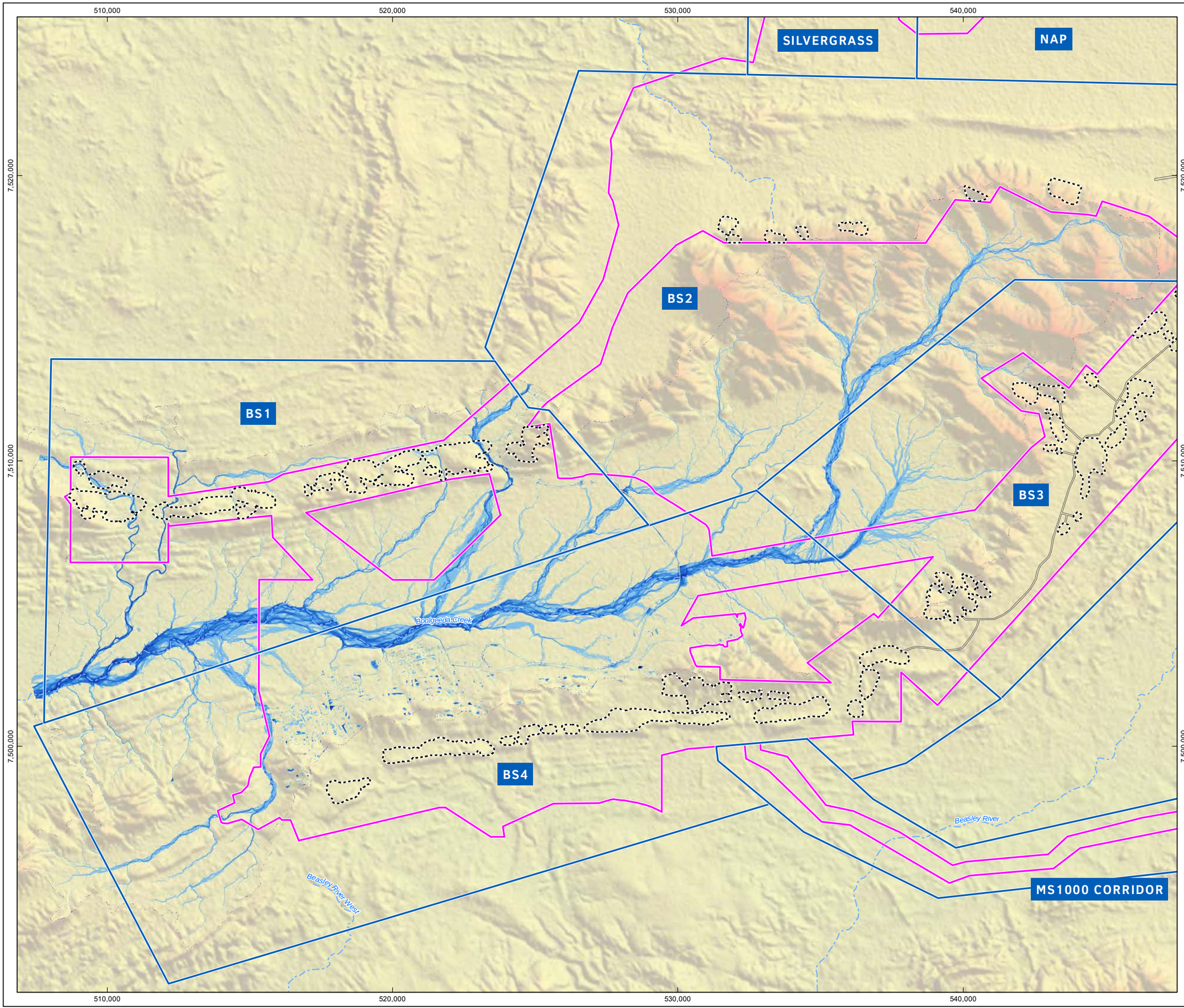

542,500 545,000 547,500 550,000 552,500

7,522,500 7,520,000 7,517,500 7,515,000

BS2

BS3

RioTinto

Figure 6-14
Baseline Flood Mapping of BS2 Assessment Area; 1 in 100 AEP Flood Depth Showing the Broad Internally Draining Basin

Drawn: L.fuentes
Plan: PDE0182255v1
Date: August 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:35,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Assessment Area
- Proposed Conceptual Pit
- Haul Road

Depth (mAHD)

- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- > 5.0

N

0 0.5 1 1.5 2

Kilometres

Map units in metres

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6.3.4.6. Surface Water Dependent Vegetation

Pool ecosystems and riparian vegetation are partially surface water dependent as they rely on occasional surface water runoff and infiltration following rainfall events. Riparian vegetation is discussed in Section 7.3.2.5. No other surface water dependent vegetation types have been identified within the Development Envelope (Stantec 2021).

6.3.5. Aquatic fauna

6.3.5.1. Species Assemblage

The Pilbara provides a range of aquatic habitats from fresh to hypersaline and has high biological diversity. The region is temporally complex as watercourses expand during the wet season and contract during the dry season depending on the magnitude of wet season rainfall and degree of flushing and recharge from year to year (WRM 2019b). The aquatic fauna habitats of Duck Creek and Boolgeeda Creek are described in WRM (2019b).

More than 200 zooplankton species, 80 hyporheic species, and 300 macroinvertebrate species have been recorded from within and adjacent to the Proposal during aquatic ecosystem surveys spanning over 10 years from November 2009 to the present (WRM 2020). This includes four conservation-listed species, eight stygal taxa of conservation interest, and five zooplankton species (rotifers), potentially new to science. A summary of aquatic organisms of international, national and State significance collected from the Development Envelope and the approximate local and regional distribution of these species is provided in Table 6-5.

The IUCN conservation listings for the Pilbara pin damselfly *Eurysticta coolawanyah* and the Pilbara emerald dragonfly *Hemicodulia koomina* have only recently been upgraded from Near Threatened to Vulnerable, because the perceived 'risk of extinction' has increased as a result of continuing habitat loss due to dams, water abstraction and severe weather associated with climate change. Both species have been recorded from numerous ephemeral and semi-permanent pools along Duck Creek and Boolgeeda Creek and are known to occur widely across the Pilbara.

The IUCN listing for the copepod *Eodiaptomus lumholtzi* is based on a 1996 assessment and requires updating. This species is now known to occur in ephemeral and permanent pools at numerous locations across the Pilbara (Table 6-5) as well as the Northern Territory, Queensland and Papua New Guinea (WRM 2020).

The rotifer species potentially new to science belong to known genera with Australia-wide or worldwide distributions. The fact they have only recently been discovered is probably due to the paucity of historical surveys for Australian freshwater zooplankton rather than restricted distributions (WRM 2020).

Table 6-5: Summary of Aquatic Species of Significance and/or Scientific Value

Species	Common Name	Conservation Significance	Occurrence within Survey Area	Regional Distribution
Micro invertebrates				
Ceriodaphnia n. sp.	Cladocera	New species record; undescribed	Duck Creek	Likely a Western Australian endemic species, undescribed (WRM 2019b).
Eodiaptomus lumholtzi	Calanoid copepod	IUCN Vulnerable (VU)	Caves Creek and Duck Creek	Gudai_Darri Spring, Mindy Creek, Coondiner Creek, Kalgan Creek, Weeli Wolli Creek, Cane River, Fortescue River, Northern Territory, Queensland and Papua New Guinea.
Lecane 'bulloid' n. sp.	Rotifer	Undescribed species	Duck Creek, Palm Spring, Homestead Reaches of Caves Creek	Marillana Creek, Weeli Wolli Creek, Plunge Pool.
Proales n. sp.	Rotifer	Potentially new species record; undescribed	Duck Creek	None known but likely occurs elsewhere (WRM 2020).
cf. *Resticula* n. sp.	Rotifer	Potentially new species	Duck Creek	None known but likely occurs elsewhere (WRM 2020)
Hexarthra sp. A n. sp. *Eosphora* nr *najas* n. sp.	Rotifer	New species records from baseline sampling at Duck Creek and Caves Creek	Duck Creek	Unknown regional distribution. First record of species within Australia (WRM 2019a).
Stygal/SRE invertebrates in alluvial aquifers				
Syncarida sp. (including *Bathynellidae* sp.)	Stygal crustacea	Potential SREs (data deficient); immature specimens previously collected	Duck Creek (DCU), Boolgeeda Creek	Known from groundwater environments and hyporheic zones across the Pilbara, species may have restricted distributions
Paramelitidae spp.	Stygal amphipod	Potential SRE (data deficient)	Duck Creek (DCD and DCD)	Known to be restricted to Weeli Wolli Creek, Marillana Creek and the Coondewanna Flats Catchment (i.e., Paramelitidae sp. D and Paramelitidae sp. B; WRM 2019a). Parametlitid amphipods occur widely, but

Species	Common Name	Conservation Significance	Occurrence within Survey Area	Regional Distribution
				individual species may have restricted distributions (WRM 2020).
Chydaekata sp.	Stygal amphipod	Likely SRE (data deficient)	Palm Springs along Caves Creek, both pre and post discharge	Genus known from Marillana Creek, Weeli Wolli Creek, Mindy Creek, Kalgan Creek (distinct lineages in separate catchments (WRM 2020)).
Maarka sp.	Stygal amphipod	Likely SRE (data deficient)	Duck Creek	Recently described genus known only from upper Forescue River catchment (Ethel Creek, Roy Hill, Weeli Wolli Creek, Marillana Creek, Coondewanna, Iron Valley) (WRM 2020).
Nedsia sp.	Stygal amphipod	Likely SRE (data deficient)	Duck Creek	Known from Palm Springs, Beasley River, elsewhere uncertain. Genus known from groundwaters across the Robe River catchment, Bungaroo Creek, Cape Range and Barrow Island catchments
Melitidae sp.	Stygal amphipod	Likely SRE (data deficient)	Duck Creek (DCD), Boolgeeda Creek	Known from the Robe River catchment.
Pygolabis sp.	Stygal isopod	Likely SRE (data deficient; restricted distribution)	Duck Creek, Boolgeeda Creek	Species of *Pygolabis* usually restricted to individual creeklines, for example the Fortescue, Ashburton or Robe River catchments) (WRM 2019a).
cf. *Areacandona* sp. [juvenile]	Ostracoda	Potential SRE species, stygal undescribed ostracod	Duck Creek Tributaries (DCT)	Known from Robe River, Weeli Wolli Creek, and Marillana Creek catchments. The genus *Areacandona* is endemic to the Pilbara region, with many species confined to single localities associated with one or two surface sub-catchments of tributaries flowing into major rivers.

Species	Common Name	Conservation Significance	Occurrence within Survey Area	Regional Distribution
Macroinvertebrates				
Eurysticta coolawanyah	Pilbara pin damselfly	IUCN Vulnerable (VU), Pilbara endemic	Duck Creek (DCU and DCD) and Boolgeeda Creek	Known from multiple locations across the Pilbara (e.g., Coondinder Creek, Kalgan Creek, Weeli Wolli Creek, Fortescue Falls, Millstream, Robe River).
Hemicordulia koomina	Pilbara emerald dragonfly	IUCN Vulnerable, (VU), Pilbara endemic	Duck Creek (DCU and DCD and DCT) and Boolgeeda Creek	Known from multiple locations across the Pilbara (e.g., Coondiner Creek, Kalgan Creek, Weeli Wolli Creek, Fortescue Falls, Robe River).
Fish				
Leiopotherapon aheneus	Fortescue grunter	IUCN Endangered (EN), DBCA Priority 4, Pilbara endemic	Duck Creek and Boolgeeda Creek.	Known from multiple locations across Pilbara; Robe River catchment, Fortescue River (below Fortescue Marsh); Ashburton River.

**Sampling location codes: DCU = Duck Creek Upstream, DCD = Duck Creek Downstream, DCT = Duck Creek Tributaries, HS = Homestead (Caves Creek), Palm Springs*
Source: WRM 2020b and 2020

6.3.5.2. Pools and Wetland Habitat Types

Drainage systems in the Pilbara are generally characterised by intermittent and highly variable flows, similar to other arid zones across Australia (WRM 2019a). Creek and river pools are the dominant wetland habitat type in the Pilbara. Permanent river pools support a high degree of habitat and aquatic species diversity as they provide refugia for resident species (WRM 2019a).

Three major creeklines intersect the Development Envelope, Duck Creek, Boolgeeda Creek and Caves Creek. The access road within the approved Development Envelope (MS 1000) also intersects the Beasley River. None of the Proposal elements are within the Caves Creek catchment, and it is included in the Development Envelope only as part of the Approved Proposal.

The pools within and downstream of the Development Envelope are shown in Figure 6-9 and Figure 6-10 and described in detail in Sections 6.3.4.2 and 6.3.4.3. Permanent 'river' pools are predominantly associated with the lower reaches of Caves Creek and Duck Creek and are outside of the Development Envelope. Ephemeral pools are more common within the creeks and tributaries and therefore this type of aquatic habitat occurs within the Development Envelope. Historic sampling of river pool habitats along Duck and Boolgeeda Creeks has enabled the characterisation of associated wetland habitat types and the overall ecological value of these creeks within the Development Envelope (WRM 2019a).

Duck Creek

The micro and macroinvertebrate assemblages vary between the upstream and downstream pools in Duck Creek; likely driven by differences in water quality, habitat complexity and fish predation over time. The ephemeral pools in Duck Creek support a similar diversity of aquatic fauna to the semi-permanent and permanent pools in Duck Creek, Caves Creek, Beasley River and the upper Ashburton River. Most taxa of conservation and/or scientific interest in Duck Creek occur in both the ephemeral and semi-permanent/permanent pools. The more permanent pools support refugia for a greater diversity of fauna during dry periods, which can colonise the ephemeral waterbodies following inundation events. Three fish species were recorded in ephemeral pools in Duck Creek and seven within the semi-permanent pool in Duck Creek (WRM 2020). This diversity is consistent with other ephemeral and semi-permanent pools in Boolgeeda Creek, Caves Creek and Beasley River.

Boolgeeda Creek

When inundated, Boolgeeda Creek ephemeral pools support a relatively high diversity of aquatic invertebrate species (WRM 2020). Most of these species are widespread throughout the Pilbara. Fewer taxa of conservation and/or scientific interest are known from surface waters and hyporheic zones of Boolgeeda Creek, compared to Duck Creek, likely because of the shorter hydroperiod of Boolgeeda Creek.

6.3.6. Geochemistry

The Proponent has undertaken an extensive program of geochemical testing over many years to understand the potential AMD to occur as a result of exposing rock types common to Pilbara mining operations (Rio Tinto 2021f). A risk-based process is used to identify those rock types which require specific management.

The most significant geochemical risk related to Rio Tinto iron ore deposits is associated with sulfides, such as pyrite (FeS_2), which can form sulfuric acid when exposed to oxygen and water. The geological unit most commonly associated with pyrite and AMD in the Pilbara is the Mount McRae Shale.

A geochemical assessment was undertaken by RGS (2021) for the Proposal and is included as an appendix of the AMD risk assessment (Rio Tinto 2021f, Appendix C.8). A selection of 390 samples were analysed for several parameters, including paste pH and EC, net acid production potential, net acid

generating tests, multi-element chemical assay, sulfur and carbon speciation, acid buffering characteristic curve, x ray diffraction, sulfur speciation, nitrogen analysis and leachate analysis.

The total sulfur content of the samples was <0.01% S to 1.8% S, with an average value of 0.04 % S. Of the 390 samples, 366 had low total sulfur concentrations comparable to the average crustal abundance for sulfur of 0.1 %. Materials with a sulfur content less than or equal to 0.1% S are essentially barren of sulfur and have negligible capacity to generate acidity.

The majority of samples collected from the Proposal deposits are broadly NAF with only a small portion (<4%) classified as PAF. PAF was identified in the Tertiary detritals, Mount McRae Shale and Wittenoom Formation and those samples typically containing lignite (these occur within Tertiary detritals, however, have not been identified within the Development Envelope) and pyrite. The overall risk of AMD from across the Greater Brockman area is typically classified as low (Rio Tinto 2021f).

6.3.6.1. Total Sulfur Content and Chemical Analyses

Geochemical data has been examined to identify enriched concentrations of elements that may pose an environmental risk. For the Proposal, approximately 222,830 drill hole samples from across the Proposal deposits have been analysed for a range of potential contaminants, including Al, Ca, Fe, Mg, Mn, P, S, Si and Ti, as well as, Ba, Cl, Co, Cr, Cu, Pb, Ni, K, Na, Sn, Sr, V, Zn and Zr. In addition, Ag, B, Be, Cd, F, Hg, Mo, Sb, Se, Th and U were analysed for their elemental abundance in solids.

The results indicate that there are elevated levels of Fe, As, S, Mn, Sn, CaO, MgO, Co, Cl, Cr, Cu, Ni, Pb, V, Zn in the samples, compared to average crustal abundance. Given the iron-rich mineralised nature of the Pilbara, elevated concentrations of metals are not unexpected, and it is considered likely that surrounding receptors have adapted to the naturally elevated concentrations (Rio Tinto 2021f).

Table 6-6 presents the distribution of samples for the Proposal and any elevated sulfur values for waste samples in-pit. Overall, there is a low number of waste samples (approximately 2%) with elevated sulfur levels (>0.1% sulfur). The lower sulfur levels in samples are consistent with the low sulfur acid-based accounting results, supporting the conclusion that most of the material sampled is likely to be NAF. Even for those deposits with the highest levels of sulfur, less than 1% of samples have greater than 0.3% sulfur (Table 6-6).

6.3.6.2. Waste Fines Characteristics

The waste fines currently produced by the Nammuldi wet-processing plant are typically a silt with clay and trace sand and are typically described as fine tailings (KCB 2021). The waste fines resulting from the Proposal are likely to be NAF with elevated concentrations of As, Fe, Mn and Sn. However, these elements are not expected to be leachable, given the overall neutral pH of the waste fines material (KCB 2021).

There are no specific regulatory criteria for metal/metalloid concentrations in leachate from waste materials on mine sites in Western Australia. As such, the multi-element results in water extracts from 145 drill hole samples from the existing operations were compared with Australian guidelines for livestock drinking water and aquatic freshwater ecosystems (KCB 2021). These guidelines were used for context only and are not “maximum permissible levels”. The concentration of trace metals/metalloids tested in the water extracts were generally below the laboratory limits of reporting. There were only a few samples that showed leached metal/metalloid concentrations above the applied livestock drinking water guidelines; this included Se, B and As from the Mount McRae Shale; and Se from detritals and Wittenoom Formation (KCB 2021).

Table 6-6: Summary of Sulfur Statistics and Geochemical Abundance Index (GAI) for In-pit Proposal Deposit Waste Samples

Assessment Area (deposits included in analysis)	Total samples assayed for sulfur	Total waste samples assayed for sulfur	Total waste samples with sulfur >0.1%	Percentage of waste samples with sulfur >0.1%	Total waste samples with sulfur > 0.3%	Percentage of waste samples with sulfur >0.3%	Enriched elements (GAI >=3)
BS1 (BS1 West and BS1 East)	34,156	9,352	247	2.6%	67	0.7%	Fe, As, S, Mn
BS2* (BS2 West and BS2 East)	116,575	65,485	1,490	2.3%	371	0.6%	Fe, As
BS3 (BS3, MM-M, MM-N, Endeavour)	20,467	7,268	251	3.5%	49	0.7%	Fe, As, Sn, Mn
Lens G and Diesel (Lens G, Diesel, Sandleford, Monkey, Creekside, Lauriston, Brokenwood, MM-J	13,465	8,700	77	0.9%	16	0.2%	Fe, As, Sn, Mn
BS4 (MM-O, MM-R, MM-Q)	38,167	22,793	444	2.0%	161	0.7%	Fe, As, Mn
Total	**222,830**	**113,598**	**2,283**	**2.0%**	**664**	**0.6%**	**-**

**Pit shells for the BS2 project area were not yet determined at time of assessment. Therefore, analysis for this site is based on samples taken from the entire project area for BS2 until an assessment of final pit shells can be undertaken.*

6.3.7. Current Water Management

The Brockman Syncline has an altered hydrological system due to the existing operations at BS2/Nammuldi and BS4.

The current water management regime operates in two water management areas: with Silvergrass water management infrastructure connected to BS2/Nammuldi; and a separate system for BS4 (Figure 2-6).

BS2 Hub servicing BS2/Nammuldi and Silvergrass approved mines: Water surplus to operational needs is currently utilised by the NAP in the first instance. The NAP is an irrigated agricultural project which supports growing of hay for Hamersley Station pastoral activities via a series of rotating spray pivots, with 19 of 41 approved pivots (circular irrigation areas) currently installed and operational. If the NAP scheme cannot utilise all the surplus water available on any given day, the excess water is discharged to Duck Creek. Approval to periodically discharge surplus water to Duck Creek is included in MS 925.

The ERD associated with MS 925 previously considered surplus water discharge impacts resulting from up to 200 ML/day with a modelled wetting footprint extending 157 km along Duck Creek from the point of discharge. The EPA decision report for this approval (Report 1457, November 2012) considered that discharges in excess of 20 ML/day are unlikely and a steady state discharge of this rate would travel over 80 km down the creek.

Approval to discharge surplus water to Duck Creek is predicated on meeting water quality criteria as defined by MS 925 Condition 7-3 which links back to ANZG water quality guidelines. Duck Creek discharge rates from 2018 to 2020 are shown in Figure 6-16.

Using 2019 as an example; the peak monthly water use for irrigation of the NAP in that year was approximately 46 ML/d over a month; with a daily peak of approximately 58 ML/d and an annual average of 35 ML/d (~13 GL/a). The NAP (19 pivots irrigating 902 ha of the approved 40 pivots under MS 925) has a maximum capacity of 50-90 ML/d (Rio Tinto 2022d). The variation in capacity is due to variation in the seasonal water demand of irrigated crops. The discharge to Duck Creek over the same period in 2019 peaked at 34 ML/d, with an average of 14 ML/d (~5 GL/a). Periods of no discharge were also recorded (Figure 6-16).

Saturated waste fines from the Nammuldi wet plant are currently disposed to the existing Nammuldi WFSF, and water released from the deposited slurry that ponds on the surface are returned to the plant via a decant pumping system. The existing WFSF is expected to reach capacity in 2027.

Mining at Silvergrass involves dewatering from the Caves Creek hydrogeological zone, a narrow aquifer limited to the Caves Creek valley. Dewatering at Silvergrass will require management to ensure the long-term maintenance of groundwater dependent ecosystems and cultural heritage values downstream in Caves Creek and at Palms Spring. Operational and closure based MAR schemes are planned to be implemented, subject to receiving all relevant approvals and in consultation with Traditional Owners. This MAR scheme does not form part of this Proposal under assessment.

BS4 Hub: Surplus water is discharged to Boolgeeda Creek and remains within the authorised maximum wetting front of 37 km from the discharge point during natural no-flow conditions (as defined by MS 1000). The current Part V licence for discharge limits this to 6.4 GL/a or 17.5 ML/d. Actual discharge rates from 2016 to 2019 are shown in Figure 6-17, and the observed wetting front is approximately 5.5 km downstream of the discharge point (Rio Tinto 2022d).

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Figure 6-15
Current Water Management Infrastructure Schematic

Drawn: L.Fuentes
Plan: PDE0182265v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:210,000 @A3
GIS.Team@riotinto.com

500,000 520,000 540,000 560,000

7,540,000
7,520,000
7,500,000

Riparian Vegetation

Mallu Mallu Springs

DUCK CREEK

CAVES CREEK

SGE

NAMMULDI AGRICULTURAL PROJECT

DUCK CREEK DISCHARGE

BS2 **NAM**

B2N HUB

BROKMAN SYNCLINE AQUIFER

BOOLGEEDA CREEK DISCHARGE

BOOLGEEDA CREEK

37 km discharge extent limit

BS4 **BS4**

BS4 HUB

Plunge Pool

Legend

- ORE PROCESSING PLANT
- AQUIFER OUTLINE
- BWT DEPOSIT
- AWT DEPOSIT

N

0 2 4 6 8 10
Kilometres

Map units in metres

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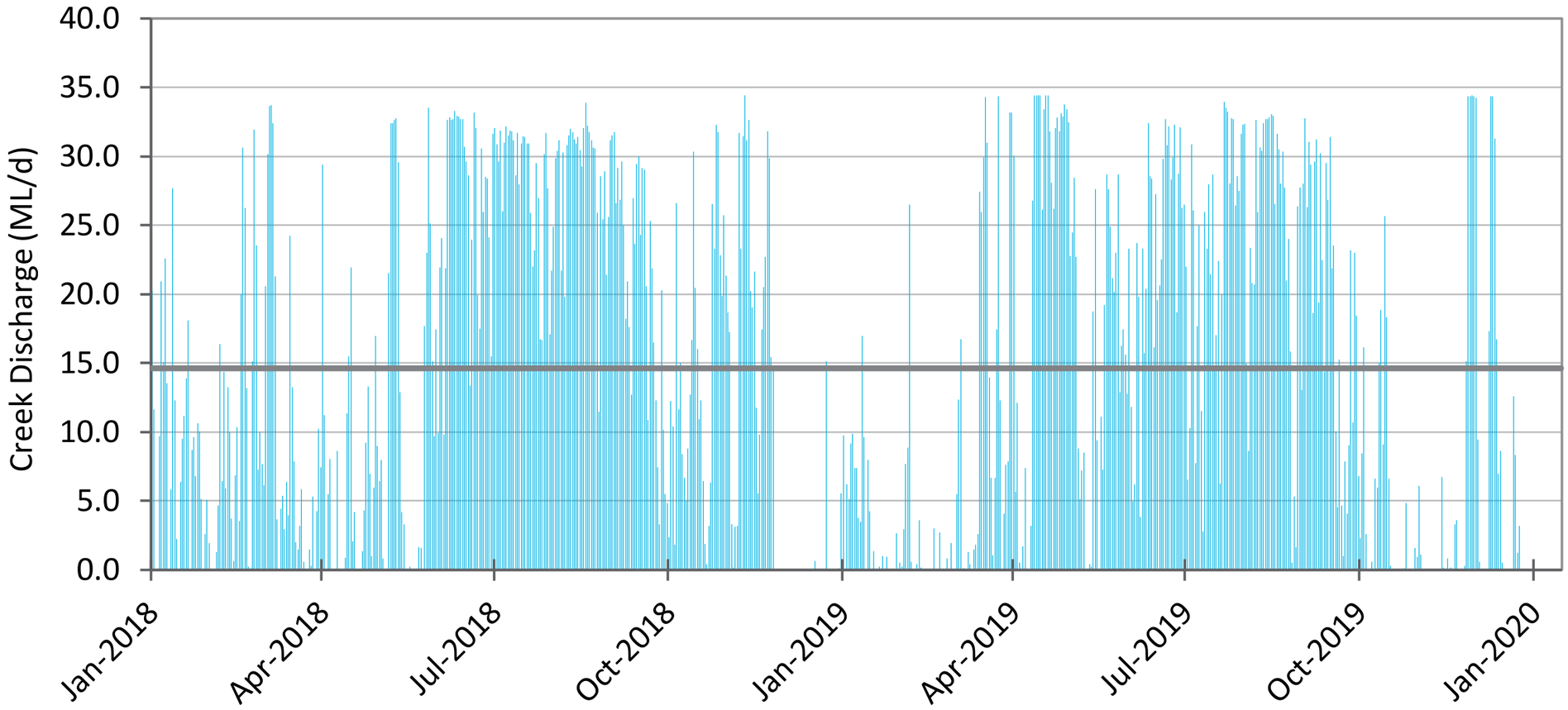

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Figure 6-16
Metered Discharge from BS2 Hub to Duck Creek (January 2018 to January 2020)

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Plan: PDE0182263v1
Date: May 2022

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Legend

Daily Discharge

Average Discharge

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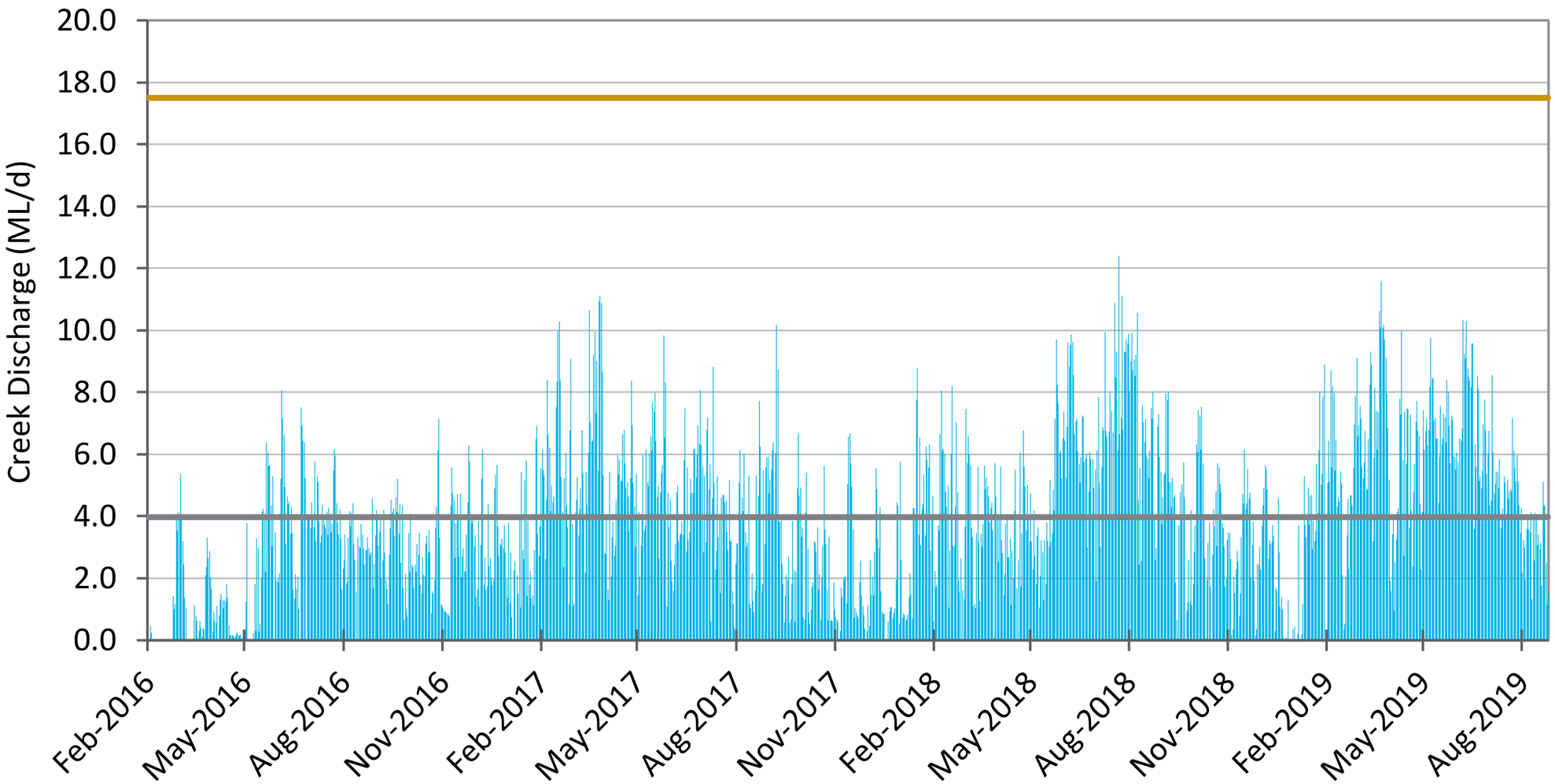

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Figure 6-17
Metered Discharge from BS4 Hub to Boolgeeda Creek (February 2016 to August 2019)

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Plan: PDE0182264v1
Date: July 2022

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Legend

- Daily Discharge
- Average Discharge
- Creek Discharge Limit

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6.3.8. Proposed 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.

The Proposal includes BWT mining which requires dewatering of mine pits to safely access ore (Figure 2-3). Based on the modelled site water balance (EMM 2021; Appendix C.5), predicted dewatering volumes will initially exceed the predicted operational water demand, however as mining progresses into later years of the LOM, water demand is modelled to exceed dewatering volumes; this potential deficit can be met by the integration of ground water management with the existing operations.

Water management is currently managed in two hubs: BS2 Hub and the BS4 hub (Section 6.3.7). These existing water management hubs are relevant to the Proposal, and the proposed linking of the hubs into a fully integrated system forms part of this Proposal. This would allow flexibility for surplus water to be transferred between the two hubs, if required.

Hub level water balances have been estimated based on the summation of deposit level water balances (pit dewatering and operational demand) with consideration of hub level water demands and surplus management options. The hub water balances include the Proposal and all existing Brockman operations as water management will be fully integrated. The estimated water surplus for the BS2 Hub is included in Figure 6-18 and BS4 hub in Figure 6-19. Surplus water volumes are modelled to remain within the NAP (as approved under MS 925) usage capacity (BS2 Hub) and within the approved discharge limits to Boolgeeda Creek (BS4 Hub), therefore, no additional or new discharge options will be required for the Proposal.

The site water balance estimates indicate that both hubs transition to water deficit sites after the mid to late 2030's as BWT pits are completed. This water deficit is proposed to be addressed through accessing surplus water that will be stored within disused mine pits/aquifers.

6.3.8.1. Dewatering Rates

The maximum dewatering rates for each pit (existing and proposed) and for the two water management hubs has been estimated (Rio Tinto 2022c) in order to determine total dewatering volumes per annum:

- BS2 Hub: 23 GL/a in 2029 (excluding 12 GL/a required for Silvergrass)
- BS4 Hub: 13 GL/a in 2029.

These dewatering volumes are within the current licence limits held by the Proponent (55 GL/a for BS2/Nammuldi and Silvergrass under Groundwater Licence (GWL) 107421 and 13 GL/a for BS4 under GWL164398) and no increase in groundwater abstraction volumes per annum is proposed (Rio Tinto 2022c.

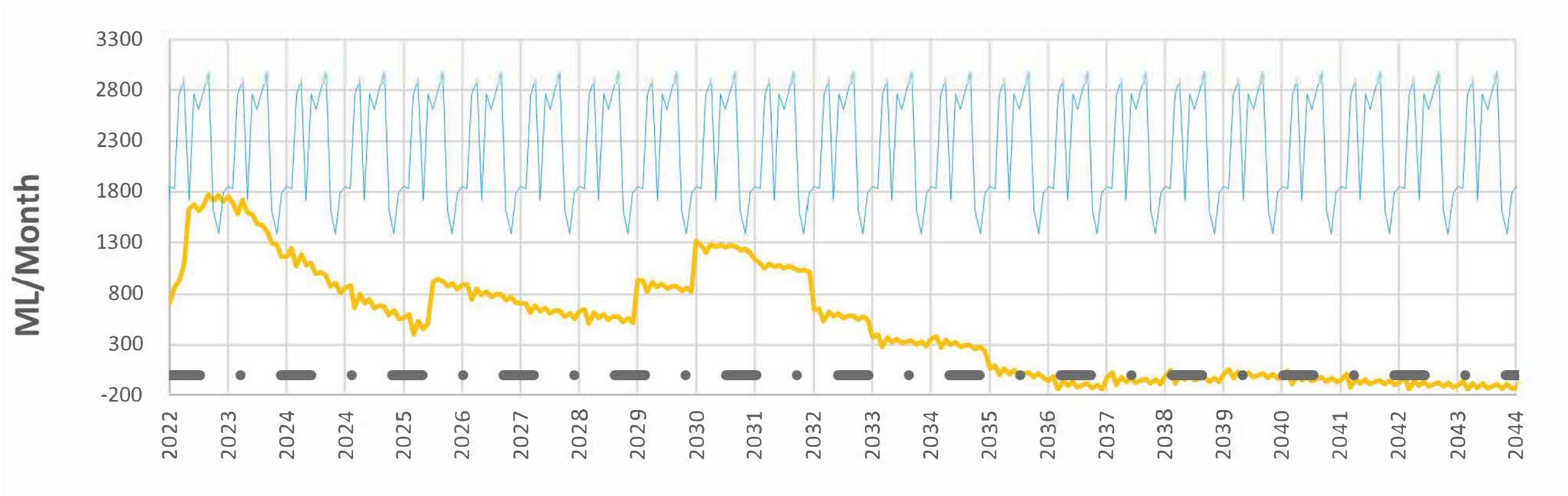

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Figure 6-18
Surplus Water Volumes from Approved and Proposed Pits in the BS2 Hub Illustrating that the Volume of Surplaus is with the Capacity of NAP

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LEGEND

- Surplus to B2N Hub (2021 Lom)
- NAP Capacity (902Ha)

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Figure 6-19
Surplus Water Volumes from all Approved and Proposed Pits in the BS4 Hub illustrating that the Volume of Surplus is within the Current 17.5ML/d Boolgeeda Discharge Licence Limit

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Legend

- Boolgeeda Discharge License Limit
- BS4, BSM - M, BSM - N & BS1 (crusher & dust suppression) Combined Water Balance
- BS4, BSM - M, BSM - N & BS1 (haul & dust suppression) Combined Water Balance

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6.3.8.2. Water Management Strategy and Infrastructure

The water management strategy and surplus use hierarchy is described in Section 2.1.3.8. Following meeting environmental mitigation obligations and operational water use, storage of surplus water in disused pits is the preferred surplus water management strategy as it will minimise discharge to the broader environment and minimise the overall loss of water from the Development Envelope.

Rio Tinto has an aspirational target of zero creek discharge from iron ore dewatering activities by 2032 as part of its commitment to environmental water stewardship and this Proposal is being developed consistent with that target. By 2030, sufficient mine void or aquifer storage capacity is expected to be available to ensure there is no need for creek discharge unless some initial season discharge is required to support ecosystem adjustment back to a natural ephemeral state. It is noted that discharge of surplus water to the environment is subject to the DWER Water in Mining guideline (DoW 2013), licence requirements, and ministerial conditions of approval. Discharge to the environment is not permitted where there is a likelihood that it will cause impacts on other land users (including inundation of land) or significant 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). The Proponent's proposed approach is consistent with these guidelines.

Figure 6-20 presents a conceptual decision tree to illustrate how the surplus water management hierarchy will be applied operationally. The overarching intent of the water management approach is to protect cultural heritage and environmental values and minimise closure obligations whilst being practical and supporting the needs of the existing and proposed mining operations and supporting any environmental water requirements.

It is acknowledged that the mining sequence may change as orebody knowledge and market conditions evolve. Therefore, the surplus water management approach requires flexibility to allow variability in the mine plan. Decisions will be guided by the water use hierarchy and decision tree as well as meeting all approval limits.

Groundwater Management Flow Chart

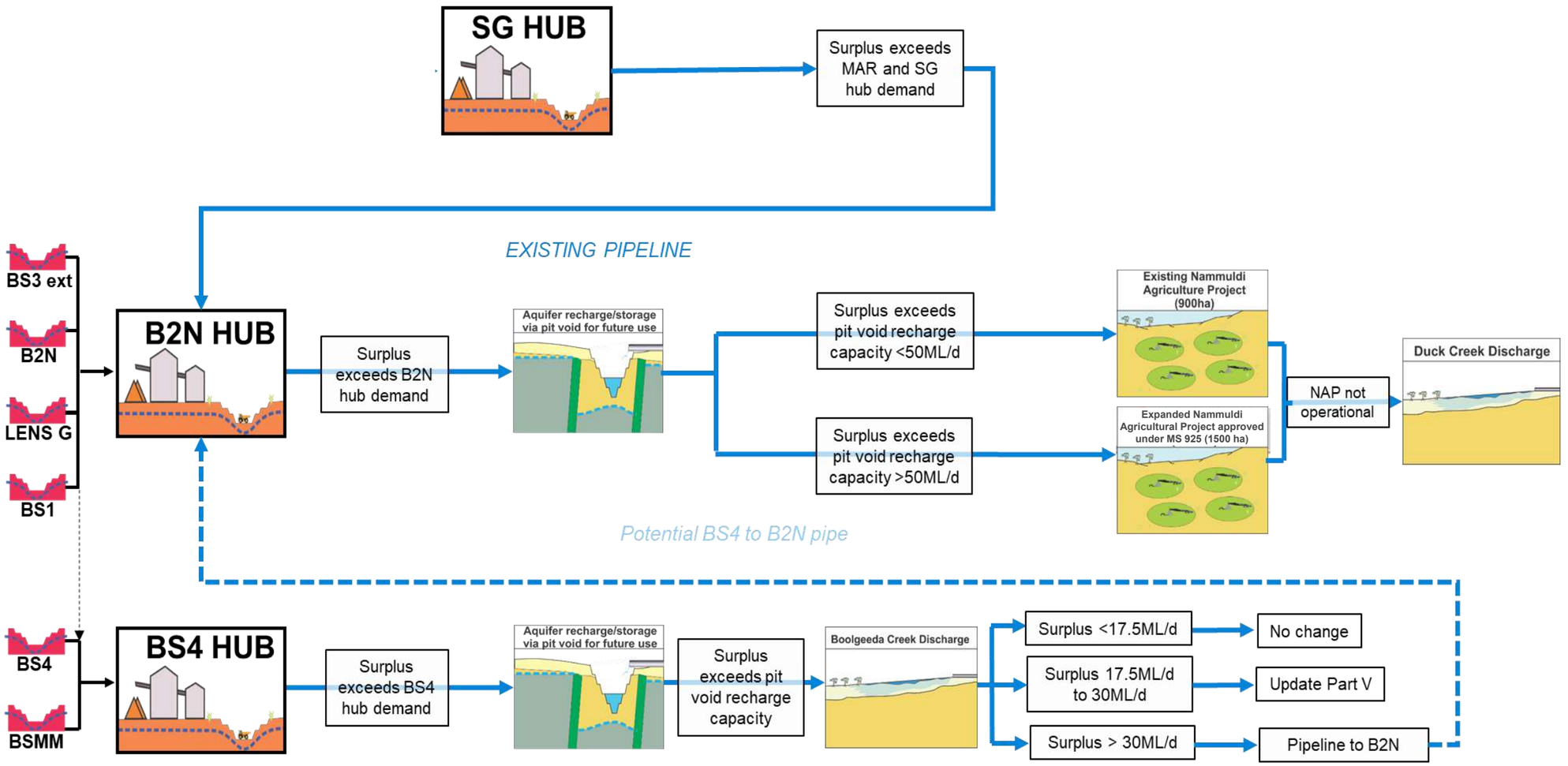

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Figure 6-20
Groundwater Management Flow Chart

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Illustrating how the Surplus Management Hierarchy can be Followed Operationally with Key Decision Points

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Caves Creek Managed Aquifer Recharge

A MAR scheme, comprising the intentional recharge of an aquifer under controlled conditions, either by active injection or passive infiltration of water, will be established and operated for the Caves Creek shallow aquifer, subject to receiving all relevant approvals and in consultation with Traditional Owners. A MAR trial is underway and will determine the feasibility and scale of an operational MAR scheme which is anticipated to be operational in late 2023 and is proposed to be operated at recharge rates of up to 18 ML/d. Any additional MAR requirements at closure will be addressed in the MCP. The scheme will be supplied with surplus water from the BS2 Hub, including water stored in disused pits. This MAR scheme does not form part of the Proposal under assessment.

6.3.8.3. Operational Use

The major water demand for the existing operation and for the Proposal is associated with the operation of the Nammuldi wet processing plant (approximately 6 GL/a), the BS4 plant (approximately 2 GL/a), and the Silvergrass primary crusher (approximately 2 GL/a). Water use for dust suppression across the current operational areas varies from 0.5 to 2.9 GL/a, with smaller volumes utilised for administration and camp use. Operational water demands, including for dust suppression, are likely to remain relatively consistent throughout the project life as the production profile is stable.

6.3.8.4. Preferential Storage within Disused Mine Pits

The storage of surplus water in disused pits and/or dewatered formations provides an opportunity to:

- Allow for storage of water for future beneficial use.
- Accelerate groundwater recovery post-dewatering.

This strategy increases passive recharge of the aquifers and reduces the total water deficit from the Development Envelope. Therefore, in accordance with the water use hierarchy, surplus water will be preferentially stored in suitable disused mine pits.

In addition to mine planning and engineering constraints, the following hydrogeological and environmental criteria will be assessed to determine the suitability of disused mine pits to be used for water storage:

- Groundwater quality modelling and assessment undertaken to ensure pit is suitable for water storage, including PAF considerations/risks
- There will be no significant change to the quality of the receiving groundwater system, i.e., water transfer will only occur between aquifers with comparable water quality
- Pit storage will not cause groundwater mounding in areas with a shallow watertable
- Pit storage will not result in water seeping out of pit walls on down-gradient slopes
- Infrastructure required to support pit storage (i.e., pipelines) are within approved clearing limits and minimise clearing of vegetation with elevated significance
- Minimal potential for storage to increase dewatering requirements of other pits (i.e., recirculation)
- Geotechnical assessment undertaken to assure pit is suitable for water storage and not scheduled for progressive backfill during operations
- Pit storage will not result in overtopping of the mine pit
- Pit storage will take into consideration public access and safety risks.

The Brockman Syncline provides an ideal setting for the storage of surplus groundwater, owing to natural compartmentalisation of the aquifer due to dolerite dykes acting as hydraulic barriers. These low permeability barriers create discrete “buckets”. Discharge can occur to either disused pits or partially backfilled pits (Figure 6-21).

An assessment of pit void availability and storage volume has been undertaken by calculating the total void volume as 5 m below a spill point to allow for risk of flood events. The predicted available storage over the LoM has been compared to the expected surplus water volumes within each hub and indicates that cumulative storage capacity will exceed surplus water volumes by around 2030 (Figure 6-22).

6.3.8.5. Discharge to Boolgeeda Creek

Surplus water discharge to Boolgeeda Creek will be required to be continued in the interim until adequate pit storage becomes available. The current LoM predicts an operational surplus at BS4 hub of 16 ML/d. This does not exceed the current Part V discharge limit (17.5 ML/d) or the approved 37 km wetting front under MS 1000, however if mine plans change, updated creek modelling suggests the creek could accept up to 30 ML/d without exceeding the current MS 1000 wetting front limit of 37 km. If an increase was required, an application to increase the licence limit would be sought.

Based on the current LoM plan, discharge to Boolgeeda Creek is only likely to be required until approximately 2030, which is consistent with the Rio Tinto target of achieving no discharge to creeks by 2032.

6.3.8.6. Discharge to the NAP and Duck Creek

The Proponent will continue to utilise surplus water for irrigation of the NAP as per MS 925. The NAP has capacity (50-90 ML/d depending on season) to utilise the full volume of predicted surplus water from the BS2 Hub. Discharge to Duck Creek will still occur during the following scenarios:

- When evaporation rates are low in winter months or due to rainfall, discharge will be required in some months of some years
- A “temporary diversion” of water if a rise in the groundwater table under the NAP is recorded
- Short term release of water in response to rainfall events, maintenance or emergencies with the pipelines or NAP infrastructure.

No material change to the existing approved discharge is proposed. However, to modernise the approval and align with the approach to Boolgeeda Creek discharge in MS 1000, Rio Tinto proposes a new condition to limit the surplus water discharge extent to no further than 67 km along Duck Creek from the discharge point.

Based on the current LoM plan, discharge to Duck Creek is only likely to be required until around 2030, which is consistent with the Rio Tinto target of achieving no discharge to creeks by 2032.

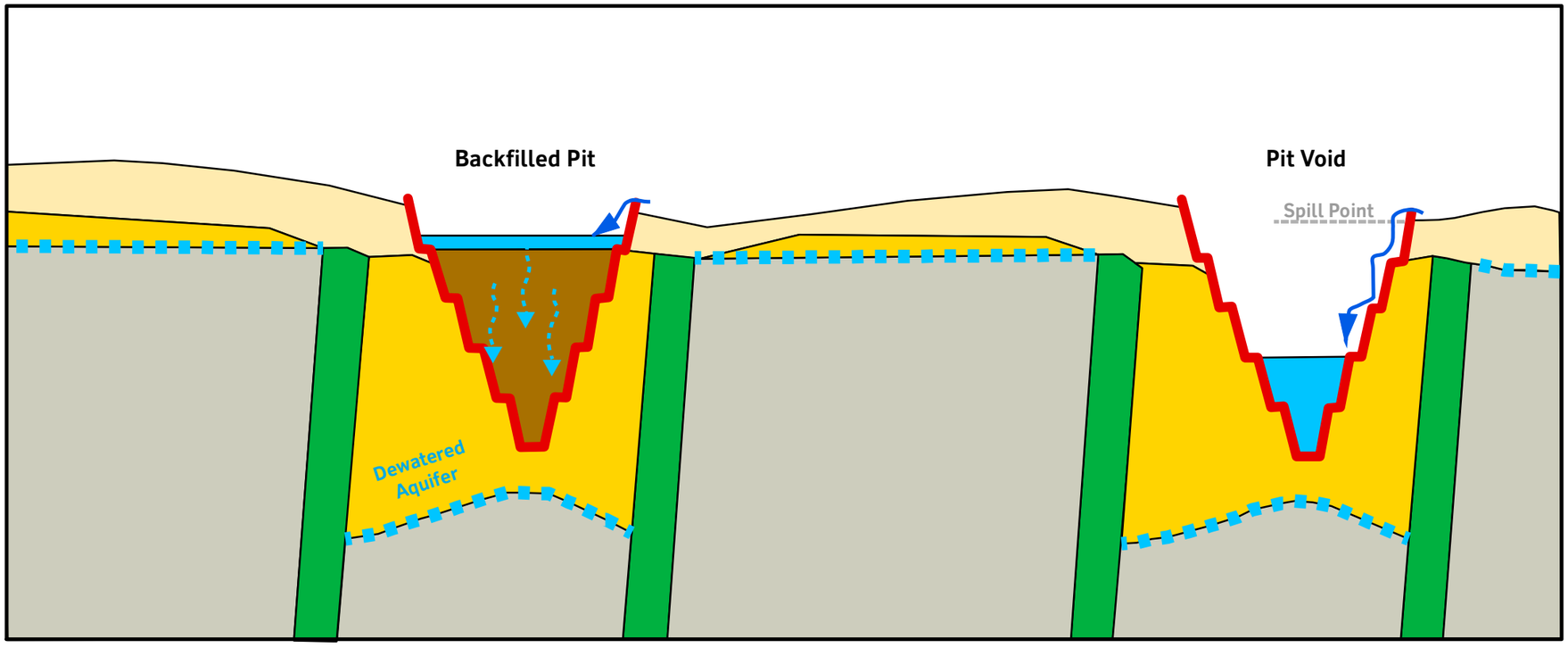

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Figure 6-21
Comparison of Landform Options for Storing Groundwater in Disused Mine Pits

Drawn: L.Fuentes
Plan: PDE0182271v1
Date: June 2022

GIS.Team@riotinto.com

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Figure 6-22
Anticipated Timing and Volume of Disused Pits Becoming Available for Water Storage

Drawn: A.Coulson
Plan: PDE0182272v1
Date: May 2022
GIS.Team@riotinto.com

Cumulative pit void storage

Suitable pit void storage

Cumulative Surplus: BS4 (includes BSM - NI, N2 & M2) + BSI Crush & Convey Water Balance

Cumulative Surplus: BS4 (includes BSM - NI, N2, M2) + BSI Haul Water Balance

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6.3.8.7. Waste Fines Storage Facilities

The existing WFSF at Nammuldi is expected to reach capacity in 2027. Additional in-pit WFSF's are proposed to be developed in the Lens A, Pit 5 and Pit 8 (Figure 2-4). These pits are part of the approved operations at BS2-Nammuldi and are due for mining completion by 2026 (Table 6-7 and Figure 2-4). The conversion of these existing pits to in-pit WFSF forms part of this Proposal. No additional proposed pits are anticipated to be required for additional waste fines as part of this proposal.

Table 6-7: Key Characteristics of Pits Proposed to be Converted to WFSF

Pit ID	Mining schedule		Footprint area	Pit rim elevation		Pit floor elevation	Void volume
	Start (year)	Finish (year)	ha	Maximum mRL	Minimum mRL	mRL	Mm^3
Lens A	2019	2026	91.3	606	582	465	57.9
Pit 8	2014	2028	57.4	655	619	460	28.5
Pit 5	<1997	<2002	13.4	631	623	584	2.3

Lens A and Pit 8 void volumes will provide sufficient capacity for the estimated LOM waste fines storage requirement (calculated total of ~84 Mt waste fines) without risk of overtopping during flooding. If required, additional capacity will be provided by constructing perimeter dams at pit-rim low-spots and/or using Pit 5 void as a contingency. Pit 5 provides limited additional capacity but provides flexibility given it is an already disused pit. The probability of the pits overflowing is assessed to be low for Lens A and very low for Pit 8 (KCB 2021). At closure, all in pit facilities will be capped with 2 m material, in addition Lens A will be backfilled with tailings and capped to surface so that pre-mining drainage flows can be reinstated. This backfill strategy will avoid the need for a significant permanent diversion.

There are no existing or proposed WFSFs in the BS4 assessment area or within the approved Silvergrass mine.

6.3.9. Summary of Key Inland Waters Values

The key environmental values associated with Inland Waters include:

- Plunge Pool – a permanent pool with:
- Cultural significance for Muntulgura Guruma
- High value to fauna
- GDE's associated with Plunge Pool
- Boolgeeda and Duck Creeks, including riparian vegetation
- Kurwillinha and Ridge Pools – ephemeral pools with:
- Cultural significance to Muntulgura Guruma
- Moderate value to fauna
- Aquifers supporting stygofauna
- Aquifers supporting groundwater dependent vegetation
- Culturally important mulga communities in the BS2 assessment area.

6.4. Potential Environmental Impacts

6.4.1. Direct Impacts

Implementation of the Proposal has the potential to result in the following direct impacts on Inland Waters:

- Lowering of groundwater levels as a result of mine pit dewatering and closure (Note potential impacts to GDV and stygofauna are addressed in Section 7.4.2.2 and Section 9.4.1.1)
- Groundwater mounding from surplus water storage in disused mine pits
- Changes to surface hydrological regimes of Boolgeeda Creek and Duck Creek from the continued discharge of surplus water
- Changes to surface water catchments, flow paths, flooding and sheet flows from mine pits and infrastructure placement.

6.4.1.1. Lowering of Groundwater Levels as a Result of Mine Pit Dewatering and Closure

A numerical groundwater model was developed to quantify the groundwater drawdown within the Brockman Syncline based on the combined dewatering required for approved and proposed BWT mining as described in Section 6.3.3.1. Details of the Brockman groundwater model is provided in RPS (2021a) included in Appendix C.4.

As mining progresses, the dewatering of open cut pits to access BWT ore will result in a cone of depression within the aquifer and cause groundwater to flow towards the pits. In the long term (post mining), mine pits that extend below the watertable and are not backfilled will continue to act as groundwater sinks due to evaporation, resulting in continued propagation of the drawdown away from the pits. The lateral extent of groundwater drawdown from mine pit dewatering is naturally restricted from extending around the entire syncline as a result of dolerite dykes forming barriers to groundwater flow.

Modelled drawdown due to groundwater abstraction from all approved and proposed components of the Amended Proposal at the end of mining is shown in Figure 6-23. Drawdown depths are greatest in the BS2 assessment area, and the effect of dolerite dykes limiting the propagation of groundwater drawdown around the syncline can be clearly seen. It is noted that Figure 6-23 does not represent a specific date but illustrates an amalgamation of the modelled maximum drawdowns across the affected aquifers, regardless of the date of the maximum drawdown during mining.

The post closure drawdown of the Amended Proposal is shown in Figure 6-24. As recharge rates are low, groundwater recovery is slow and long-term drawdowns are predicted to stabilise after several hundred years. Long term drawdowns of up to 80 m are expected to remain due to the continued effect of evaporation from pit lakes, for two approved pits (Lens CD and EF) and five proposed pits (MM-O1, MM-M2, MM-N1, MM-N2 and Lens G) as shown in Figure 6-25.

Potential for Drawdown to Affect Other Users

Drawdown from the FMG Eliwana Mine and Rio Tinto operations can overlap at the BS1 assessment area due to their proximity to one another, which may affect the pit inflow and/or bore abstraction rates at both operations, depending on abstraction rates and timing. Any impact on FMG water supply will be addressed through commercial discussions between the two parties. Groundwater abstraction by both parties will be managed in accordance with groundwater licence conditions, administered by DWER.

No other third-party bores exist within the Brockman Syncline aquifers. As groundwater drawdown is constrained within the syncline, there will be no impact on other users, such as Pastoral Stations, beyond the syncline.

Potential for Drawdown to Affect Groundwater Dependent Vegetation

The potential impacts of groundwater drawdown on terrestrial environmental values are limited to shallow watertables where groundwater-dependent vegetation may occur. The depth to groundwater in the Brockman Syncline is generally well beyond the rooting depth of vegetation (>20 mbgl). Therefore, there are limited areas of terrestrial GDEs potentially affected by groundwater drawdown. The potential impacts on GDV are assessed in Section 7.4.2.2. The potential for drawdown in subterranean fauna habitats is assessed in Section 9.4.

Potential for Drawdown to Affect Plunge Pool

The conceptual hydrogeological model that has been developed for the Proposal shows that dewatering of deposits to the west (MM-M and MM-N) of Plunge Pool will not have any impact on groundwater level within the Plunge Pool aquifer as this aquifer is compartmentalised due to the presence of cross-cutting dolerite dykes, which prevents drawdown propagation across these hydraulic barriers. Similarly, the hydrogeological model predicts that dewatering of the BS3 Extension deposits (Creekside and MM-J), although being upgradient of the pool, are in separate aquifer compartments and of sufficient distance from the pool such that the reduction in overflow into the down gradient compartments is not expected to result in an impact to groundwater levels at the pool (Rio Tinto 2022b). However, as a precautionary measure, the BS3 Extension pits will be backfilled at closure so that groundwater recovery can occur in these upstream aquifer compartments, mitigating the potential for any long-term impact (Section 6.5.2).

6.4.1.2. Groundwater Mounding from Surplus Water Storage in Disused Mine Pits

Surplus water storage in disused mine pits is the preferred surplus water management strategy as outlined in Section 6.3.8.4. Surplus water storage in mine pits may increase the recovery of groundwater levels and contribute towards localised mitigation of the effect of groundwater drawdown, however, has the potential to result in groundwater mounding. Groundwater mounding in areas of naturally shallow watertables (i.e., <20 m bgl) may potentially affect vegetation in these areas from waterlogging of root zones. Further detail is provided in Section 7.4.2.2.

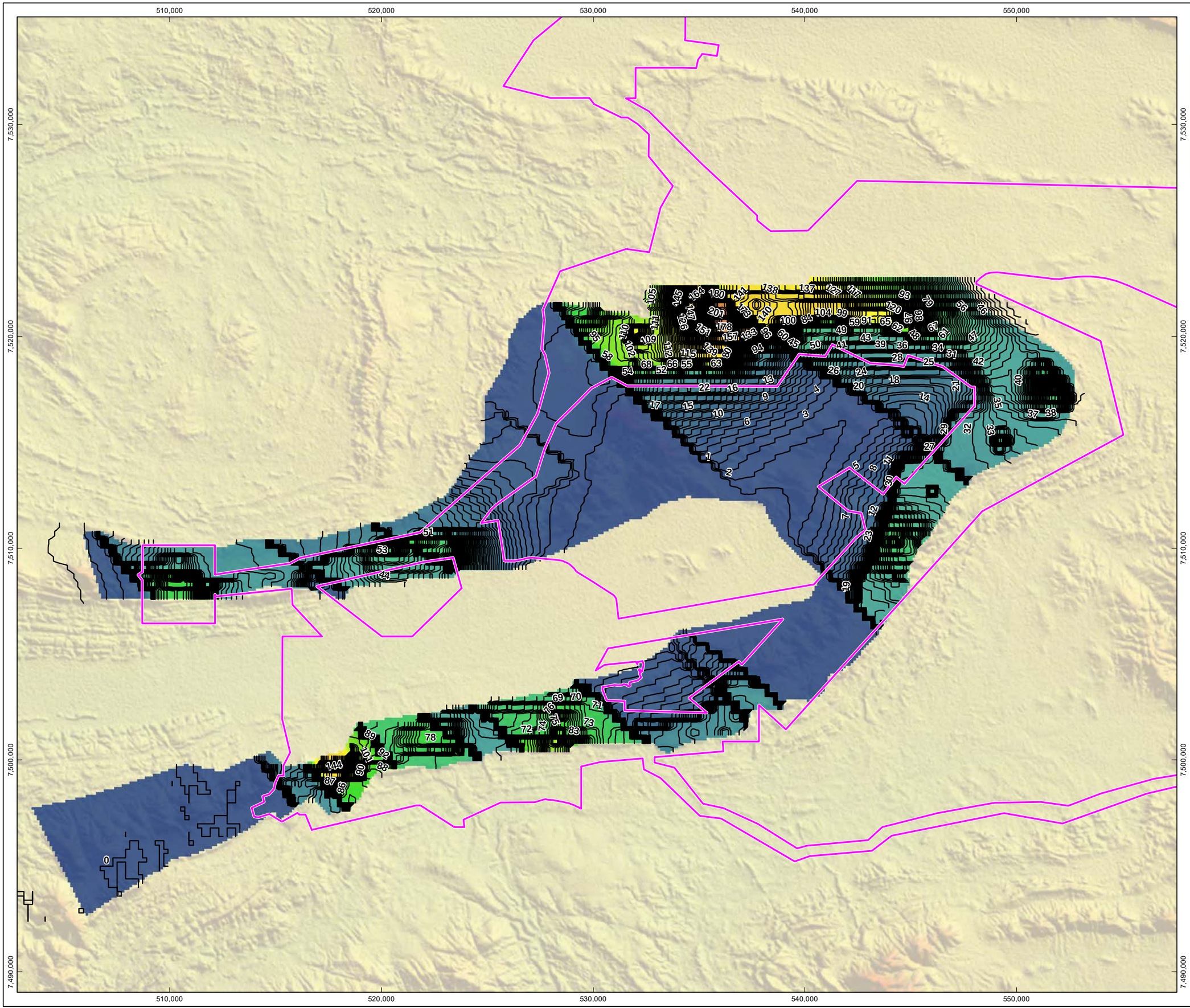

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Figure 6-23
Predicted Maximum Drawdown at End of Mining from the Approved and Proposed Mining (to 2050)

Drawn: L.Fuentes
Plan: PDE0182273v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:165,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Drawdown Contour (m)

Groundwater Drawdown (m)

High : 210

Low : 0

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 6-24
Predicted
Long-term Drawdown (2350)

Drawn: L.Fuentes
Plan: PDE0182275v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:165,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Drawdown Contour (m)

Groundwater Drawdown (m))

High : 210

Low : 0

510,000 520,000 530,000 540,000 550,000

7,530,000 7,520,000 7,510,000 7,500,000 7,490,000

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 6-25
Post Closure Pits
Predicted to Form Pit Lakes

Drawn: L.Fuentes
Plan: PDE0191424v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Approved Pits (MS 925)
- Proposed Pits
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Robe River
Caves Creek
Duck Creek
Boolgeeda Creek
Beasley River

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

SEE INSET A
SEE INSET B

White Quartz Road

INSET A

0 1 2 3 Kilometres

Lens CD
Lens EF
Lens G

INSET B

0 1 2 3 Kilometres

Pit O-1
Pit N2
Pit N1
Pit M2

N

0 2 4 6 8 10 Kilometres

Map units in metres

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6.4.1.3. Changes to Surface Hydrological Regimes of Boolgeeda Creek and Duck Creek from the Continued Discharge of Surplus Water

Discharge of surplus water to creeks is expected to occur early in mine life when water storage options are not yet available. The following sections outline the potential direct impacts predicted to occur as a result of water discharge to creeks. Potential impacts to surface water quality are addressed in Section 6.4.2.

Duck Creek

Continued surplus water discharge to Duck Creek will be required until adequate pit storage becomes available. To ensure adequate approved options for managing surplus water in the northern part of the Development Envelope, the Proposal includes provision for the continuation of surplus water discharge to Duck Creek. This is an extension of the existing operations approved discharge regime, however, discharge volumes and wetting front limits have not previously been set for Duck Creek. A 2D hydraulic model of Duck Creek was developed to estimate the extent of continuous flow from a range of surplus water discharge rates (Rio Tinto 2019a). This study was used in the planning and assessment of discharge options. The Proposal would result in a maximum discharge rate of 60 ML/d with an associated maximum wetting front, if the flow continued, of 67 km (Figure 6-26).

Discharge to Duck Creek will be greatest when the NAP system is undergoing maintenance and before mine pit voids become available. Based on the current mine plan, periodic discharge to Duck Creek is likely to be required until around 2030, which is consistent with the Rio Tinto target of achieving no discharge to creeks by 2032. During discharge, there may be short term mounding of the groundwater levels in the alluvials, but these levels are expected to dissipate following cessation of discharge. The wetting fronts have been calculated from the existing licenced discharge point, which is likely to continue to be used. If an alternative site is required for any reason, an amended licence would be applied for, and the discharge would be managed to remain within the assessed 67 km wetting front.

Boolgeeda Creek

Continued surplus water discharge to Boolgeeda Creek will be required until adequate pit storage becomes available in the Development Envelope. However, no increase to the existing approved wetting front extent of 37 km is being sought as part of this Proposal. The discharge will utilise the existing licenced discharge outlet within Boolgeeda Creek.

The current LoM predicts an operational surplus at BS4 hub of 16 ML/d. This is within the current Part V discharge limit of 17.5 ML/d. It is noted that monitoring to date and updated creek modelling suggests the creek could accept 30 ML/d without exceeding the current MS 1000 wetting front limit of 37 km (Figure 6-26).

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Figure 6-26
Modelled Wetting Front under Natural No Flow Conditions for Duck and Boolgeda Creek

Drawn: L.Fuentes
Plan: PDE0182278v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:300,000 @A3
GIS.Team@riotinto.com

460,000 480,000 500,000 520,000 540,000

7,560,000 7,540,000 7,520,000 7,500,000 7,480,000

Serpentine Creek
Robe River
Caves Creek
Duck Creek
Silvergrass
Nammuldi
Brockman 2
Boolgeeda Creek
Brockman 4
Beasley River
Beasley River West
Nanutarra - Munjina Road

Maximum discharge of 60 ML/d with a wetting front of 67 km

Maximum discharge of 60 ML/d with a wetting front of 37 km

Legend

- Development Envelope
- Discharge Point
- Maximum Duck Creek Wetting Front
- Maximum Boolgeeda Creek Wetting Front
- Duck Creek
- Pilbara Major Streams

Discharge Extents

- Extrapolated
- Modelled

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access

N

0 2 4 6 8 10
Kilometres

Map units in metres

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6.4.1.4. Changes to Surface Water Catchments, Flow Paths, Flooding and Sheet Flows from Mine Pits and Infrastructure Placement

Mine pits, WRLs and linear infrastructure associated with mining have the potential to impact the surface water hydrological regime, altering the amount and distribution of surface water flow. Mining creates internally draining mine pits and controls runoff from waste landforms to reduce risks to surface water quality. This reduces the catchment areas of streams which can cause a corresponding reduction in runoff and streamflow.

Surface water flows in the Development Envelope are generally confined to well-defined flow channels with narrow floodplains. Any change to the hydrological regime (flow depths and velocities) is therefore expected to occur within the defined creeklines (Rio Tinto 2021b). Difference mapping of flood depths and velocities is presented in Appendix G.1 of Rio Tinto (2021b; Appendix C.1). It shows that flood depths and velocities are decreased downstream of proposed pits and increased upstream of infrastructure. This assessment compares the modelled pre-development scenario (including the approved projects) and the development scenario before closure. The shadowing and retention effects of the proposed development are shown for the 1 in 100 AEP in Boolgeeda Creek from mining in BS 1, 2, 3 and 4 assessment areas (Figure 6-27) and in Lens G (Figure 6-28). These changes to flood depths are relatively minor even in a rare flood event of 1 in 100 AEP. Reductions in flow depths do not translate to large reductions in flood extent. Consequently, the overall drainage pattern remains largely the same.

In the BS2 assessment area there is a large flat catchment with surface water flows dominated by direct rainfall runoff and diffuse overland sheet flows during high rainfall events. The naturally shallow, low velocity runoff is unlikely to be altered significantly as direct rainfall runoff will continue to be generated in the undisturbed areas (Figure 6-28). The haul road crosses this valley and has been designed with multiple large culverts to allow overland sheet flows to be maintained.

Consideration of the influence of closure landforms on surface flows is provided in the MCP included in Appendix B.4.

RioTinto

Figure 6-27
Flood Depth Difference Mapping Showing the Modelled Change in Flood Depth from the Pre-development to the Post-development Scenario in Boolgeeda Creek

Drawn: L.Fuentes
Plan: PDE0182279v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:122,500 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,520,000 7,510,000 7,500,000

SILVERGRASS

NAP

BS1

BS2

BS3

BS4

MS1000 CORRIDOR

Boolgeeda Creek

Beasley River

Beasley River West

Legend

- Development Envelope
- Assessment Area
- Proposed Conceptual Pit
- Haul Road
- Major Creek

Depth (m)

- < -1
- -1.0 - -0.5
- -0.5 - -0.1
- -0.1 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- > 1.0

N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 6-28
Flood Depth Difference Mapping Showing the Modelled Change in Flood Depth from the Pre-development to the Post-development Scenario in BS2 Assessment Area

Drawn: L.Fuentes
Plan: PDE0189500v1
Date: August 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:35,000 @A3
GIS.Team@riotinto.com

542,500
545,000
547,500
550,000
552,500
7,522,500
7,520,000
7,517,500
7,515,000

BS2
BS3

Legend

- Development Envelope
- Assessment Area
- Proposed Conceptual Pit
- Haul Road

Depth (m)

- < -1
- -1.0 - -0.5
- -0.5 - -0.1
- -0.1 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- > 1.0

N

0 0.5 1 1.5 2
Kilometres

Map units in metres

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Catchment changes

Boolgeeda Creek Catchment

The Proposal will result in the loss of approximately 55.0 km^2 (approximately 3.3%) of the catchment area of Boolgeeda Creek at the confluence with Duck Creek. The proportional catchment loss and annual runoff reduction is greatest (up to 9.7%) within the small tributaries of Boolgeeda Creek in the BS1 assessment area that will have a large portion of the catchment developed. These catchments are also subject to the cumulative impacts of the Proposal and the approved FMG Eliwana Mine, with up to 18.5% cumulative reduction in runoff estimated (Rio Tinto 2021b).

The catchment loss within Boolgeeda Creek at the point of the semi-permanent pool 9 km upstream of the confluence with Duck Creek will be approximately 12%.

Beasley River Catchment

The Proposal will result in the loss of approximately 63 km^2 (approximately 3.1%) of the catchment area of Beasley River, which would result in an estimated 2.5% reduction (Proposal only) or 4% cumulative reduction (including approved projects in mean annual runoff to the Beasley River (Rio Tinto 2021b). The percentage change in runoff is lower than the catchment loss for the Beasley River as part of the catchment is internally draining.

Duck Creek Catchment

The Proposal elements within the Duck Creek catchment are all located in the upper slopes of the catchment, with very little contributing catchment area. The Proposal is also upstream of existing pits and infrastructure (approved under MS 925) and therefore does not significantly further truncate the surface water catchment of Duck Creek.

Plunge Pool Catchment

Plunge Pool is a groundwater fed pool with a pre-mining catchment area of 21 km^2. Although the pool is a surface expression of groundwater, surface water contributions are important to fill, overtop and flush the pool (Rio Tinto 2021c). Mining of the BS3 deposits is proposed within the Plunge Pool catchment extending into the 1 in 100 AEP floodplain. Diversions and flood protection levees are proposed during operations to allow safe mining and minimise the loss of catchment runoff to the pool. It is expected that these flood protection structures would be removed at closure.

The Proposal will ultimately result in the removal of up to 66% of the contributing surface water catchment area, creating a final catchment area of 7 km^2 (Rio Tinto 2021c). An overall reduction in the volume of discharge downstream from the pool is predicted for the post-mining scenario, however modelling shows that the pool would still be filled and overtop multiple times annually.

Kurwillinha Pool catchment

The 0.72 km^2 Kurwillinha Pool catchment is drained from north to south and is located in the Beasley River catchment. The Proposal includes mining of the Endeavour deposit (Figure 2-3), which intersects with the catchment of Kurwillinha Pool and may reduce the pool's contributing catchment by up to two thirds (0.48 km^2). However, modelling indicates that the pool would continue to be topped up by surface water contributions.

Ridge Pool Catchment

There is no direct disturbance to Ridge Pool or any activity within its catchment as part of this Proposal. Therefore, no impact is expected to Ridge Pool and hence it is not further discussed in this assessment.

6.4.2. Indirect Impacts

Implementation of the Proposal has the potential to result in the following indirect impacts on Inland Waters:

- Change to surface water quality within pools downstream from surplus water discharge points
- Impacts to ground and/or surface water quality due to mineral waste management, WRLs and WFSFs
- Post closure formation of pit lakes resulting in impacts to groundwater
- Increased sediments in runoff from infrastructure and drainage resulting in adverse impacts to Plunge Pool
- Contamination of surface water due to accidental spills of hazardous materials and waste.

6.4.2.1. Change to Surface Water Quality Within Pools Downstream from Surface Water Discharge Points

The Proponent will continue to discharge surplus water to Boolgeeda Creek within the approved 37 km wetting front and continue discharge to Duck Creek, up to a 67 km wetting front. Discharge to either creek system is proposed to cease after 2032 pending availability and suitability of the alternate water storage options (Refer to Section 6.3.8).

Boolgeeda Creek is largely ephemeral, and the only semi-permanent pool (referred to as BC in WRM 2019) occurs near the confluence with Duck Creek. This pool is more than 40 km downstream of the maximum wetting front for Boolgeeda Creek, and therefore, its hydrological regime will not be affected by surplus water discharge. Surplus water discharge will be well mixed with flood flows before reaching BC pool and therefore water quality differences are thus not expected.

Surplus water discharge to Duck Creek may reach the following semi-permanent and/or permanent pools mapped within the discharge extent assessed under MS 925:

- DCU 1,2 and 3 which are all located within Duck Creek and approximately 10 km downstream of the discharge location
- DCU 11, which is located within Duck Creek approximately 40 km downstream of the discharge
- DCD 3, 5, 6, 7 and 9, which are located within Duck Creek (downstream of the confluence with Caves Creek) approximately 50 to 70 km downstream of the discharge.
- DCDT2 is a rock pool on a tributary of Duck Creek and would not be affected by discharge flows.

WRM (2020) have undertaken a hazard analysis and risk assessment for surplus water discharge to Duck Creek and Boolgeeda Creek based on potential water quality impacts on aquatic fauna. The water quality of the receiving environment (Boolgeeda and Duck Creeks) was compared to groundwater quality in the Brockman Syncline aquifers to be dewatered, and the following potential risks were identified (WRM 2020):

- Inorganic nitrate. Moderate to high risk of temporary habitat quality reduction for the duration of discharge through eutrophication and low to moderate risk of direct toxicity
- Total phosphorus. Moderate to high risk of temporary habitat quality reduction for the duration of discharge through eutrophication
- Total suspended solids. Moderate to high risk of temporary habitat quality reduction for the duration of discharge, noting that the ephemeral creek systems in the Pilbara are naturally exposed to high sediment loads during periods of rainfall stream flow and flood events
- Dissolved barium. Low to moderate risk of direct toxicity
- Calcite precipitation causing creek bed armouring. Low to moderate risk.

These potential risks are the same for the current operations approved discharge; the change of risk profile relates to the increased discharge volume, duration and extent for the Proposal. Therefore, water quality within the surplus water wetting front is expected to continue to be affected for the duration of the discharge. The significance of this for aquatic fauna is assessed in Section 6.6.2.1.

6.4.2.2. Impacts to Groundwater or Surface Water Quality as a Result of PAF Exposures in Pit Walls, Waste Rock Landforms and Waste Fines Storage

Considering acid-based accounting data compiled from a number of investigations including RGS (2021), RTIO (2017), SRK (2013, 2015 and 2016) the majority of samples collected representing the geological formations likely to be encountered during mining are broadly NAF with only a small portion (<4%) classified as PAF. Sequences with samples identified as PAF include detritals, Mt McRae Shale and Wittenoom Formation and those samples typically containing lignite (within the detrital sequence and not identified within the Greater Brockman area) and pyrite. This would suggest the risk of AMD from across the Greater Brockman project area is overall classified as low.

Table 6-8 presents the deposits which form part of the Proposal that have been identified to contain PAF material. These geological units pose moderate AMD risk and will require management through encapsulation as detailed in Section 2.1.3.4. All other deposits are considered to represent low AMD risk (Rio Tinto 2019 f; Appendix C.8).

Table 6-8: Deposits Encountering PAF Material

Assessment area	In-pit waste Net Potential Ratio	Tonnes of waste estimated to be mined (Mt)	AMD Risk rating
BS1	58	276	Moderate
BS2	-	-	Moderate
BS4 (BS3/BS4)	3.83	698	Moderate
BS2 (Lens G and Diesel Deposits)	40	296	Low
Brockman 4 Marra Mamba	8.44	295	Moderate

In-pit WFSF are proposed to be developed in the Lens A pit, Pit 5 and Pit 8 (Figure 2-4). These pits are part of approved mining in the BS2 assessment area and Lens A pit, and Pit 8 are due for completion by 2025 whereas Pit 5 is already available. The change in closure strategy of these existing pits to hosting in-pit WFSFs is part of this Proposal. The waste fines levels in all pits will be designed to be above the recovered groundwater level and therefore prevent the formation of permanent pit lakes above these facilities at closure.

The proposed in-pit WFSFs have sufficient storage volumes and designed freeboard that they will not overtop and therefore do not have the potential to affect surface water quality.

Work has been undertaken to identify any impacts to sensitive receptors from utilising these pits as in-pit WFSFs. Results show that LOM waste fines storage capacity can be provided between Lens A and Pit 8 (KCB 2021). Pit 5 is unlikely to be required but would provide useful contingency storage. Storage of waste fines within Pit 8 is anticipated to permanently cover reactive shales (black shale) exposed in the final pit walls. There are no known sensitive receptors (terrestrial and/or subterranean GDEs or creeklines) within the immediate vicinity of these pits, thus making them suitable for in-pit WFSFs.

The proposed waste fines levels in Pits 5 and 8 will be above the recovered groundwater level and, therefore, permanent pit lakes will not form at closure. Lens A is within the 1:100 AEP flood extent, and flood risk during operation is managed by using in-pit sump and pump. The Proponent proposes that all in-pit WFSFs will be capped with at least 2 m of inert material over the entire tailings surface. In addition,

Lens A pit will be capped and filled to the surface to avoid creek inflows and the need to implement a significant permanent diversion drain around the closed pit.

In-pit WFSFs have the potential to affect groundwater quality through seepage. However, there are no GDEs in the vicinity of the proposed in-pit WFSFs that could potentially be affected.

6.4.2.3. Post Closure Formation of Pit Lakes

The Proposal includes the formation of permanent pit lakes which are expected to form in five pits attributable to the Proposal and two pits attributable to existing operations at closure (Table 6-9) as outlined in the MCP in Appendix B.4. Pit lakes can affect groundwater quality in the aquifer compartment in which they will form. However, no PAF material is anticipated to be encountered in the final pit walls of the pits which will form pit lakes due to the current understanding of the geology and the pit lakes are not expected to be acidic based on geochemical characterisation of the pits and pit lake modelling results for the Proposal. Due to the ongoing high evaporation rates expected from the pit lakes, modelled has shown that they will continue to act as groundwater sinks post-closure. Therefore, any potential seepage into groundwater aquifers is expected to be highly localised.

Table 6-9: Modelled Pit Lake Water Levels where Groundwater Recovers Above Pit Floor

Pit	Approximate lake formation time (years)	Modelled equilibrium level (mRL)	Current planned pit depth (mRL)	Modelled pit lake depth (m)	TDS at 300 years post closure
BS4 Assessment Area					
MM O (1)	20	428	400	28	16,940
MM-M (2)	5	484	470	14	59,765
MM-N (1)	5	482	470	12	82,112
MM-N (2)	20	481	460	21	29,903
BS2 Assessment Area					
Lens G	60	503	480	23	24,279

Source: RPS (2021b). Note that this report was prepared before the commitment to limit mining at BS3 to AWT, therefore it lists BS3 as a pit lake, which will not occur.

6.4.2.4. Increased Sediments from Infrastructure and Drainage

Given that runoff in the Pilbara is typically in response to intense storms or cyclonic activity, runoff in the region naturally has a high sediment load. While sediment transfer is a natural geomorphic process, disturbed material resulting from construction and/or mining activities and areas where vegetation cover has been removed may increase sediment availability and, hence, the sediment load in runoff.

Where practicable, natural runoff will be diverted around operating areas, limiting the volume of water required to be treated before being released to the natural environment. Where diversion of larger drainage channels is required, the design will aim to incorporate geomorphic design principles such that the natural sediment transport through the channel is maintained and the structure itself doesn't become a sediment source.

Stormwater emanating from or flowing through a disturbed area will be diverted to sediment basins prior to discharge.

Erosion and sedimentation due to the proposed development is unlikely to present a significant environmental risk given the management measures to be implemented.

The Proposal extends into the 1:100 AEP flood extent of Plunge Pool and mining activities have the potential to generate sediment in runoff. It is noted that flow velocities will reduce due to catchment reductions which may minimise the potential for sediment mobilisation. However, surface water management measures will be in place during construction and operations to ensure that sedimentation of the pool is minimised (Rio Tinto 2022a).

6.4.2.5. Contamination of Surface Water Due to Accidental Spills of Hazardous Materials and Waste

During construction and operation, the Proposal has the potential to contaminate surface water due to spills of hazardous materials and waste. Site drainage will be designed to collect, minimise or eliminate surface runoff into areas where hydrocarbon contamination may occur. Hydrocarbon storage facilities will be appropriately constructed and bunded in accordance with Australian Standards. Regular facility inspection, maintenance and spill management procedures are expected to mitigate the risk of contamination effectively and this impact is not further discussed.

6.4.3. Cumulative Impacts

Active dewatering for BWT mining currently occurs at the existing BS2-Nammuldi and BS4 mining operations, with drawdown of the pre-mining groundwater level by up to 154 m and 74 m, respectively. Abstraction of groundwater has been from the Brockman, Marra Mamba and Wittenoom formations. The drawdown from BS2-Nammuldi has propagated around the Syncline to the Diesel deposit (Figure 2-3), whilst at BS4, the extent of groundwater drawdown has been observed to be contained and localised by cross-cutting dolerite dykes, which compartmentalise the aquifer. There are small areas of shallow watertables in BS2-Nammuldi where historical drawdown has occurred. The combined groundwater drawdown of the approved BWT mining at BS2-Nammuldi and BS4 with the Proposal is presented in Section 6.4.1.1 and Figure 6-23 and Figure 6-24.

FMG's Eliwana Mine is located directly north of BS1 assessment area and is within the same aquifer as the BS1 deposits. Information from the EPA assessment on the groundwater abstraction associated with that project has been used to assess cumulative impacts on the BS1 aquifers (Rio Tinto 2021b).

The cumulative effect of the Amended Proposal at the end of mining with estimated groundwater drawdown from the FMG Eliwana Project is shown in Figure 6-29 and long-term changes in Figure 6-30. The cumulative effect increases the drawdown depth in the BS1 assessment area but does not increase the spatial extent of drawdown due to the compartmentalisation of the aquifers from cross-cutting dolerite dykes.

The FMG Eliwana Mine is the only third-party project that exists within the same surface water catchments as the Proposal. Therefore, the cumulative impacts of the Proposal, approved Brockman projects, and the Eliwana Mine have been assessed. The existing and proposed reduction in catchment areas are presented in Table 6-10 (Rio Tinto 2021b).

Table 6-10: Cumulative Catchment Area Reduction for Currently Approved Mining Projects and the Brockman Syncline Proposal

Regional catchment	Catchment area (km^2)	Project	Potential reduced catchment area (km^2)	Percentage of catchment (%)
Beasley River	2,058	Nammuldi-Silvergrass (MS 925)	15.2	0.7
		Western Turner Syncline (MS 946)	2.4	0.1
		Brockman Syncline 4 (MS 1000)	28.1	1.4
		Subtotal (approved impact)	45.8	2.2
		Brockman Syncline Proposal	62.9	3.1
		Cumulative loss of Beasley River catchment	**108.6**	**5.3**
Boolgeeda Creek	1,658	Eliwana (MS 1109)	133.7	8.1
		Brockman Syncline Proposal	55.0	3.3
		Cumulative loss of Boolgeeda Creek catchment	**188.7**	**11.4**

**Duck Creek catchment area upstream of the confluence with Caves Creek Source: Catchment losses are included for Beasley River, Boolgeeda Creek and Duck Creek from Rio Tinto (2021b). Catchment losses for Caves Creek are sourced from the specific Caves Creek Hydrology Impact Assessment (HARC 2019).*

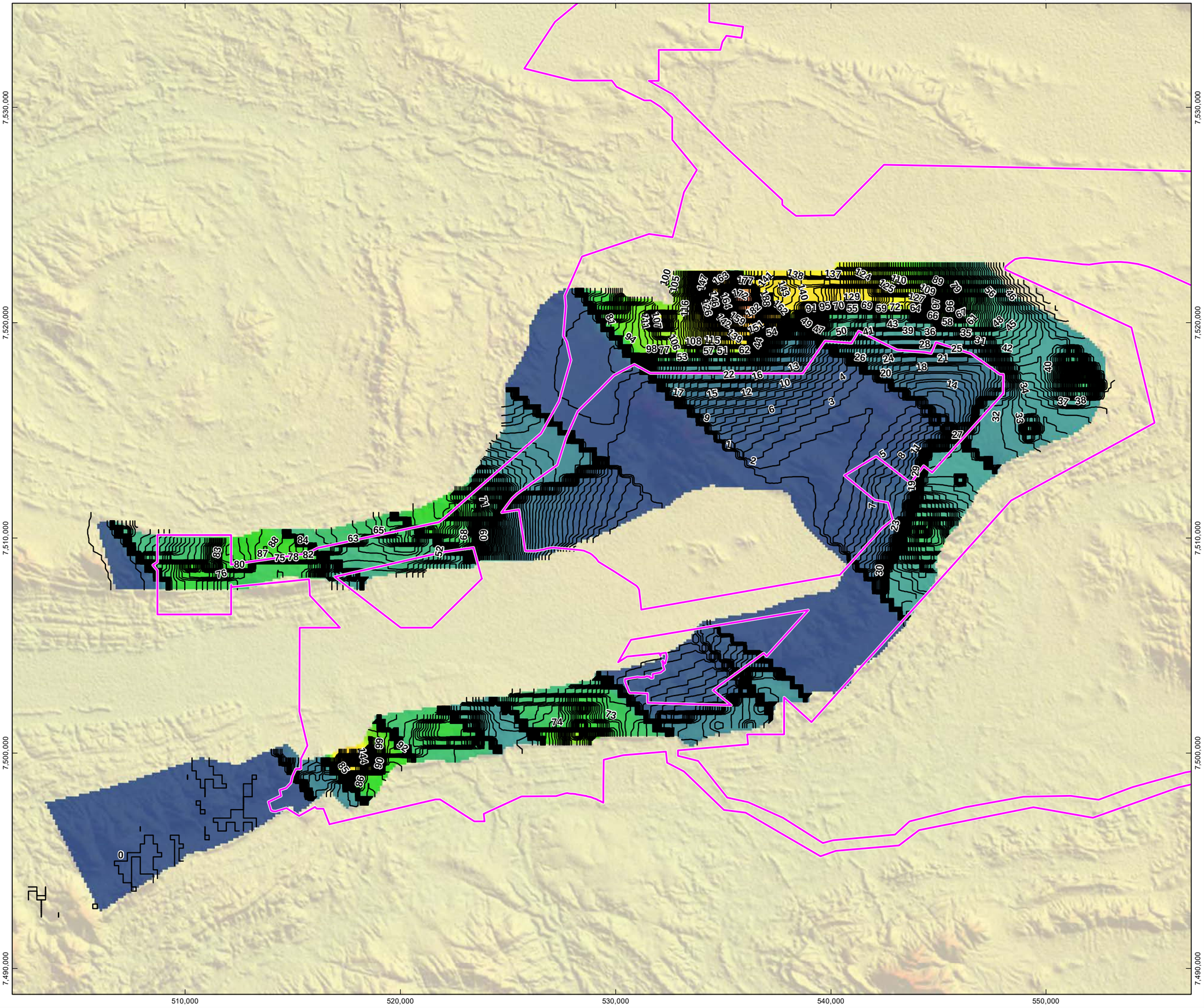

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Figure 6-29
Predicted Maximum Drawdown at End of Mining (2050) with FMG

Drawn: L.Fuentes
Plan: PDE0182274v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:165,000 @A3
GIS.Team@riotinto.com

Legend

Development Envelope

Groundwater Contour (mAHD)

Groundwater Elevation (mAHD)

High : 215

Low : 0

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 6-30
Predicted Long Term Drawdown With FMG

Drawn: A.Coulson
Plan: PDE0182276v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:165,000 @A3
GIS.Team@riotinto.com

Legend

Development Envelope

Groundwater Contour (mAHD)

Groundwater Elevation

High : 215

Low : 0

N

0 2 4 6 8

Kilometres

Map units in metres

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6.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids or minimises, where practicable, impacts on water-related environmental values known within the Development Envelope and downstream.

6.5.1. Mitigation Hierarchy

Table 6-11 summarises how the EPA mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during the Proposal design to develop appropriate mitigation and management strategies in order to address the key potential impacts on Inland Waters. Mitigation is proposed to protect the key environmental values associated with inland waters, where mitigation is required to achieve the proposed environmental outcome.

Plunge Pool

Plunge Pool is the only permanent pool in the Development Envelope and the Proponent has applied the mitigation hierarchy to ensure the hydrological regime is maintained. Plunge Pool is hydraulically separated from all BWT mining by the effect of groundwater compartmentalisation by dolerite dykes, but given some uncertainties based on the local heterogeneity of the geology, which may affect local hydraulic conductivities, additional measures are proposed to ensure there will be no change in groundwater levels that support the base water level in the pool. These measures are:

- Limit mining at the BS3 deposit (1 km north of Plunge Pool) to AWT.
- Backfill of the BS3 Extension deposits (MM-J and Creekside, 9 km north-east of Plunge Pool) to above post mining recovered water levels to minimise long-term drawdown in the upstream aquifer; and minimise any potential for a reduction in groundwater contribution to the Plunge Pool aquifer compartment.

These measures are expected to effectively ensure no change in the groundwater levels in the aquifer that supports Plunge Pool. To demonstrate this outcome, monitoring of groundwater levels is included in the EMP.

The potential for increased sediment loads affecting water quality or sedimentation of Plunge Pool during construction and operation will be managed through the installation of leaky weir sediment traps or similar (Rio Tinto 2022c). Surface water levels and water quality in Plunge Pool will be monitored to ensure these mitigation measures are effective.

Due to the importance of Plunge Pool, Plunge Pool has been placed in a MEZ (Figure 6-31).

Water Management Strategy to Minimise Discharge to Creeks

The water management strategy has been designed to:

- Reduce surpluses where possible with mine scheduling and efficient dewatering design
- Minimise discharge to creeks through preferential use for operation, discharge to mine pits and irrigation of the NAP (as approved under MS 925).

Surplus water discharge to Boolgeeda Creek and Duck Creek will continue early in mine life within existing approved and new proposed limits and then is proposed to be phased out as mine pits become available for water storage. The proposed water management strategy will minimise surplus water discharge to creeks and reduce the potential impacts to creek environmental values. The existing management and monitoring of water quality will continue to be implemented for creek discharge and have been incorporated into the EMP.

Storage of surplus water in disused mine pits is an important part of the water management strategy but will be managed to ensure that no acidic pit lakes will form or cause mounding of groundwater in areas

of shallow watertable (i.e., <20 m bgl). This will ensure that the stored water will provide passive local recharge to aquifers and are available as a water supply later in mine life when the operational demand versus dewatering abstraction water balance is in deficit.

Management of overland surface water flows

The Lens G haul road crosses the broad valley between the Lens G and Diesel deposits. Maintaining overland flow in this area has been identified as important by the Muntulgura Guruma and therefore, the haul road has been designed with multiple large culverts to allow overland flow in this area to continue similarly to its natural state.

Management of PAF and Prevention of AMD

Rio Tinto operations in the Pilbara manage and reduce the risk of AMD through standard operating procedures and implementation of provisions included in the Mine Closure Plan (MCP; Appendix B.3). A Mineral Waste Management Plan and the Spontaneous Combustion and Acid Rock Drainage (SCARD) Management Plan (Appendix C.9) is currently being implemented for existing operations and will continue to be implemented as part of the Proposal to ensure waste material is adequately geochemically characterised in line with existing operational procedures which will ensure that any PAF material encountered for the Proposal that poses an AMD risk is appropriately managed.

Current operations manage PAF material on-site by encapsulating it within inert material within WRLs and monitoring water quality surrounding these facilities. This strategy will be utilised for any PAF potentially encountered in the proposed pits. Selection and design criteria for new PAF material storage areas are detailed in the MCP and may include encapsulation within ex-pit WRLs, or in-pit as backfill to either above or below the predicted recovered groundwater level to avoid repeated inundation and exposure to oxygen. Locations of any new PAF WRLs will consider environmental and heritage/social receptors and be located away from these.

At closure, WRLs containing PAF material are likely to require store and release covers, as implemented at other Rio Tinto operations in the Pilbara. Further detailed designs will be undertaken to support subsequent revisions of the MCP (Appendix B.4).

The Proponent commits to ensuring no significant ecological risk posed by the permanent pit lakes proposed to remain at closure. All proposed pits with a closure AMD risk of moderate or high will be backfilled to above post mining recovered water levels to support achieving this outcome as per the MCP. Backfilling will cover the PAF and therefore reduce the risk of AMD at closure (Rio Tinto 2020a).

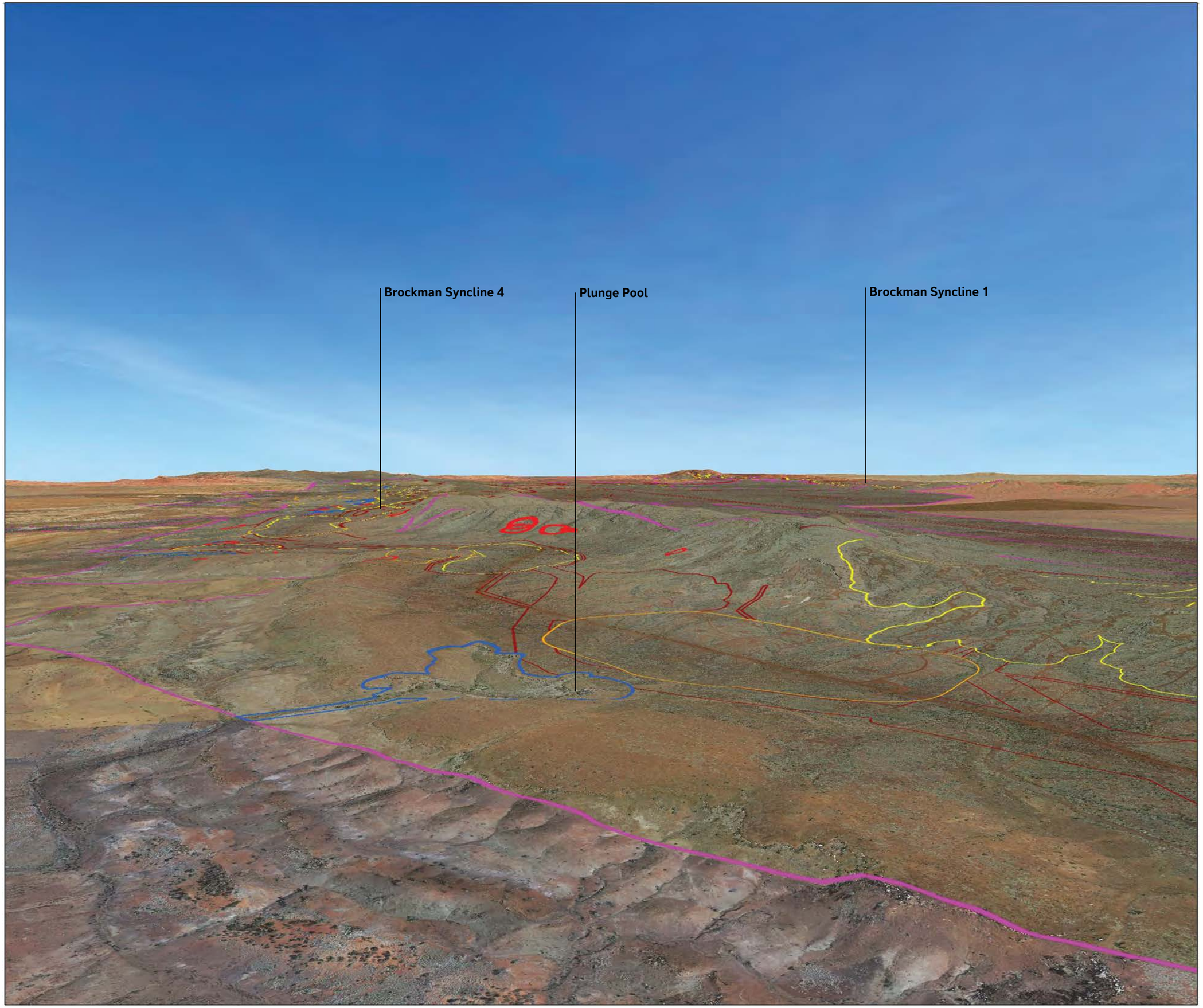
6.5.2. Mitigation of Risks at Closure

An MCP has been prepared to address closure requirements for the Proposal (Appendix B.4). The MCP will be updated regularly to ensure its objectives remain relevant and aligned to stakeholder expectations and its strategies are appropriate to achieve closure outcomes.

A summary of the approach to closure and how it relates to the Inland Waters environmental factor is provided below.

The post mining landform will include mine voids and WRLs. Pits where the pit floor is greater than 10 m from the pre-mining ground level will be the focus for backfill to ensure pits with higher risk of instability will be appropriately managed. Closure landforms will be designed to avoid this zone of potential instability.

The proposed post mining land use assumes that all disturbed areas within the Development Envelope, excluding the pits, will be rehabilitated to create a safe, stable and non-polluting landscape vegetated with native vegetation of local provenance. WRL will be reshaped to be stable based on their waste material physical characteristics and will include a toe and crest bunds on each lift, which will minimise the potential for sedimentation in surface water runoff.



RioTinto

Figure 6-31
Plunge Pool
Mine Exclusion Zone

Drawn: L.Fuentes
Plan: PDE0191426v1
Date: September 2022

Scale: NTS@A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Mine Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zones

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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Table 6-11: Application of the Mitigation Hierarchy for the Inland Water Environmental Factor

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Lowering of groundwater levels as a result of mine pit dewatering and closure	**Measures to Avoid**			
	• Mining of the BS3 deposit will be limited to AWT to ensure no groundwater abstraction occurs within the same hydrological compartment to prevent the potential for drawdown close to Plunge Pool. • All operational water demand will be supplied from mine dewatering, avoiding the need for a non-potable water supply borefield. • Mine pits to the west and down gradient of the pool are not hydraulically connected to the Plunge Pool aquifer compartment as a result of dolerite dykes.	Proposal specific	Yes – Groundwater Operating Strategies developed as part of the Groundwater Licences requires Proponents to provide detail on those pits to be mined BWT and management of groundwater levels.	Groundwater levels at Plunge Pool are not expected to be affected by the Proposal. This avoidance strategy removes the potential impact source and therefore has a high level of certainty. Avoidance is the first and preferred strategy in the EPA mitigation hierarchy.
	Measures to Rehabilitate			
	• The mine closure strategy includes backfilling of the BS3 Extension BWT pits (MM-J and Creekside) to above post mining recovered water levels to minimise the potential risk of long-term groundwater drawdown in aquifers that are 9 km upgradient of Plunge Pool. • The water management strategy includes the preferential storage of surplus water in mine pits when they are available. This strategy will result in passive aquifer recharge at those locations and minimise the total export of water and groundwater drawdown within the Brockman syncline aquifers.	Proposal specific	No	• This closure strategy is consistent with the EP Act precautionary principle. • The water management strategy provides a robust decision-making framework to ensure outcomes are achieved.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• Mining at BS3 deposit will be AWT only.		• Proposal definition as per the Proposal Content Document • Mine Closure Plan	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Backfilling of BS3 Extension deposits (MMJ and Creekside) to above post mining recovered water levels following BWT mining. • No measurable drawdown of groundwater levels at Plunge Pool as a result of mining attributable to the Proposal • Annual limit on groundwater abstraction.		• Outcome based provision in the EMP	
Groundwater mounding from surplus water storage in disused mine pits	**Measures to Avoid**			
	To avoid impacts to environmental values, surplus water storage in pits will only occur where pit lakes would not be expected to cause mounding in areas of shallow watertables (i.e., <20 m bgl).	Proposal specific	No	This strategy will effectively remove any potential pathway for impact to vegetation as a result of changes to water availability in the root zone.
	Measures to Minimise			
	Surplus water storage in mine pits that do not have exposed PAF is the proposed surplus water strategy once mine pits are available and criteria for storage are met.	Proposal specific	No	• Storage of surplus water in disused mine pits is not expected to affect groundwater beyond the pits and the local aquifers. There is high confidence in this approach as the hydrogeology of the syncline is well understood. • This surplus water management strategy is consistent with the Water in Mining guideline (DoW 2013).
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• No surplus water storage in pits that would cause mounding of groundwater in areas of shallow watertables (i.e., <20 m bgl). • Surplus water storage in mine pits will only occur when pit suitability criteria (Section 6.3.8.4) are met.		Outcome based condition addressed in the EMP	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Changes to surface hydrological regimes of Boolgeeda and Duck Creek from continued discharge of surface water	**Measures to Minimise**			
	• Surplus water discharge to creeks will be avoided once suitable completed mine pits become available for surplus water storage/passive aquifer recharge. • Only water that is surplus to operational use requirements will be discharged. • Discharge to surface water systems will be minimised where practicable via alternative discharge methods including transfer to the NAP (as approved under MS 925) and storage in completed mine pits. • Surface water discharge to creeks is only expected to be required early in mine life before suitable completed mine pits become available.	Proposal specific	No	• The hub water balance indicates there is a high level of confidence in this strategy. • Discharge to creeks is consistent with the existing approved operations water management strategy. • The surplus water management strategy is consistent with the water use hierarchy in DoW Water in Mining Guidelines (DoW 2013).
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• No increase in the approved Boolgeeda Creek wetting front of 37 km. • Discharge to Duck Creek limited to within a 67 km wetting front. • Discharge to continue to be managed through the EMP.		• Ministerial condition limiting the wetting front in Boolgeeda Creek to 37 km under natural no flow conditions. • Ministerial condition limiting the wetting front in Duck Creek to 67 km from surplus water discharge under natural no flow conditions. • Outcome based provisions in the EMP to prevent long term impact on the health of vegetation in Boolgeeda and Duck Creeks.	
Changes to surface water catchments, flow paths, flooding and sheet flows from mine pits and	**Measures to Minimise**			
	• Linear infrastructure will be designed to convey high frequency flood events (up to 1 in 10 AEP) through culverts or similar structures to avoid impediment of flows. Infrastructure may be designed to allow overtopping in lower frequency events.	Proposal specific	No	Minimum design requirements for linear infrastructure are standard practice and effective at preventing ponding and maintaining flow regimes downstream.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
infrastructure placement	• The Lens G haul road will be designed with major culverts to maintain flows within the broad valley between Lens G and Diesel deposits. • Infrastructure in Plunge Pool catchment will be minimised to maintain an effective catchment of at least 7 km^2.			
	Measures to Rehabilitate			
	All linear infrastructure will be removed at closure unless required for a future use identified through the mine closure planning process.	Proposal specific	No	Standard practice for mining proposals. Will reinstate uninterrupted flows in the areas of linear infrastructure.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• All linear infrastructure will be removed at closure unless required for a future use identified through the mine closure planning process. • The outcome that the catchment area of Plunge Pool will be no less than 7 km^2 is anticipated as an outcome based condition in the MS and included in the EMP		• Mine Closure Plan • Outcome based provision in the EMP to ensure a minimum catchment size limit is retained.	
Indirect Impacts				
Changes to surface water quality within pools downstream from surface water discharge points	**Measures to Minimise**			
	Discharge to creeks will be minimised through the surplus use hierarchy, including preferential discharge to mine pits and NAP (as approved under MS 925). Water quality will be monitored to ensure it is within approved water quality parameters.	Proposal specific	No	Discharge is anticipated to be managed in accordance with licence conditions that regulate water quality of surplus water discharge. As the Proposal is for the continuation (Boolgeeda Creek) and expansion (Duck Creek) of discharge, there is a high degree of certainty that water quality will be effectively managed.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Water quality will be managed to ensure no significant detrimental effects to environmental values adjacent to disturbance.		The management, monitoring and continency measures relating to these outcomes will be detailed in the EMP.	
Increased sediment from infrastructure and drainage	**Measures to Minimise**			
	• Water management structures will be constructed in key risk areas to minimise the discharge of sediment laden runoff from the site (e.g., banks, sediment traps, catch bunds) during operation. • Leaky weir sediment traps or similar, will be implemented within the Plunge Pool catchment to minimise sediment contributions to Plunge Pool.	Proposal specific	No	Activities in the Plunge Creek catchment will be managed to ensure there is no reduction in the Plunge Pool depth as a result of sedimentation derived from mining. The Proponent is currently undertaking mining within the floodplain of Caves Creek and risks associated with sedimentation are being effectively managed through the use of sediment ponds. This provides confidence that this risk can be effectively managed in the Plunge Pool catchment.
	Measures to Rehabilitate			
	The stabilisation and revegetation of landforms at closure is anticipated to minimise sediment runoff.	Proposal specific	No	Implementation of the MCP is considered an effective control
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	The EMP will include objective based provisions to ‘Avoid where possible, and otherwise minimise, impacts to water quality and sedimentation in Plunge Pool as a result of mining or closure.’		The targets, management actions and monitoring in relation to this objective during construction and operation is detailed in the EMP and closure in the MCP.	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Contamination of surface and groundwater due to accidental spills of hazardous materials	**Measures to Avoid**			
	• Hazardous materials would be stored and handled in accordance with AS 1940, AS 3833 or AS 3780, the Dangerous Goods Safety Act, 2004 (WA), any conditions identified as part of EP Act Part V licensing or associated regulations • Facilities containing hydrocarbons and/or chemicals would be designed within bunds to contain at least 110% of the contents of the material stored	Standard business practice	Yes – Dangerous goods license and approvals required under Part V of the EP Act	Standard practices for mining operations which are effective in managing potential impacts
	Measures to Minimise			
	• Refuelling and fuel delivery inlets would be located on concrete or HDPE-lined pads to contain any drips or spills. The pads would drain to a sump to allow removal of collected material • Overland pipes containing hazardous materials would be installed within bunds with catchment sumps constructed at low elevations points as required to provide containment capacity in the case of a pipeline leak • Flow sensors would be fitted along pipelines to allow detection of loss of contents • Isolation valves would be installed at appropriate intervals along pipelines • Spill kits would be located at strategic locations throughout the project area and employees trained in their use	Standard business practice	Yes – Approvals required under Part V of the EP Act	Standard practices for mining operations which are effective in managing potential impacts

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Rehabilitate			
	• Hazardous spills would be cleaned up and contaminated soils would either be remediated or removed from site by a licensed third party. Incident investigation would be undertaken as required to determine the cause of environmentally harmful spills/leaks and control measures identified to prevent future incidents. As required, spills would be reported to the relevant authorities • Decommissioning and removal of all hazardous storages and hazardous materials pipelines	Proposal specific	No	Implementation of the MCP is considered an effective control

6.6. Assessment and Significance of Residual Impact

6.6.1. Assessment of Direct Impacts

6.6.1.1. Lowering of Groundwater Levels as a Result of Mine Pit Dewatering and Closure

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.

As the Brockman Syncline aquifer is primarily a closed system with little connection to the surrounding lithologies, no impact on groundwater levels beyond the Syncline is expected as a result of the Proposal.

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 FMG. FMG has licences enabling abstraction from the Flying Fish deposit aquifer in the northwest of the syncline. Drawdown from the FMG and Rio Tinto operations have the potential to overlap at the BS1 assessment area, which may affect the pit inflow and/or bore abstraction rates at both operations, depending on abstraction rates and timing. Any impact on FMG water supply will be addressed through commercial discussions between the two parties. Groundwater abstraction by both parties will be managed in accordance with groundwater licence conditions, administered by DWER.

As the aquifers being dewatered for the Proposal are generally deep, potential impacts to environmental values from groundwater drawdown are limited to:

- Subterranean fauna addressed in Section 9
- Small areas of GDV addressed in Section 7.4.2.2.

In addition, the Proposal has been modified to avoid impacting water levels and the functioning of the groundwater dependent pool; Plunge Pool.

Plunge Pool

The conceptual hydrogeological model that has been developed for the Proposal based on drilling and geological data shows that dewatering of BWT deposits approximately 3 km to the west and down gradient of Plunge Pool (BSM-M and BSM-N) is not expected to impact groundwater levels at Plunge Pool due to the presence of dolerite dykes preventing drawdown within the pool's hydraulic compartment (Rio Tinto 2022b). Dewatering of deposits propagating upgradient of the pool (BS3 Extension deposits BSM-J and Creekside; 9 km north east of Plunge Pool), are modelled to be of sufficient distance from the pool, such that the reduction in overflow into the down gradient compartments is unlikely to result in an impact to groundwater levels at the pool. However, to further reduce the risk and minimise drawdown in these up-gradient aquifers long-term, the BS3 Extension deposits (BSM-J and Creekside) are proposed to be backfilled to above post mining recovered water levels at closure. This will support recovery of those aquifer levels over time.

The BS3 deposit is located immediately north (1 km) but in a separate aquifer compartment to Plunge Pool. During the assessment of the Proposal, some uncertainty regarding the hydrological relationship between this deposit aquifer and Plunge Pool was identified. To address this uncertainty and ensure protection of Plunge Pool, the Proposal has been amended to limit mining at BS3 deposit to AWT.

The relationship of Plunge Pool to aquifers and proposed pits is shown in Figure 6-32.

In summary, the water levels in Plunge Pool are not expected to be affected by the Proposal on the basis that:

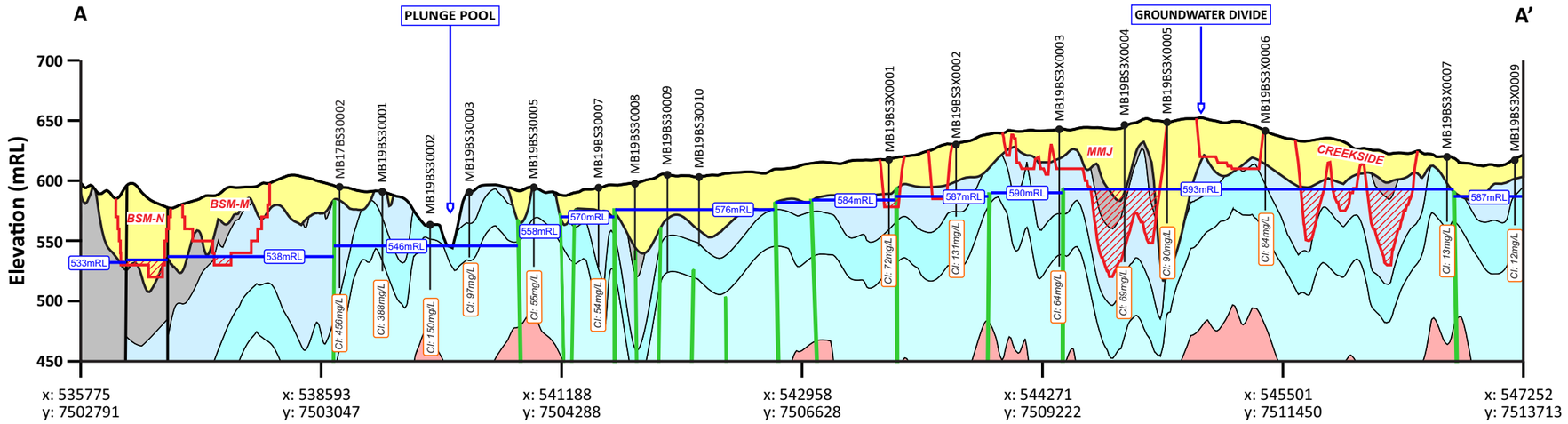
- Mine pits to the west and down gradient of the pool are not hydraulically connected to the Plunge Pool aquifer compartment as a result of dolerite dykes
- Deposits that are 9 km upgradient of the pool are in different aquifer compartments and modelling indicates that a reduction in overtopping from these compartments will not affect groundwater levels at Plunge Pool. However, for additional certainty, these pits will be backfilled to above post mining recovered water levels at closure to ensure groundwater recovery does occur
- Mining of the BS3 pit will be limited to AWT to prevent the potential for drawdown at Plunge Pool.

RioTinto

Figure 6-32
Fence Section from Plunge Pool Around the Syncline to the North East Indicating the Aquifer Compartmentalisation and Separation from the Deposits to be Mined

Drawn: L.Fuentes
Plan: PDE0189502v1
Date: June 2022
GIS.Team@riotinto.com

Brockman Syncline Fence Section



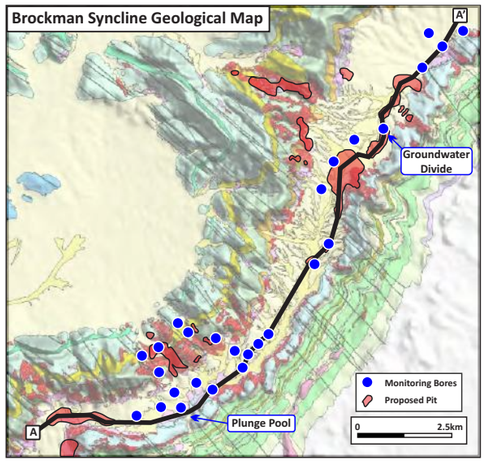
Legend

Stratigraphy
- Cenozoic Alluvials
- Wittenoom Formation
- Mt Newman Member
- Macleod Member
- Nammuldi Member
- Fortescue Group

Structural/Groundwater
- PMWL
- Dolerite Dyke
- Fault

Pit Outlines
- Proposed Pit
- Pit Below PMWL

Vertical exaggeration: 15x
0 — 3km
Scale: 1:68,000



Model Source: Leapfrog
Model Name: BS_2017_South_16122017.aproj

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6.6.1.2. Groundwater Mounding from Surplus Water Storage in Disused Mine Pits

The final location, timing and volumes of surplus water storage in pits will be dependent on mine schedule, operational water demands, ongoing materials characterisation work, mine closure planning and consultation with Traditional Owners. However, surplus water storage in pits will be selected on the basis that this would not be expected to cause groundwater mounding in areas of shallow watertables and where there are associated values that would be potentially impacted.

6.6.1.3. Changes to Surface Hydrological Regimes of Boolgeeda and Duck Creek from the Continued Discharge of Surplus Water

All aquatic fauna taxa collected from within the Development Envelope and/or the predicted surplus discharge extent are also known to occur, or are likely to occur, at locations outside the Development Envelope and discharge extent (WRM 2020).

The aquatic fauna habitat in Duck Creek and Boolgeeda Creek will continue to be modified due to surplus water discharge into these creeks however the functioning of these systems is expected to be maintained to support associated values as described below.

Duck Creek

Discharge to Duck Creek is currently approved and occurs for the existing operations. The Proposal is anticipated to temporarily extend this wetting front, cumulatively affecting up to 67 km downstream of the discharge point. This distance is the maximum modelled extent of continuous flow under natural no flow conditions. Sustained water availability or groundwater mounding is required to shift the ecology and to result in effects such as root truncation. As all discharges are not proposed to be long term, there is unlikely to be sustained additional water availability that would permanently alter the ecology of the creek. The EMP (Appendix B.3) includes outcome based management provisions to ensure that there will be no long-term impact on the health of vegetation in Duck Creek as a result of surplus water discharge.

Duck Creek supports naturally semi-permanent to permanent pools, particularly beyond the confluence with Caves Creek (>30 km west of the Development Envelope). Therefore, if discharges are sustained, the wetting front may reach nine semi-permanent or permanent pools mapped by Biologic 2020a that occur within 67 km of the discharge outfall.

The upper reaches of Duck Creek (before the confluence with Caves Creek) will be the most frequently affected by the wetting front caused by discharge. Periodic discharge already occurs to this section of creek as part of the existing approved operations. The upper reaches of Duck Creek do not support mesic indicator species (Biologic 2020a) indicating the creek is naturally drier in this area and representative of the higher order streams that occur more extensively in the Pilbara than those that support GDEs and permanent pools.

Groundwater levels will temporarily increase during and following discharge along the extent of the discharge wetting front. Natural groundwater levels in Duck Creek are very close to the surface (<2 mbgl) as evidenced by the existence of numerous permanent pools in the lower reaches. Discharge is predicted to remain within the low flow channel and the increase in groundwater levels as a result of discharge is likely to be limited as groundwater is already close to the surface.

The discharge to Duck Creek is expected to be required predominantly early in mine life consistent with a Rio Tinto aspirational target of no surface discharge by 2032 across its operations.

Boolgeeda Creek

Controlled surplus water discharge to Boolgeeda Creek will continue within the existing operations approved wetting front limit of 37 km downstream of the discharge point. These distances are the maximum modelled extent of continuous flow under natural no flow conditions. As discharge rates will

be variable, the areas of the creek close to the discharge point will be most regularly affected. Surplus water discharge to creeks is only expected to be required early in mine life (before 2032), and therefore, the change in hydrological regimes is not proposed to be long term.

No permanent or semi-permanent pools occur within the approved wetting front. The continuation of this discharge is not expected to increase impacts on the hydrological regime of Boolgeeda Creek.

There are no groundwater dependent ecosystems within Boolgeeda Creek and therefore, there is no interaction between surface water flows and groundwater in this creek.

Aquatic Fauna

Altered hydroperiod as a result of discharge can alter reproductive cycles in aquatic environments adapted to periodic or seasonal flows. Continuous discharge is likely to lead to a loss of 'seasonal' cues, favouring species adapted to perennial flows within the wetting front. This effect is likely to change the dominant assemblages within the zones that experience continuous discharge. It is unlikely that any species would be lost from Boolgeeda or Duck Creek entirely, as these taxa are expected to be present outside of the area of discharge influence and in adjacent tributary creeks. Following cessation or reduction of discharge, these invertebrates would be expected to re-colonise via natural dispersal following rain events (e.g., downstream drift or aerial invasion by winged adult stages) (WRM 2020).

Discharge may temporarily increase the carrying capacity of the creek by increasing the total aquatic habitat of the creeks (WRM 2020). This effect will only last for the duration of discharge.

Most species recorded are known to occur widely outside the Development Envelope. The exception to this is the new rotifer *Proales* n. sp. (family Proalidae), which is currently known from a single ephemeral pool on Duck Creek (DCD10 in WRM 2020). This pool is approximately 100 km downstream of the Duck Creek discharge point and is outside the maximum wetting front associated with the proposed discharge to Duck Creek. Therefore, no impacts are expected to the single known record of this species.

No changes to current conservation listings would be expected as a result of the Proposal. This includes the three species formally listed as vulnerable: the copepod *Eodiaptomus lumholtzi*, the Pilbara pin damselfly *Eurysticta coolawanyah*, and the Pilbara emerald dragonfly *Hemicordulia koomina.* All three listed species occur widely across the Pilbara, in ephemeral as well as permanent pools. For each, the known extent of distribution within pools in the Development Envelope constitutes less than 10% of their known extent outside the Development Envelope (WRM 2020).

Based on long term monitoring at existing Rio Tinto Pilbara BWT mines and known local and regional species distributions, the consequences of ongoing discharge to Boolgeeda Creek may include (WRM 2020):

- Short-term shifts in benthic invertebrate and zooplankton species assemblage composition due to altered flow regime, i.e., still water (lentic) species replaced by flowing water (lotic) species
- Short-term increase in abundance of native fish, and some hyporheic (e.g., stygal amphipods) and benthic invertebrate species due to increased spatial extent of surface water and sub-surface flow.

It is anticipated that there will be a statistically measurable response in most faunal indicators (species richness, abundance and composition) across all trophic levels (zooplankton, hyporheos, macroinvertebrates and fish) in the areas which experience consistent discharge flows. The majority of responses are anticipated to be short-term, returning to baseline conditions on cessation of surplus water discharge (WRM 2020).

6.6.1.4. Changes to Surface Water Catchments, Flow Paths, Flooding and Sheet Flows from Mine Pits and Infrastructure Placement

Boolgeeda Creek

The Proposal will result in a small overall loss of catchment for Boolgeeda Creek (3.3%). The proportion of catchment reduction is the highest immediately downstream of the proposed development and the proportion reduces as the incremental catchment area increases downstream. As a result, the Proposal would have little effect on the overall hydrological regimes within the creek. The modelled water level difference mapping predicts that there would be less than 0.1 m reduction in flood depths in a 1 in 2 AEP (i.e., 1 in 2 or 50% probability of occurring in any given year) and less than 0.5 m reductions in flood depths in extreme events (up to 1 in 1000 AEP) (Rio Tinto 2021b). These changes are considered very small from a hydrology perspective and would not be expected to cause changes to the associated environmental values.

The proportional catchment loss and annual runoff reduction caused by the Proposal is greatest (up to 9.7%) within the small tributaries of Boolgeeda Creek in the BS1 assessment area that will have a large portion of the catchment developed. There is a corresponding modelled reduction in flooding depths of up to 0.5 m in the 1 in 2 AEP and up to 3 m for extreme flood events (1 in 1000 AEP) immediately downstream of the proposed pits. It is estimated that a reduction in flood depth at Boolgeeda Creek of up to 0.1 m and 0.5 m for the 1 in 2 AEP and 1 in 1000 AEP events respectively in the post-development scenario. These changes will affect the depth and velocity of flood flows; however, catchment runoff is generally high in these rocky arid environments, so the frequency of flooding is unlikely to be affected. Riparian vegetation utilises soil moisture from infiltration of both rainfall and concentrated runoff (i.e., surface flows) which would not be expected to be significantly affected.

The BS1 West sub-catchment and the other small tributaries of Boolgeeda Creek do not contain any pools or semi-permanent water bodies so aquatic or wetland values would not be expected to be affected.

Beasley River

The Proposal will result in the loss of approximately 63 km^2 (approximately 3.1%) of catchment area of Beasley River. Unlike Boolgeeda Creek, the Beasley River has a 43 km^2 internally draining basin within the catchment, and therefore the catchment loss does not result in a proportionate loss in runoff to the Beasley River. Runoff reduction in the upper reaches of Beasley River catchment has been modelled, and, similar to Boolgeeda Creek, the areas that coincide with proposed pits have the largest potential runoff reductions of up to 10.3% for the smallest catchment (Rio Tinto 2021b).

The internally draining area of the upper Beasley River Catchment occurs between the Lens G and Diesel deposits (Figure 6-14) within the BS2 assessment area and is required to be crossed with a haul road. The basin is surrounded by steep embankments and has a low-lying valley at the centre. The design of this haul road, incorporating multiple large culverts across the water drainage path, is anticipated to maintain overland flow in this area and maintain the cultural values identified by the Muntulgura Guruma people in this area.

Similar to Boolgeeda Creek, these catchment losses are not expected to affect environmental values, with the exception of Plunge Pool, which is discussed below.

Duck Creek

The Proposal elements in the Duck Creek catchment are all located in the upper slopes of the catchment, with very little contributing catchment area. The Proposal is also upstream of existing pits and infrastructure (approved under MS 925) and therefore does not further truncate the surface water catchment of Duck Creek. Approximately 7.9% of the Duck Creek catchment (upstream of the confluence with Caves Creek) is already approved to be removed as part of the existing approved

operations. The Proposal will not increase the area of catchment reduction and therefore is not expected to have a significant impact on flows.

Plunge Pool

The Proposal has been amended to ensure the hydrological regime of Plunge Pool is maintained.

The Proposal will result in removing 66% of the Plunge Pool surface water catchment, creating a final catchment area of 7 km^2 (Rio Tinto 2021c). Plunge Pool has an estimated total volume of 1,900 kL, with approximately 700 kL of that being permanent volume supported by groundwater inflow. Therefore, 1,200 kL is required to fill the pool from surface inflows and the frequency of that volume of runoff being generated by the reduced catchment has been calculated (Rio Tinto 2021c). On average, the number of days where the catchment produces sufficient runoff to fill Plunge Pool will decrease from approximately 7 days per year under pre-mining conditions to approximately 4 days per year as a result of the Proposal.

The catchment flow response for a 1:2 AEP event was modelled to estimate the likely change in flows in a rainfall event that would be expected approximately every one to two years. This scale of event was chosen as it is likely that flushing of the pool at this frequency is more important than larger but less frequent events. The results indicated that the pre-mining runoff volume under this rainfall event was 47 ML (25 times the total pool volume of 1,900 kL) which will be reduced to approximately 16 ML (or 8 times the pool volume) as a result of the Proposal (Rio Tinto 2021c). These flows would continue to be sufficient to fill and flush the pool many times over in a regular (approximately annual) flood event.

Based on the above analysis, the Proposal will reduce the contributing catchment of Plunge Pool, however as the pool is groundwater-fed, the pool is expected to persist despite the reduction in surface water catchment contribution. Whilst the frequency of surface water flushing will be reduced, the pool is expected to continue to fill and flush multiple times per year and therefore no significant change to the associated environmental values is anticipated.

Kurwillinha Pool

The Proposal includes mining of the Endeavour deposit, which intersects with the catchment of Kurwillinha Pool (ephemeral surface water gorge pool) and may reduce the pool's contributing catchment by up to two thirds.

The daily runoff was analysed to determine the number of days per year the pool would be expected to fill per year in the pre-development and post-development scenarios (Rio Tinto 2021b). The results suggest that the residual catchment area is large enough to generate sufficient runoff to fill Kurwillinha Pool at the same frequency as baseline conditions, i.e., one to two days per year. A sensitivity analysis was undertaken, and even the most conservative scenarios indicated the potential for a 0.1% absolute reduction in the exceedance probability for daily runoff with sufficient volume to fill Kurwillinha Pool.

Therefore, due to the small volume of catchment runoff required to fill the pool and the frequency of full water level recovery, the persistence of Kurwillinha Pool is unlikely to be impacted by the proposed reduction in the contributing catchment area.

6.6.2. Assessment of Indirect Impacts

6.6.2.1. Changes to Surface Water Quality Within Pools Downstream from Surface Water Discharge Points

Groundwater that is abstracted during dewatering activities and discharged to Duck and Boolgeeda Creeks has a neutral pH and is classified as ‘fresh’. The Proposal will continue the requirement to discharge to these creek systems.

Water quality comparisons of groundwater to surface water in the receiving environment indicate that discharge from the Proposal presents the following risk to aquatic fauna (zooplankton, hyporheos, macroinvertebrates and fish) (WRM 2020):

- Moderate-high risk of periodic habitat degradation/alteration from:
- Eutrophication due to nitrate and phosphorus enrichment
- Sedimentation due to elevated TSS
- Low-moderate risk of habitat reduction due to calcite precipitation
- Low-moderate risk of periodic direct toxicity from nitrate and dissolved barium enrichment.

The key environmental receptor for these changes are aquatic fauna. The sensitivity and response of fauna to potential changes to water quality are uncertain and therefore, it has been assumed for the purpose of this impact assessment that habitat modification will occur within the existing approved Boolgeeda Creek discharge extent (37 km from the discharge outfall) and the Duck Creek discharge extent, which is proposed to be limited to 67 km from the discharge outfall. Modification of the aquatic fauna habitat of Boolgeeda and Duck Creek is expected to be localised to the discharge wetting front (WRM 2020). As no species is limited to the impact area, there is not expected to be any loss of aquatic diversity in the region as a result of surface water discharge impacts.

Semi-permanent and permanent pools are ‘exceptionally important’ refugia during drought periods, supporting a diverse and abundant aquatic flora and fauna (WRM 2019). There are no semi-permanent pools within the wetting front of Boolgeeda Creek. The pools in Duck Creek that are situated within the proposed wetting front are not expected to experience long term water quality changes.

Surplus discharge to creeks will continue to affect the ephemeral creekline habitat within Duck and Boolgeeda Creek for the duration of the proposed surplus water discharge until pit voids become available to support surplus water storage and passive aquifer recharge. These ephemeral creekline habitat types were assessed by WRM (2019) as Medium to Low conservation value and all aquatic values found within the wetting fronts occur beyond the impact area.

The water quality risks from surplus discharge are consistent with the managed risks of the approved operations discharges to Boolgeeda and Duck Creek. The provisions of the existing approved EMPs have been included in the consolidated EMP for the Amended Proposal and include consideration of the following in relation to water quality, together with the objective that no long-term impacts occur to these creek systems:

- Quality of water being discharged
- Prevention of erosion at the discharge location and downstream reaches
- Minimise eutrophication and algal growth in downstream pools
- Avoid carbonate precipitation and deposition in downstream reaches.

Existing management is considered sufficient to manage the identified risks and achieve the objective of no long-term impacts to the creek systems.

6.6.2.2. Impacts to Groundwater or Surface Water Quality as a Result of PAF Exposures in Pit Walls, Waste Rock Landforms and Waste Fines Storage

The risk of surface water contamination from the potential seepage of AMD will be minimised by continuing to implement the current approved operations management, monitoring and contingency measures. Management measures to be implemented include constructing bunding to reduce surface runoff flowing over potentially exposed PAF material and storing waste material in appropriately designed WRLs.

A Mineral Waste Management Plan and SCARD Management Plan is currently being implemented for existing operations and will continue to be implemented as part of the Proposal to ensure waste material

is adequately geochemically characterised in line with existing operational procedures which will ensure that any PAF material encountered for the Proposal that poses an AMD risk is appropriately managed. As per the existing operations, this will involve encapsulating PAF waste with inert material within the WRL and constructing a 'store and release' cover on the top surface to reduce water percolating through the WRL. Regular groundwater monitoring will continue to be undertaken in PAF excavation and/or storage areas.

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 (KCB 2021).

In-pit WFSFs are proposed to be established in Lens A, Pit 8 and Pit 5 (Figure 2-4). These pits have sufficient capacity to accept the LOM waste fines (KCB 2021).

Pit 8 has some exposed PAF in the pit walls, comprised of pyritic Mount McRae Shale, which can oxidise and generate AMD upon contact with oxygen and water. It is noted that the vast majority of the pit wall is NAF and may release alkalinity via dissolution of carbonates and silicates (Rio Tinto 2021e). Simplified water quality modelling for concentrations of nitrate and sulfate due to runoff over exposed PAF in Pit 8 indicates that elevated concentrations may occur during early operation (where pit wall exposure is greatest). Still, these concentrations will reduce as filling of Pit 8 occurs. The model indicates that ANZECC stock water quality criteria would be met by water in the Pit 8 tailings pond during operations (KCB (2021).

Though the tailings do not have significant neutralising capacity, they are neutral with a pH of 7.4. When the mildly acidic runoff from pit walls comes in contact with tailings water, it has the potential to lower the pH of the tailings water, but only slightly, to below 7.4. The pH of the TSF pond in Pit 8 is expected to reach equilibrium at a pH of around 7.7. Therefore, issues with acidity are not expected. Based on the Rio Tinto (2021e) assessment, the risk of developing acidic conditions in the WFSF Pit 8 is considered low to negligible. Monitoring will be implemented to ensure that the predicted outcomes are as expected.

It is noted that the proposed in-pit WFSFs in Lens A, Pit 5 and Pit 8 will require a Part V licence approval. Detailed information required to support the assessment includes design information, emissions and modelling of impact pathways as well as ongoing management and monitoring. The WFSF management is also addressed in the Mine Closure Plan required under the State Agreement.

6.6.2.3. Post Closure Formation of Pit Lakes

The Proponent commits to avoiding significant ecological risk posed by the permanent pit lakes proposed to remain at closure. All proposed pits with a closure AMD risk of moderate or high will be backfilled to above post mining recovered water levels in line with the MCP completion criteria. Backfilling will enable covering of any potential exposures of PAF and therefore reduce the risk of AMD at closure (Rio Tinto 2020a).

Based on a combination of the groundwater modelling and the analytical water balance method, pit lakes are predicted to form in 5 of the 32 BWT pits for the Proposal. The modelling of equilibrium lake levels and long-term total dissolved solids is presented in RPS (2021b). The BWT pits that are not predicted to form pit lakes are either adjacent to deeper BWT pits or located in aquifer compartments with minimal recharge and low groundwater level recoveries. Rainfall may pond for a short duration at the base of these pits but will ultimately infiltrate into the unsaturated zone below the pit or evaporate (RPS 2021b).

All proposed pit lakes are modelled to form groundwater sinks and therefore there will be no migration of groundwater below pit lakes to other aquifers or environmental receptors (RPS 2021b).

6.6.2.4. Increased Sediments from Infrastructure and Drainage

As mining is proposed within the Plunge Pool catchment, there is potential for sediment to be mobilised and transported downstream into the pool. Modelling of the potential for sediment to be mobilised in the catchment indicates that the reduced catchment will reduce flow rates, stream power and hence erosion potential (Rio Tinto 2022a). However, mining activities are still expected to increase sediment concentrations in the channel upstream of Plunge Pool during the construction and operational period. Therefore, leaky weir sediment traps (or similar) are proposed to be constructed at multiple locations along the main drainage line leading to Plunge Pool to minimise any suspended sediment reaching Plunge Pool. The leaky weirs will be placed immediately downstream of mining activity.

The risk of sedimentation to Plunge Pool is expected to reduce post closure as the rehabilitated landforms will be designed to contain incidental rainfall on the landform itself. For example, for WRLs, this will be achieved through crest bunds on each lift and a toe bund around the perimeter of the landform. In addition, abandonment bunds around pit void landforms would also hold back any residual sediment from runoff.

The sedimentation assessment focussed on the 1:2 AEP events. Larger, less frequent floods would have higher stream power with the ability to mobilise and transport a higher sediment load towards Plunge Pool. These events will however also have sufficient flushing capacity to mobilise and transport sediment through Plunge Pool (Rio Tinto 2022a).

The potential for increased sediment loads in runoff throughout the Development Envelope is expected to be effectively managed and therefore, no significant change to sediment load downstream of infrastructure is expected.

6.6.3. Assessment of Cumulative Impacts

The cumulative impacts of the Proponent's approved and proposed mining activity in the Development Envelope have been considered in the assessment of the Proposal impacts.

A groundwater supply borefield at the FMG Flying Fish deposit is located directly north of BS1 and therefore the Proponent's groundwater modelling has included this abstraction in the cumulative assessment of groundwater drawdown. The modelling showed that due to aquifer compartmentalisation, the combined drawdowns increased the depth but not the extent of predicted drawdown. As no GDEs have been identified in this area or are unlikely to occur given the topography and depth of groundwater, no environmental values are expected to be impacted by this potential cumulative impact.

No other projects include groundwater abstraction that are connected to the Brockman Syncline aquifers.

The cumulative catchment loss in Boolgeeda Creek as a result of the Proposal and the FMG Flying Fish Deposit is 11.4%; with 8.1% loss estimated from FMG and 3.3% loss from the Proposal.

The magnitude of the impact progressively reduces with increasing distance downstream as additional catchment area from undisturbed areas is incrementally increased. The proportion of catchment loss to Boolgeeda Creek is greatest in the vicinity of BS1, where the upper catchment is expected to be lost due to FMG's Flying Fish deposit. Catchment loss in this area is anticipated to result in a runoff reduction of 18.5% in Boolgeeda Creek at this location (Rio Tinto 2021b). These changes will affect the depth and velocity of flood flows; however, catchment runoff is generally high in these rocky arid environments, so the frequency of flooding is unlikely to be affected. There are no pools or surface water dependent ecosystems identified in the upper reaches of Boolgeeda Creek and therefore, no environmental values are expected to be impacted as a result of this reduction.

Strategies to reinstate natural surface flow through the BS1 assessment area will be investigated through the closure planning process and include permanent surface water diversions and buttressing

of pits where practical. This work is predicated on the hydrological regime from the upstream areas of FMG's Flying Fish deposit not reducing or truncating flows.

6.6.4. Significance of Residual Impacts

6.6.4.1. Non-Significant Residual Impacts

The proposed avoidance and management measures associated with the Proposal, that demonstrate non-significant residual impacts to Inland Waters include:

- No other third-party bores exist within the Brockman Syncline aquifers. As groundwater drawdown is constrained within the syncline, there will be no predicted impact on other users beyond the syncline
- Groundwater levels that support the base water level in Plunge Pool (which has been placed in a MEZ) will be maintained by:
    - Limiting mining at the BS3 deposits (1 km north of Plunge Pool) to AWT
    - Backfill of the BS3 Extension deposits (MM-J and Creekside, 9 km northeast of Plunge Pool) to above post mining recovered water levels to minimise long-term drawdown in the upstream aquifer; and minimise any potential for a reduction in groundwater contribution to the Plunge Pool aquifer compartment.
    - A catchment area of no less than 7 km^2 will be maintained within the catchment that supports Plunge Pool to ensure flushing of the pool.
- Discharge to Boolgeeda Creek will be limited to within a 37 km wetting front as previously approved (MS 1000)
- Discharge to Duck Creek will be limited to within a 67 km wetting front (previously assessed under MS 925), noting that a formal wetting front is being proposed as part of a modernisation to conditions
- Infrastructure will be placed in a manner that will allow natural low flow paths and functioning of Boolgeeda and Duck Creek will be maintained within the Development Envelope
- Five pit lakes are expected to form from the Proposal (7 as a result of the Amendment Proposal) and are likely to be groundwater sinks. Backfill will be prioritised in the remaining pits should PAF be predicted to be of a high risk to environmental receptors
- Pits utilised for the surplus storage of water will be selected on the basis of pits where this would not expect to cause groundwater mounding in areas of shallow watertables
- The waste fines solids are likely to be NAF and considered low risk given the neutral pH of the supernatant and NAF solids
- There are no known sensitive receptors within the immediate vicinity of Lens A, Pit 8 and Pit 5, thus making them suitable for in-pit WFSFs.

6.6.5. Summary of Assessment and Proposed Regulatory Mechanisms

A summary of the Inland Waters assessment and the Proposed conditions and applicable DMA regulations is provided in Table 6-12.

Table 6-12: Assessment Findings and Proposed Regulatory Mechanisms for Inland Waters

Residual impact or risk to environmental value	Assessment finding	Proposed conditions and DMA regulation
Lowering of groundwater levels as a result of mine pit dewatering and closure	Groundwater drawdown is mostly within areas with deep watertables, and the extent of drawdown is limited by cross cutting dykes which create hydrogeological barriers and compartmentalise the aquifers. Potential impacts to GDV and stygofauna are addressed in Section 7 and 9. Drawdown from the FMG and Rio Tinto operations have the potential to overlap at the BS1 assessment area, which may affect the pit inflow and/or bore abstraction rates at both operations, depending on abstraction rates and timing. This potential will be managed effectively through the licensing process and negotiations between the two parties.	Proposed to be regulated through implementation conditions: • Annual dewatering limit. Other DMA processes: • RiWI Act - Groundwater abstraction will be regulated through a groundwater licence and operating strategy.
The Proposal will avoid adverse impacts to the hydrological regime of Plunge Pool from groundwater abstraction	Plunge Pool is a culturally and environmentally important pool that is reliant on groundwater for base water levels and surface water inflows. The pool is separated from all mine pits by dolerite dykes which form hydrologic barriers, however due to risk relating to potential for localised hydraulic conductivity, the application of the mitigation hierarchy has been required to ensure that the pool and its values are protected. The Proposal has been modified to include backfill of two upstream pits and limit mining to AWT at the BS3 deposit A condition is proposed to ensure the Plunge Pool water levels are not affected by mine dewatering thus ensuring consistency with the EPA objective.	Proposed to be regulated through implementation conditions: • Limit mining at BS3 deposit to AWT • Backfill BS3 Extension pits (MM-J and Creekside) to above post mining recovered water levels to minimise long-term drawdown in these upstream aquifers • The outcome “No measurable drawdown of groundwater levels at Plunge Pool as a result of mine dewatering attributable to the Proposal” is anticipated as an outcome based condition in the MS. Outcome based management provisions are included in the EMP to demonstrate this outcome is met. Other DMA processes • Backfilling of BS3 Extension deposits (MM-J and Creekside) to above post mining recovered water levels is included in the Mine Closure Plan.
Surface water management in Plunge Pool catchment	The Proposal will result in the removal of 66% of the Plunge Pool catchment creating a final catchment area of 7 km^2. The pool is expected to continue to fill and flush multiple times per year and no change to environmental values is anticipated. Mining activity in the Plunge Pool catchment may cause sediment runoff	Proposed to be regulated through the following implementation conditions: • Minimise changes to the hydrological regime of Plunge Pool to ensure environmental and cultural heritage values are maintained. • Avoid where possible and otherwise minimise impacts to water quality and

Residual impact or risk to environmental value	Assessment finding	Proposed conditions and DMA regulation
	and installation of surface water management infrastructure such as leaky weir sediment traps are proposed to ensure there is no increase in sedimentation of Plunge Pool as a result of mining.	sedimentation in Plunge Pool as a result of the Proposal.
No increase in the approved surplus water discharge to Boolgeeda Creek No material changes in the approved surplus water discharge to Duck Creek. Introduction of a 67 km wetting front limit.	Water quality and fauna assemblages will continue to be affected within the wetting fronts associated with surplus water discharge to Duck and Boolgeeda Creeks. No aquatic fauna is limited to the wetting fronts and impacts are short-term, returning to baseline conditions on cessation of discharge. Surplus water discharge has been minimised through mine scheduling and preferred discharge to completed mine pits.	Proposed to be regulated through the following implementation conditions: • Limits on discharge volumes and wetting fronts • Monitoring of water quality and vegetation health in the creeks will continue to be monitored as per the updated EMP.
Linear infrastructure interrupting overland through in the broad valley between Lens G and Diesel deposits	Overland flow between Lens G and Diesel has been identified as supporting culturally important values. The potential for overland flow to be affected by the Lens G haul road will be mitigated through the installation of culverts. This management and monitoring have been included in the EMP.	Proposed to be regulated through the following implementation conditions: • Conditioned objective “To minimise interruption to overland flow as a result of the Lens G haul road” and a condition requirement to meet this management requirement in the EMP.
Potential impacts to groundwater quality from PAF in waste landforms and WFSF will be effectively managed	The majority of material is non-acid forming and identified PAF can be effectively managed through existing and well-established operational measures such as encapsulation in waste landforms. DMA legislation (Part V EP Act) will undertake review and assessment of the impacts from prescribed facilities and waste landforms and regulate the construction design and operation of these facilities, and condition emissions and discharges.	No Part IV implementation conditions required as this is effectively managed through other DMA processes: • Ongoing waste characterisation, management and monitoring included in the Mine Closure Plan. • Part V of the EP Act – works approval and licence to manage emissions and discharges from prescribed premises
Pit lakes will form at closure but are not expected to adversely affect any environmental values.	The closure strategy includes backfilling of any pits with a closure AMD risk of moderate or high to above post mining recovered water levels as per the MCP.	Other DMA processes: • The backfill strategy is included in the Mine Closure Plan and will be continually refined in response to ongoing materials characterisation.

6.7. 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 and objectives that apply to Inland Waters are set out below.

6.7.1.1. Plunge Pool

The following environmental outcomes are proposed in relation to Plunge Pool:

- No measurable drawdown of groundwater levels at Plunge Pool as a result of mine dewatering attributable to the Proposal
- Minimise changes to the hydrological regime of Plunge Pool to ensure environmental and cultural heritage values are maintained.

The following environmental objectives are proposed in relation to Plunge Pool:

- Avoid where possible and otherwise minimise impacts to water quality and sedimentation in Plunge Pool as a result of the Proposal.

To meet the requirements of the above the Proponent intends to implement an EMP, SCHMP and MCP that incorporates the following as a minimum:

- No mining activity within the Plunge Pool catchment unless culturally safe mining in some areas is mutually agree with the Muntulgura Guruma People. This applies specifically to the BS3, MM-J and Orbe deposits and associated landforms.
- No construction of waste rock landforms in the area immediately north of the Plunge Pool catchment
- Should mining within the Plunge Pool catchment be mutually agreed with the Muntulgura Guruma People:
    - Limit mining of the BS3 deposit (1 km north of Plunge Pool) to AWT
    - Backfill BS3 Extension deposits MM-J and Creekside (9 km northeast of Plunge Pool) to above the post-mining recovered groundwater level at closure
    - Ensure that the surface water catchment of Plunge Pool is maintained to the extent that environmental and cultural heritage values are not compromised.
- Agreed measures to monitor the health of the catchment that corresponds to its cultural values in agreement with Muntulgura Guruma
- Subject to access to Plunge Pool being approved by the Muntulgura Guruma People:
    - Undertake at least two years of water quality and sediment monitoring at Plunge Pool to establish site specific water quality thresholds prior to mining BS3 and/or Creekside deposits
    - Undertake at least two years of bathymetric monitoring of Plunge Pool to establish site specific sedimentation thresholds prior to mining BS3 and/or Creekside deposits
- Details of the mining methods and limits that are deemed culturally safe prior to mining commencing.

6.7.1.2. Inland Waters and Vegetation – Dewatering and Discharge

The following environmental outcomes are predicted in relation to dewatering and discharge:

- Discharge of surplus water as a result of mining does not cause long term impacts on the environmental values of the Boolgeeda and Duck Creek systems
- Ensure water discharged to Boolgeeda and Duck Creek meets specified agreed water quality requirements developed in accordance with the Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG 2018) framework or its revisions.

To meet the above outcomes, the Proponent shall ensure that:

- Discharge to Boolgeeda Creek under natural no flow conditions (wetting front) does not extend further than 37 km downstream of the discharge location (Figure 2-7)
- Discharge to Duck Creek under natural no flow conditions (wetting front) does not extend further than 67 km downstream of the discharge location (Figure 2-7).

The Proponent will implement the EMP as per Appendix B.3 to meet these outcomes.

After implementation of the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to Inland Waters. Accordingly, the Proponent considers the Proposal can be managed to meet the EPA's objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

7. FLORA AND VEGETATION

7.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021b) lists the following as their objective for Flora and Vegetation:

To protect flora and vegetation so that biological diversity and ecological integrity are maintained

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.

7.2. Relevant Policy and Guidance

Table 7-1 presents relevant policy and guidance for flora and vegetation and demonstrates how this has been considered for the Proposal.

Table 7-1: Relevant Policy and Guidance for Flora and Vegetation

Policy and Guidance	Explain How the Policy and Guidance have been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021b)	The EPA objective for flora and vegetation 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: Flora and Vegetation (EPA 2016a)	Considered in the design (methods and approach) of flora and vegetation surveys
EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b)	
Instructions on how to prepare an Environmental Review Document (EPA 2021d)	This document forms the basis of the headings and content provided in this ERD, that has been prepared by WA EIA practitioners
Instructions on how to prepare *Environmental Protection Act 1986* Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports (EPA 2021h)	Considered in the impact assessment and offset strategy for flora and vegetation
Template for *Environmental Protection Act 1986* Part IV Reconciliation Procedures (EPA 2021i)	
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

Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans (EPA 2021f)	The EMP has been prepared in accordance with the instructions and addresses relevant matters related to flora and vegetation (Appendix B.3)
Other State or Commonwealth	
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 flora and vegetation (Appendix B.4)
Statutory Guidelines for Mine Closure Plans (MCP) (DMIRS 2020b)	
WA Environmental Offsets Policy (Government of Western Australia 2011)	Considered in the impact assessment and offset strategy for flora and vegetation
WA Environmental Offsets Guidelines (Government of Western Australia 2014).	

7.3. Receiving Environment

7.3.1. Studies and Survey Effort

Over 300 flora and vegetation surveys have been undertaken within or overlapping the Proposal dating back to the late 1990s. As such, the Proponent has an in-depth understanding of the environmental values within and surrounding the Proposal.

Table 7-2 summarises the Proposal specific and other relevant regional surveys and studies undertaken for flora and vegetation. See Appendix D.1 to D.6 for key studies and survey reports. Figure 7-1 illustrates the spatial extent of the various surveys, whilst Figure 7-2 depicts the survey effort.

Table 7-2: Summary of Technical Studies for the Flora and Vegetation Environmental Factor

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Greater Brockman Syncline: Consolidated Vegetation Type and Condition Mapping (Stantec 2021; Appendix D.1)	**Study/Survey area:** The Development Envelope consists of previously mapped and unmapped areas of the Greater Brockman Operation hub. The consolidated vegetation mapping covered an area of 76,199 ha. This area has been ground truthed by multiple surveys in the last five years. **Type:** Desktop assessment and multi-phase ground-truthing, consolidation of previous and current vegetation type and condition mapping. The consolidated vegetation mapping layer was compiled using data from 58 surveys within the Development Envelope. **Timing:** 17 to 29 May, 11 to 23 August and 26 to 31 August 2019.	Survey meets relevant EPA policy and guidance. Survey approach and method were undertaken with consideration of the following: Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b) The following limitations and constraints associated with this report are detailed below: • In order to consolidate the mapping from previous reports, vegetation types and condition have been extrapolated based on aerial imagery and surrounding habitat types. To validate the mapping, the whole survey area has been ground truthed within the last five years • The confidence of this consolidation mapping is limited by the quality, consistency, scope, seasonal conditions and dates of the previous reports • Despite the above limitations, consolidation of 58 previous reports and surveys followed by three phases of ground truthing field survey led by Alice Bott (10 years' experience) and supported by Julia Mattner (20 years' experience) has provided a comprehensive understanding of flora and vegetation values across the Development Envelope and surrounds and is considered sufficient to meet the EPA requirements and objectives of the study.
Brockman Syncline Riparian Vegetation Survey Duck Creek (Biologic 2021b; Appendix D.2)	**Study/Survey area**: Duck Creek, 120 km watercourse located approximately 53 km northwest of Tom Price. **Type:** Desktop assessment and detailed riparian flora and vegetation assessment over two seasons, Phase 1 and Phase 2. Sixty-six quadrats were surveyed in both 2019 and 2020. **Timing:** 15 to 21 October and 24 October to 1 November 2019 (Phase 1) and 12 to 19 June 2020 (Phase 2).	Survey meets relevant EPA policy and guidance. Survey approach and method were undertaken with consideration of the following: • Statement of Environmental Principles. Factors and Objectives (EPA 2021b) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016a) • Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b) • Environmental Factor Guideline: Inland Waters (EPA 2018) • Establishing Vegetation Transects (DEC 2009). The following limitations and constraints associated with this report are detailed below:

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
		• The phase one survey followed below-average rainfall, which hindered the ability to confirm taxonomic identifications • Due to the global pandemic, transects were unable to be resampled during the phase two survey • Some portions of the study area were inaccessible by vehicle, and quadrats were unable to be established • Some portions of Duck Creek were flooded during the phase two survey, which led to an underrepresentation of flora on creek banks than anticipated • Some quadrats were re-scored on one side only due to inaccessibility as a result of flooding • Despite the above, the study, led by Principal Botanist Clinton van den Bergh (over 10 years' experience), was of a sufficient level to meet EPA requirements and objectives of the survey (Biologic 2021).
Brockman Syncline Proposal (Revised Operations) Baseline Groundwater Dependent Ecosystem Exposure Assessment for the Greater Brockman Operations (Biologic 2021a; Appendix D.3)	**Study/Survey area:** Greater Brockman Operations hub, which encompasses the Development Envelope. **Type:** Desktop and targeted field survey assessment to identify riparian vegetation indicative of potential GDEs and assess their sensitivity/significance and thus exposure to potential impacts of groundwater drawdown or changes to catchment attributable to the Proposal. **Timing:** No field survey was conducted.	N/A – The EPA has developed no guidance specific to this type of study. Based on relevant EPA guidance, the study has drawn on hydrogeological, hydrological, and vegetation studies for the Proposal and utilised the experience of GDE experts from Rio Tinto and Biologic. For this EIA the classification of GDEs in this ERD is based on the results of this report as the most in-depth investigation conducted to identify and assess GDEs. It is noted that this work builds on previous vegetation survey data and supersedes the general identification of potential GDE's in Stantec (2021) Consolidated Vegetation Mapping report. The following limitations and constraints associated with this report are detailed below: **Riparian Vegetation - Flora & Vegetation Factor** No limitations or constraints identified – a targeted flora and vegetation survey was conducted as per the Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). **Inland Waters Factor** In the absence of a prescriptive methodology for industry use the Proponent has developed a risk assessment methodology for the detection and assessment of GDEs specific to the Pilbara. Similar risk assessment approaches are utilised in GDEs assessments being

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
		conducted in eastern states of Australia. This approach initially identifies and then aims to quantify potential impacts to riparian ecosystems by providing an initial indication of significance of these features at a local and regional scale. **Groundwater Dependent Ecosystem detection** The Proponents approach to GDE detection utilises a multi-step qualitative and quantitative assessment leveraging, NDVI persistence analyses, the use of high-resolution aerial photography for the assessment of vegetation structure and overstorey composition, eco-physical characteristics (for example landform, landscape position), available groundwater height data and conceptual understanding of relevant hydrogeology/topography. These are supported by targeted field survey of key riparian characteristics and composition of key potential GDE features identified by the above evidence. As with all technical studies some limitations exist, these are listed below: Vegetation persistence mapping (remote sensing) • There is potential for minor inaccuracies in the persistence ranges used to delineate riparian vegetation and GDE classes (e.g., classification between ephemeral riparian, inflow dependent ecosystems, potential GDE and GDE). Aerial photography interpretation • Variability in the spectral characteristics, resolution and timing of aerial photography capture, which may impact the accuracy of the interpretation of riparian vegetation structure and composition. Groundwater • Groundwater tables in relevant bores adjacent to features of interest were assumed to be flat. • Constraints surrounding the available network of groundwater monitoring bores in targeted areas. This also intersects with challenges surrounding the interpretation of the available suite and scale of surface water and groundwater sources (noting that a number of these sources cannot be detected by traditional monitoring infrastructure). It is noted that these limitations are also true for the traditional approach to GDE detection.

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
		Riparian ecotype classification framework The riparian ecotype classification framework uses the presence absence data for a list of mesic/hydric indicator species to support classification of riparian features into ecotypes. These ecotypes are assigned a significance rating based on degrees of representation and environmental values listed in the factor guideline for Inland Waters including, but not limited to, springs, pools, wetlands, ecosystems that support significant flora, vegetation, fauna species and cultural values. The framework was developed due to the absence of an accepted and robust framework for estimating degrees of representation and significance for riparian ecosystems in the Pilbara for environmental impact assessment. The Proponent proposes the use of this framework to provide a transparent, consistent, and repeatable approach which helps to contextualise the consequences of any potential impacts to inland waters supported features. Typically, a key limitation of the ecotype classification framework utlised is that it does not adequately address internally draining riparian features. For the study in question, no internally draining (or similar) riparian features were highlighted by the assessment, so this limitation is not applicable to this study The Proponent notes that the EPA considers the riparian ecotype classification framework a novel framework. The Proponent is in the process of commissioning a peer review of this framework and will seek advice from EPA to define the scope of the peer review. The above limitations are not considered significant, and the method used is consistent with the EPAs objective for this factor.
Brockman Syncline Riparian Vegetation Survey Boolgeeda Creek (Biologic 2020c; Appendix D.4) Prepared for Rio Tinto	**Study/Survey area:** A 48 km stretch of Boolgeeda Creek, located within the Ashburton River basin and Duck Creek sub-catchment. **Type:** Desktop assessment and detailed riparian flora and vegetation assessment over two seasons, Phase 1 and Phase 2. Forty quadrats were sampled in 2019, and 24 resampled in 2020.	Survey meets relevant EPA policy and guidance. Survey approach and method undertaken with consideration of the following: • Statement of Environmental Principles. Factors and Objectives (EPA 2021b) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016a) • Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b) • Environmental Factor Guideline: Inland Waters (EPA 2018)

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
	Timing: 17 to 20 October and 27 October to 3 November 2019 (Phase 1) and 18 to 19 June 2020 (Phase 2).	• Establishing Vegetation Transects (DEC 2009). The following limitations and constraints associated with this report are detailed below: • Foot traverses were used to complete the survey for a large portion of the study area due to inaccessibility • The phase one survey was undertaken followed below-average rainfall, which resulted in an underrepresentation of the flora expected to occur • Due to the global pandemic, time allocation for the resampling of quadrats was impacted in the phase two survey, with a total of 29 quadrats unable to be resampled • None of the above were considered significant. The survey was led by Principal Botanist Clinton van den Bergh (over 10 years' experience), completed to a sufficient level to meet EPA requirements and the scope and objectives of the survey were addressed in full (Biologic 2020).
Brockman 2 Deposits Detailed Flora and Vegetation Survey: Phase 1 and 2 (Biota (2019a; Appendix D.5) Prepared for Rio Tinto	**Study/Survey area:** BS2 (comprising BS2 Southwest tenure, BS2 Southwest non-tenure, BS2 West Extension and Maybelline), and Lens G/Diesel (comprising of Pit 14, Lens G, Lens G non-tenure, Diesel, Sandalford Monkey, BS3 and BS3 Extension). **Type:** Two phased detailed flora and vegetation survey. One hundred and fifty-six sites were surveyed, comprising 96 quadrats and 60 relevés. **Timing:** October 2018 and March 2019.	Survey approach and methodology were undertaken with consideration of the following: • Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016a). Surveys were undertaken by Pierre-Louis de Kock (11 years' experience), Michi Maier (27 years' experience – Phase 1 only), Brian Morgan (18 years' experience) and associated botanists.
Flora and Vegetation Assessment: Boolgeeda Valley, Pilbara, WA (Mattiske 2019) Prepared for Rio Tinto	**Study/Survey area:** Boolgeeda valley area. **Type:** Single Phase Level 2 flora and vegetation survey. Two hundred and two sites (quadrats) were surveyed. **Timing:** May 2019 and June 2019	Survey approach and methodology were undertaken with consideration of the following: • Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016a). All botanists conducting field surveys had extensive experience working within the Pilbara region.

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Greater Brockman 4 Sustaining Tonnes Project: Detailed Flora and Vegetation Survey 2019 (Stantec 2019; Appendix D.6) Prepared for Rio Tinto	**Study/Survey area:** BS1, BS1 Extension Area, Vivash, Infrastructure corridors (BS1 Eastern Corridor, Central Corridor and BS3). **Type**: Two season detailed flora and vegetation surveys. One hundred and fifty-two sites were surveyed, comprising of 113 quadrats and 39 relevés. **Timing:** May 2019 and August 2019.	The survey approach and methodology were undertaken with consideration of the following: • Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b). Both Phase 1 and Phase 2 of the Survey were led by Alice Bott (Nine years' experience) and supported by Julia Mattner (20 years' experience).

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Figure 7-1
Spatial Extent of Flora and Vegetation Surveys Conducted for the Proposal

Drawn: L.Fuentes
Plan: PDE0189764v5
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Flora and Vegetation Surveys

- Multiple-phase detailed survey
  Biota Environmental Sciences 2012, 2013, 2019;
  Stantec 2019;
  Biologic Environmental Survey 2020, 2021
- Single-phase detailed survey
  Biota Environmental Sciences 2010, 2011, 2013, 2014, 2016;
  Mattiske Consulting Pty Ltd 2019
- Systematic Flora Survey
  Biota Environmental Sciences, 2013;
  Eco Logical Australia and Rio Tinto, 2014
- Targeted Survey
  Biota Environmental Sciences, 2011

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000 540,000 560,000
7,540,000 7,520,000 7,500,000

Mount Brockman Road
Silvergrass Road
Silvergrass
Monitoring Survey
Targeted Survey
Nammuldi
Brockman_2
Brockman 4
Systematic Flora Survey
Single-phase Detailed Survey
Multiple-phase Detailed Survey
Targeted Survey
White Quartz Road
Munjina Road
Western Turner Syncline
NVCP-level biological assessment

RioTinto

Figure 7-2
Survey Effort
for the Proposal

Drawn: L.Fuentes
Plan: PDE0189666v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Survey Effort

- Transect
- Quadrat
- Releve
- Photography
- Mapping Note
- Other

- Rio Tinto Mine
- Major Creek
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Homestead Silvergrass Road
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
White Quartz Road
Nanutarra - Munjina Road
Western Turner Syncline

7.3.2. Vegetation

7.3.2.1. Pre-European Vegetation

The Development Envelope intersects five vegetation associations mapped by Beard (1975). The vegetation associations were defined from broad vegetation mapping of Western Australia (WA), completed on a broadscale (1:1,000,000 and 1:250,000) by Beard (1975). 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 associations.

Figure 7-3 spatial presents and Table 7-3 summarises these five vegetation associations' current and pre-European extent.

Table 7-3: Pre-European Vegetation Types within the Development Envelope

Vegetation Association and Description	Extent within the Hamersley Subregion (ha)			Pre-European Extent with Formal Protection*	Extent within the Development Envelope	
	Pre-European (ha)	Current (ha)	% Remaining	(%)	(ha)	(%)
Hamersley_18 Low woodland; mulga (*Acacia aneura*)	581,246.1	576,541.7	99.1	19.5	10,729.5	1.9
Hamersley_29 Sparse low woodland; mulga, discontinuous in scattered groups	172,082.6	170,747.6	99.2	11.2	11,078.5	6.5
Hamersley_82 Hummock grassland, low tree steppe; snappy gum over *Triodia wiseana*	2,177,573.9	2,165,224.2	99.4	12.0	19,213.0	0.9
Hamerlsey_175 Short bunch grassland – savanna/grass plain (Pilbara)	93,039.8	92,751.1	99.7	0.0	8,949.5	9.6
Hamersley_567 Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & *Triodia basedowii*	776,824.0	774,213.0	99.7	22.4	13,373.5	1.7
Total					**63,343**	**20.6**

**Proportion of vegetation association within the conservation estate*

RioTinto

Figure 7-3
Pre-European Vegetation Associations

Drawn: L.Fuentes
Plan: PDE0189674v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road

Vegetation Associations (Beard 1970)

- Hamersley - 18
- Hamersley - 29
- Hamersley - 82
- Hamersley - 175
- Hamersley - 567

N

0 2 4 6 8 10

Kilometres

Map units in metres

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520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Homestead Silvergrass Road
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

7.3.2.2. Vegetation Types

Over 300 flora and vegetation surveys have been conducted across the Development Envelope and surrounds. Findings of these surveys have been reviewed with reference to the current EPA guidance and where relevant, consolidated into a single report encompassing an area of 76,198 ha (Stantec 2021a).

One hundred and twelve (112) vegetation types and six mosaics have been described within the consolidated vegetation mapping area, of which 104 occur within the Development Envelope (Stantec 2021) (Figure 7-4 and Table 7-4). In undertaking the analysis underpinning the consolidation process, some areas mapped according to a particular vegetation code were deemed suitable to be matched with another as part of a two-code mosaic; thus, 'mosaic' is denoted in Table 7-3 where appropriate.

Dominant vegetation types include:

- **P17**: *Eucalyptus leucophloia* subsp. leucophloia (*Corymbia deserticola* subsp. deserticola and *C. hamersleyana*) scattered low trees and/or *E. gamophylla* scattered low mallees over *Acacia atkinsiana, A. exigua* and *A. bivenosa* shrubland over *Triodia epactia* and/or *T. wiseana* hummock grassland (occupying 7,409.8ha (17.0%) of the Development Envelope)
- **H26**: *Eucalyptus leucophloia* subsp. leucophloia scattered low trees over *Acacia maitlandii* shrubland over *Triodia wiseana* open hummock grassland (occupying 6,333 ha (14.5%))
- **P24**: *Corymbia deserticola* subsp. deserticola scattered low trees to low open woodland over *Eucalyptus gamophylla* low open mallee woodland over *Acacia exigua* and *A. atkinsiana* (A*. kempeana*) tall open shrubland over *Triodia wiseana* and *T. epactia* open hummock grassland (occupying 2,920.2 ha (6.9%) of the Development Envelope).

Table 7-4: Vegetation Types

Vegetation Type	Vegetation Code	Description	Total Extent in Survey Area (ha)	Total Extent in Development Envelope (ha)*	Representative Photographs
Acacia 'aneura' Woodlands and Shrublands					
A1	AanAayTeTw	*Acacia 'aneura'* and *A. ayersiana* low woodland over *Triodia epactia* and *T. wiseana* open hummock grassland.	379.5	379.5	
A2	AanAprAbAeTe	*Acacia 'aneura'* scattered low trees to low open woodland over *A. pruinocarpa* scattered tall shrubs over *A. bivenosa* and *A. exigua* open shrubland over *Triodia epactia* hummock grassland.	3,202.1	3,202.1	
A3	AanAprTwTe	*Acacia aneura* (*A. pruinocarpa*) low open forest over *Triodia epactia* hummock grassland.	48.1	48.1	
A4	Mosaic: AanAprTwTe/AxAanTspp	*Acacia aneura* (*A. pruinocarpa*) low open forest over *Triodia epactia* hummock grassland / *Acacia xiphophylla* (*A. 'aneura'*) tall shrubland over *Triodia* spp. very open hummock grassland.	0.9	0.9	
A5	AanCHf	*Acacia 'aneura'* is low open woodland over *Chrysopogon fallax* very open tussock grassland.	90.3	90.3	
A6	AanCHfTe	*Acacia 'aneura'* low woodland over *Chrysopogon fallax* very open tussock grassland over *Triodia epactia* very open hummock grassland.	931.9	808.9	
A7	AanExAatAbCHfTe	*Acacia 'aneura'*, *Eucalyptus xerothermica* open woodland over *A. atkinsiana*, *A. bivenosa* open shrubland over *Chrysopogon fallax* open tussock grassland over *Triodia epactia* hummock grassland.	2.1	2.1	
A8	AanGsTbrTlo	*Acacia 'aneura'* and *Grevillea saxicola* low open woodland over *Triodia brizoides* and *T. longiceps* very open hummock grassland.	1.2	1.2	
A9	AanTeTw	*Acacia 'aneura'* low woodland to tall open scrub over *Triodia epactia* and *T. wiseana* very open hummock grassland.	1,359.3	1,359.3	
A10	AanTspp	*Acacia 'aneura'* low open forest over *Triodia* spp. very open hummock grassland and mixed bunch grassland.	48.6	48.6	

Vegetation Type	Vegetation Code	Description	Total Extent in Survey Area (ha)	Total Extent in Development Envelope (ha)*	Representative Photographs
Creeklines and Floodplains					
C1 (Boolgeeda Creek)	EvAciGOrSsAbApyTrFTeCc	*Eucalyptus victrix* low woodland over *Acacia citrinoviridis* and *Gossypium robinsonii* tall shrubland over *Stylobasium spathulatum, A. bivenosa* and *A. pyrifolia* scattered shrubs to open shrubland over *Tephrosia rosea* var. Fortescue creeks (M.I.H Brooker 2186) low open shrubland over *Triodia epactia* very open hummock grassland and **Cenchrus ciliaris* (*Themeda triandra*) tussock grassland.	122.0	109.2	
C2	ExAciAlTHtTe	*Eucalyptus xerothermica* scattered low trees over *Acacia citrinoviridis* tall shrubland to tall open scrub over *Androcalva luteiflora*, (*A. maitlandii*) open shrubland over *Themeda triandra* very open tussock grassland over *Triodia epactia* very open hummock grassland.	336.4	336.4	
C3 (Duck Creek)	EcGOrSsANlTErTHtTe	*Eucalyptus camaldulensis* subsp. *refulgens* (*E. victrix*) scattered trees to open woodland over *Gossypium robinsonii* (*Acacia citrinoviridis*, *A. coriacea* subsp. *pendens* and *Melaleuca glomerata*) tall shrubland over *Stylobasium spathulatum*, *Androcalva luteiflora* shrubland over *Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186) low shrubland over *Themeda triandra* very open tussock grassland and *Triodia epactia* very open hummock grassland.	26.4	25.7	
C4 (Caves Creek)	ECMgCYPv	*Eucalyptus camaldulensis* subsp. *refugens* woodland to open forest over *Melaleuca glomerata* (M. bracteata) tall shrubland to tall open scrub over *Cyperus vaginatus* scattered sedges.	35.0	0.0	
C5	EvAciTeCc	*Eucalyptus victrix* scattered trees over *Acacia citrinoviridis* tall shrubland over *Triodia epactia* open hummock grassland and/or **Cenchrus ciliaris* open tussock grassland.	2.1	2.1	
C6 (Caves Creek)	EvEcChAcEUa	*Eucalyptus victrix* and *E. camaldulensis* subsp. *refulgens* woodland over *Corymbia hamersleyana* scattered low trees over *Acacia citrinoviridis* (**Vachellia farnesiana*) tall open scrub over *Eulalia aurea* (*Themeda triandra*, *Enteropogon ramosus*, *Dichanthium fecundum* and *Bothriochloa ewartiana*) open tussock grassland.	123.9	69.5	
C7	AciAbTe	*Acacia citrinoviridis* (*Eucalyptus leucophloia* subsp. *leucophloia*) low open woodland over *Acacia bivenosa* tall shrubland over *Triodia epactia* open hummock grassland.	48.8	48.7	
C8	AciAtuAbTe	*Acacia citrinoviridis* (*Eucalyptus leucophloia* subsp. *leucophloia*) low open woodland over *A. tumida* var. *pilbarensis* and *A bivenosa* tall shrubland over *Triodia epactia* open hummock grassland.	10.2	10.2	
C9 (Boolgeeda Creek)	CdEgAatAeTw	*Corymbia deserticola* subsp. *deserticola* low open woodland over *Eucalyptus gamophylla* low open mallee woodland over *Acacia atkinsiana* (*A. exigua*) tall open shrubland over *Triodia epactia* and *T. wiseana* hummock grassland.	85.3	23.1	
C10	ChAciGOsSsVfCcTHt	*Corymbia hamersleyana* low open woodland over *Acacia citrinoviridis* high shrubland over *Gossypium sturtianum*, *Stylobasium spathulatum*, and **Vachellia farnesiana* open shrubland over **Cenchrus ciliaris* and *Themeda triandra* open tussock grassland to tussock grassland.	90.7	18.9	

Vegetation Type	Vegetation Code	Description	Total Extent in Survey Area (ha)	Total Extent in Development Envelope (ha)*	Representative Photographs
C11	ChAncAmonAbAciSaoTeTHtERmCc	*Corymbia hamersleyana* scattered low trees over *Acacia ancistrocarpa*, *A. monticola*, *A. bivenosa* and *A. citrinoviridis* tall open scrub over *Senna artemisioides* subsp. *oligophylla* scattered shrubs *Triodia epactia* open hummock grassland to hummock grassland and *Themeda triandra*, *Eriachne mucronata* and **Cenchrus ciliaris* scattered hummock grasses.	5.5	5.5	
C12	Mosaic: ChAncAmonAbAciSaoTeTHtERmCc/Tw	*Corymbia hamersleyana* scattered low trees over *Acacia ancistrocarpa*, *A. monticola*, *A. bivenosa* and *A. citrinoviridis* tall open scrub over *Senna artemisioides* subsp. *oligophylla* scattered shrubs *Triodia epactia* open hummock grassland to hummock grassland and *Themeda triandra*, *Eriachne mucronata* and **Cenchrus ciliaris* scattered hummock grasses / *T. wiseana* hummock grassland.	131.3	3.2	
C13	ChAtuGOrApyCOcPoTrFTHtTe	*Corymbia hamersleyana* low open woodland over Acacia tumida var. pilbarensis and Gossypium robinsonii tall open shrubland over A. pyrifolia open shrubland over Corchorus crozophorifolius, Ptilotus obovatus and Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186) low open shrubland over Themeda triandra (*Cenchrus ciliaris) very open tussock grassland	31.6	30.8	
C14 (Boolgeeda Creek)	ChElAlTrFTeEUaTHtCc	*Corymbia hamersleyana* low open woodland to low woodland over Eremophila longifolia and Androcalva luteiflora open shrubland over Tephrosia rosea var. Fortescue creeks (M.I.H Brooker 2186) (Acacia pyrifolia, Senna artemisioides subsp. oligophylla and Ptilotus obovatus subsp. obovatus) low open shrubland to low shrubland over Triodia epactia very open hummock grassland and Eulalia aurea, Themeda triandra and *Cenchrus ciliaris (Chrysopogon fallax, Cymbopogon ambiguus and Enneapogon robustissimus) tussock grassland.	1,592.2	1,469.5	
C15	ChElGwGOrTsMBEUaPmTe	*Corymbia hamersleyana* and Eucalyptus leucophloia low woodland over Grevillea wickhamii tall shrubland over Gossypium robinsonii open shrubland over Themeda sp. Mt. Barricade, Eulalia aurea and Paraneurachne muelleri open tussock grassland or Triodia epactia hummock grassland.	118.8	118.8	
C16 (Duck Creek)	EcExAciAanTe	*Eucalyptus camaldulensis* and *E. xerothermica* low woodland over *Acacia citrinoviridis* and *A. 'aneura'* tall open shrubland over mixed tussock grassland and *Triodia epactia* very open hummock grassland.	581.5	581.5	
C17	EgAaAkTeTw	*Eucalyptus gamophylla* scattered mallees over *Acacia atkinsiana* and *A. kempeana* scattered high scrubs to high open shrubland over *Triodia epactia* and *Triodia wiseana* open hummock grassland to tussock grassland.	324.1	0.0	
C18	ElAciAbAmonTeTHt	*Eucalyptus leucophloia* low open woodland over *Acacia citrinoviridis, A. bivenosa* and *A. monticola* high shrubland over *Triodia epactia* open hummock grassland and *Themeda triandra* very open tussock grassland.	52.1	45.5	
C19	ElChApyAiAmaiTetw	*Eucalyptus leucophloia* subsp. leucophloia and Corymbia hamersleyana low open woodland over Acaia pyrifolia, A.inaequilatera and A. maitlandii tall open shrubland over Trioida epactia and T.wiseana hummock grassland.	12.6	0.0	
C20	ElChGOrApyTHtTe	*Eucalyptus leucophloia* subsp. leucophloia and Corymbia hamersleyana scattered low trees over Gossypium robinsonii and Acacia pyrifolia var. pyrifolia open shrubland over Themeda triandra very open tussock grassland over Triodia epactia very open hummock grassland.	24.0	24.0	

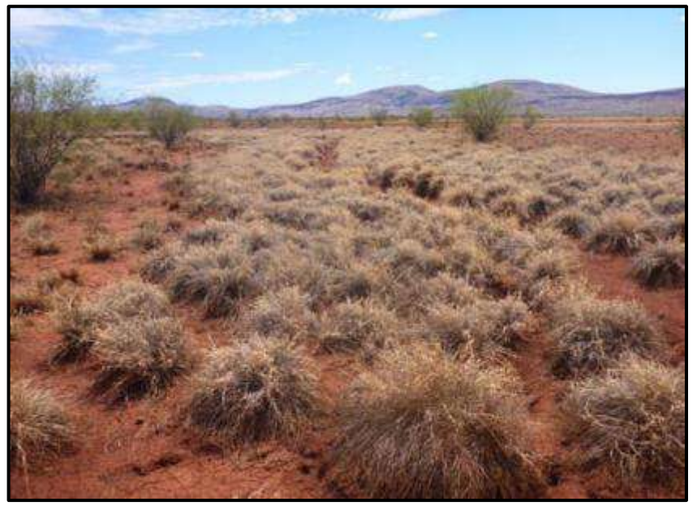
Vegetation Type	Vegetation Code	Description	Total Extent in Survey Area (ha)	Total Extent in Development Envelope (ha)*	Representative Photographs
C21	ElAbTe	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia bivenosa* shrubland over *Triodia epactia* hummock grassland.	49.6	49.6	
C22 (Boolgeda Creek)	EvAciAtuApyTHtTe	*Eucalyptus victrix* open woodland over *Acacia citrinoviridis* scattered low trees over *Acacia tumida, A. bivenosa* and *A. pyrifolia* tall open shrubland over *Themeda triandra* very open tussock grassland over *Triodia epactia* very open hummock grassland.	90.3	90.3	
C23	ExAciSsAbElTe	*Eucalyptus xerothermica* scattered low trees over Acacia citrinoviridis, *Stylobasium spathulatum* and *Acacia bivenosa* high shrubland over *Eremophila longifolia* open shrubland over *Triodia epactia* (*Triodia angusta*) hummock grassland.	100.1	66.5	
C24	ExAciTeCc	*Eucalyptus xerothermica* open woodland over *Acacia citrinoviridis* low woodland over *Triodia epactia* very open hummock grassland with **Cenchrus ciliaris* and *Themeda triandra* tussock grassland.	312.7	297.7	
C25	ExChAbAcAelaAeTeEUa	*Eucalyptus xerothermica* and *Corymbia hamersleyana* scattered low trees over *Acacia bivenosa*, *A. cowleana*, *A. elachantha* and *A. exigua* tall shrubland over *Triodia epactia* hummock grassland and *Eulalia aurea* open tussock grassland.	110.0	110.0	
C26	ExChAsppGgTe	*Eucalyptus xerothermica* and/or *Corymbia hamersleyana* low open woodland over *Acacia* spp. and *Gastrolobium grandiflorum* open shrubland over *Triodia epactia* (*T. wiseana*) open hummock grassland.	155.7	99.8	
C27 (Boolgeeda Creek)	ExEvMgAciAcpAbTaTeTHtCc	*Eucalyptus xerothermica* and *Eucalyptus victrix* low open woodland to low woodland over *Melaleuca glomerata*, *Acacia citrinoviridis*, *A. coriacea* subsp. *pendens* and *A. bivenosa* tall shrubland over *Triodia angusta* and *Triodia epactia* very open hummock grassland and *Themeda triandra* and **Cenchrus ciliaris* very open tussock grassland.	137.2	105.8	
C28	EcFgFbTYdPLr	*Eucalyptus camaldulensis* subsp. *refulgens* open woodland over *Ficus geniculata* var. *insignis*, (*F. brachypoda*) low open woodland over *Typha domingensis* very open sedgeland with *Pluchea rubelliflora* scattered low shrubs.	0.3	0.3	
C29 (Duck Creek)	ElAmonAmaiAatTeTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia monticola*, *A. maitlandii* and *A. atkinsiana* tall open scrub over *Triodia epactia* and *T. wiseana* open hummock grassland.	620.8	620.8	
C30	AancAciTe	*Acacia ancistrocarpa*, (*A. citrinoviridis*) tall open shrubland over *Triodia epactia* open hummock grassland.	30.1	30.1	

Vegetation Type	Vegetation code	Description	Total Extent in Survey Area (ha)	Total extent in Development Envelope (ha)	Representative Photograph
Hills					
H1	ChAiAbTw	*Corymbia hamersleyana* low open woodland over *Acacia inaequilatera* and *A. bivenosa* open shrubland over *Triodia wiseana* hummock grassland.	2,057.0	2,007.4	
H2	ElAbMeTw	*Eucalyptus leucophloia* scattered low trees over *Acacia bivenosa* scattered tall shrubs over *Melaleuca eleuterostachya* over *Triodia wiseana* hummock grassland	53.0	41.8	
H3	ElAeTw	*Eucalyptus leucophloia* scattered low trees over *Acacia exigua* open shrubland over *Triodia wiseana* open hummock grassland.	411.3	202.2	
H4	ElTbr	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia brizoides* open hummock grassland.	823.9	823.9	
H5	ElTe	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Triodia epactia* open hummock grassland.	216.5	216.5	
H6	EsTw	*Eucalyptus socialis* subsp. *eucentrica* low open mallee over *Triodia wiseana* open hummock grassland.	473.6	384.0	
H7	AapAciTeTw	*Acacia* 'aneura' and *A. citrinoviridis* tall shrubland over *Triodia epactia* and *T. wiseana* open hummock grassland.	167.2	133.7	
H8	AbAexAaTw	*Acacia bivenosa*, *A. exigua* and *A. ancistrocarpa* tall open shrubland over *Triodia wiseana* hummock grassland.	418.6	416.6	
H9	AiTbr	*Acacia inaequilatera* scattered tall shrubs over *Triodia brizoides* hummock grassland.	202.9	165.6	
H10	AiTw	*Acacia inaequilatera* scattered tall shrubs over *Triodia wiseana* hummock grassland.	589.1	589.1	

Vegetation Type	Vegetation code	Description	Total Extent in Survey Area (ha)	Total extent in Development Envelope (ha)	Representative Photograph
H11	ElEpTspp	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Eucalyptus pilbarensis* low open mallee woodland over *Triodia longiceps*, *T. wiseana* and *T. epactia* open hummock grassland.	168.3	22.2	
H13	ElAatAciAprAmarTwTe	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia atkinsiana*, *A. citrinoviridis* and *A. pruinocarpa* open shrubland over A. *marramamba* open shrubland over *Triodia wiseana* and *Triodia epactia* hummock grassland.	631.8	607.7	
H14	ElAatAkAprTbrTeTw	*Eucalyptus leucophloia* (*Corymbia hamersleyana*) low open woodland over *Acacia atkinsiana*, *A. kempeana* and *A. pruinocarpa* shrubland over Triodia brizoides, Triodia epactia and Triodia wiseana hummock grassland.	597.1	47.7	
H15	ElTaTl	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia angusta* and *T. longiceps* hummock grassland.	1,128.7	1,118.3	
H16	AsiEeTe	*Acacia sibirica* low open woodland over Eremophila *exilifolia* scattered shrubs over *Triodia epactia* hummock grassland.	132.0	132.0	
H17	ElAbTbr	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia bivenosa* open shrubland over *Triodia brizoides* hummock grassland.	301.0	263.9	
H18	ElAbTbrTeTHsMBCa	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia bivenosa* open shrubland over *Triodia brizoides* and *T. epactia* hummock grassland with *Themeda* sp. Mt. Barricade (M.E. Trudgen 2471) and *Cymbopogon ambiguus* open tussock grassland.	0.8	0.8	
H19	AcAbTw	*Acacia citrinoviridis* tall open shrubland over *Acacia bivenosa* open shrubland over *Triodia wiseana* very open hummock grassland	8.4	3.9	
H20	ElAbTw	*Eucalyptus leucophloia* scattered low trees over *Acacia bivenosa* tall shrubland over *Triodia wiseana* hummock grassland.	283.9	283.9	
H21	ElTwTbas	Eucalyptus leucophloia subsp. leucophloia scattered low trees over Triodia wiseana (Triodia basitricha) open hummock grassland.	300.5	300.5	
H22	ElAhTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees ov *Acaica inaequilatera* scattered tall shrubs over *Triodia wiseana* hummock grasslands.	17.9	17.9	

Vegetation Type	Vegetation code	Description	Total Extent in Survey Area (ha)	Total extent in Development Envelope (ha)	Representative Photograph
H23	ElAiTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia inaequilatera* scattered tall shrubs over *Triodia wiseana* hummock grassland.	1,282.0	1,016.1	
H24	ElAmaiAatAeTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia maitlandii*, *A. atkinsiana* and *A. exigua* open shrubland over *Triodia wiseana* hummock grassland.	1,060.0	1,059.7	
H25	ELAmaiAatAeTw	*Eucalyptus leucophloia* subsp. *leucophloia*, (*Corymbia hamersleyana*) low open woodland over *Acacia maitlandi*i open shrubland over *A. hilliana* low open shrubland over *Triodia wiseana* hummock grassland.	1,212.8	0.0	
H26	ElAmTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low tree over *Acacia maitlandii* shrubland over *Triodia wiseana* open hummock grassland.	8,903.9	6,944.0	
H27	ElAmTwTe	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia maitlandii* open shrubland over *Triodia wiseana* and/or *T. epactia* open hummock grassland.	17.0	17.0	
H28	ElAprAciTe	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia pruinocarpa*, *A. citrinoviridis* tall open shrubland.	6.3	6.3	
H29	ElAprTwTe	*Eucalyptus leucophloia* scattered low trees over *Acacia pruinocarpa* (A. *atkinsiana*) tall open shrubland over *Triodia wiseana* and *Triodia epactia* hummock grassland.	367.1	255.3	
H30	Tss	*Triodia* sp.Silvergrass (P.-L. de Kock BES 00808) (P1) hummock grassland	19.4	0.0	
H31	ElChAprAmaiERmTHsMBPm	*Eucalyptus leucophloia* subsp. *leucophloia* and/or *Corymbia hamerselyana* sattered low trees over *Acacia pruinocarpa* high open shrubland over *Acacia maitlandii* low open shrubland over *Triodia wiseana* very open hummock grassland and *Erichne mucronata*, Themeda sp. Mt Barricade and *Paraneurachne muelle*ri very open tussock grassland to open tussock grassland.	891.3	1.0	
H32	ElEgAbTwTbr	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *E. gamophylla* low open mallee woodland over *Acacia bivenosa* scattered shrubs over *Triodia wiseana* and *T. brizoides* open hummock grassland.	3.0	3.0	
H33	ElEgAmaiTw	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *E. gamophylla* low open mallee woodland over *Acacia bivenosa* scattered shrubs over *Triodia wiseana* and *T. brizoides* open hummock grassland.	303.1	303.1	

Vegetation Type	Vegetation code	Description	Total Extent in Survey Area (ha)	Total extent in Development Envelope (ha)	Representative Photograph
H34	Tw	*Triodia wiseana* hummock grassland.	925.2	434.8	
H35	Mosaic: ElTbr/ElTe	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia brizoides* open hummock grassland / *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Triodia epactia* open hummock grassland.	277.3	223.3	
H36	Mosaic: ElTe/ElTw	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Triodia epactia* open hummock grassland / *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia wiseana* open hummock grassland.	1,572.4	720.9	
H37	ElTlTw	*Eucalyptus leucophloia* subsp. leucophloia scattered low trees over *Triodia longiceps* and *Triodia wiseana* (*Triodia epactia*) hummock grassland.	128.0	74.3	
H38	ElTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia wiseana* open hummock grassland.	1,583.8	1,086.2	
Plains and Valleys					
P1	ElChAtuPlTe	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis* and *Petalostylis labicheoides* tall open scrub over *Triodia epactia* open hummock grassland.	17.5	16.6	
P2	ElMeTaTw	*Eucalyptus leucophloia* scattered low trees over *Melaleuca eleuterostachya* open shrubland over *Triodia angusta* and *T. wiseana* open hummock grassland.	138.2	138.2	
P3	AaAbTlTe	*Acacia ancistrocarpa* and *A bivenosa* shrubland to open heath over *Triodia longiceps* hummock grassland.	5.7	5.7	
P4	ElAaAkApTbTeTw	*Eucalyptus leucophloia* (*Corymbia hamersleyana*) low open woodland over *Acacia atkinsiana*, *A. kempeana* and *A. pruinocarpa* shrubland over *Triodia brizoides*, *Triodia epactia* and *Triodia wiseana* hummock grassland.	4.4	4.4	
P5	ElAatTeTw/ElAbAatTePm	*Eucalyptus leucophloia* scattered low trees over *Acacia atkinsiana* scattered shrubs over *Triodia epactia* open hummock grassland / *Eucalyptus leucophloia* scattered low trees over *Acacia bivenosa* and *A. atkinsiana* high shrubland over *Triodia epactia* open hummock grassland and *Paraneurachne muelleri* very open tussock grassland.	677.3	130.8	

Vegetation Type	Vegetation code	Description	Total Extent in Survey Area (ha)	Total extent in Development Envelope (ha)	Representative Photograph
P6	ElAbAeTaTw	*Eucalyptus leucophloia* scattered low trees over *Acacia bivenosa* scattered tall shrubs over *A. exigua* open shrubland over *Triodia angusta* and *T. wiseana* open hummock grassland.	75.7	75.7	
P7	AxAanTspp	*Acacia xiphophylla* (*A. 'aneura'*) tall shrubland over *Triodia* spp. very open hummock grassland.	561.6	520.8	
P8	AxERmaSENspp	*Acacia xiphophylla* scattered shrubs to open shrubland over *Eremophila maculata* subsp. *brevifolia* and *Senna* spp. low shrubland over Mixed bunch grasses and herbs	188.3	166.2	
P9	AxSlfSENsppTl	*Acacia xiphophylla* tall shrubland over *Sida fibulifera* (*Senna artemisioides* subsp. *oligophylla* x subsp. *helmsii, Senna* sp. Karijini (M.E. Trudgen 1392)) low shrubland over *Triodia longiceps* scattered hummock grasses.	3.4	0.5	
P10	CdExAanAatAbTeTHt	*Corymbia deserticola* subsp. *deserticola* and *Eucalyptus xerothermica* scattered mallees over *Acacia 'aneura'*, *A. atkinsiana* and *A. bivenosa* high shrubland over *Triodia epactia* open hummock grassland and *Themeda triandra* very open tussock grassland.	1,931.7	1,723.8	
P11	ChElAbAsynAancTw	*Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia* open woodland over *Acacia bivenosa*, *A. synchronicia* and *A. ancistrocarpa* scattered tall shrubs to high open shrubland over *Triodia wiseana* open hummock grassland.	167.5	167.5	
P12	EgAatAbAeTeTw	*Eucalyptus gamophylla* scattered mallees over *Acacia atkinsiana*, *A. bivenosa* and *A. exigua* tall open shrubland over *Triodia epactia* and *T. wiseana* hummock grassland.	33.1	33.1	
P13	ElAeTl	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia exigua* shrubland over *Triodia longiceps* tall hummock grassland.	159.6	159.6	
P14	ElAtAbAsyAtenTbas	*Eucalyptus leucophloia* scattered low trees over *Acacia tetragonophylla, A. bivenosa, A. synchronicia* and *A. tenuissima* open shrubland over Triodia basedowii hummock grassland with mixed herbs.	440.5	440.5	
P15	ElAxAsiAtMeTa	*Eucalyptus leucophloia* scattered low trees over *Acacia xiphophylla*, *A. sibirica*, *A. tetragonophylla* and *Melaleuca eleuterostachya* scattered shrubs over *Triodia angusta* hummock grassland.	178.6	178.6	
P16	ElCdEgAatAeTwTe	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia deserticola* subsp. *deserticola* scattered low trees over *Eucalyptus gamophylla* scattered low mallees over *Acacia atkinsiana* and *A. exigua* tall open shrubland over *Triodia wiseana* and/or *T. epactia* hummock grassland	2,604.8	1,992.4	

Vegetation Type	Vegetation code	Description	Total Extent in Survey Area (ha)	Total extent in Development Envelope (ha)	Representative Photograph
P17	ElEgAatAeAbTeTw	*Eucalyptus leucophloia* subsp. *leucophloia* (*Corymbia deserticola* subsp. *deserticola* and *C. hamersleyana*) scattered low trees and/or *E. gamophylla* scattered low mallees over *Acacia atkinsiana*, *A. exigua* and *A. bivenosa* shrubland over *Triodia epactia* and/or *T. wiseana* hummock grassland.	11,958.2	10,044.3	
P18	ElAsyAbSENsppTbr	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia synchronicia*, *A. bivenosa* and *Senna* spp. scattered shrubs over *Triodia brizoides* open hummock grassland.	186.8	186.8	
P19	ElEsAbTw	*Eucalyptus socialis* subsp. *eucentrica* low open mallee woodland to low mallee woodland over *Acacia bivenosa* scattered shrubs over *Triodia wiseana* open hummock grassland.	1,024.5	1,024.5	
P20	ElEsMeAeTlTw	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *E. socialis* subsp. *eucentrica* very open mallee over *Melaleuca eleuterostachya* and *Acacia* exigua shrubland over *Triodia longiceps* and *T. wiseana* hummock grassland.	670.3	670.3	
P21	ExEsAbAsyTw	*Eucalyptus xerothermica* and *E. socialis* subsp. *eucentrica* low open mallee woodland over *Acacia bivenosa* and *A. synchronicia* tall open shrubland over *Triodia wiseana* low hummock grassland.	35.8	35.8	
P22	VfSfSENsppCHf	*Vachellia faresiana* scattered tall shrubs over *Sida fibulifera, Senna* spp. Low open shrubland with *Chrysopogon fallaz* scattered tussock grasses.	9.0	0.0	
P23	ElAeAsiTw	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia exigua* and *A. sibirica* scattered tall shrubs to tall open shrubland over *Triodia wiseana* hummock grassland.	102.9	102.9	
P24	CdEgAeAatTeTe	*Corymbia deserticola* subsp. *deserticola* scattered low trees to low open woodland over *Eucalyptus gamophylla* low open mallee woodland over *Acacia exigua* and *A. atkinsiana* (*A. kempeana*) tall open shrubland over *Triodia wiseana* and *T. epactia* open hummock grassland.	2,985.5	2,985.5	
P25	ElAbCAPuTspp	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia bivenosa* scattered tall shrubs over *Capparis umbonata* scattered shrubs over *Triodia epactia* open hummock grassland.	15.5	15.5	
P26	ElGsGOOsTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Grevillea saxicola* scattered tall shrubs over *Triodia wiseana* very open hummock grassland and *Goodenia stobbsiana* very open herbland.	1.9	1.9	
P27	ARlCHfERAxASe	*Aristida latifolia* and *Chrysopogon fallax* (*Eragrostis xerophila* and *Astrebla elymoides*) tussock grassland.	264.8	232.6	

Vegetation Type	Vegetation code	Description	Total Extent in Survey Area (ha)	Total extent in Development Envelope (ha)	Representative Photograph
P28	MOSAIC: CHfTHsASspp./ARlASeCHf	*Chrysopogon fallax* and *Themeda sp*. Hamersely Station (M.E. Trudgen 11431) (*Astrebla* spp.) open tussock grassland / *Astida latifolia* (*Astrebla elymoides* and *Chysopogon fallax*) tussock grassland	14.5	0.0	
P29	MOSAIC: CHfTHsASspp/ASlASp/ARIASchf	*Chrysopogon fallax* and *Themeda* sp. Hamersely Station (M>E> Trudgen 11431) (Astrebla spp.) open tussock grassland / *Astrebla lappacea* and *A. pectinata* tussock grassland / *Aristida latifolia* (*Astrebla elymoides* and *Chysopogon fallax*) tussock grassland.	124.8	0.0	
P30	ERb	*Eriachne benthamii* tussock grassland.	34.7	4.3	
P31	ASe	*Astrebla elymoides* tussock grassland	20.2	0.0	
P32	MOSAIC: ASe/ASlASp	*Astrebla elmoides* tussock grassland/*Astrebla lappacea* and *A.pectinata* tussock grassland.	40.4	0.0	
P33	ASlASp	*Astrebla lappacea* and *A. pectinata* tussock grassland	95.0	56.2	
P34	AvVfTHsCHf	*Acacia victoriae* and *Vachellia farnesiana* tall open shrubland over *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) and *Chrysopogon fallax* open tussock grassland.	7.7	0.0	
P35	Herb	Mixed herbland.	46.9	46.5	
P36	THs	*Themeda* sp. Hamersely Station (M.E. Trudgen) tussock grassland	146.2	0.0	
P37	ElExAiTw	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Eucalyptus xerothermica* scattered low mallees to low open mallee woodland over *Acacia inaequilatera* scattered tall shrubs over *Triodia wiseana* open hummock grassland.	81.8	28.3	

Vegetation Type	Vegetation Code	Description	Total Extent in Survey Area (ha)	Total Extent in Development Envelope (ha)	Representative Photograph
Gorges, Gullies and Free Faces					
G1	CfAanAciPROaPToCYaTHtARb	*Corymbia ferriticola*, *Acacia 'aneura'* woodland over *A. citrinoviridis* tall shrubland over *Eremophila latrobei* subsp. *latrobei*, *Santalum lanceolatum*, *Dodonaea pachyneura*, (*Gossypium robinsonii*) tall open shrubland over *Prostanthera albiflora*, *Ptilotus obovatus* subsp. *obovatus*, (*Corchorus crozophorifolius*) low shrubland over *Cymbopogon ambiguus* (*Themeda triandra* and *Aristida burbidgeae*) open tussock grassland.	0.8	0.8	
G2	ChAsppTHtTeTw	*Corymbia hamersleyana* low open woodland over *Acacia* spp. tall shrubland over *Themeda triandra* very open tussock grassland over *Triodia epactia* and *T. wiseana* open hummock grassland.	66.2	65.3	
G3	ElCfAprAanDpERImTe	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia ferriticola*, *Acacia pruinocarpa* and *A. 'aneura'* low open woodland over *Dodonaea pachyneura* scattered tall shrubs over *Triodia epactia* very open hummock grassland with *Eriachne mucronata* open tussock grassland.	994.3	415.0	
G4	ElCfAciAanGbDpTe	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia ferriticola*, *Acacia citrinoviridis*, *A. 'aneura'*, (*Grevillea berryana*) low woodland over *Dodonaea pachyneura* tall over *Triodia epactia* very open hummock grassland.	38.6	20.0	
Total			**65,142.9**	**52,318.0**	

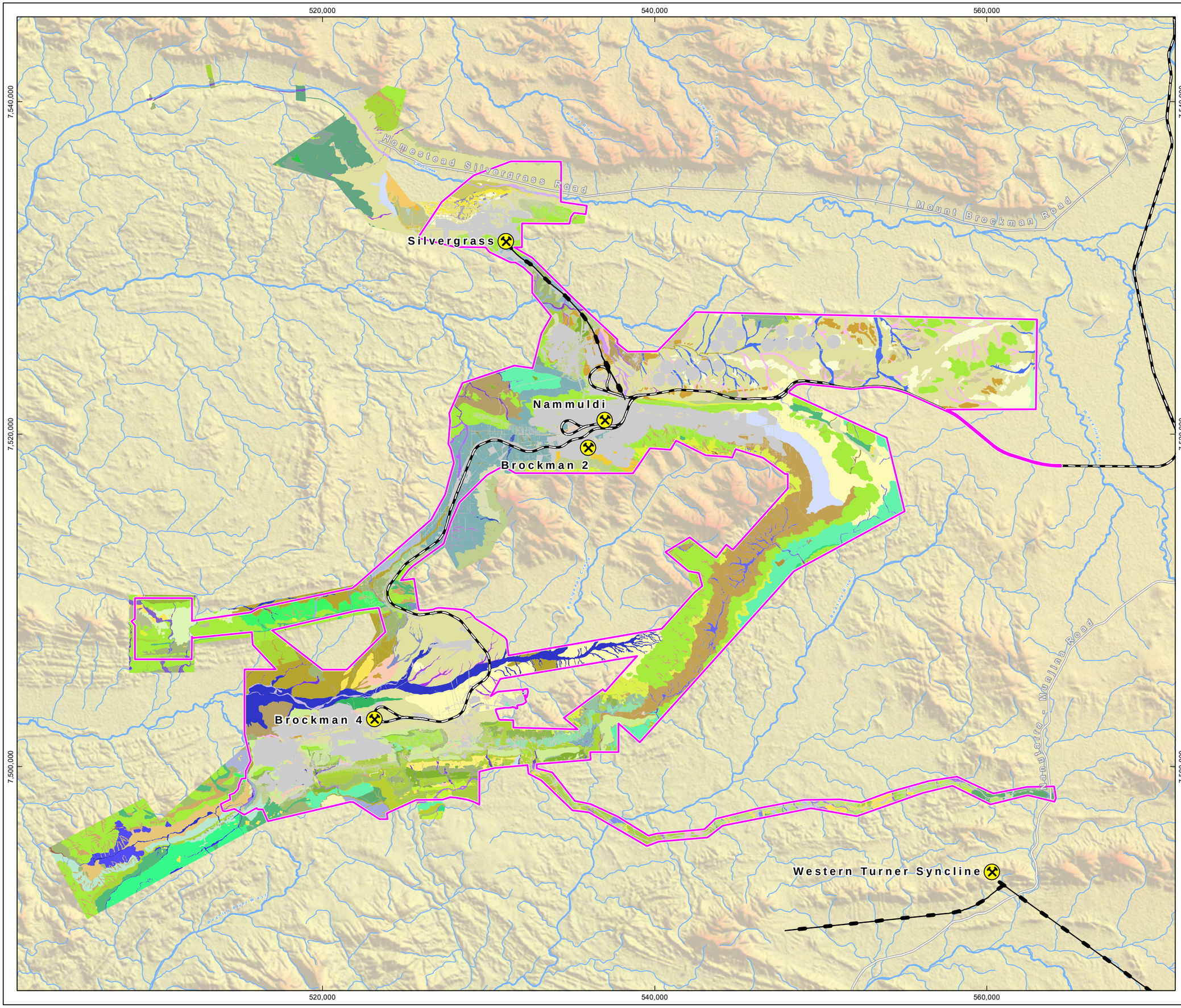


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Figure 7-4
Vegetation Types Overview

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:210,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

Note: For vegetation types legend, please see Vegetation Types Legend figure

N

0 2 4 6 8 10

Kilometres

Map units in metres

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RioTinto

Figure 7-4
Vegetation Types
Map A

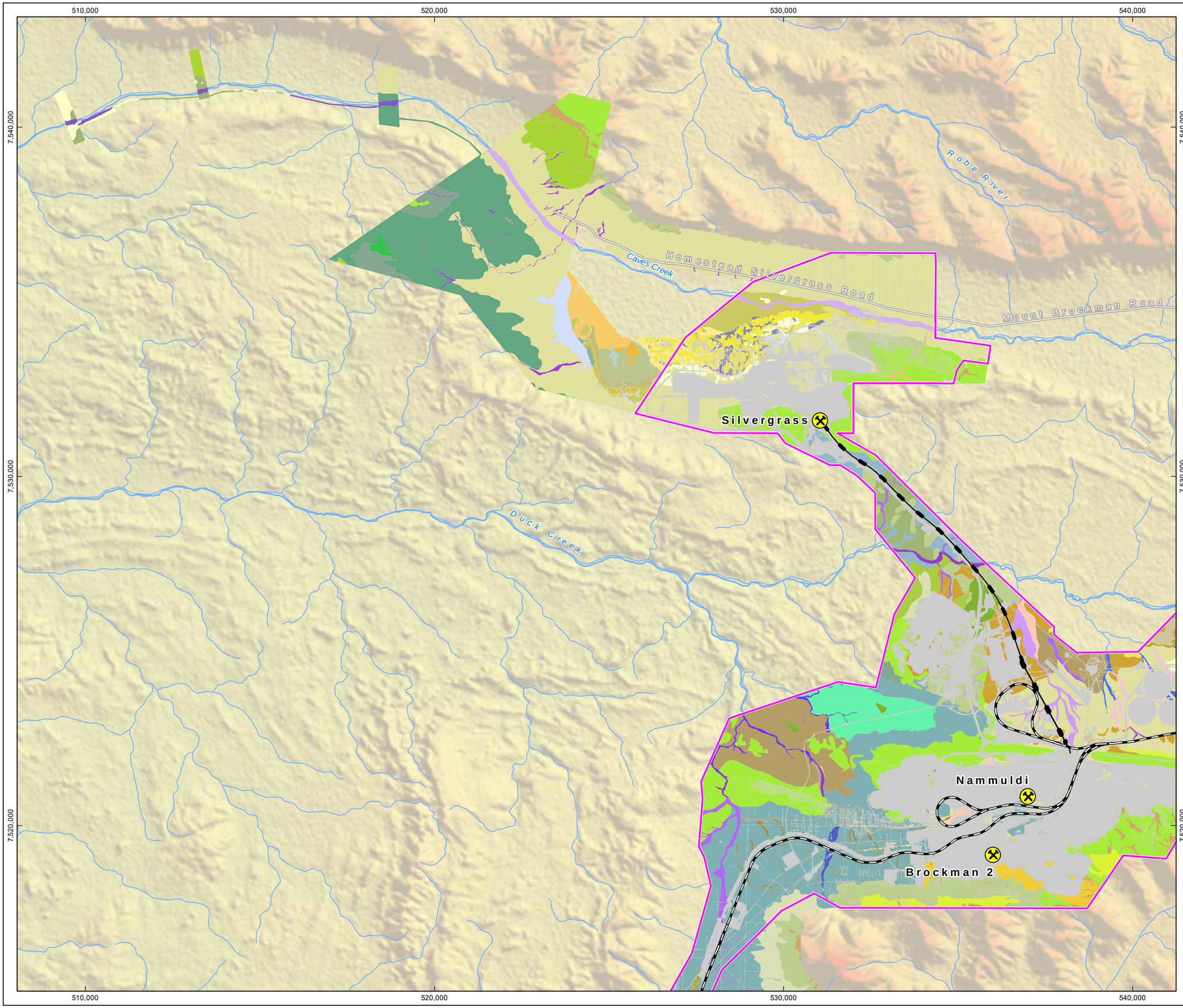
Drawn: L.Fuentes
Plan: PDE0189667v1
Date: May 2023

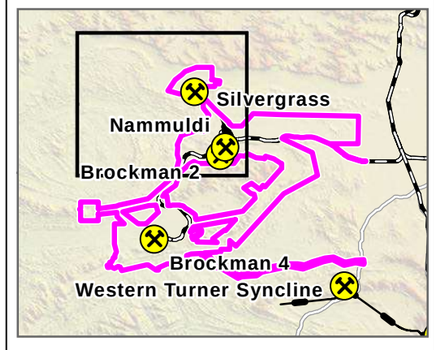
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek

Note: For vegetation types legend, please see Vegetation Types Legend figure





N

0 1 2 3 4 5

Kilometres

Map units in metres

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RioTinto

Figure 7-4
Vegetation Types
Map B

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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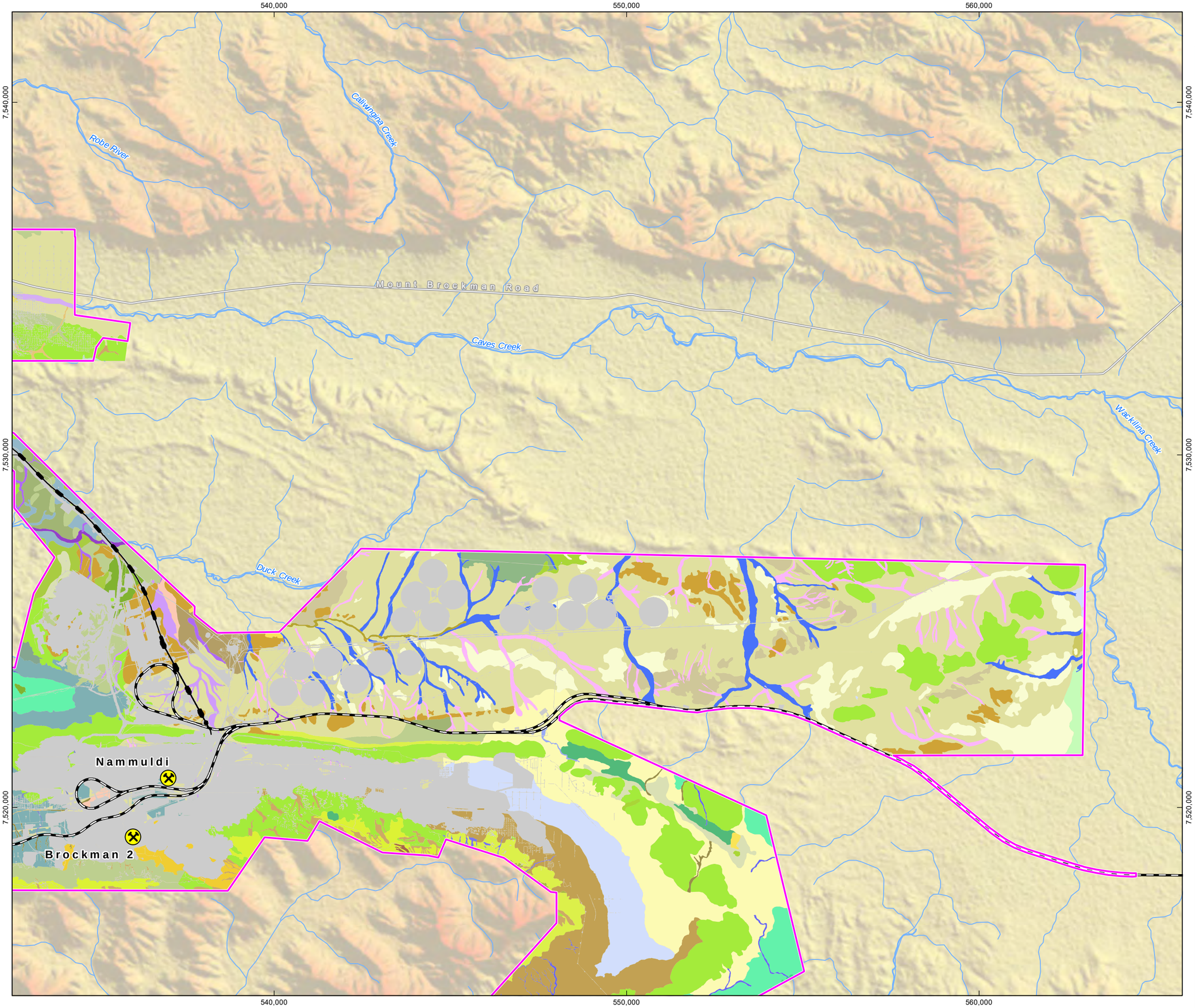
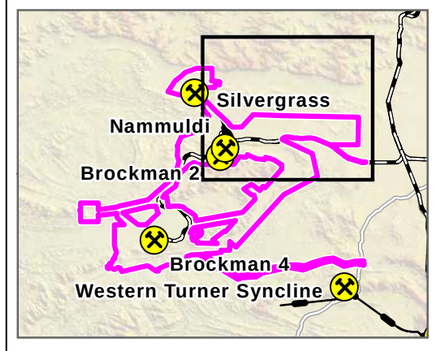
Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek

Note: For vegetation types legend, please see Vegetation Types Legend figure





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0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 7-4
Vegetation Types
Map C

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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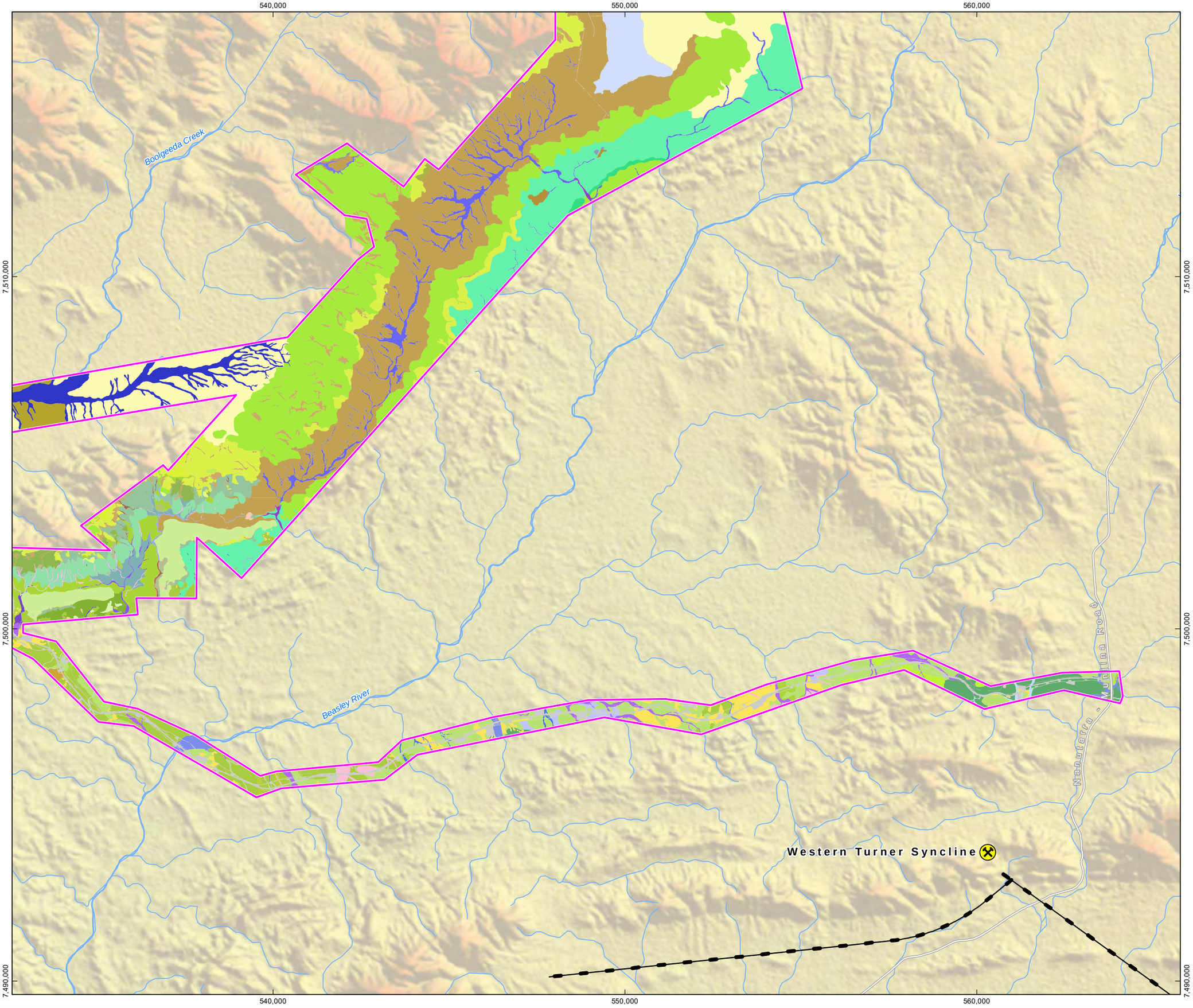
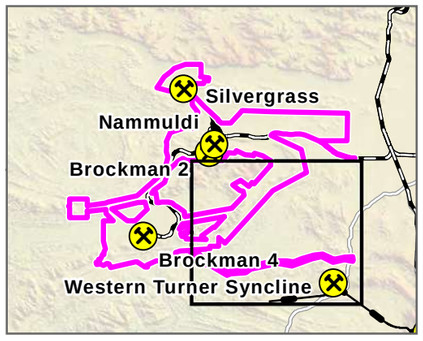
Legend

- Development Envelope
- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek
- Minor Creek

Note: For vegetation types legend, please see Vegetation Types Legend figure





N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 7-4
Vegetation Types
Map D

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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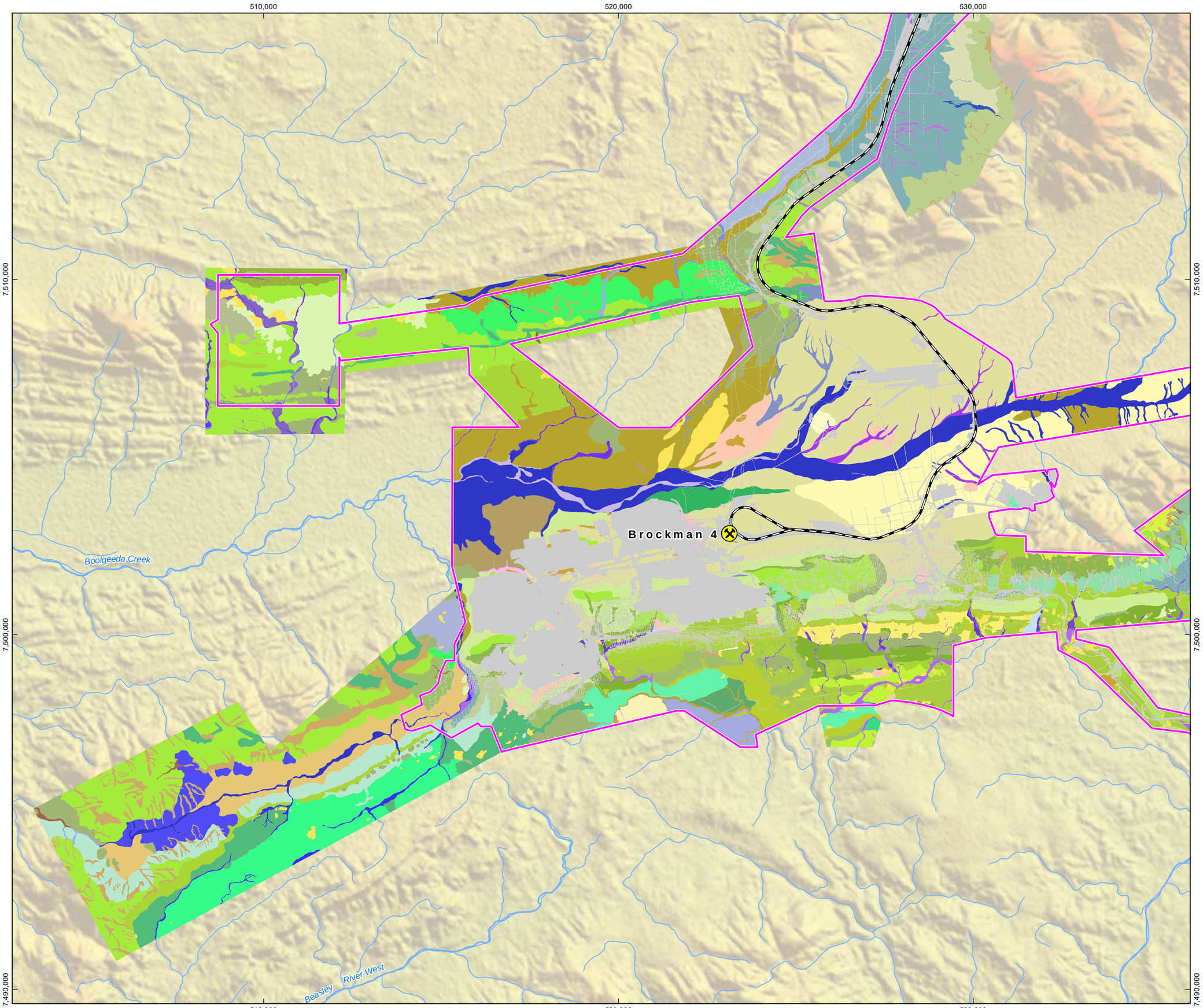
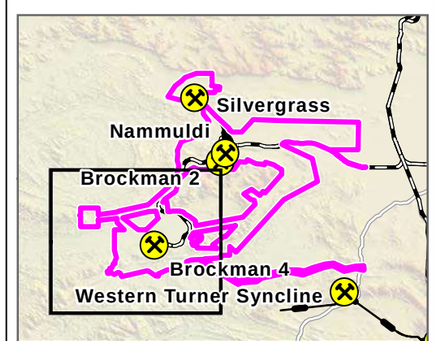
Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek
- Minor Creek

Note: For vegetation types legend, please see Vegetation Types Legend figure





N

0 1 2 3 4 5
Kilometres

Map units in metres

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LEGEND - Vegetation Types

Acacia 'aneura' Woodlands and Shrublands

- A1, AanAayTeTw
- A2, AanAprAbAeTe
- A3, AanAprTwTe
- A4, AanAprTwTe/AxAanTspp
- A5, AanCHf
- A6, AanCHfTe
- A7, AanExAatAbCHfTe
- A8, AanGsTbrTIo
- A9, AanTeTw
- A10, AanTspp

Creek Lines and Floodplains

- C1, EvAciGOrSsAbApyTrFTeCc
- C2, ExAciAlTHtTe
- C3, EcGOrSsANlTErTHtTe
- C4, EcMgCYPv
- C5, EvAciTeCc
- C6, EvEcChAcEUa
- C7, AciAbTe
- C8, AciAtuAbTe
- C9, CdEgAatAeTw
- C10, ChAciGOsSsVfCcTHt
- C11, ChAncAmonAbAciSaoTeTHtERmCc
- C12, ChAncAmonAbAciSaoTeTHtERmCc/Tw
- C13, ChAtuGOrApyCOcPoTrFTHtTe
- C14, ChElAlTrFTeEUaTHtCc
- C15, ChElGwGOrTsMBEUaPmTe
- C16, EcExAciAanTe
- C17, EgAaAkTeTw
- C18, ElAciAbAmonTeTHt
- C19, ElChApyAiAmaiTeTw
- C20, ElChGOrApyTHtTe
- C21, ElAbTe
- C22, EvAciAtuApyTHtTe
- C23, ExAciSsAbElTe
- C24, ExAciTeCc
- C25, ExChAbAcAelaAeTeEUa
- C26, ExChAsppGgTe
- C27, ExEvMgAciAcpAbTaTeTHtCc
- C28, EcFgFbTYdPLr
- C29, ElAmonAmaiAatTeTw
- C30, AancAciTe

Hills

- H1, ChAiAbTw
- H2, ElAbMeTw
- H3, ElAeTw
- H4, ElTbr
- H5, ElTe
- H6, EsTw
- H7, AapAciTeTw
- H8, AbAexAaTw
- H9, AiTbr
- H10, AiTw
- H11, ElEpTspp
- H12, ElAancAbAiTwTbr
- H13, ElAatAciAprAmarTwTe
- H14, ElAatAkAprTbrTeTw
- H15, ElTaTl
- H16, AsiEeTe
- H17, ElAbTbr
- H18, ElAbTbrTeTHsMBCa
- H19, AcAbTw
- H20, ElAbTw
- H21, ElTwTbas
- H22, ElAhTw
- H23, ElAiTw
- H24, ElAmaiAatAeTw
- H25, ElAmaiAhiTw
- H26, ElAmTw
- H27, ElAmTwTe
- H28, ElAprAciTe
- H29, ElAprTwTe
- H30, Tss
- H31, ElChAprAmaiERmTHsMBPm
- H32, ElEgAbTwTbr
- H33, ElEgAmaiTw
- H34, Tw
- H35, ElTbr/ElTe
- H36, ElTe/ElTw
- H37, ElTlTw
- H38, ElTw

Plains and Valleys

- P1, ElChAtuPlTe
- P2, ElMeTaTw
- P3, AaAbTlTe
- P4, ElAaAkApTbTeTw
- P5, ElAatTeTw/ElAbAatTePm
- P6, ElAbAeTaTw
- P7, AxAanTspp
- P8, AxERmaSENspp
- P9, AxSlfSENsppTl
- P10, CdExAanAatAbTeTHt
- P11, ChElAbAsynAancTw
- P12, EgAatAbAeTeTw
- P13, ElAeTl
- P14, ElAtAbAsyAtenTbas
- P15, ElAxAsiAtMeTa
- P16, ElCdEgAatAeTwTe
- P17, ElEgAatAeAbTeTw
- P18, ElAsyAbSENsppTbr
- P19, ElEsAbTw
- P20, ElEsMeAeTlTw
- P21, ExEsAbAsyTw
- P22, VfSfSENsppCHf
- P23, ElAeAsiTw
- P24, CdEgAeAatTeTe
- P25, ElAbCAPuTspp
- P26, ElGsGOOsTw
- P27, ARlCHfERAxASe
- P28, CHfTHsASspp./ARlASeCHf
- P29, CHfTHsASspp./ASlASp/ARlASeCHf
- P30, ERb
- P31, ASe
- P32, ASe/ASlASp
- P33, ASlASp
- P34, AvVfTHsCHf
- P35, Herb
- P36, THs
- P37, ElExAiTw

Gorges, Gullies and Free Faces

- G1, CfAanAciPROaPToCYaTHtARb
- G2, ChAsppTHtTeTw
- G3, ElCfAprAanDpERImTe
- G4, ElCfAciAanGbDpTe

Other

- Disturbed

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Figure 7-4
Vegetation Types
Legend

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: June 2022
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7.3.2.3. Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) as defined by the EPBC or the *Biodiversity Conservation Act (WA) 2016* (BC Act) occur within the Development Envelope. The closest TEC is the Themeda grasslands on cracking clays (Hamersley Station, Pilbara), located approximately 1.2 km west of the Development Envelope (Figure 7-5). This TEC will not be directly or indirectly impacted by the Proposal and is not discussed further in the ERD.

One vegetation type (P33) was considered to represent the Brockman Iron Cracking Clay Priority Ecological Community (PEC) of the Hamersley Ranges (P1) (Plate 7-1). Approximately 56 ha of this vegetation type is within the approved Silvergrass Area and represents the westernmost known occurrence of this PEC (Figure 7-5; Biota 2019b). The PEC has been mapped in various locations outside the Development Envelope, with the closest being 20 km to the east on Hamersley Station (Biota 2019b).

The PEC occurs on cracking clays derived in the valley or depositional floors of the Hamersley Range. It is described as a “rare tussock grassland dominated by *Astrebla lappacea* (DBCA 2022).

Four additional vegetation types (P27, P28, P29 and P31) were identified as sharing broad similarities to the Brockman Iron Cracking Clay PEC, such as the presence of *Astrebla* spp (mainly *A. elymoides* and *A. pectinata*). P27 is the only vegetation type to occur within the Development Envelope, covering 217.2 ha and is restricted to areas around the Silvergrass Mine and the NAP.

The Proposal does not include any expansion of approved mining and infrastructure in the area of the Silvergrass mine or the NAP.



Plate 7-1: P33 - Priority 1 PEC - Brockman Iron Cracking Clay Communities of the Hamersley Range

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road

Silvergrass

Nammuldi

Brockman 2

Brockman 4

Western Turner Syncline

Nanutarra - Munjina Road

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Figure 7-5
Threatened and Priority Ecological Communities

Drawn: L.Fuentes
Plan: PDE0189767v1
Date: May 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

PEC / TEC as per DBCA

- PEC
- TEC

Potential PEC

- Vegetation Unit P33 resembling PEC
- Potential PEC
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road

N

0 2 4 6 8 10
Kilometres

Map units in metres

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7.3.2.4. Significant Vegetation

Regionally significant, high and moderate local significance vegetation types are shown in Figure 7-6 and Figure 7-7. The vegetation types considered to be of high local significance are described in Table 7-5. Low to negligible local significance vegetation types are described in Appendix D.1 (Stantec 2021).

Regionally Significant Vegetation

Seven vegetation types were considered 'Regionally Significant' by Stantec (2021), of which two occur within the Development Envelope (Table 7-5):

- **P33**: Represents the Priority 1 PEC 'Brockman Iron Cracking Clay Communities of the Hamersley Range' (Cracking Clay PEC). Details of this vegetation type are presented in Section 7.3.2.3.
- **A6**: Considered significant due to it supporting the previously Priority 1 flora species *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) which has since been downgraded to Priority 3 (Plate 7-2). However, this species has never been recorded as occurring in this vegetation type within the Development Envelope. Therefore, in this assessment, the vegetation type will be considered of moderate local significance and will be discussed as such for the remainder of the ERD.



Plate 7-2: A6 - Priority 1 flora Vittadinia sp. Coondewanna Flats [S.van Leeuwen 4684]) dominant

Source: Biota 2019c; Stantec 2021b

Locally Significant Vegetation Types

Ten vegetation types were considered to have a high local significance, of which seven occur within the Development Envelope. These vegetation types typically supported P1 species, clusters of P3 species, represented potential GDV and/or are considered major/moderate drainage systems (Figure 7-6, Figure 7-7 and Table 7-5).

One vegetation type (C3) was identified as having both a high and moderate local significance depending on location, with areas mapped in association with Duck Creek given the 'high' ranking due to it occurring on a moderate-sized drainage system, supporting GDV and supporting riparian vegetation, (Figure 7-6 and Figure 7-7); as such, this vegetation type has been split into two subsets for the purpose of EIA:

- 'C3 (DkCk)' for the relevant area of high significance vegetation on Duck Creek
- 'C3' for the remainder.

The majority of vegetation types classified as "moderate" local significance represent Mulga (*Acacia aneura* complex) and/or Snakewood (*Acacia xiphophylla*) Ecosystems at Risk (EAR) communities, riparian vegetation or vegetation with limited local representation (Table 7-6). EARs are vegetation communities that are currently being significantly impacted by threatening processes

Forty vegetation types across 18,018.5 ha (41.3%) of the Development Envelope were classified as being of low significance as they possessed minimal conservation significant features or flora species.

Table 7-5: Vegetation Types of High Local Significance

Vegetation Type	Vegetation Code	Justification for Significance Rating	Extent within Survey Area (ha (%))	Extent within Development Envelope (ha (%))	Representative Photograph
C3 (DkCk)*	EcGOrSsANlTErTHtTe	• Potential GDV • Major drainage system supporting riparian vegetation (Duck Creek)	26.4 (< 0.1)	25.7 (< 0.1)	
C6	EvEcChAcEUa	• Potential GDV • Major drainage systems supporting riparian vegetation (Caves Creek) • Significant cultural drainage system • This reach of Caves creek also supports persistent ephemeral pools and some unique mesophytic riparian characteristics.	123.9 (< 0.1)	55.9 (< 0.1)	

Vegetation Type	Vegetation Code	Justification for Significance Rating	Extent within Survey Area (ha (%))	Extent within Development Envelope (ha (%))	Representative Photograph
C28	EcFgFbTYdPLr	• Potential GDV • Moderate drainage systems supporting riparian vegetation (Plunge Pool) • P1 Flora – *Hibiscus* sp. Mt Brockman	0.3 (< 0.1)	0.3 (< 0.1)	
G3	ElCfAprAanDpERImTe	• P1 flora – *Hibiscus* sp. Mt Brockman and *Tetratheca butcheriana* • EAR – *Acacia aneura* complex	994.3 (1.3)	415.0 (0.9)	

Vegetation Type	Vegetation Code	Justification for Significance Rating	Extent within Survey Area (ha (%))	Extent within Development Envelope (ha (%))	Representative Photograph
H35	ElTbr/ElTe	• P1 flora – *Hibiscus* sp. Mt Brockman	277.3 (0.4)	223.3 (0.5)	
H36	ElTe/ElTw	• P1 flora – *Hibiscus* sp. Mt Brockman	1,572.4 (2.1)	720.9 (1.6)	

Vegetation Type	Vegetation Code	Justification for Significance Rating	Extent within Survey Area (ha (%))	Extent within Development Envelope (ha (%))	Representative Photograph
P27	ARlCHfERAxASe	• Similar to Priority 1 PEC • P3 flora cluster – *Rostellularia adscendens* var latifolia, *Astrebla lappacea* and *Themeda* sp. Hamersley Station (M.E.Trudgen 11431)	264.8 (0.4)	217.2 (0.5)	

Table 7-6: Vegetation Types of Moderate Local Significance

Vegetation Type	Justification for Significance Rating
A1, A2, A3, A5, A6, A7, A9, A10, G1	EAR (Mulga)
P8, P9, P15	EAR (Snakewood)
A4, P7	EAR (Mulga and Snakewood)
P10	EAR (Mulga and Snakewood) Presence of P2 flora
A8, H7	EAR (Mulga). Presence of P3 flora cluster with limited local representation
C1	Moderate drainage systems supporting riparian vegetation Presence of P2 flora
C3*	Potential GDV Moderate sized drainage supporting riparian vegetation
C13, C14, H3, H4, H6, H15, H17, H21, H28, P5, P16, P19	Presence of P3 flora cluster
C16	EAR (Mulga) Potential GDV
C22, H13, H31	Presence of P2 flora
C27	Moderate drainage systems supporting riparian vegetation
G4	EAR Presence of P2 flora
H26	P3 and P4 flora P1 and P2 flora usually close to a different vegetation type

**Vegetation type C3 was identified as both high (for part of Duck Creek) and moderate local significance (refer to Section 7.3.2.4).*

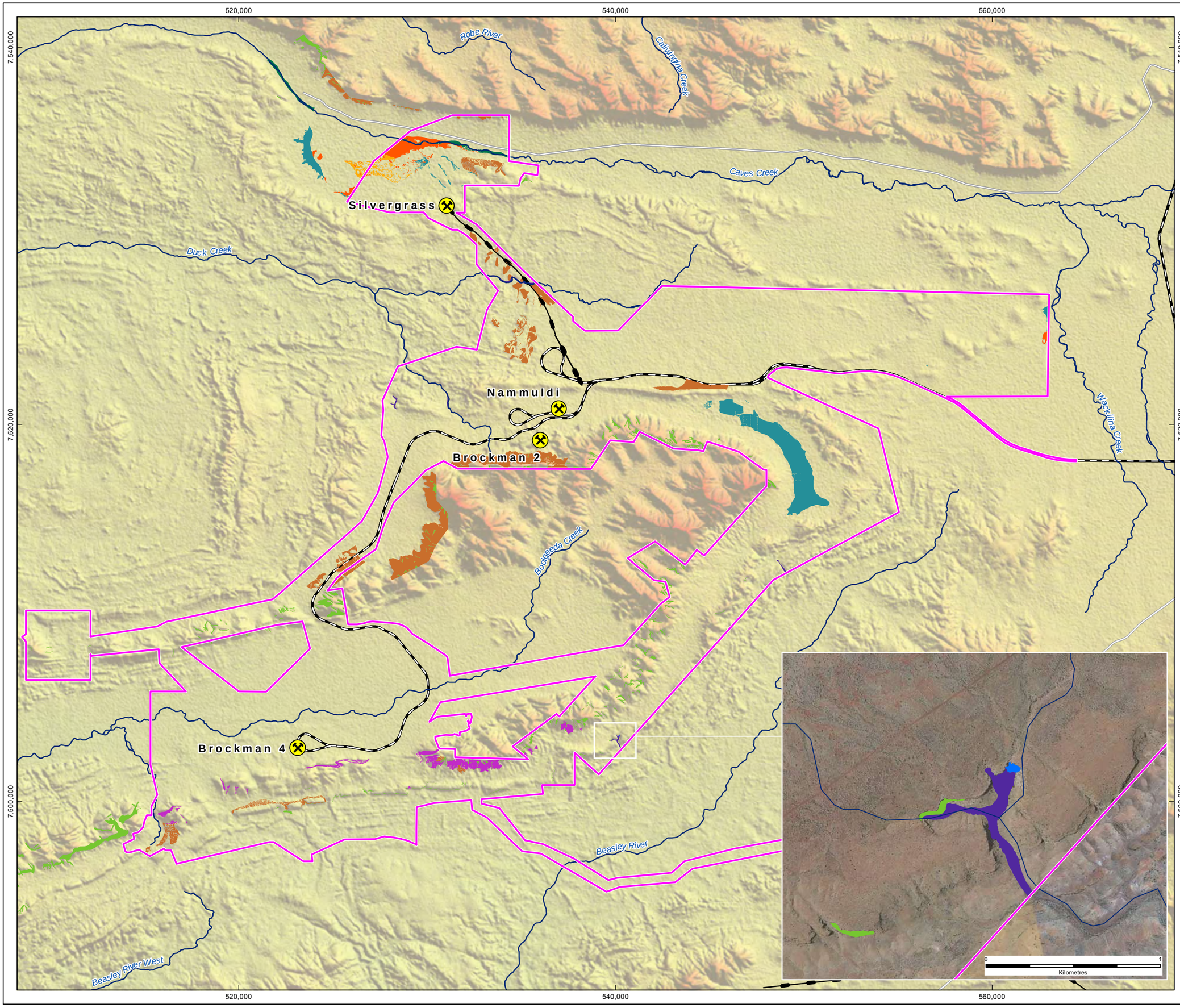

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Figure 7-6
Regionally and Locally Significant Vegetation Types

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

Development Envelope

Vegetation Types
Regionally and Locally Significant

- A6, AanCHfTe
- C28, EcFgFbTYdPLr
- C3, EcGOrSsANlTErTHtTe
- C6, EvEcChAcEUa
- G3, ElCfAprAanDpERImTe
- H35, ElTbr/ElTe
- H36, ElTe/ElTw
- P27, ARlCHfERAxASe
- P33, ASlASp

Rio Tinto Mine
Rio Tinto Railway
Conveyor
Major Road
Minor Road
Major Creek
Minor Creek

N

0 2 4 6 8 10
Kilometres
Map units in metres

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Figure 7-7
Vegetation Significance Ratings Overview

Drawn: L.Fuentes
Plan: PDE0189669v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Caves Creek
Robe River
Caliwingina Creek
Duck Creek
Wackiina Creek
Bodgeeda Creek
Purlykuti Creek
Beasley River
Beasley River West
Nanutarra - Munjina Road

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

Legend

- Development Envelope

Vegetation Significance

- Regionally Significant
- High
- Moderate
- Low
- Negligible
- Disturbed
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 7-7
Vegetation Significance Ratings
Map A

Drawn: L.Fuentes
Plan: PDE0189669v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000
520,000
530,000
540,000
7,540,000
7,530,000
7,520,000

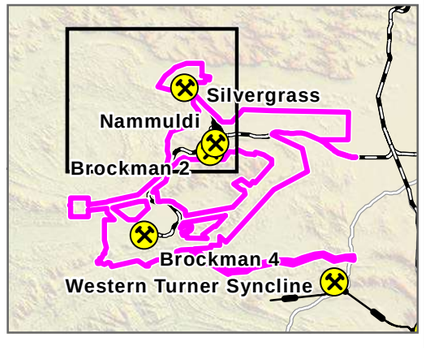
Caves Creek
Robe River
Duck Creek
Silvergrass
Nammuldi
Brockman 2

Legend

- Development Envelope

Vegetation Significance

- Regionally Significant
- High
- Moderate
- Low
- Negligible
- Disturbed
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 7-7
Vegetation Significance Ratings
Map B

Drawn: L.Fuentes
Plan: PDE0189669v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

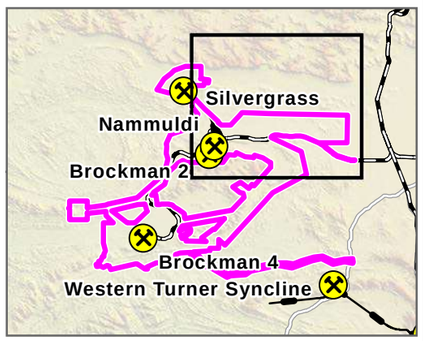
Legend

- Development Envelope

Vegetation Significance

- Regionally Significant
- High
- Moderate
- Low
- Negligible
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 7-7
Vegetation Significance Ratings
Map C

Drawn: L.Fuentes
Plan: PDE0189669v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

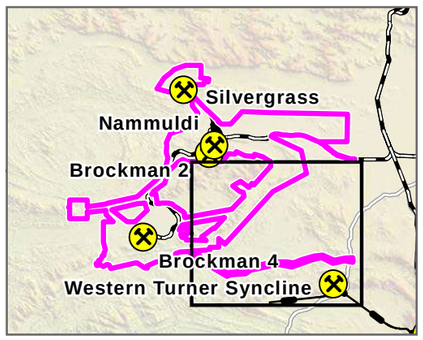
Legend

- Development Envelope

Vegetation Significance

- Regionally Significant
- High
- Moderate
- Low
- Negligible
- Disturbed

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 7-6
Vegetation Significance Ratings
Map D

Drawn: L.Fuentes
Plan: PDE0189669v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

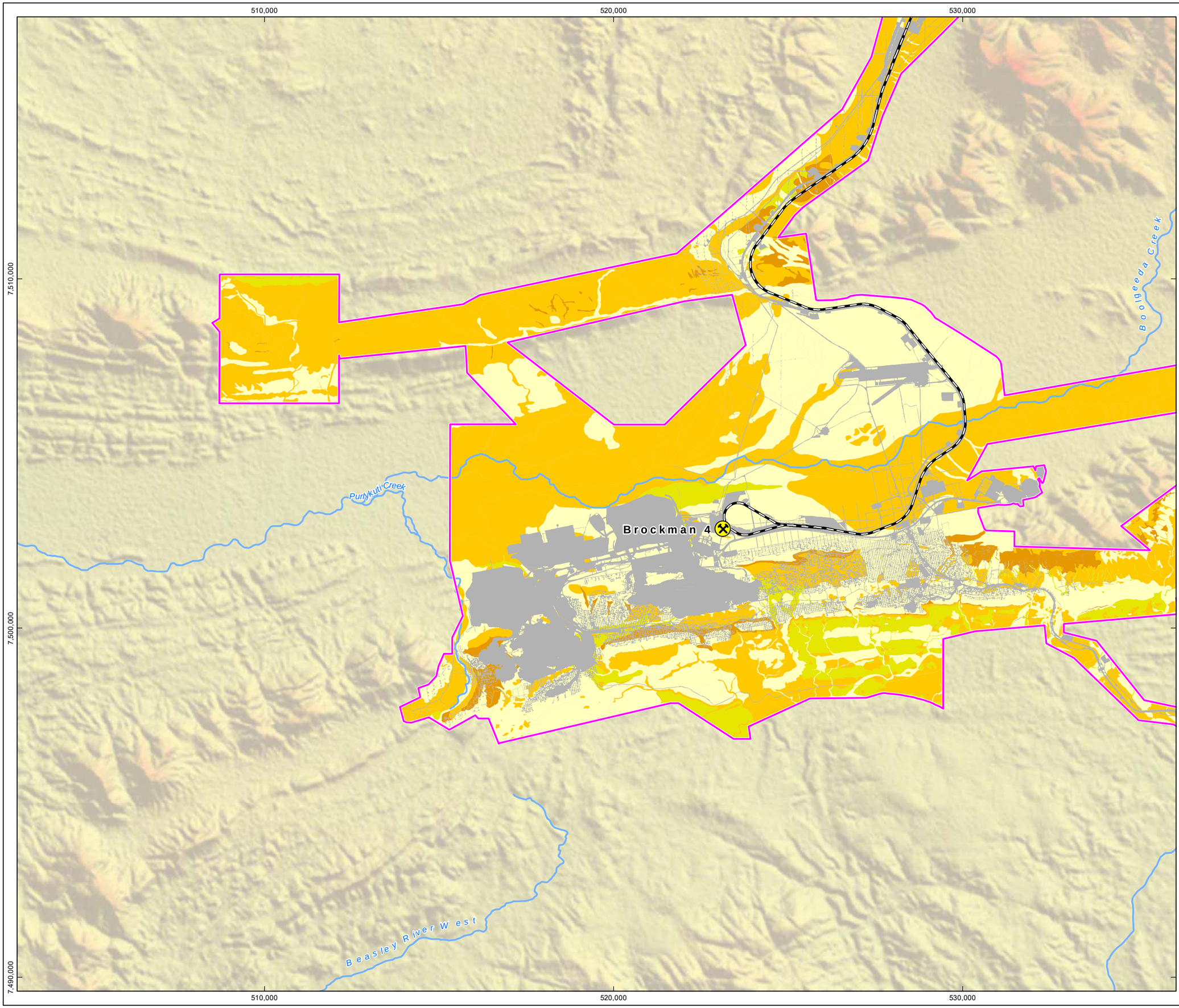
Legend

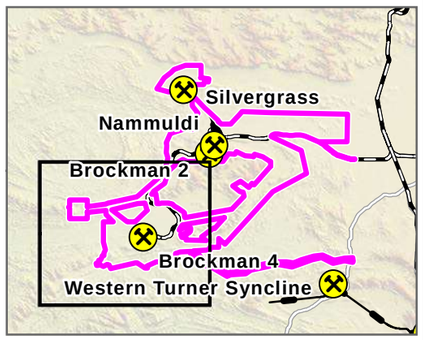
- Development Envelope

Vegetation Significance

- High
- Moderate
- Low
- Negligible
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek





N

0 1 2 3 4 5

Kilometres

Map units in metres

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7.3.2.5. Riparian Vegetation

Riparian vegetation generally occurs in the major and moderate-sized creeklines that intersect the Development Envelope (Boolgeeda Creek, Duck Creek and Caves Creek and their larger tributaries) as well as within some parts of the minor tributaries of these creeklines.

Stantec 2021 identified vegetation types that support riparian vegetation within the consolidation vegetation mapping area. In addition to this Biologic (Biologic 2020c, Biologic 2021b) undertook detailed riparian flora and vegetation mapping of Boolgeeda and Duck Creeks within and beyond the Development Envelope. A consolidated dataset has been created and is presented in Table 7-7 and Figure 7-8 showing 24 vegetation types that support riparian vegetation.

These vegetation types cover approximately 1,509 ha or 2.4% of the Development Envelope. Of this, 136.2 and 407.5 ha are considered to be of high and moderate local significance. Riparian vegetation types have also been mapped beyond the Development Envelope in Boolgeeda Creek and Duck Creek (Biologic 2020c, Biologic 2021b).

Table 7-7: Vegetation Types Identified to Support Riparian Vegetation

Vegetation Type	Vegetation Code	Drainage System	Extent within Survey Area (ha)	Extent within Development Envelope (ha)
High Local Significance				
C3(DkCk) (Duck Creek)	EcGOrSsANlTErTHtTe	Major	26.4	25.7
C6 (Caves Creek)	EvEcChAcEUa	Major	123.9	69.5
C28	EcFgFbTYdPLr	Moderate	0.3	0.3
Moderate Local Significance				
C1 (Boolgeeda Creek)	EvAciGOrSsAbApyTrFTeCc	Moderate	122.0	109.2
C3	EcGOrSsANlTErTHtTe		26.3	26.3
C27 (Boolgeeda Creek)	ExEvMgAciAcpAbTaTeTHtCc		137.2	105.8
Low and Negligible Local Significance				
AcExLW*	AcExLW AppSsGrMSS CcCdEcMOTG	Major	65.5	62.9
EvExMOW*	EvExMOW AcAcpAbTOS EaCcTtMSTG		41.8	13.2
Ac LOW*	AcLOW AssAppHllTOS CcLTG TeLSHG	Moderate	1,388.9	156.3
EcrEvMOW*	EcrEvMOW MgAppGrMSS CaEaMSTG		908.0	13.5
EvCcdChMOW*	EvCcdChMOW AcAppAssTOS CcEuTtMOTG		293.8	142.9
EvEcrMOW*	EvEcrMOW AcLST AppAssPlTSS CcTtEa MSTG		493.5	15.2
C5	EvAciTeCc	Minor local	2.1	2.1
C7	AciAbTe		48.8	48.8
C8	AciAtuAbTe		10.2	10.2

Vegetation Type	Vegetation Code	Drainage System	Extent within Survey Area (ha)	Extent within Development Envelope (ha)
C9 (Boolgeeda Creek)	CdEgAatAeTw		85.3	23.1
C10	ChAciGOsSsVfCcTHt		90.7	18.9
C11	ChAncAmonAbAciSaoTeTHtERmCc		5.5	5.5
C12	ChAncAmonAbAciSaoTeTHtERmCc/Tw		131.3	3.2
C15	ChElGwGOrTsMBEUaPmTe		118.8	118.8
C20	ElChGOrApyTHtTe		24.0	24.0
C23	ExAciSsAbElTe		100.1	66.5
C24	ExAciTeCc		311.6	296.6
C25	ExChAbAcAelaAeTeEUa		64.7	64.7
C26	ExChAsppGgTe		155.7	99.8

Major Creekline

The riparian vegetation supported by Duck Creek has been identified by Stantec (2021) to be of high local significance, predominantly due to their position along a major creekline and the elevated likelihood that Duck Creek supports GDV and associated GDEs. Furthermore, the communities that Duck Creek supports also support a higher diversity of riparian species than other riparian vegetation units across the Development Envelope, including several Priority flora species (discussed further in Section 7.3.3.1). Approximately 25.7 ha of this vegetation type C3 (DkCk) occurs within the Development Envelope.

Within the Development Envelope, Boolgeeda Creek represents a higher order stream that does not support GDVs. As such the riparian vegetation supported by Boolgeeda Creek (vegetation types C1 and C27) are classified as only being of moderate to low local significance.

The riparian vegetation types along with the major creek systems within the Development Envelope generally have an overstorey dominated by species that are known to have the potential of being groundwater dependent (*Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix*); this is discussed in Section 7.3.2.6. These species are common to riparian vegetation units throughout the Pilbara bioregion. The effects of weeds and cattle grazing are impacting some of these riparian vegetation units. (Biologic 2020c) (Biologic 2021b).

RioTinto

Figure 7-8
Riparian Vegetation

Drawn: L.Fuentes
Plan: PDE0189670v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Caves Creek
Robe River
Caliwingina Creek
Duck Creek
Boolgeeda Creek
Beasley River
Beasley River West

Silvergrass
Nammuldi
Brockman 2
Brockman 4

0 0.5 1 1.5 2
Kilometres

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

Riparian Vegetation

High Local Significance

- C28
- C3
- C6

Moderate Local Significance

- C1
- C27
- C3

Low Local Significance

- AcExLW AppSsGrMSS CcCdEcMOTG
- AcLOW AssAppHllTOS CcLTG TeLSHG
- C10
- C11
- C12
- C15
- C20
- C23
- C24
- C25
- C26
- C5
- C7
- C8
- C9
- EcrEvMOW MgAppGrMSS CaEaMSTG
- EvCcdChMOW AcAppAssTOS CcEuTtMOTG
- EvEcrMOW AcLST AppAssPlTSS CcTtEa MSTG
- EvExMOW AcAcpAbTOS EaCcTtMSTG

N

0 2 4 6 8 10
Kilometres

Map units in metres

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7.3.2.6. Groundwater Dependent Ecosystems

GDEs are terrestrial, aquatic or subterranean ecosystems that require access to groundwater to persist in the landscape (Biologic 2021a) and therefore only occur where the watertable is shallow. Aquatic fauna that may inhabit groundwater dependent waterbodies is addressed in Section 6. Subterranean ecosystems dependent on groundwater are addressed in relation to stygofauna in Section 9. This chapter focuses on GDV and the ecosystems they support.

Terrestrial GDEs rely on shallow groundwater and are typified by GDV and GDV indicator species called phreatophytes. Phreatophytes may be classified as either obligate or facultative depending on their reliance on groundwater (Eamus et al. 2016 cited in Biologic 2021a). Obligate phreatophytes are confined to habitats with access to, and are highly dependent on, groundwater. Facultative phreatophytes will use groundwater where it is available but can also exist in environments without access to groundwater. Not all riparian vegetation is groundwater dependent; vadophytes are commonly associated with drainage lines and rely on moisture in the soil profile, independent of groundwater (Biologic 2020c; 2021b).

Three tree species considered keystone Pilbara phreatophytes are *Melaleuca argentea* (obligate phreatophyte), and *Eucalyptus camaldulensis* subsp. *refulgens* (facultative phreatophyte) and *Eucalyptus victrix* (facultative phreatophyte or a vadophyte) (Biologic 2020b; Biologic 2020c; Biologic 2021b).

The depth to groundwater in the Development Envelope is generally well beyond the rooting depth of vegetation (approximately 20 m bgl) (Section 6), limiting the potential for groundwater dependence to a small number of locations where local stratigraphy and topography support discrete areas of shallow groundwater.

In order to properly identify and assess the sensitivity of any potential terrestrial GDEs, and associated aquatic GDEs, within and surrounding the development envelope, a baseline GDE exposure assessment was conducted. This assessment followed methodology developed by Rio Tinto biologists, which leveraged relevant remote sensing analysis techniques (Barron et al., 2012) and was also guided by assessment techniques and characteristics utilised by presented by the IESC (Independent Expert Scientific Committee on coal seam gas and large coal mining development, Doody et al., 2019). The GDE exposure assessment focused on identifying areas of vegetation displaying characteristics indicative of potential GDV (Biologic 2021a) within a ‘broad hydrological development zone’ (Figure 7-9); a broad area of interest developed for the GDE study where aquifers may be connected or are close to those potentially being dewatered for the Proposal (Biologic 2021a). This zone was deliberately larger than the Development Envelope, so any changes to the Proposal and groundwater model would not result in gaps in the GDE study.

Long-term normalised difference vegetation index (NDVI) and normalised difference water index (NDWI) satellite data was used to identify areas with persistent vegetation cover and ‘greenness’ indicating some potential for access to additional water sources (Biologic 2021a). These areas were then subject to a review of aerial imagery and topography to assess various additional lines of evidence such as species composition, vegetation density, landscape position and eco-physical properties. This was done in order to determine whether the detected vegetation features appear to have greater access to water than surrounding areas supported by typical ephemeral water sources. This resulted in 54 potential GDE features identified within the broad hydrological development zone with persistent vegetation and potential for groundwater dependence based on topography and regional groundwater depth. The minimum characteristics applied to the initial feature detection process were quite conservative and as such the majority of the features detected possessed the marginal potential for groundwater dependence. This was done so that the end result of applying the study methodology was that the potential to miss potential GDV was extremely low, and that the remaining list of features represents the GDV exposure profile of the study area.

The likely groundwater dependence of the 54 potential GDE features was assessed and refined:

- Initially using Aerial photo interpretation
- Regional hydrogeological information
- Refined using targeted biological survey data and ground truthing at ten of the most relevant sites
- Further refined using project hydrogeological data and pre-mining groundwater levels.

Generally, groundwater levels deeper than 15 m were considered too deep for vegetation to access and were excluded as potential GDE features; except where *Eucalyptus camaldulensis* (or other specific species assemblages) was identified from aerial imagery as this species can sometimes access groundwater beyond 20 m (Plate 7-3; Biologic 2021a).

A broad tiered biological significance ranking framework was applied to each potential GDE feature, with higher ratings given to larger and more complex potential GDE features with shallow watertable and obligate phreatophytes. All 28 potential GDE features identified through this process were assessed as having only local significance based on these ratings, with the potential exception of Plunge Pool. In vegetation terms, its riparian vegetation does not appear to represent an obligate GDV (Table 7-8; Biologic 2021a) but given the groundwater dependent pool and the significant fauna and cultural heritage, Plunge Pool has the highest significance of the potential GDE features assessed. Plunge Pool has been placed within a MEZ (Section 6.5) and as such riparian vegetation will be protected from direct impacts.

The process identified 28 features in the broad hydrological development zone with some potential for groundwater dependence:

- Two features were of ‘high’ potential dependence
- Nine features were of ‘moderate’ potential dependence although some features likely rely on perched groundwater or other smaller scale groundwater sources
- Seventeen (17) features were of ‘low’ dependence and are not discussed further.

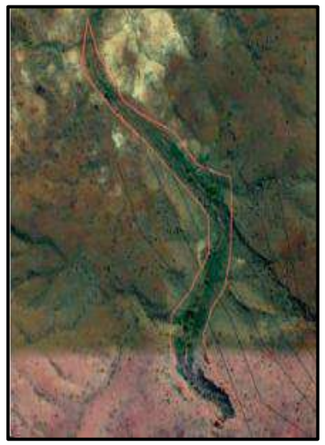
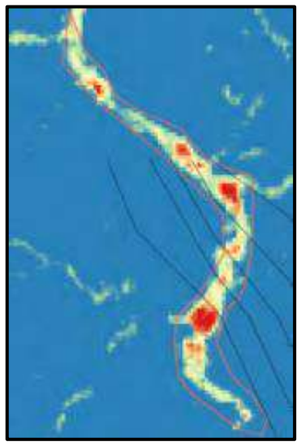
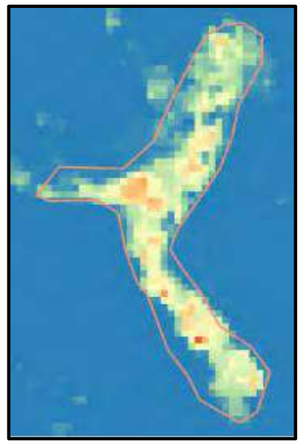
The 11 potential GDE features of moderate to high potential groundwater dependence are outlined in Table 7-8 and Figure 7-10.

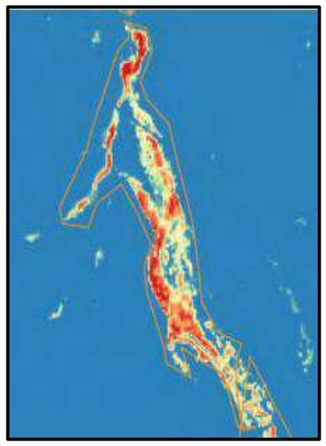
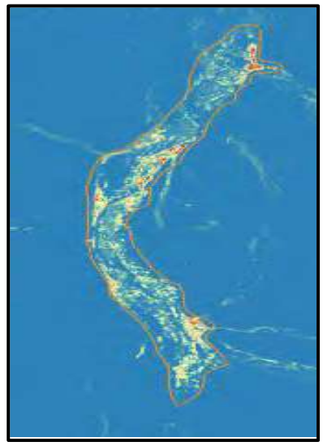
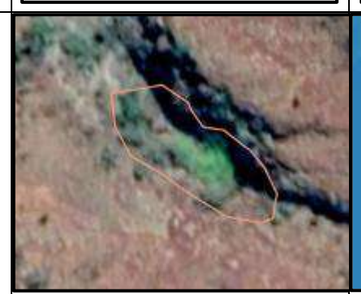
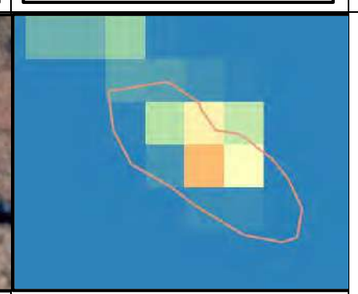


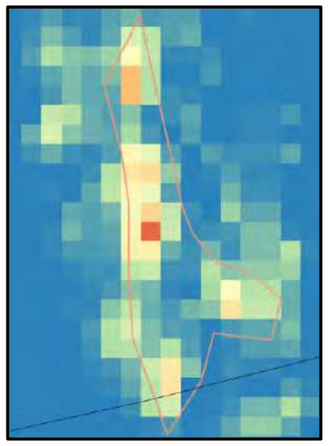
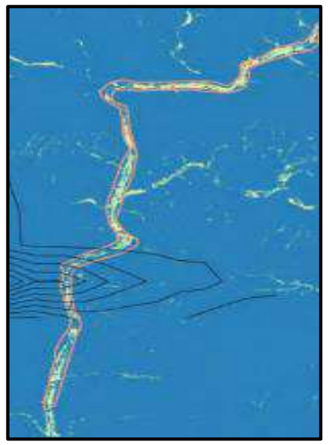
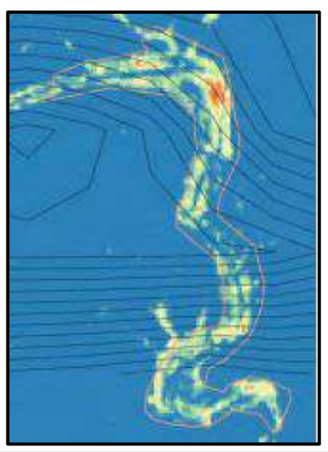
Plate 7-3: Example of *Eucalyptus camaldulensis* (Orange Circles) and *Eucalyptus victrix* (Green Circles) on High Resolution Aerial Photography

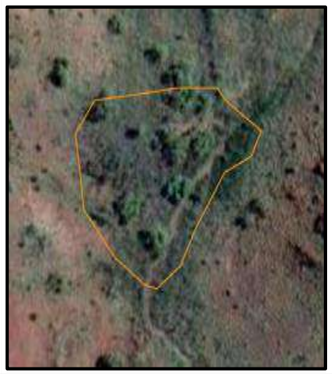
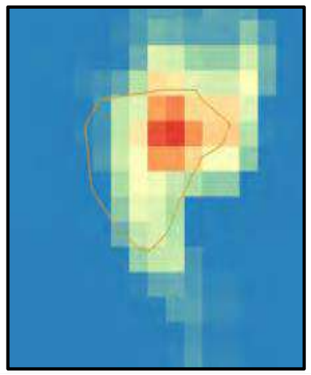
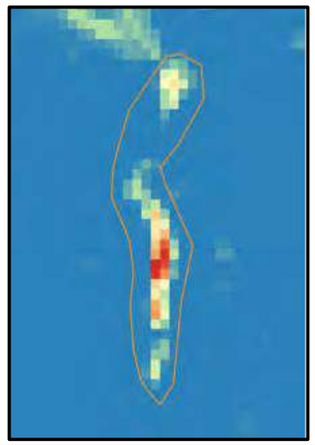
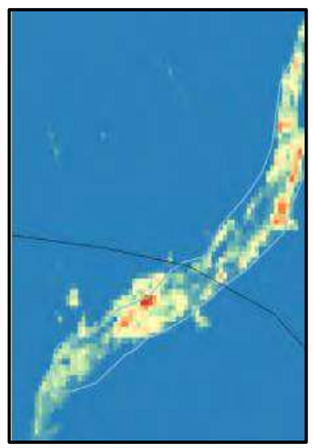
Source: Biologic 2021a

Table 7-8: Potential GDE Features Identified within Broad Hydrological Development Zone

Potential GDE Feature ID	Name/Location	Key Characteristics and Biological Significance Rating	Aerial Photo	NDVI Persistence Mapping	Total Extent (ha)*	Extent within Existing Operations Development Envelopes	Extent within DE (ha)*
Likely High Dependence							
109	Duck Creek catchment BS2 assessment area	Key Characteristics: • GDV present; high NDVI persistence; groundwater potentially within ≤5 m of the surface • Low to moderate			10.5	10.5	10.5
355	Plunge Pool BS3 assessment area	Key Characteristics: • GDV present; scattered high NDVI persistence (coinciding with eucalypts). Upper catchment likely to be impacted; groundwater likely within ≤5 m of the surface. • Moderate			5.9	0	5.9

Potential GDE Feature ID	Name/Location	Key Characteristics and Biological Significance Rating	Aerial Photo	NDVI Persistence Mapping	Total Extent (ha)*	Extent within Existing Operations Development Envelopes	Extent within DE (ha)*
Likely Moderate Dependence							
130	Duck Creek catchment BS2 assessment area, west of the existing Nammuldi processing area	Key Characteristics: • Possible minor GDV present; within existing periodic discharge wetting front. • Very low			66.3	0.0	60.3
89	Boolgeeda Creek catchment BS4 assessment area	Key Characteristics: • Within Boolgeeda Creek discharge zone, which is likely to be influencing NDVI persistence. • Very low			285.6	0.0	236.7
90	Ridge Pool Outside of Development Envelope	Key Characteristics: • Known ephemeral pool high in the landscape and not connected to deep groundwater aquifers. • Any groundwater would be perched and therefore this feature is not further assessed. • Low to moderate	 -		0.1	0.0	0

Potential GDE Feature ID	Name/Location	Key Characteristics and Biological Significance Rating	Aerial Photo	NDVI Persistence Mapping	Total Extent (ha)*	Extent within Existing Operations Development Envelopes	Extent within DE (ha)*
108	Duck Creek catchment BS2 assessment area	Key Characteristics: • Low density of eight E. camaldulensis with scattered high NDVI. • Low			0.6	0.6	0.6
118	Boolgeeda Creek catchment BS1 assessment area	Key Characteristics: • Long ephemeral creek; coincides with calcrete geology; scattered high NDVI persistence; groundwater likely within ≤15 m of the surface • Low			56	0.0	23
119	Boolgeeda Creek catchment BS1 assessment area	Key Characteristics: • Ephemeral creek; coincides with calcrete geology; scattered high NDVI persistence; groundwater likely within ≤15 m of the surface • Low			28.0	0.0	28.0

Potential GDE Feature ID	Name/Location	Key Characteristics and Biological Significance Rating	Aerial Photo	NDVI Persistence Mapping	Total Extent (ha)*	Extent within Existing Operations Development Envelopes	Extent within DE (ha)*
93	Beasley River catchment Outside Development Envelope near BS3 and LBS2 assessment areas	Key Characteristics: • Possible minor GDV present; groundwater possible within ≤15 m of the surface • Very low			0.3	0.0	0.0
284	Boolgeeda Creek Catchment Outside Development Envelope approx. 5 km west of BS1 assessment area	Key Characteristics: • Minor GDV likely present; located in a tight gorge. May rely on small, perched aquifers. • Low			1.8	0.0	0.0
117	Boolgeeda Creek Catchment Outside Development Envelope. BS2 assessment area (at BS1 assessment area boundary)	Key Characteristics: • Broad ephemeral channel: No GDV present based on field investigation. Calcrete occurs in this area and feature likely to be inflow dependent. Groundwater likely within ≤15 m of the surface so conservatively considered likely moderate dependence. • Low			7.5	8	0.0

**Total extent rounded to the nearest ha*

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Figure 7-9
GDE Desktop Assessment Area and Broad Hydrological Development Zone

Drawn: L.Fuentes
Plan: PDE0189672v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:350,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Desktop Assessment Area
- Broad Hydrological Development Zone
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

460,000 480,000 500,000 520,000 540,000 560,000

7,560,000 7,540,000 7,520,000 7,500,000 7,480,000

Caliwingina Creek
Robe River
Caves Creek
Serpentine Creek
Duck Creek
Silvergrass
Wackiina Creek
Barnett Creek
Nammuldi
Brockman 2
Pinarra Creek
Boolgeeda Creek
Brockman 4
Western Turner Syncline
Beasley River West
Beasley River
Hardey River
Nanutarra - Munjina Road

N

0 5 10 15 20
Kilometres
Map units in metres

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Figure 7-10
GDE Features of High and Moderate Potential Groundwater Dependence

Drawn: L.Fuentes
Plan: PDE0189673v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Broad Hydrological Development Zone
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

Exposure Rating

Likely High Dependence

- 109
- 355

Likely Moderate Dependence

- 89
- 90
- 94
- 108
- 117
- 118
- 119
- 130
- 284

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Robe River
Callawinga Creek
Caves Creek
Silvergrass
Nammuldi
Brockman 2
Boolgeeda Creek
Brockman 4
Munjina - Roy Hill Road

0 0.25 0.5 0.75 1
Kilometres

7.3.2.7. Vegetation Condition

The condition of native vegetation within the Development Envelope ranges from excellent to completely degraded (cleared) (Table 7-9 and Figure 7-11) (Stantec 2021). The majority is in excellent (68.0 %) or Very Good (24.4 %) condition. Vegetation in poor and degraded condition has been influenced by cattle grazing and weed infestation (Stantec 2019).

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).

Vegetation condition within the Development Envelope is considered consistent with that observed locally and within the Pilbara region (Stantec 2019). Riparian vegetation types were typically observed to be in poorer condition than upland areas due to weed infestation and cattle grazing pressure (Plate 7-4; Stantec 2019; Biologic 2020c; Biologic 2021b).



Plate 7-4: Riparian Vegetation (Acacia low open woodland) Condition (Duck Creek (left), Boolgeeda Creek (right)

Source: Biologic 2020c; 2021b

Table 7-9: Vegetation Condition for Remnant Vegetation in the Development Envelope

Vegetation Condition	Total Extent within Survey Area		Total Extent in Development Envelope	
Units	**Area(ha)**	**%**	**Area (ha)**	**%**
Excellent	44,832.7	58.8	35,467.2	56.0
Very Good	15,783.9	20.7	12,854.8	20.3
Good	3,932.5	5.1	3,421.4	5.4
Poor	310.9	0.4	293.7	0.5
Degraded	282.9	0.4	281.0	0.4
Completely Degraded	11,055.6	14.5	11,024.4	17.4
Total	**76,198.6**	**100.0**	**63,343**	**100.0**

RioTinto

Figure 7-11
Vegetation Condition Overview

Drawn: L.Fuentes
Plan: PDE0189668v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:210,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Caves Creek
Robe River
Calwadgina Creek
Duck Creek
Silvergrass
Nammuldi
Brockman 2
Wacklina Creek
Bodgeeda Creek
Nanutarra - Munjina Road
Brockman 4
Beasley River
Western Turner Syncline
Beasley River West

Legend

- Development Envelope

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 7-11
Vegetation Condition
Map A

Drawn: L.Fuentes
Plan: PDE0189668v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

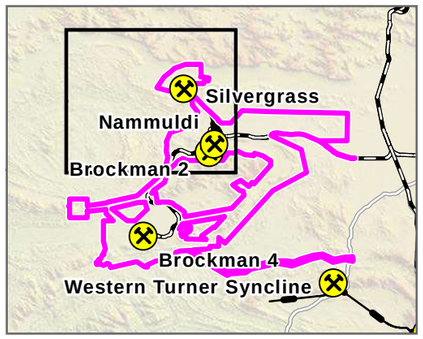
Legend

- Development Envelope

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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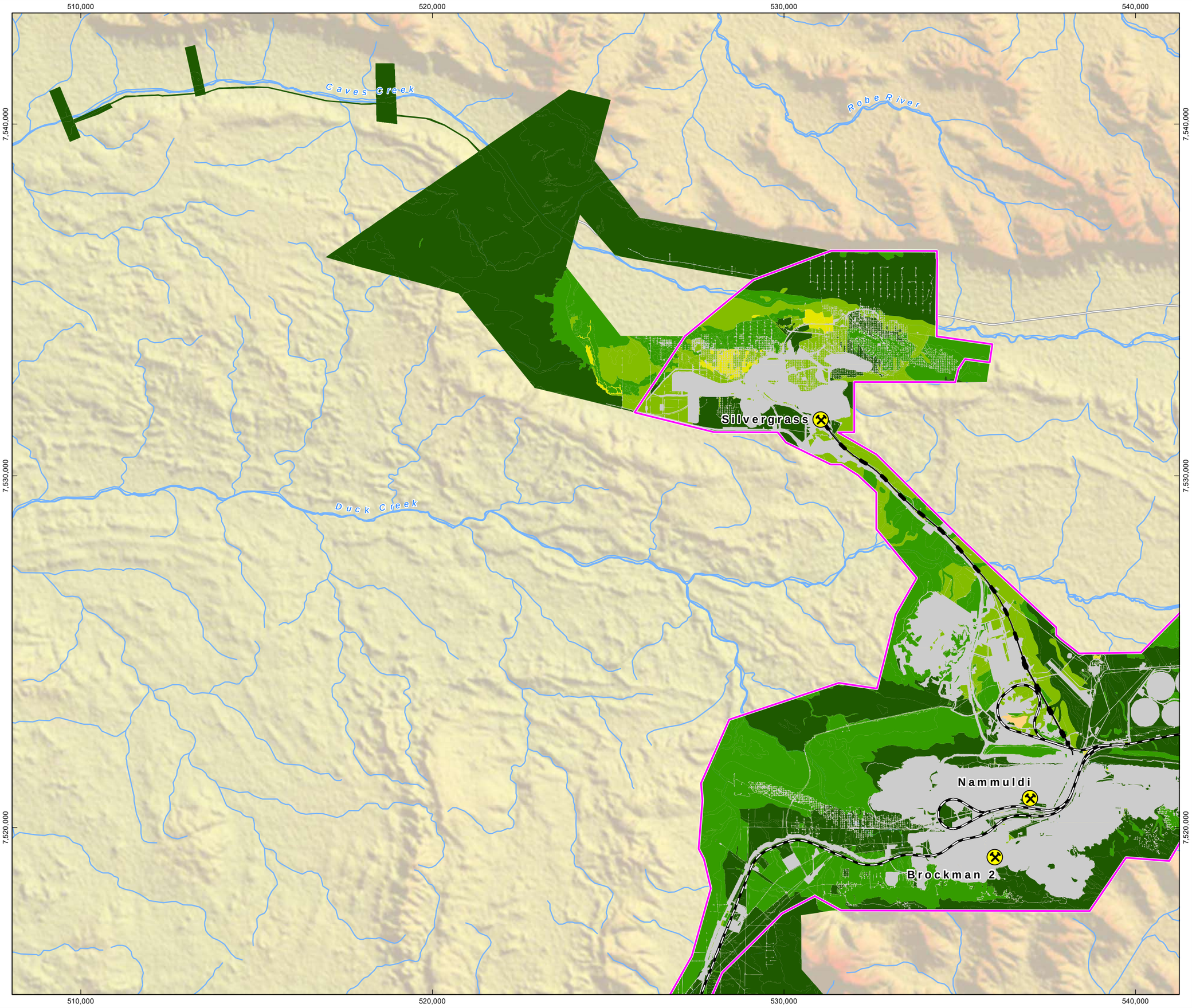


RioTinto

Figure 7-11
Vegetation Condition
Map B

Drawn: L.Fuentes
Plan: PDE0189668v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

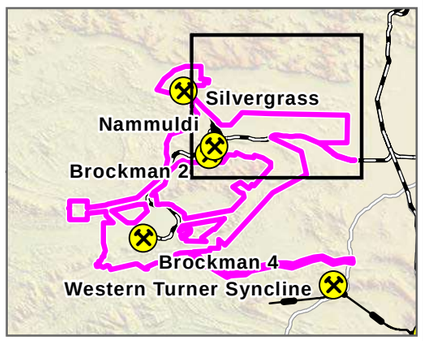
Legend

- Development Envelope

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



N

0 1 2 3 4 5

Kilometres

Map units in metres

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RioTinto

Figure 7-11
Vegetation Condition
Map C

Drawn: L.Fuentes
Plan: PDE0189668v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

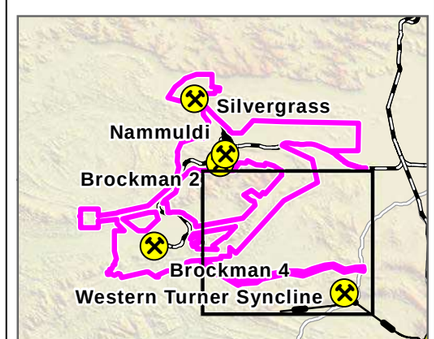
Legend

- Development Envelope

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek
- Minor Creek



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Kilometres

Map units in metres

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RioTinto

Figure 7-11
Vegetation Condition
Map D

Drawn: L.Fuentes
Plan: PDE0189668v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

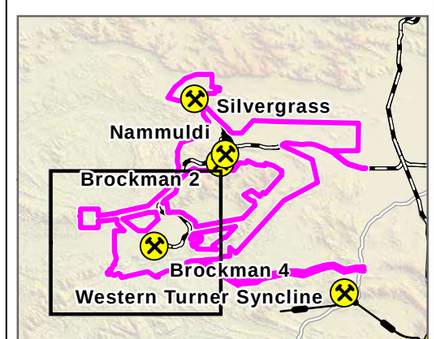
Legend

- Development Envelope

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek
- Minor Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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7.3.3. Flora

A total of 902 flora taxa have been recorded within the Development Envelope, comprising 866 native and 36 introduced species (Biologic 2021b, Biologic 2020c, Biota 2019b, Mattiske 2019 and Stantec 2019). These represent a total of 76 families and 246 genera with Poaceae, Fabaceae, Malvaceae, Asteraceae and Amaranthaceae being the most diverse families. This is in line with the expected diversity of flora taxa in the Pilbara.

This chapter considers flora in terms of environmental significance, where information is available the cultural significance to Traditional Owner groups of some plant species is also discussed in Section 12.

7.3.3.1. Threatened and Priority Flora

Significant flora includes species listed under the EPBC Act, the BC Act, or Priority species identified by DBCA as requiring further protection (EPA 2016a). 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 hybrids, or are relictual representatives of taxonomic groups that no longer occur widely in the broader landscape.

No Threatened flora, as listed under the EPBC or BC Act, have been recorded within the Development Envelope. Twenty-six Priority flora species (comprising two Priority 1, four Priority 2, 16 Priority 3 and four Priority 4) were recorded within the Development Envelope. Details of these Priority flora are provided in Table 7-10 and Figure 7-12.

No species recorded within the Development Envelope were considered to represent potential range extensions or meet other criteria defining them as significant taxa.

Table 7-10: Significant Flora Species Recorded in the Development Envelope

Taxon	Development Envelope	State-wide (regional)
	Number of individuals	Number of individuals
Priority 1 (potential to be listed as Critically Endangered)		
Tetratheca butcheriana	202	3,618
Priority 1		
Hibiscus sp. Mt Brockman (E. Thoma ET 1354)	1,445	7,491
Priority 2		
Hibiscus aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	219	362
Ipomoea racemigera	198	1,001
Oxalis sp. Pilbara (M.E. Trudgen 12725)	54	485
Pentalepis trichodesmoides subsp. *hispida*	3	863
Priority 3		
Aristida jerichoensis var. *subspinulifera*	1	670,944

Taxon	Development Envelope	State-wide (regional)
	Number of individuals	Number of individuals
Astrebla lappacea	299	8,199
Dampiera anonyma	74	408
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	51	4,931
Eremophila magnifica subsp. *velutina*	1,520	4,559
Grevillea saxicola	137	4,853
Gymnanthera cunninghamii	1	194
Indigofera gilesii	59	4,868
*Indigofera rivularis**	4,221	28,979
Ptilotus subspinescens	12,117	28,848
Rhagodia sp. Hamersley (M. Trudgen 17794)	51	51,818
Rostellularia adscendens var. latifolia	173	4,507
Sida sp. Barlee Range (S. van Leeuwen 1642)	2,411	10,963
Sida sp. Hamersley Range (K. Newbey 10692)	880	4,835
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	817	146,014
Triodia basitricha	6,237	115,211
Priority 4		
Acacia bromilowiana	700	30,50
Eremophila magnifica subsp. *magnifica*	900	10,722
Goodenia nuda	393	16,637
Lepidium catapycnon	255	38,091

Priority 1 Flora

Tetratheca butcheriana

Tetratheca butcheriana (P1) is described as an erect, sprawling shrub growing to 80 cm tall, with leafless stems and pink to purple pendulous flowers (Plate 7-5). This species prefers ironstone cliff faces and upper ridgelines (Plate 7-6; Biota 2019a), with analysis indicating it tends to prefer a north to north-eastern (to eastern) aspect at elevations ranging from 750 m to 1,050 m. Field observations suggest the species tends to occur on un-mineralised geologies.



Plate 7-5: *Tetratheca butcheriana* (*Source: Biota 2019a)*



Plate 7-6: *Tetratheca butcheriana* cliff face habitat. a-c *Tetratheca butcheriana* habitat with commonly associated vegetation, white arrows indicate plant locations on cliff faces; d – *Tetratheca butcheriana* plants flowering in a shaded cliff area. (*Source: Rio Tinto 2021a***)**

Tetratheca butcheriana is restricted to the Hamersley subregion of the Pilbara bioregion. There are 3,428 plants; with a total of 202 individuals recorded from within the Development Envelope (Table 7-10). Targeted surveys have identified seven populations in total, occurring over an approximately 7 km span (Figure 7-12). The species' area of occupancy has been calculated at 24 km^2 and its extent of occurrence as 10,317 km^2.

Tetratheca butcheriana is currently listed as a P1 species by DBCA, however, meets International Union for Conservation of Nature (IUCN) criteria to be recognised as Critically Endangered; therefore, there is potential for it to be formally listed as such under the BC Act in the future.

***Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)**

Hibiscus sp. Mt Brockman (E. Thoma ET 1354) is described as a large, robust shrub with ovate to lanceolate leaves densely covered in stellate hairs and a uniform tooth margin, as well as uniformly dense stellate-hairy stems and large flowers with long, thin calyx lobes that are approximately half the length of the petals (Plate 7-7; A. Perkins, WA Herbarium pers. comm. 2012 as cited in Biota 2016a). This species was previously included in the *Hibiscus "haynaldii"* complex but has since been allocated the phrase name, *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354) (Biota 2016a). It prefers rocky slopes, breakaways, gullies, and areas below free faces (Biota 2019a).

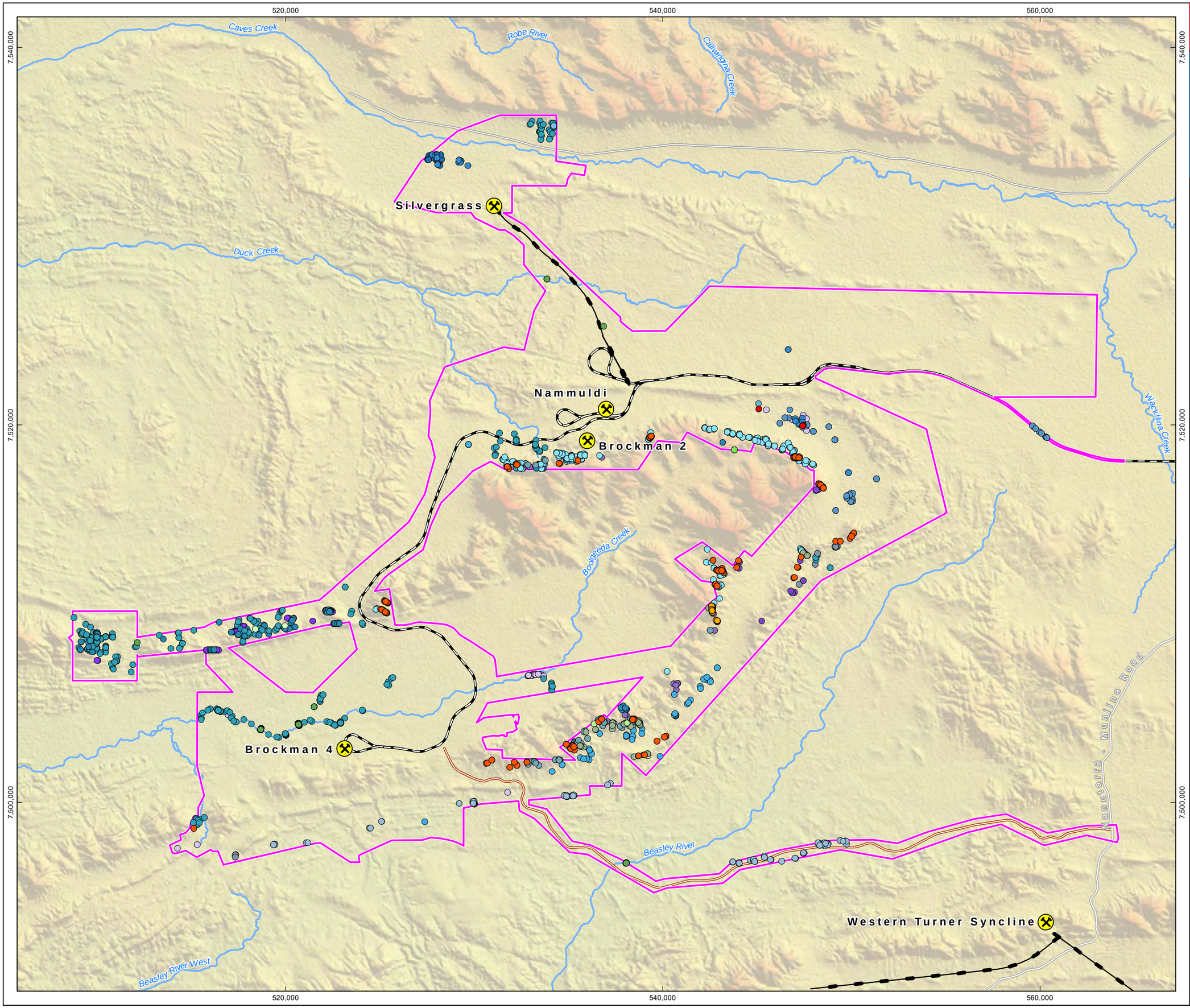
A total of 1,445 individuals of *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354) have been recorded from in the Development Envelope (Table 7-10). There are over 7,491 known individuals of *Hibiscu*s sp. Mt Brockman (E. Thoma ET 1354) that occur within WA (DBCA 2022; Rio Tinto 2021g).

Records have been identified approximately 52 km east of the Development Envelope at Karijini National Park near Wittenoom and approximately 160 km southeast near West Angeles (Eco Logical Australia 2013a; Rio Tinto 2013 and Biota 2014e as cited in Biota 2016a).

Two records consisting of 'five individuals' and 'four individuals' (DBCA 2007-2021) occur within the Karijini National Park conservation estate.



Plate 7-7: *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354) ***(Source: Biota 2019a)***



RioTinto

Figure 7-12
Priority Flora Records within the Development Envelope Overview

Drawn: L.Fuentes
Plan: PDE0189675v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

Development Envelope

Significant Flora Species

Priority 1 (P1)

- *Euphorbia inappendiculata* var. queenslandica
- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)
- *Tetratheca butcheriana*

Priority 2 (P2)

- *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Oxalis* sp. Pilbara (M.E. Trudgen 12725)
- *Pentalepis trichodesmoides* subsp. *hispida*

Priority 3 (P3)

- *Aristida jerichoensis* var. *subspinulifera*
- *Astrebla lappacea*
- *Dampiera anonyma*
- *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)
- *Eremophila magnifica* subsp. *velutina*
- *Grevillea saxicola*
- *Gymnanthera cunninghamii*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Ptilotus subspinescens*
- *Rhagodia* sp. Hamersley (M. Trudgen 17794)
- *Rostellularia adscendens* var. *latifolia*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)
- *Triodia basitricha*

Priority 4 (P4)

- *Acacia bromilowiana*
- *Eremophila magnifica* subsp. *magnifica*
- *Goodenia nuda*
- *Lepidium catapycnon*

Rio Tinto Mine
Rio Tinto Railway
Conveyor
Major Road
Minor Road
Site Access Road
Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 7-12
Priority Flora Records within the Development Envelope
Map A

Drawn: L.Fuentes
Plan: PDE0189675v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Significant Flora Species

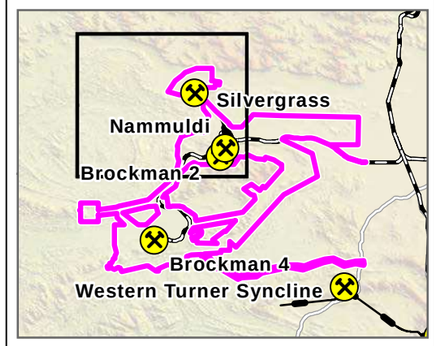
Priority 1 (P1)
- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)

Priority 2 (P2)
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*

Priority 3 (P3)
- *Astrebla lappacea*
- *Eremophila magnifica* subsp. *velutina*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Rostellularia adscendens* var. *latifolia*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)
- *Triodia basitricha*

Priority 4 (P4)
- *Acacia bromilowiana*

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



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0 1 2 3 4 5
Kilometres

Map units in metres

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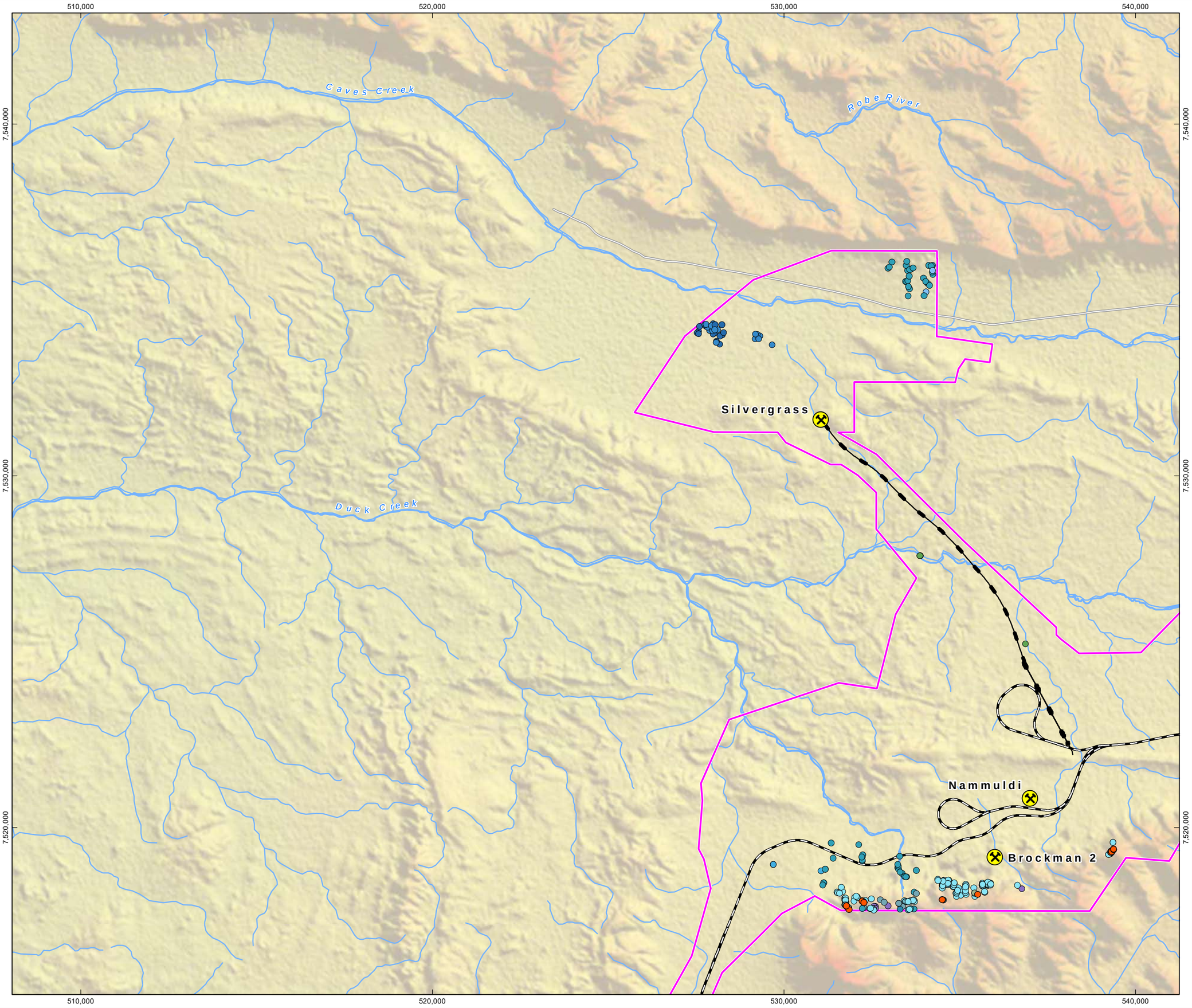
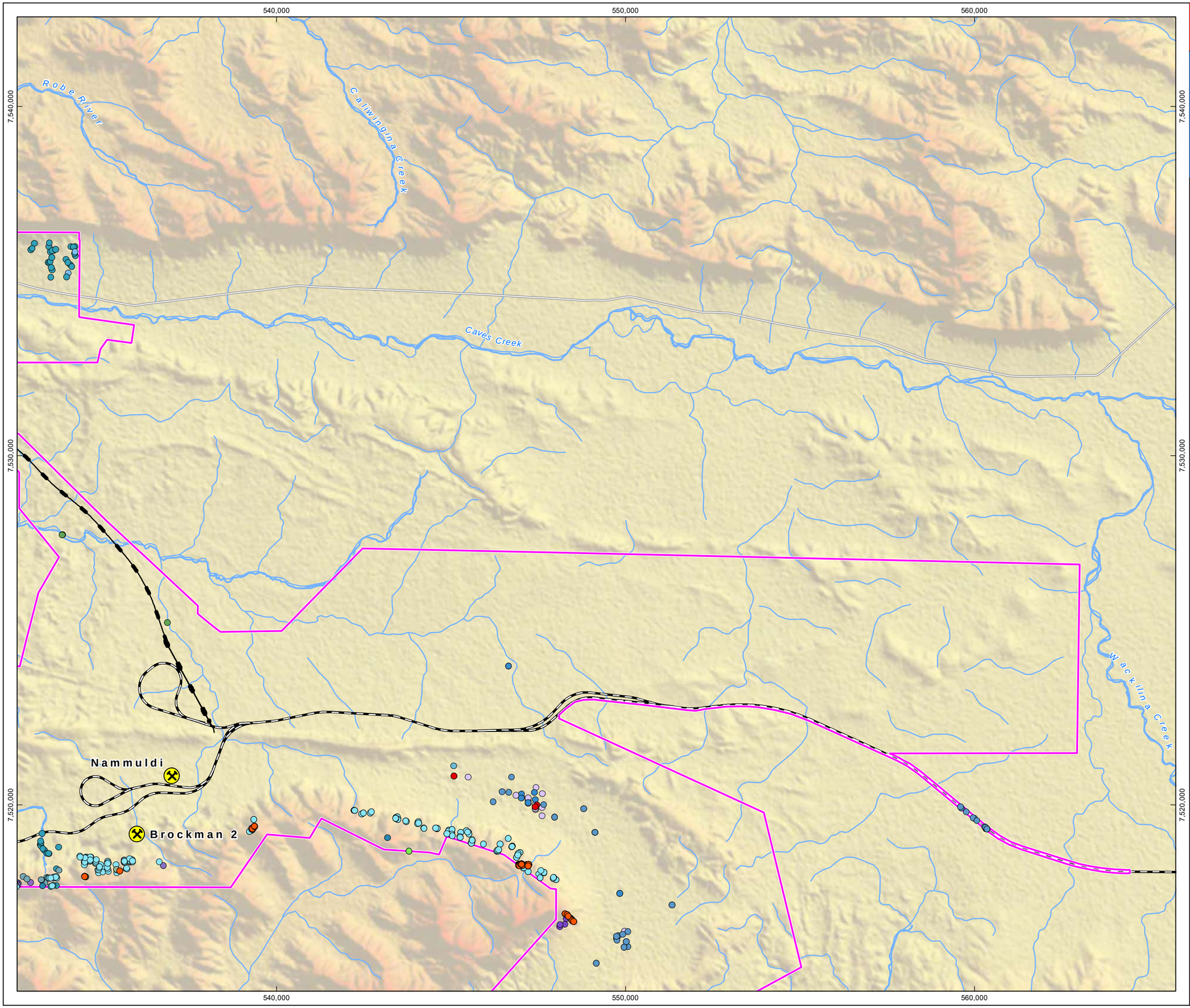




RioTinto

Figure 7-12
Priority Flora Records within the Development Envelope
Map B

Drawn: L.Fuentes
Plan: PDE0189675v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

Development Envelope

Significant Flora Species

Priority 1 (P1)

- *Euphorbia inappendiculata* var. queenslandica
- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)

Priority 2 (P2)

- *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Oxalis* sp. Pilbara (M.E. Trudgen 12725)

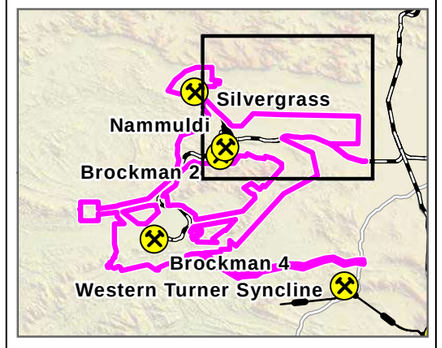
Priority 3 (P3)

- *Aristida jerichoensis* var. *subspinulifera*
- *Eremophila magnifica* subsp. *velutina*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794)
- *Rostellularia adscendens* var. *latifolia*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)

Priority 4 (P4)

- *Acacia bromilowiana*
- *Goodenia nuda*
- *Lepidium catapycnon*

Rio Tinto Mine
Rio Tinto Railway
Conveyor
Minor Road
Major Creek
Minor Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 7-12
Priority Flora Records within the Development Envelope
Map C

Drawn: L.Fuentes
Plan: PDE0189675v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

Development Envelope

Significant Flora Species

Priority 1 (P1)

- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)
- *Tetratheca butcheriana*

Priority 2 (P2)

- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Oxalis* sp. Pilbara (M.E. Trudgen 12725)
- *Pentalepis trichodesmoides* subsp. *hispida*

Priority 3 (P3)

- *Dampiera anonyma*
- *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)
- *Eremophila magnifica* subsp. *velutina*
- *Grevillea saxicola*
- *Gymnanthera cunninghamii*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Ptilotus subspinescens*
- *Rhagodia* sp. Hamersley (M. Trudgen 17794)
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)
- *Triodia basitricha*

Priority 4 (P4)

- *Acacia bromilowiana*
- *Eremophila magnifica* subsp. *magnifica*
- *Goodenia nuda*
- *Lepidium catapycnon*

Rio Tinto Mine

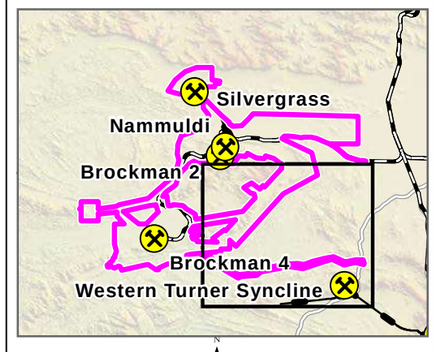
Conveyor

Major Road

Site Access Road

Major Creek

Minor Creek



N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 7-12
Priority Flora Records within the Development Envelope
Map D

Drawn: L.Fuentes
Plan: PDE0189675v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

Development Envelope

Significant Flora Species

Priority 1 (P1)

- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)

Priority 2 (P2)

- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Pentalepis trichodesmoides* subsp. *hispida*

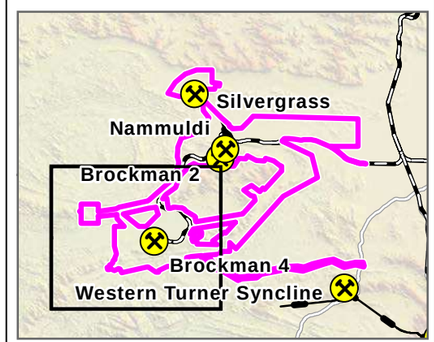
Priority 3 (P3)

- *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)
- *Eremophila magnifica* subsp. *velutina*
- *Grevillea saxicola*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Ptilotus subspinescens*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Triodia basitricha*

Priority 4 (P4)

- *Acacia bromilowiana*
- *Eremophila magnifica* subsp. *magnifica*
- *Goodenia nuda*

Rio Tinto Mine
Rio Tinto Railway
Site Access Road
Major Creek
Minor Creek



N

0 1 2 3 4 5
Kilometres
Map units in metres

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510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Brockman 4
Boolgeeda Creek
Beasley River West

7.3.3.2. Introduced Flora (Weeds)

A total of 36 weed species from multiple surveys have been recorded within the Development Envelope (Figure 7-13; Appendix D.7 Stantec 2021, Biota 2019a, Mattiske 2019 and Stantec 2019). All weed species are widespread throughout the bioregion. None represents a declared pest as listed under the *State Biosecurity and Agriculture Management Act 2007* (BAM Act) or as a Weed of National Significance (WoNS) on the Western Australian Organism List database.

Indicative weed locations, abundance and habitat within the Development Envelope are also discussed in the key flora and vegetation studies provided in Appendix D.1 to D.4.

7.3.3.3. Fire History

The Development Envelope has experienced several bushfires between 2013 and 2019. The most recent occurred in 2019 at BS1, with approximately 100 ha burnt (Stantec 2019). Other notable fires included one occurrence in October 2018, a fire of approximately 4,300 ha ignited near BS2, travelling to Lens G/Diesel and as far south as Plunge Pool. The fire affected mid to upper slope and alluvial plain areas (Biota 2019a).

Numerous other fires have occurred throughout the Development Envelope, including in 2013 when approximately 300 ha at BS1 was burnt (Stantec 2019). The frequency of fire between 1987 and 2019 in the region is presented in Figure 7-14.

7.3.4. Culturally Significant Vegetation and Flora

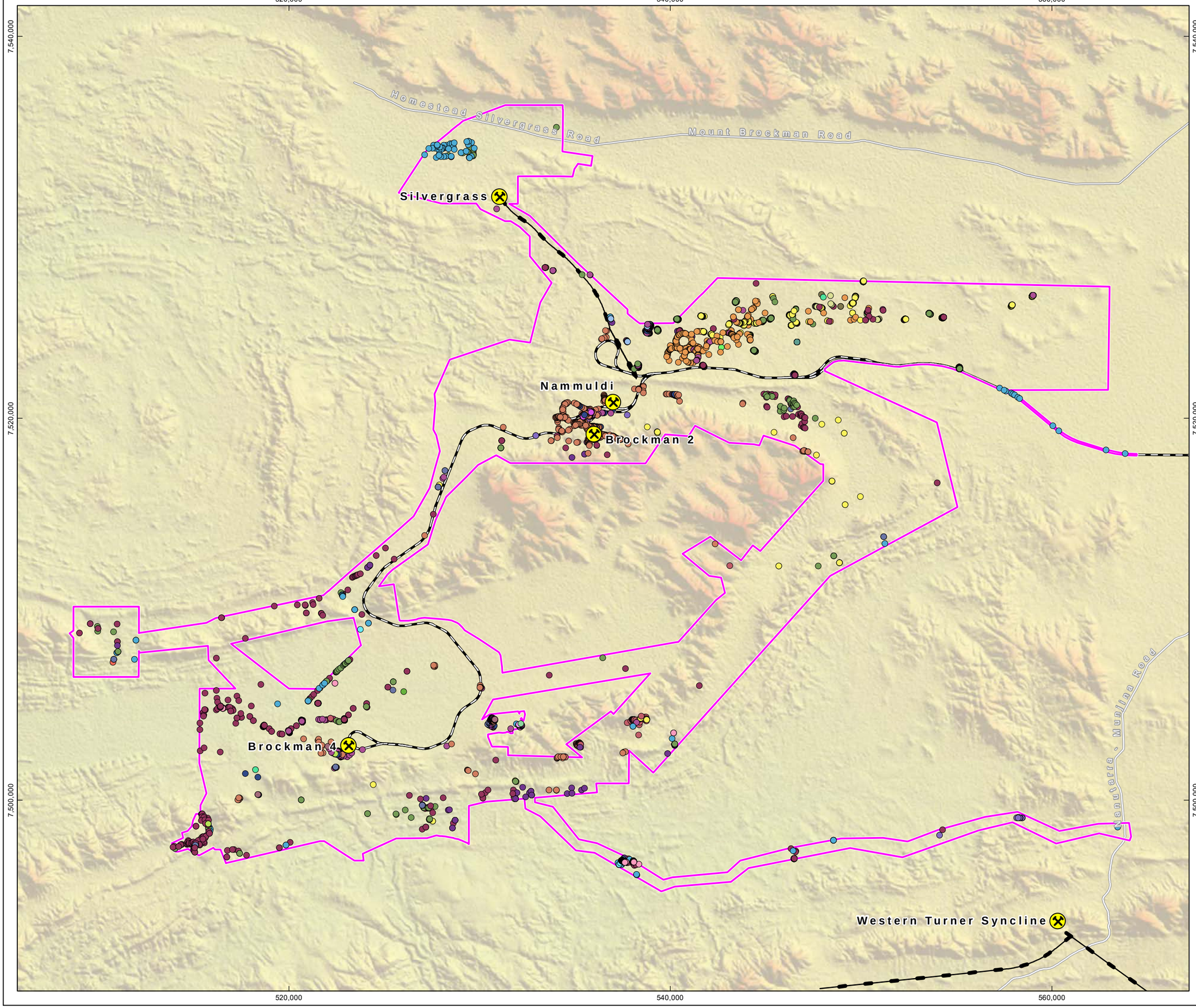
Some vegetation types and flora species recorded within the Development Envelope are of cultural significance to the local Traditional Owner groups of the area. Section 12.3 of the Social Surroundings Chapter addresses these vegetation types and species.

RioTinto

Figure 7-13
Introduced Flora Species Recorded within the Development Envelope Overview

Drawn: L.Fuentes
Plan: PDE0189676v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road

Introduced Flora Records

- *Aerva javanica*
- *Aloe vera*
- *Argemone ochroleuca* subsp. *ochroleuca*
- *Argemone ochroleuca*
- *Avena sativa*
- *Bidens bipinnata*
- *Cenchrus ciliaris*
- *Cenchrus clandestinus*
- *Cenchrus setiger*
- *Cenchrus* sp.
- *Chloris barbata*
- *Chloris gayana*
- *Chloris virgata*
- *Citrullus lanatus*
- *Citrullus* sp.
- *Conyza* sp.
- *Cyclospermum leptophyllum*
- *Cynodon dactylon*
- *Datura leichhardtii*
- *Digitaria ciliaris*
- *Echinochloa colona*
- *Eleusine indica*
- *Erigeron bonariensis*
- *Euphorbia hirta*
- *Flaveria trinervia*
- *Lactuca serriola forma serriola*
- *Lactuca serriola*
- *Malvastrum americanum*
- *Melochia pyramidata*
- *Portulaca pilosa/filifolia*
- *Rumex vesicarius*
- *Setaria verticillata*
- *Sigesbeckia orientalis*
- *Solanum nigrum*
- *Sonchus oleraceus*
- *Symphyotrichum squamatum*
- *Tribulus terrestris*
- *Tridax procumbens*
- *Vachellia farnesiana*

N

0 2 4 6 8 10
Kilometres

Map units in metres

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RioTinto

Figure 7-13
Introduced Flora Species Recorded within the Development Envelope Map A

Drawn: L.Fuentes
Plan: PDE0189676v1
Date: May 2023

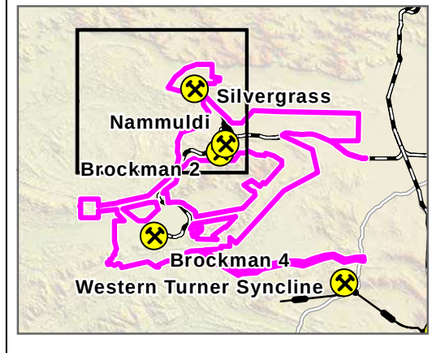
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road

Introduced Flora Records

- *Aerva javanica*
- *Bidens bipinnata*
- *Cenchrus ciliaris*
- *Cenchrus clandestinus*
- *Cenchrus setiger*
- *Chloris barbata*
- *Chloris gayana*
- *Citrullus lanatus*
- *Cyclospermum leptophyllum*
- *Cynodon dactylon*
- *Digitaria ciliaris*
- *Echinochloa colona*
- *Erigeron bonariensis*
- *Euphorbia hirta*
- *Flaveria trinervia*
- *Lactuca serriola*
- *Malvastrum americanum*
- *Rumex vesicarius*
- *Setaria verticillata*
- *Sigesbeckia orientalis*
- *Solanum nigrum*
- *Sonchus oleraceus*
- *Symphyotrichum squamatum*
- *Vachellia farnesiana*



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Kilometres

Map units in metres

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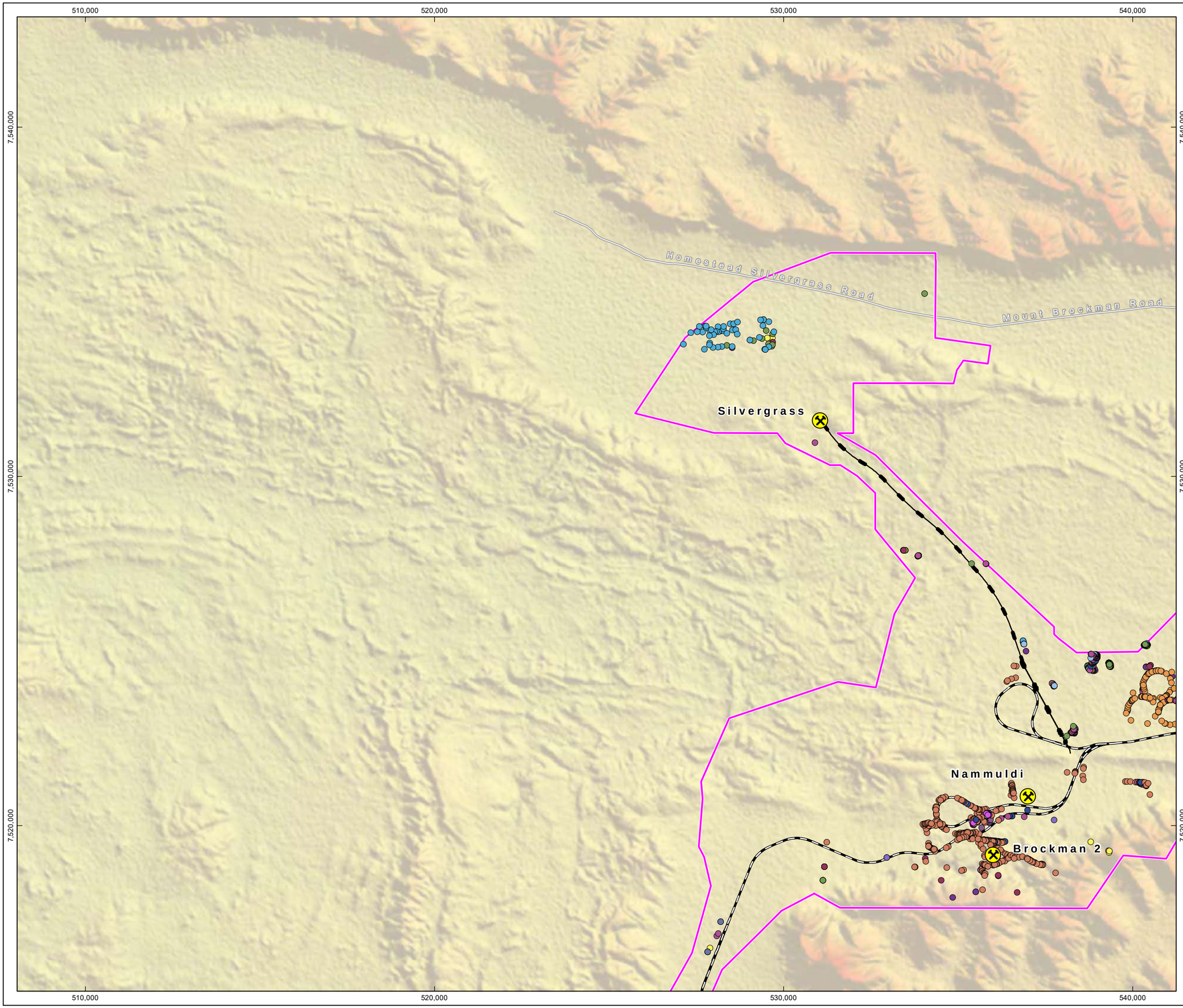
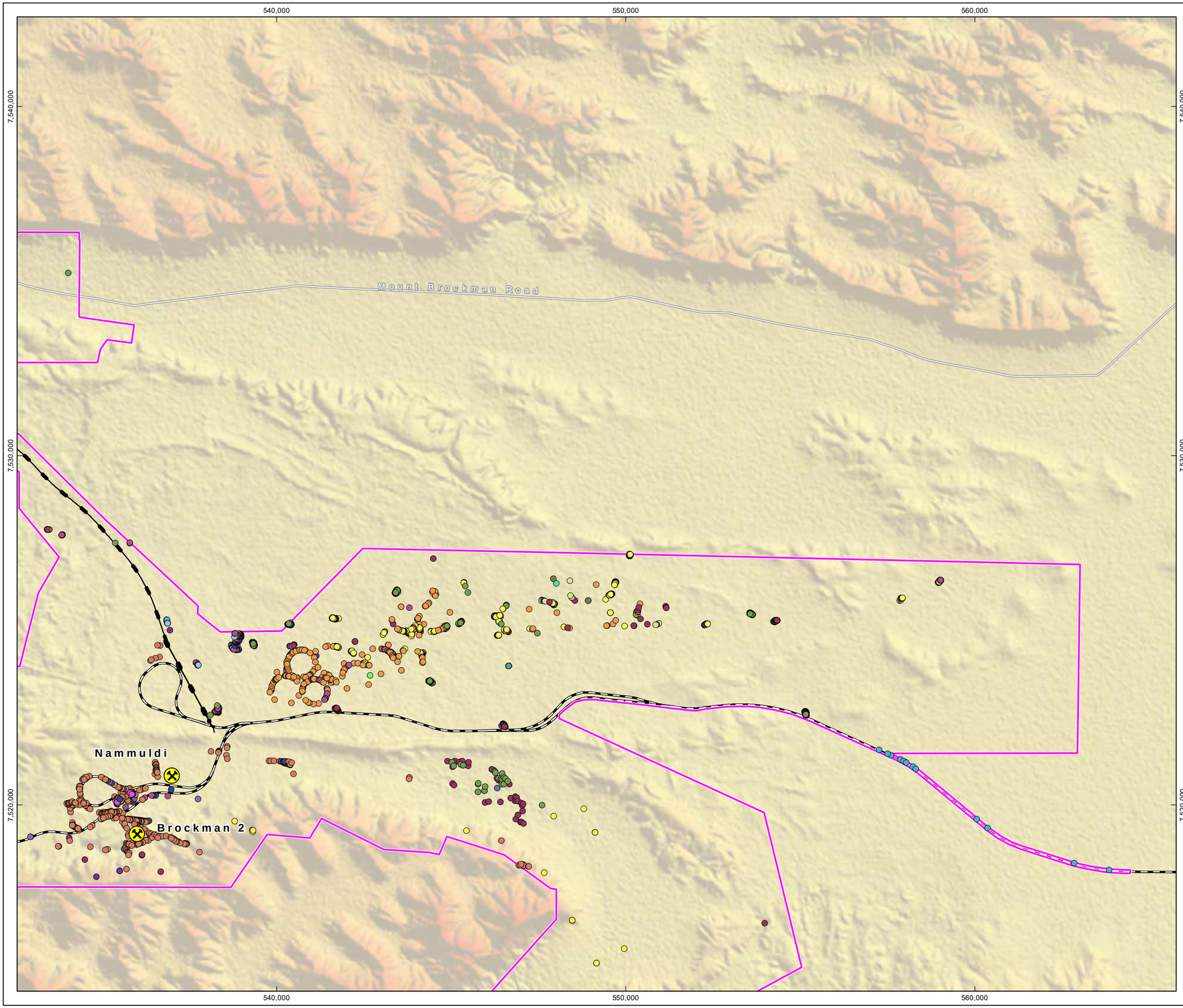




RioTinto

Figure 7-13
Introduced Flora Species Recorded within the Development Envelope Map B

Drawn: L.Fuentes
Plan: PDE0189676v1
Date: May 2023

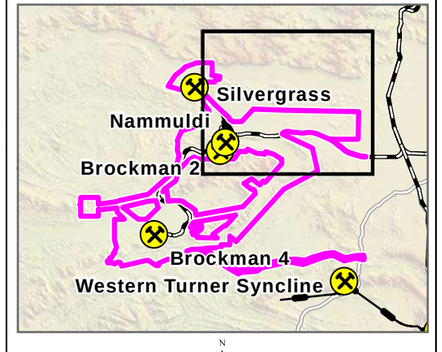
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road

Introduced Flora Records

- *Aerva javanica*
- *Avena sativa*
- *Bidens bipinnata*
- *Cenchrus ciliaris*
- *Cenchrus clandestinus*
- *Cenchrus setiger*
- *Chloris barbata*
- *Chloris gayana*
- *Chloris virgata*
- *Citrullus lanatus*
- *Citrullus* sp.
- *Conyza* sp.
- *Cyclospermum leptophyllum*
- *Cynodon dactylon*
- *Datura leichhardtii*
- *Digitaria ciliaris*
- *Echinochloa colona*
- *Eleusine indica*
- *Erigeron bonariensis*
- *Euphorbia hirta*
- *Flaveria trinervia*
- *Lactuca serriola forma serriola*
- *Lactuca serriola*
- *Malvastrum americanum*
- *Rumex vesicarius*
- *Setaria verticillata*
- *Sigesbeckia orientalis*
- *Solanum nigrum*
- *Sonchus oleraceus*
- *Symphyotrichum squamatum*
- *Vachellia farnesiana*



N

0 1 2 3 4 5

Kilometres
Map units in metres

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RioTinto

Figure 7-13
Introduced Flora Species Recorded within the Development Envelope Map C

Drawn: L.Fuentes
Plan: PDE0189676v1
Date: May 2023

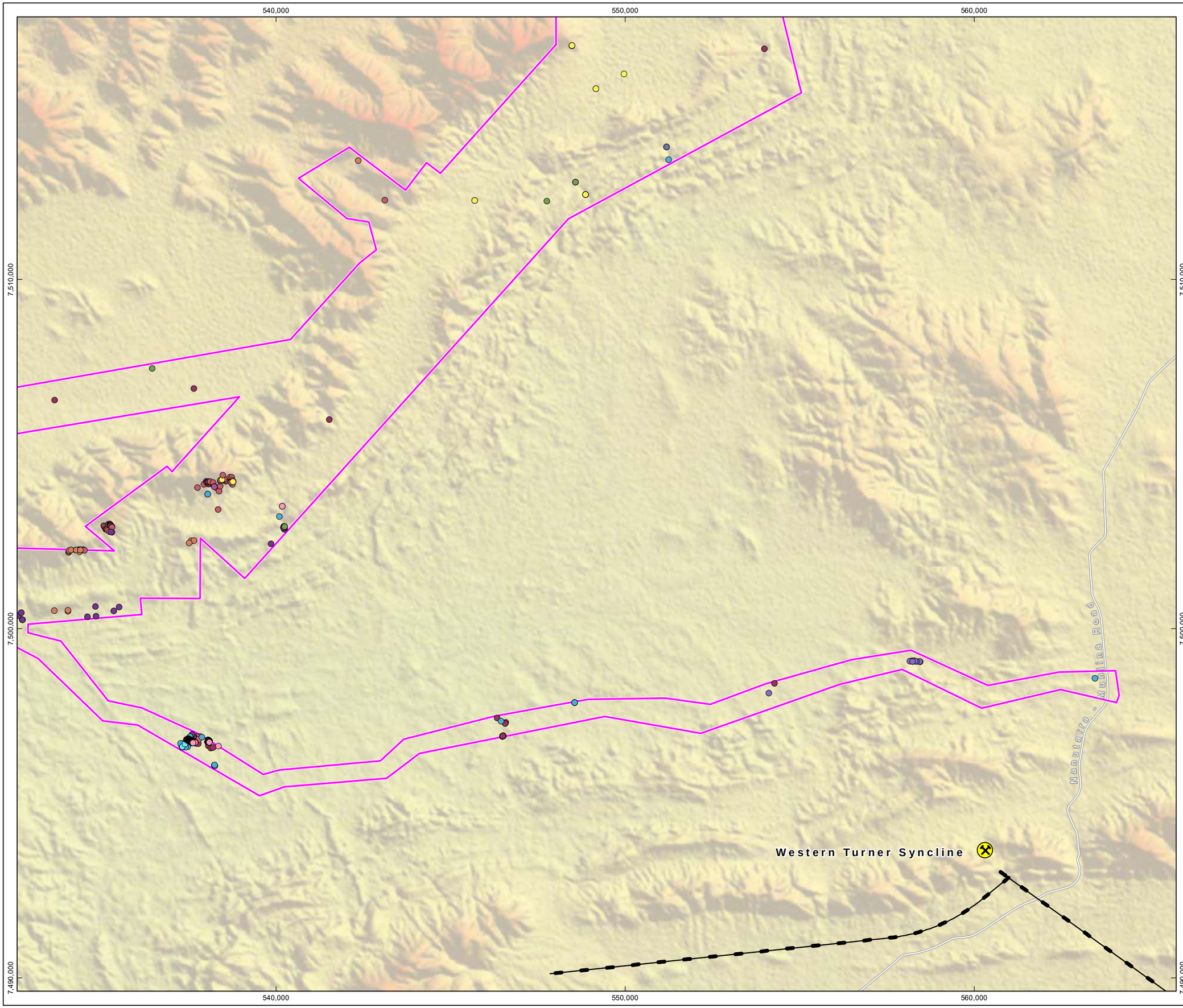
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

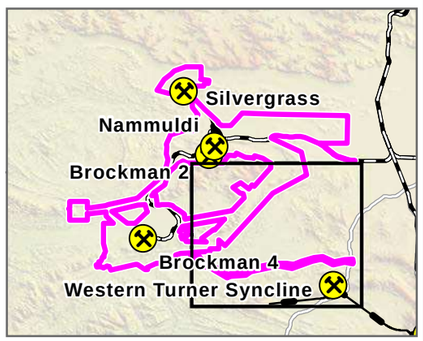
Legend

- Development Envelope
- Rio Tinto Mine
- Conveyor
- Major Road

Introduced Flora Records

- *Aerva javanica*
- *Argemone ochroleuca* subsp. *ochroleuca*
- *Argemone ochroleuca*
- *Bidens bipinnata*
- *Cenchrus ciliaris*
- *Cenchrus setiger*
- *Cenchrus* sp.
- *Chloris virgata*
- *Citrullus lanatus*
- *Datura leichhardtii*
- *Echinochloa colona*
- *Euphorbia hirta*
- *Flaveria trinervia*
- *Malvastrum americanum*
- *Melochia pyramidata*
- *Portulaca pilosa/filifolia*
- *Rumex vesicarius*
- *Setaria verticillata*
- *Sigesbeckia orientalis*
- *Sonchus oleraceus*
- *Vachellia farnesiana*





N

0 1 2 3 4 5

Kilometres

Map units in metres

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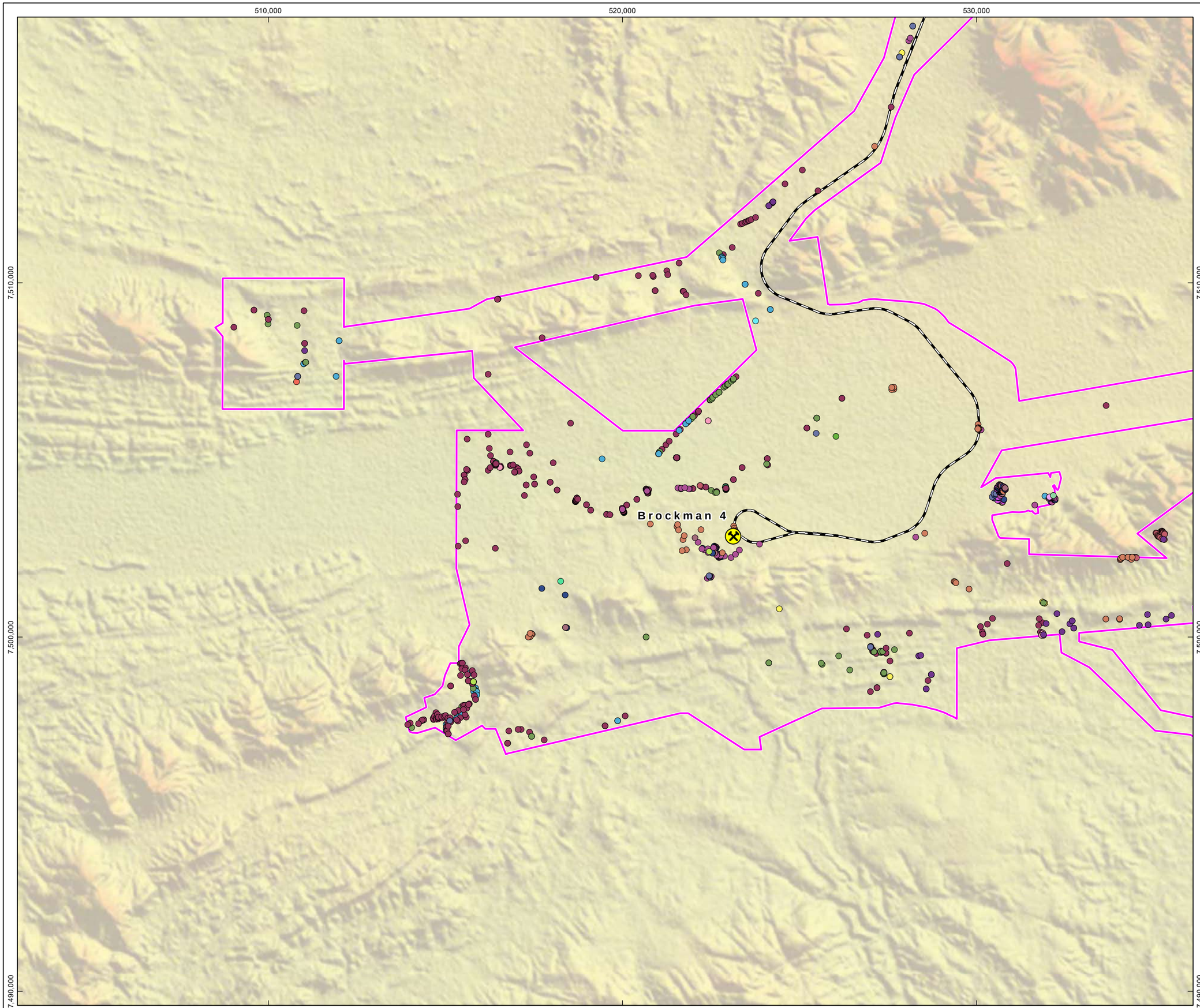

RioTinto

Figure 7-13
Introduced Flora Species Recorded within the Development Envelope
Map D

Drawn: L.Fuentes
Plan: PDE0189676v1
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway

Introduced Flora Records

- *Aerva javanica*
- *Aloe vera*
- *Argemone ochroleuca* subsp. *ochroleuca*
- *Argemone ochroleuca*
- *Bidens bipinnata*
- *Cenchrus ciliaris*
- *Cenchrus setiger*
- *Cenchrus* sp.
- *Chloris barbata*
- *Citrullus lanatus*
- *Datura leichhardtii*
- *Erigeron bonariensis*
- *Euphorbia hirta*
- *Flaveria trinervia*
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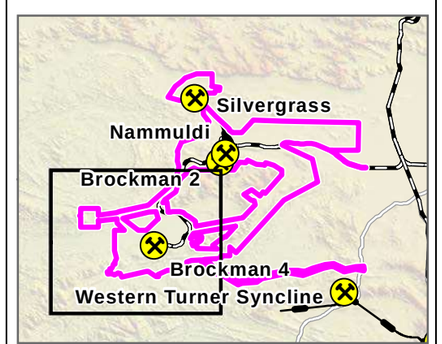
- *Rumex vesicarius*
- *Setaria verticillata*
- *Sigesbeckia orientalis*
- *Sonchus oleraceus*
- *Tribulus terrestris*
- *Tridax procumbens*
- *Vachellia farnesiana*



N

0 1 2 3 4 5

Kilometres
Map units in metres

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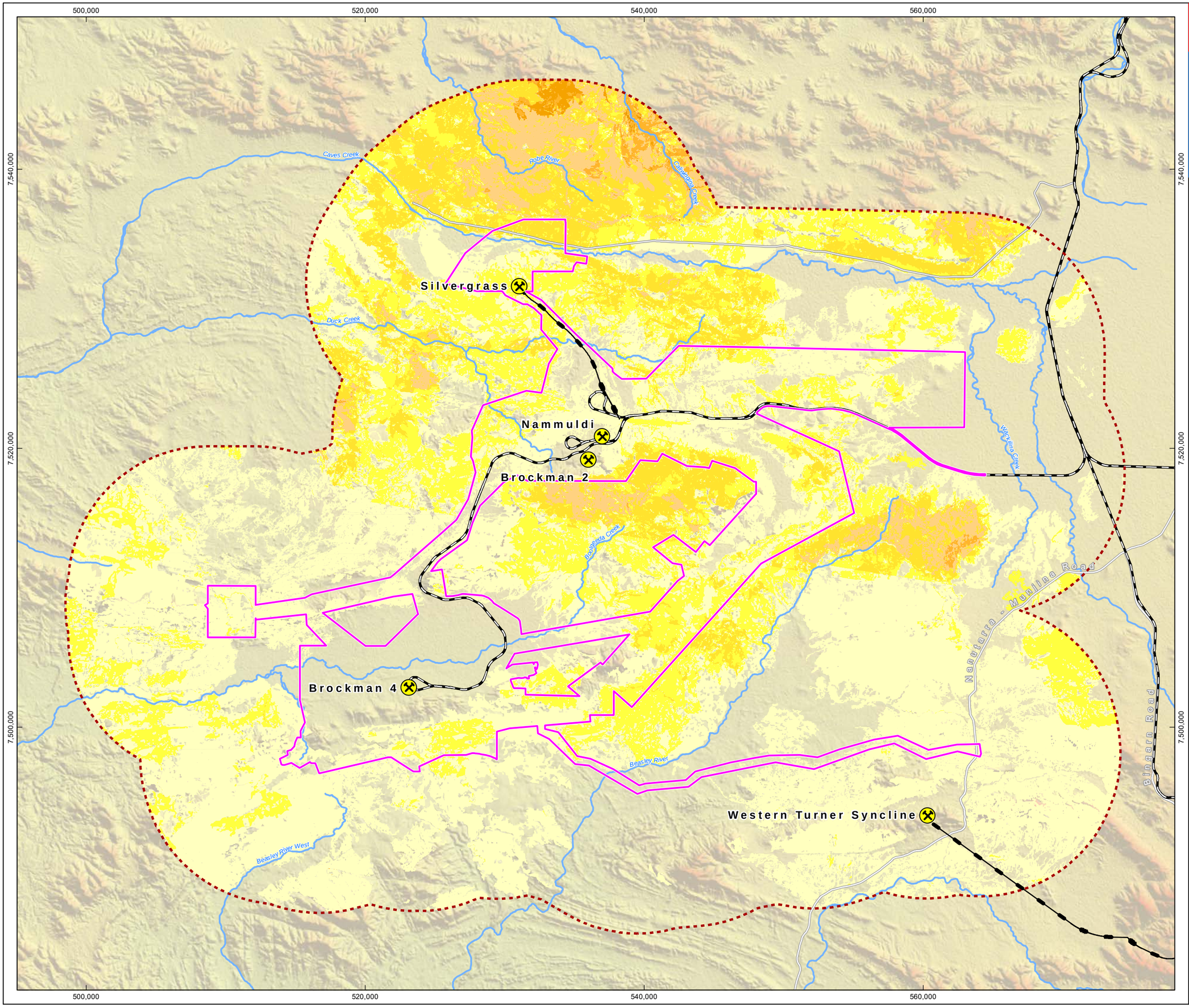

RioTinto

Figure 7-14
Fire Frequency between 1987 and 2020

Drawn: L.Fuentes
Plan: PDE0189769v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- 10 km buffer to Development Envelope

Fire Frequency 1987 to 2020 Based (number of times burnt)

- Over 14
- 13
- 9
- 7
- 6
- 5
- 4
- 3
- 2
- 1

N

0 2 4 6 8 10
Kilometres
Map units in metres

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7.3.5. Summary of Key Flora and Vegetation Values

The key environmental values associated with Flora and Vegetation include:

- 51,743 ha of native vegetation in good to excellent condition within the Development Envelope
- One Regionally Significant vegetation type P33: that represents the Priority 1 PEC 'Brockman Iron Cracking Clay Communities of the Hamersley Range' (Cracking Clay PEC)
- Seven vegetation types are considered to be of high local significance within the Development Envelope (C3 (DkCk), C6, C28, G3, H35, H36 and P27)
- 37 vegetation types considered to be of moderate local significance
- Two GDE features of likely high groundwater dependence (Feature 355 Plunge Pool and Feature 109 Duck Creek Catchment) and nine GDE features of likely moderate dependence
- 1,509 ha of riparian vegetation in the Development Envelope, of which 95.5 ha and 241.3 ha are considered to be of high and moderate local significance, respectively
- Two Priority 1 flora species (*Hibiscus* sp. Mt Brockman (E. Thoma ET 1354) and *Tetratheca butcheriana)* and 24 P2/3/4 species within the Development Envelope.

7.4. Potential Environmental Impacts

As outlined in Section 7.3, extensive survey effort across the Development Envelope and surrounds has provided the Proponent with a sound understanding of environmental values associated with the Proposal. This understanding has guided the development of mitigation measures (discussed further in Section 7.5) such that direct and indirect impacts to the majority of key flora and vegetation values will be avoided. Potential remaining impacts are discussed in the following sections.

7.4.1. Direct Impacts

Potential direct impacts of the Proposal to Flora and Vegetation have been identified as:

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

7.4.1.1. Loss of Native Vegetation (including Riparian Vegetation)

This section presents the approximate clearing of vegetation types based on a Conceptual Footprint; 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 has proposed a maximum clearing extent for vegetation types of regional and high local significance as presented as part of the proposed mitigation in Section 7.5.2.

The Proposal will clear up to 7,896.3 ha of native vegetation, of which approximately 7,715.4 ha is in good to excellent condition (Table 7-15). This clearing represents 10.1% of the total consolidated vegetation mapping area and 17.7% of the Development Envelope. Total areas and relative percentages of indicative clearing of regionally and high local significance vegetation types within the Development Envelope, which includes two GDE features covering 29 ha, are presented in Table 7-14, whilst Figure 7-15 shows the Conceptual Footprint over all vegetation types.

As discussed in Section 7.3.2.1 and shown in Figure 7-4, 14 of the 118 mapped vegetation types occur outside the Development Envelope and will not be impacted. Proposal infrastructure has been sited to avoid impacts to significant vegetation as far as practicable. Table 7-11 shows that:

- There will be no clearing of Priority 1 Cracking Clay PEC for this Proposal as it occurs only in the Silvergrass area (mapped as vegetation type P33 and classified as Regionally significant) and

within the Caves Creek catchment where no impacts to surface water or groundwater regimes are proposed

- Up to 457.4 ha will be cleared from four high local significance vegetation types (C3 (DkCk), G3, H35 and H36) as per the proposed upper limit of assessed impact for project flexibility (see Section 7.5)(Figure 7-16)
- There are no potential impacts on vegetation types P27 and C6 as these occur in the Silvergrass area and within the NAP; no new elements of the Proposal will be implemented in these areas. The conceptual footprint will avoid impacts to C28 as this vegetation type is associated with Plunge Pool (Figure 7-16). Additional mitigation measures for this vegetation type are outlined in Section 7.5.

Table 7-12 shows the indicative clearing of 66 moderate to negligible local significance vegetation types based on the Conceptual Footprint. Given that they contain no protected values and are expected to occur broadly beyond the Development Envelope, no specific clearing limits are proposed for these vegetation types (beyond the total authorised extent of clearing for the proposal). Infrastructure will be preferentially located in these lower significance vegetation types where practicable.

Approximately 129 ha of riparian vegetation occurs within the Conceptual Footprint and thus has the potential to be impacted by the Proposal (Figure 7-17). Approximately 104.7 ha of this vegetation is in good to excellent condition and of this, 40.3 ha is considered to be of moderate local significance. The remainder is considered to be of low local significance. A limit of 5.1 ha has been proposed to limit clearing of riparian vegetation considered to be of High local significance. While the Conceptual Footprint does not currently include any such vegetation, recognising its significance via a limit will ensure any potential impacts are rigorously assessed as the Proposal layout is further refined. The Proponent is not proposing any limits to clearing of riparian vegetation of moderate or low local significance. The potential levels of clearing are presented in Table 7-13.

Three potential GDE features of moderate potential groundwater dependence (Feature 89, 118 and 119) occur within the Conceptual Footprint (Figure 7-18). The area of clearing proposed for these features is presented in Table 7-14. No potential GDE features of high potential groundwater dependence will be directly impacted from the Proposal.

Table 7-11: Indicative Disturbance – Regional and High Local Significance Vegetation Types

Vegetation Code	Mapped Vegetation Extent			Percentage of Vegetation in Survey Area Impacted from Proposal (%)	Percentage of Vegetation in Development Envelope Impacted from Proposal (%)	Upper Limit of Vegetation Disturbance Assessed for Project Flexibility (ha, (%) in Development Envelope)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from Proposal (ha)			
Regional Significance						
P33	95.0	56.2	0.0	0.0	0.0	N/A occurs in Silvergrass area
High Local Significance						
C3(DkCk)*	26.4	25.7	0.0	0.0	0.0	5.1 (20.0)
C6*	123.9	69.5	0.0	0.0	0.0	N/A occurs in Silvergrass area
C28*(Plunge Pool)	0.3	0.3	0.0	0.0	0.0	0.0
G3	994.3	424.9	99.7	10.0	24.0	124.5 (30.0)
H35	277.3	223.3	97.1	35.0	43.5	111.5 (50.0)
H36	1,572.4	720.9	95.7	6.1	13.2	216.3 (30.0)
P27	264.8	232.6	0.0	0.0	0.0	N/A occurs in Silvergrass area and the NAP

** Riparian vegetation present within vegetation type.*

Table 7-12: Indicative Disturbance – Moderate and Negligible Local Significance Vegetation Types

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)		
Moderate Local Significance					
A1	379.5	379.5	12.8	3.4	3.4
A2	3,202.1	3,202.1	772.7	24.1	24.1
A3	48.1	48.1	0.0	0.0	0.0
A4	0.9	0.9	0.0	0.0	0.0
A5	90.3	90.3	0.0	0.0	0.0
A6	931.9	808.9	104.4	11.2	12.9
A7	2.1	2.1	0.0	0.0	0.0
A8	1.2	1.2	0.0	0.0	0.0
A9	1,359.3	1,359.3	0.0	0.0	0.0
A10	48.6	48.6	0.0	0.0	0.0
C1*	122.0	109.2	15.2	12.5	13.9
C3*	52.7	52.7	0.0	0.0	0.0
C13	31.6	30.8	0.0	0.0	0.0
C14	1,592.2	1,469.5	112.6	7.1	7.7
C16	581.5	581.5	0.0	0.0	0.0
C22	90.3	90.3	5.4	6.0	6.0
C27*	137.2	105.8	25.1	18.3	23.7

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)		
G1	0.8	0.8	0.0	0.0	0.0
G4	38.6	20.0	0.7	1.8	3.5
H3	411.3	202.2	3.6	0.9	1.8
H4	823.9	823.9	120.2	14.6	14.6
H6	473.6	384.0	300.2	63.4	78.2
H7	167.2	133.7	91.8	54.9	68.7
H13	631.8	607.7	522.3	82.7	85.9
H15	1,128.7	1,118.3	31.0	2.7	2.8
H17	301.0	263.9	1.9	0.6	0.7
H21	300.5	300.5	124.9	41.6	41.6
H26	8,903.9	6,944.0	1,123.9	12.6	16.2
H28	6.3	6.3	0.0	0.0	0.0
P5	677.3	130.8	0.0	0.0	0.0
P7	561.6	520.8	44.7	8.0	8.6
P8	188.3	166.2	0.0	0.0	0.0
P9	3.4	0.5	0.0	0.0	0.0
P10	1,931.7	1,723.8	526.8	27.3	30.6
P15	178.6	178.6	0.0	0.0	0.0
P16	2,604.8	1,992.4	96.9	3.7	4.9

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)		
P19	1,024.5	1,024.5	73.8	7.2	7.2
Low and Negligible Local Significance					
C10	90.7	18.9	0.0	0.0	0.0
C11	5.5	5.5	0.0	0.0	0.0
C12	131.3	3.2	0.0	0.0	0.0
C15	1,18.8	1,18.8	0.3	0.3	0.3
C17	324.1	0.0	0.0	0.0	0.0
C18	52.1	45.5	22.5	43.3	49.5
C19	12.6	0.0	0.0	0.0	0.0
C2	336.4	336.4	156.7	46.6	46.6
C20	24.0	24.0	0.0	0.0	0.0
C21	49.6	49.6	8.3	16.8	16.8
C23	100.1	66.5	47.2	47.2	71.0
C24	312.7	297.7	0.9	0.3	0.3
C25	110.0	110.0	0.0	0.0	0.0
C26	155.7	99.8	6.0	3.8	6.0
C29	620.8	620.8	22.5	3.6	3.6
C30	30.1	30.1	0.0	0.0	0.0

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)		
C4	35.0	0.0	0.0	0.0	0.0
C7	48.8	48.7	7.4	15.2	15.3
C8	10.2	10.2	2.6	25.2	25.2
C9	85.3	23.1	0.0	0.0	0.0
G2	66.2	65.3	4.6	6.9	7.0
H1	2,057.0	2,007.4	50.4	2.4	2.5
H10	589.1	589.1	0.0	0.0	0.0
H11	168.3	22.2	0.0	0.0	0.0
H14	597.1	47.7	0.0	0.0	0.0
H16	132.0	132.0	0.4	0.3	0.3
H18	0.8	0.8	0.2	25.5	25.5
H19	8.4	3.9	0.0	0.0	0.0
H2	53.0	41.8	0.0	0.0	0.0
H20	283.9	283.9	0.0	0.0	0.0
H22	17.9	17.9	0.0	0.0	0.0
H23	1,282.0	1,016.1	238.5	18.6	23.5
H24	1,060.0	1,059.7	239.5	22.6	22.6
H25	1,212.8	0.0	0.0	0.0	0.0

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)		
H27	17.0	17.0	2.8	16.3	16.3
H29	367.1	255.3	0.0	0.0	0.0
H30	19.4	0.0	0.0	0.0	0.0
H31	891.3	1.0	0.0	0.0	0.0
H32	3.0	3.0	0.0	0.0	0.0
H33	303.1	303.1	81.0	26.7	26.7
H34	925.2	434.8	95.7	10.3	22.0
H37	128.0	74.3	35.9	28.0	48.3
H38	1,583.8	1,086.2	313.7	19.8	28.9
H5	216.5	216.5	24.8	11.4	11.4
H8	418.6	416.6	97.5	23.3	23.4
H9	202.9	165.6	14.4	7.1	8.7
P1	17.5	16.6	2.6	14.7	15.4
P11	167.5	167.5	3.3	2.0	2.0
P12	33.1	33.1	0.0	0.0	0.0
P13	159.6	159.6	0.0	0.0	0.0
P14	440.5	440.5	0.0	0.0	0.0
P17	11,958.2	10,044.3	70.9	0.6	0.7

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)		
P18	186.8	186.8	12.4	6.6	6.6
P2	138.2	138.2		0.0	0.0
P20	670.3	670.3	3.1	0.5	0.5
P21	35.8	35.8	0.5	1.4	1.4
P22	9.0	0.0	0.0	0.0	0.0
P23	102.9	102.9	0.0	0.0	0.0
P24	2,985.5	2,985.5	1746.7	58.5	58.5
P25	15.5	15.5	0.0	0.0	0.0
P26	1.9	1.9	0.0	0.0	0.0
P28	14.5	0.0	0.0	0.0	0.0
P29	124.8	0.0	0.0	0.0	0.0
P30	5.7	5.7	0.0	0.0	0.0
P30	34.7	4.3	0.0	0.0	0.0
P31	20.2	0.0	0.0	0.0	0.0
P32	40.4	0.0	0.0	0.0	0.0
P34	7.7	0.0	0.0	0.0	0.0
P35	46.9	46.5	0.0	0.0	0.0
P36	146.2	0.0	0.0	0.0	0.0

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)		
P37	81.8	28.3	0.0	0.0	0.0
P4	4.4	4.4	0.0	0.0	0.0
P6	75.7	75.7	0.0	0.0	0.0

Table 7-13: Indicative Disturbance - Riparian Vegetation

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from Proposal (ha)		
High Local Significance					
C3 (DkCk)	26.4	25.7	5.1 (upper limit)	19.3	20.0
C6	123.9	69.5	0.0	0.0	0.0
C28	0.3	0.3	0.0	0.0	0.0
Moderate Local Significance					
C1	122.0	109.2	15.2	12.5	13.9
C3	26.3	26.3	0.0	0.0	0.0
C27	137.2	105.8	25.1	18.3	23.7
Low Local Significance					
AcExLW*	65.5	62.9	0.0	0.0	0.0
EvExMOW*	41.8	13.2	0.0	0.0	0.0
ACLOW*	1,388.9	156.3	5.1	0.4	3.3

Vegetation Code	Mapped Vegetation Extent			Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from Proposal (ha)		
WcrEvMOW	908.0	13.5	0.0	0.0	0.0
EvCcdChMOW*	239.8	142.9	13.2	5.5	9.2
EvEcrMOW*	493.5	15.2	0.1	0.0	0.7
C5	2.1	0.1	0.0	0.0	0.0
C7	48.8	37.5	7.4	15.2	19.7
C8	10.2	8.8	2.6	25.5	29.5
C9	85.3	9.2	0.0	0.0	0.0
C10	90.7	15.3	0.0	0.0	0.0
C11	5.5	0.3	0.0	0.0	0.0
C12	131.3	3.2	0.0	0.0	0.0
C15	118.8	92.7	0.3	0.3	0.3
C20	24.0	23.1	0.0	0.0	0.0
C23	100.1	66.5	47.2	47.2	71.0
C24	312.7	227.8	0.9	0.3	0.4
C25	110.0	99.3	0.0	0.0	0.0
C26	155.7	81.4	6.0	3.9	7.4
All	**4,768.8**	**1,406.7**	**128.2**	**2.7**	**9.1**

Table 7-14: Indicative Disturbance – Potential Groundwater Dependent Features

Potential GDE Feature ID	Location	Total Extent of Feature (ha)	Approximate Impact from Proposal (ha)	Approximate Percentage of Impacted by the Proposal (%)	Potential for Indirect Impact?
Low Biological Significance					
118	BS1 assessment area (Boolgeeda Creek catchment)	56.4	11.0	19.5	Yes
119	BS1 assessment area (Boolgeeda Creek catchment)	28.0	18.0	62.3	Yes
Very Low Biological Significance					
89	BS4 assessment area (Boolgeeda Creek catchment)	285.6	18.0	6.3	Yes

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Figure 7-15
Conceptual Footprint in the Context of Mapped Vegetation Types Overview

Drawn: L.Fuentes
Plan: PDE0191153v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:210,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

Note: For vegetation types legend, please see Vegetation T ypes Legend figure

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

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Figure 7-15
Conceptual Footprint in the Context of Mapped Vegetation Types
Map A

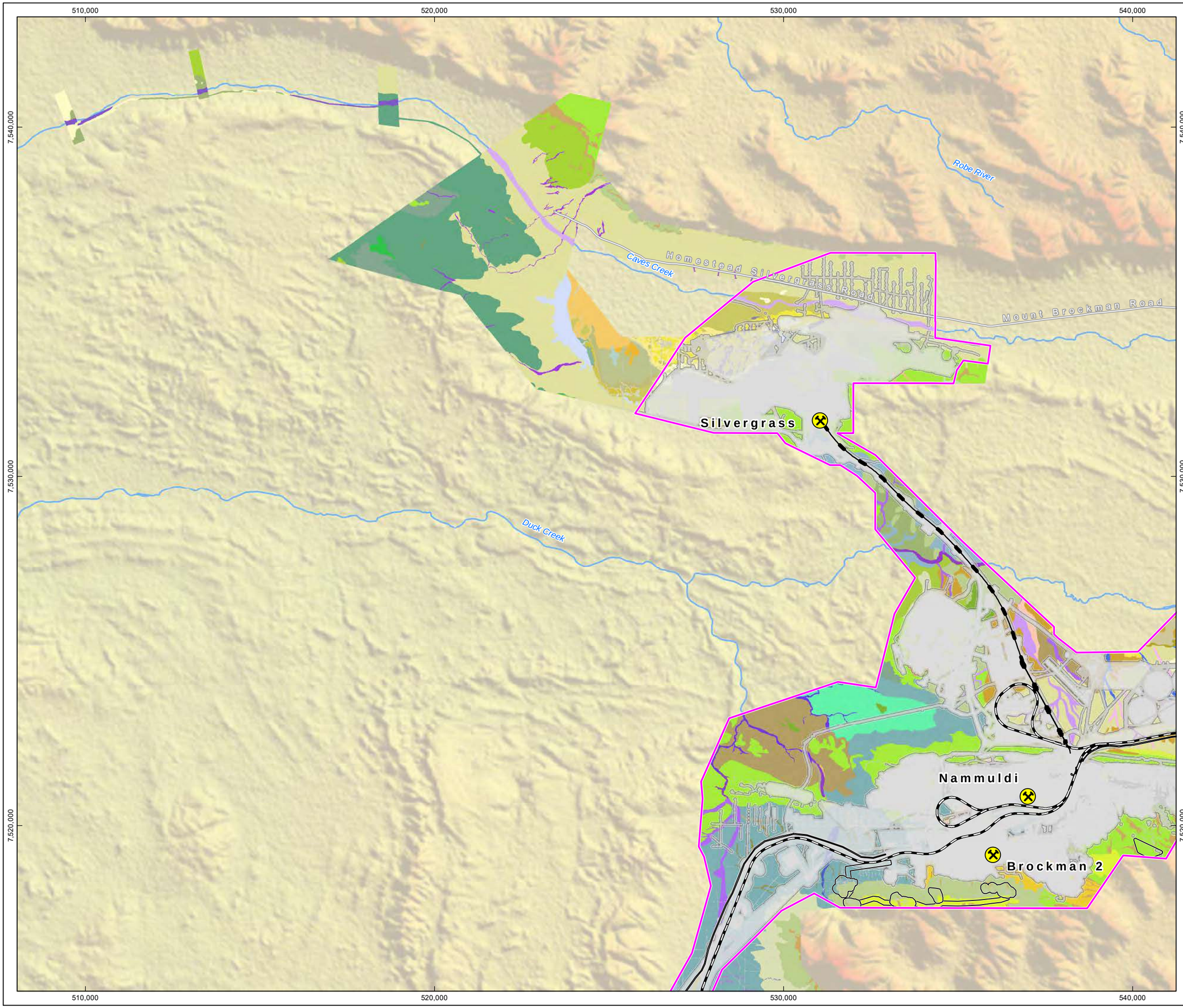
Drawn: L.Fuentes
Plan: PDE0191153v2
Date: May 2023

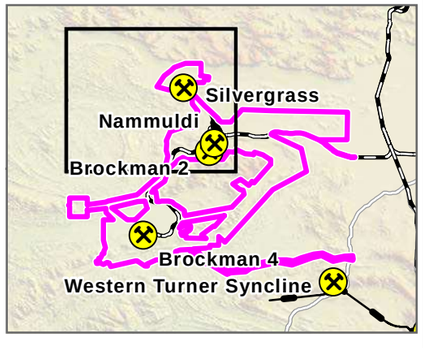
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek

Note: For vegetation types legend, please see Vegetation T ypes Legend figure





N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 7-15
Conceptual Footprint in the Context of Mapped Vegetation Types
Map B

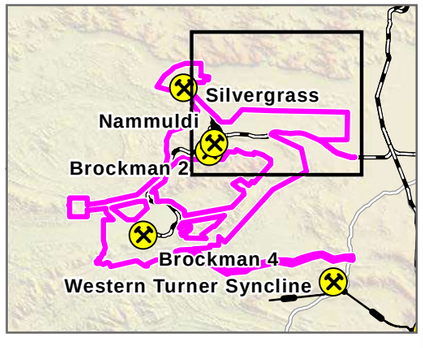
Drawn: L.Fuentes
Plan: PDE0191153v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek

Note: For vegetation types legend, please see Vegetation T ypes Legend figure



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 7-15
Conceptual Footprint in the Context of Mapped Vegetation Types
Map C

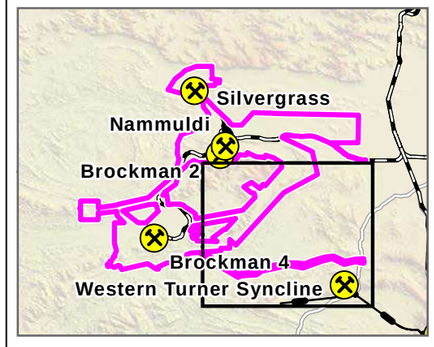
Drawn: L.Fuentes
Plan: PDE0191153v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek

Note: For vegetation types legend, please see Vegetation T ypes Legend figure



N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 7-15
Conceptual Footprint in the Context of Mapped Vegetation Types
Map D

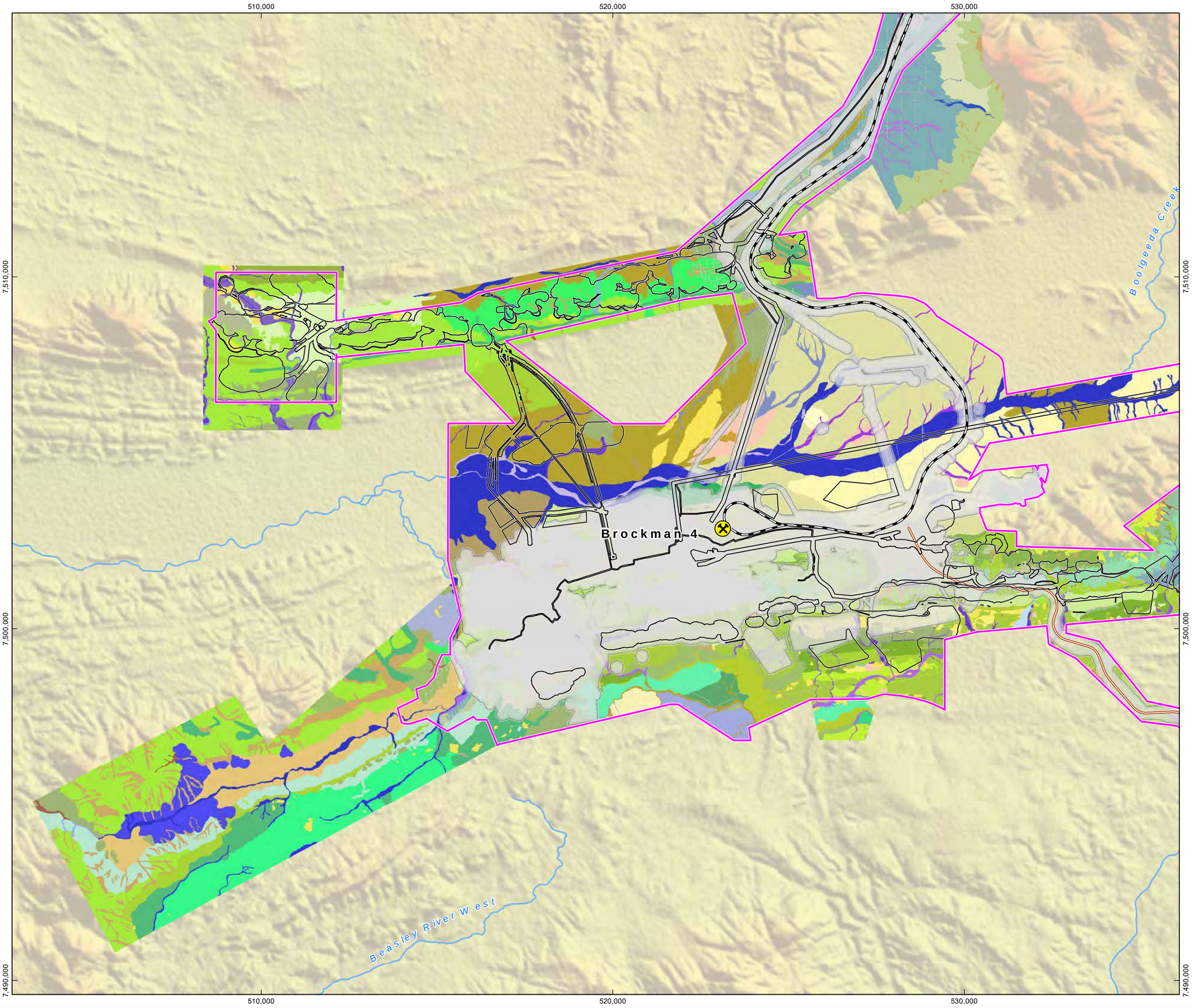
Drawn: L.Fuentes
Plan: PDE0191153v2
Date: May 2023

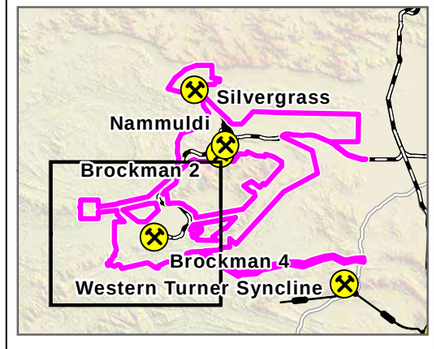
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek

Note: For vegetation types legend, please see Vegetation T ypes Legend figure





N

0 1 2 3 4 5

Kilometres

Map units in metres

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LEGEND - Vegetation Types

Acacia 'aneura' Woodlands and Shrublands

- A1, AanAayTeTw
- A2, AanAprAbAeTe
- A3, AanAprTwTe
- A4, AanAprTwTe/AxAanTspp
- A5, AanCHf
- A6, AanCHfTe
- A7, AanExAatAbCHfTe
- A8, AanGsTbrTIo
- A9, AanTeTw
- A10, AanTspp

Creek Lines and Floodplains

- C1, EvAciGOrSsAbApyTrFTeCc
- C2, ExAciAlTHtTe
- C3, EcGOrSsANlTErTHtTe
- C4, EcMgCYPv
- C5, EvAciTeCc
- C6, EvEcChAcEUa
- C7, AciAbTe
- C8, AciAtuAbTe
- C9, CdEgAatAeTw
- C10, ChAciGOsSsVfCcTHt
- C11, ChAncAmonAbAciSaoTeTHtERmCc
- C12, ChAncAmonAbAciSaoTeTHtERmCc/Tw
- C13, ChAtuGOrApyCOcPoTrFTHtTe
- C14, ChElAlTrFTeEUaTHtCc
- C15, ChElGwGOrTsMBEUaPmTe
- C16, EcExAciAanTe
- C17, EgAaAkTeTw
- C18, ElAciAbAmonTeTHt
- C19, ElChApyAiAmaiTeTw
- C20, ElChGOrApyTHtTe
- C21, ElAbTe
- C22, EvAciAtuApyTHtTe
- C23, ExAciSsAbElTe
- C24, ExAciTeCc
- C25, ExChAbAcAelaAeTeEUa
- C26, ExChAsppGgTe
- C27, ExEvMgAciAcpAbTaTeTHtCc
- C28, EcFgFbTYdPLr
- C29, ElAmonAmaiAatTeTw
- C30, AancAciTe

Hills

- H1, ChAiAbTw
- H2, ElAbMeTw
- H3, ElAeTw
- H4, ElTbr
- H5, ElTe
- H6, EsTw
- H7, AapAciTeTw
- H8, AbAexAaTw
- H9, AiTbr
- H10, AiTw
- H11, ElEpTspp
- H12, ElAancAbAiTwTbr
- H13, ElAatAciAprAmarTwTe
- H14, ElAatAkAprTbrTeTw
- H15, ElTaTl
- H16, AsiEeTe
- H17, ElAbTbr
- H18, ElAbTbrTeTHsMBCa
- H19, AcAbTw
- H20, ElAbTw
- H21, ElTwTbas
- H22, ElAhTw
- H23, ElAiTw
- H24, ElAmaiAatAeTw
- H25, ElAmaiAhiTw
- H26, ElAmTw
- H27, ElAmTwTe
- H28, ElAprAciTe
- H29, ElAprTwTe
- H30, Tss
- H31, ElChAprAmaiERmTHsMBPm
- H32, ElEgAbTwTbr
- H33, ElEgAmaiTw
- H34, Tw
- H35, ElTbr/ElTe
- H36, ElTe/ElTw
- H37, ElTlTw
- H38, ElTw

Plains and Valleys

- P1, ElChAtuPlTe
- P2, ElMeTaTw
- P3, AaAbTlTe
- P4, ElAaAkApTbTeTw
- P5, ElAatTeTw/ElAbAatTePm
- P6, ElAbAeTaTw
- P7, AxAanTspp
- P8, AxERmaSENspp
- P9, AxSlfSENsppTl
- P10, CdExAanAatAbTeTHt
- P11, ChElAbAsynAancTw
- P12, EgAatAbAeTeTw
- P13, ElAeTl
- P14, ElAtAbAsyAtenTbas
- P15, ElAxAsiAtMeTa
- P16, ElCdEgAatAeTwTe
- P17, ElEgAatAeAbTeTw
- P18, ElAsyAbSENsppTbr
- P19, ElEsAbTw
- P20, ElEsMeAeTlTw
- P21, ExEsAbAsyTw
- P22, VfSfSENsppCHf
- P23, ElAeAsiTw
- P24, CdEgAeAatTeTe
- P25, ElAbCAPuTspp
- P26, ElGsGOOsTw
- P27, ARlCHfERAxASe
- P28, CHfTHsASspp./ARlASeCHf
- P29, CHfTHsASspp./ASlASp/ARlASeCHf
- P30, ERb
- P31, ASe
- P32, ASe/ASlASp
- P33, ASlASp
- P34, AvVfTHsCHf
- P35, Herb
- P36, THs
- P37, ElExAiTw

Gorges, Gullies and Free Faces

- G1, CfAanAciPROaPToCYaTHtARb
- G2, ChAsppTHtTeTw
- G3, ElCfAprAanDpERImTe
- G4, ElCfAciAanGbDpTe

Other

- Disturbed

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Figure 7-15
Vegetation Types
Legend

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: June 2022
GIS.Team@riotinto.com

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Figure 7-16
Conceptual Footprint in the Context of Regionally and High Locally Significant Vegetation

Drawn: L.Fuentes
Plan: PDE0189667v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Vegetation Types
Regionally and Locally Significant

- A6, AanCHfTe
- C28, EcFgFbTYdPLr
- C3, EcGOrSsANITErTHtTe
- C6, EvEcChAcEUa
- G3, ElCfAprAanDpERImTe
- H35, ElTbr/ElTe
- H36, ElTe/ElTw
- P27, ARlCHfERAxASe
- P33, ASlASp
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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RioTinto

Figure 7-17
Conceptual Footprint in the Context of Riparian Vegetation

Drawn: L.Fuentes
Plan: PDE01191154v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

Riparian Vegetation

High Local Significance

- C28
- C3
- C6

Moderate Local Significance

- C1
- C27
- C3

Low Local Significance

- AcExLW AppSsGrMSS CcCdEcMOTG
- AcLOW AssAppHllTOS CcLTG TeLSHG
- C10
- C11
- C12
- C15
- C20
- C23
- C24
- C25
- C26
- C5
- C7
- C8
- C9
- EcrEvMOW MgAppGrMSS CaEaMSTG
- EvCcdChMOW AcAppAssTOS CcEuTtMOTG
- EvEcrMOW AcLST AppAssPlTSS CcTtEa MSTG
- EvExMOW AcAcpAbTOS EaCcTtMSTG

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Caves Creek
Robe River
Duck Creek
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Bodgeeda Creek
Beasley River
Beasley River West

0 0.5 1 1.5 2
Kilometres

Figure 7-18
Conceptual Footprint in the Context of GDE Features of High and Moderate Potential Groundwater Dependence

Drawn: L.Fuentes
Plan: PDE0189673v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Broad Hydrological Development Zone
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

Exposure Rating

Likely High Dependence

- 109
- 355

Likely Moderate Dependence

- 89
- 90
- 94
- 108
- 117
- 118
- 119
- 130
- 284

Kilometres
0 2 4 6 8 10

Map units in metres

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7,500,000

Table 7-15: Indicative Disturbance by Vegetation Condition

Vegetation Condition	Survey Area (ha)	Development Envelope (ha)	Approximate Impact from the Proposal (ha)	Approximate Percentage of Vegetation in Survey Area Impacted by the Proposal (%)	Approximate Percentage of Vegetation in Development Envelope impacted by the Proposal (%)
Excellent	44,832.7	35,467.2	6,851.3	15.3	19.3
Very Good	15,783.9	12,854.8	666.1	4.2	5.2
Good	3,932.5	3,421.4	199.0	5.1	5.8
Poor	310.9	293.7	0.9	0.3	0.3
Degraded	282.8	281.0	178.3	63.0	63.5
Completely Degraded	11,055.6	11,024.4	0.0	0.0	0.0
Total	**76,198.5**	**63,342.5**	**7895.6**	**-**	**-**

7.4.1.2. Direct Impacts to Individuals of Priority Flora Species

Direct impacts to significant flora records within the Conceptual Footprint are presented in Table 7-16 and Figure 7-19. The conceptual footprint has been modified to avoid direct impacts to all *Tetratheca butcheriana* individuals and this is discussed further in Section 7.5. It should be noted that:

- *Tridoda* sp. Silvergrass was identified within the survey area not the Development Envelope and as such was not included within the impact assessment as is appropriate.
- *Euphorbia inappendiculata* var. queenslandica (P2) is located within the approved Nammuldi-Silvergrass Development Envelope and was approved for clearing under MS 925. No additional records were found outside of these locations during surveys for the Proposal and this species is not required to be considered further in the EIA.
- One specimen of the Priority 3 *Vittadinia* sp. Coondeanna Flats (S. Van Leeuwen 4684)) was recorded within an area of existing operations which has since been cleared as was allowed for under previous approvals. There are thus no records remaining within the Development Envelope. No additional records were found outside of these locations during surveys for the Proposal and this species is not required to be considered further in the EIA.

Table 7-16: Impacts on Significant Flora Species within the Development Envelope

Species	Number of Individuals in State	Number of Individuals in Development Envelope	Number of Individuals in Conceptual Footprint	Total Predicted Impact (%) of Known Individuals in State	Total Predicted Impact (%) of Known Individuals in Development Envelope	The Upper Limit of Assessed Impact for Project Flexibility
Priority 1 (Potential to be Listed as Endangered/Critically Endangered)						
Tetratheca butcheriana	3,618	202	0	0.0	0.0	0.0
Priority 1						
Hibiscus sp. Mt Brockman (*E. Thoma ET 1354*)	7,491	1,445	249	3.3	17.2	51.9% of individuals within the Development Envelope
Priority 2						
Hibiscus aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	362	219	64	18.0	30.0	64 (30.0%) of individuals within the Development Envelope
Ipomoea racemigera	1,001	198	1	0.1	0.5	102 (51.5%) of individuals within the Development Envelope
Oxalis sp. Pilbara (M.E. Trudgen MET 1570)	485	54	0	0.0	0.0	54 (100%) of individuals within the Development Envelope
Pentalepis trichodesmoides subsp. *hispida*	863	3	2	0.2	66.7	3 (100%) of individuals within the Development Envelope
Priority 3						
Aristida jerichoensis var. subspinulifera	67,094	1	0	0.0	0.0	None specified
Astrebla lappacea	8,199	299	0	0.0	0.0	

Species	Number of Individuals in State	Number of Individuals in Development Envelope	Number of Individuals in Conceptual Footprint	Total Predicted Impact (%) of Known Individuals in State	Total Predicted Impact (%) of Known Individuals in Development Envelope	The Upper Limit of Assessed Impact for Project Flexibility
Dampiera anonyma	408	74	0	0.0	0.0	
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	4,931	51	0	0.0	0.0	
Eremophila magnifica subsp. *velutina*	4,559	1,520	666	14.6	43.8	
Grevillea saxicola	4,853	137	0	0.0	0.0	
Gymnanthera cunninghamii	194	1	0	0.0	0.0	
Indigofera gilesii	4,868	59	0	0.0	0.0	
Indigofera rivularis	28,979	4,221	1,007	3.5	23.9	
Ptilotus subspinescens	28,848	12,117	149	0.5	1.2	
Rhagodia sp. Hamersley (M. Trudgen 17794)	51,818	51	5	0.0	9.8	
Rostellularia adscendens var. latifolia	4,507	173	0	0.0	0.0	
Sida sp. Barlee Range (S. van Leeuwen 1642)	10,963	2,411	421	3.8	17.5	
Sida sp. Hamersley Range (K. Newbey 10692)	4,835	880	155	3.2	17.6	
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	146,014	817	0	0.0	0.0	
Triodia basitricha	115,211	6,237	3,046	2.6	48.8	
Priority 4						

Species	Number of Individuals in State	Number of Individuals in Development Envelope	Number of Individuals in Conceptual Footprint	Total Predicted Impact (%) of Known Individuals in State	Total Predicted Impact (%) of Known Individuals in Development Envelope	The Upper Limit of Assessed Impact for Project Flexibility
Acacia bromilowiana	3,050	700	16	0.5	2.3	None specified
Eremophila magnifica subsp. *magnifica*	10,722	900	452	4.2	50.2	
Goodenia nuda	16,637	393	7	0.0	1.8	
Lepidium catapycnon	38,091	255	56	0.1	22.0	

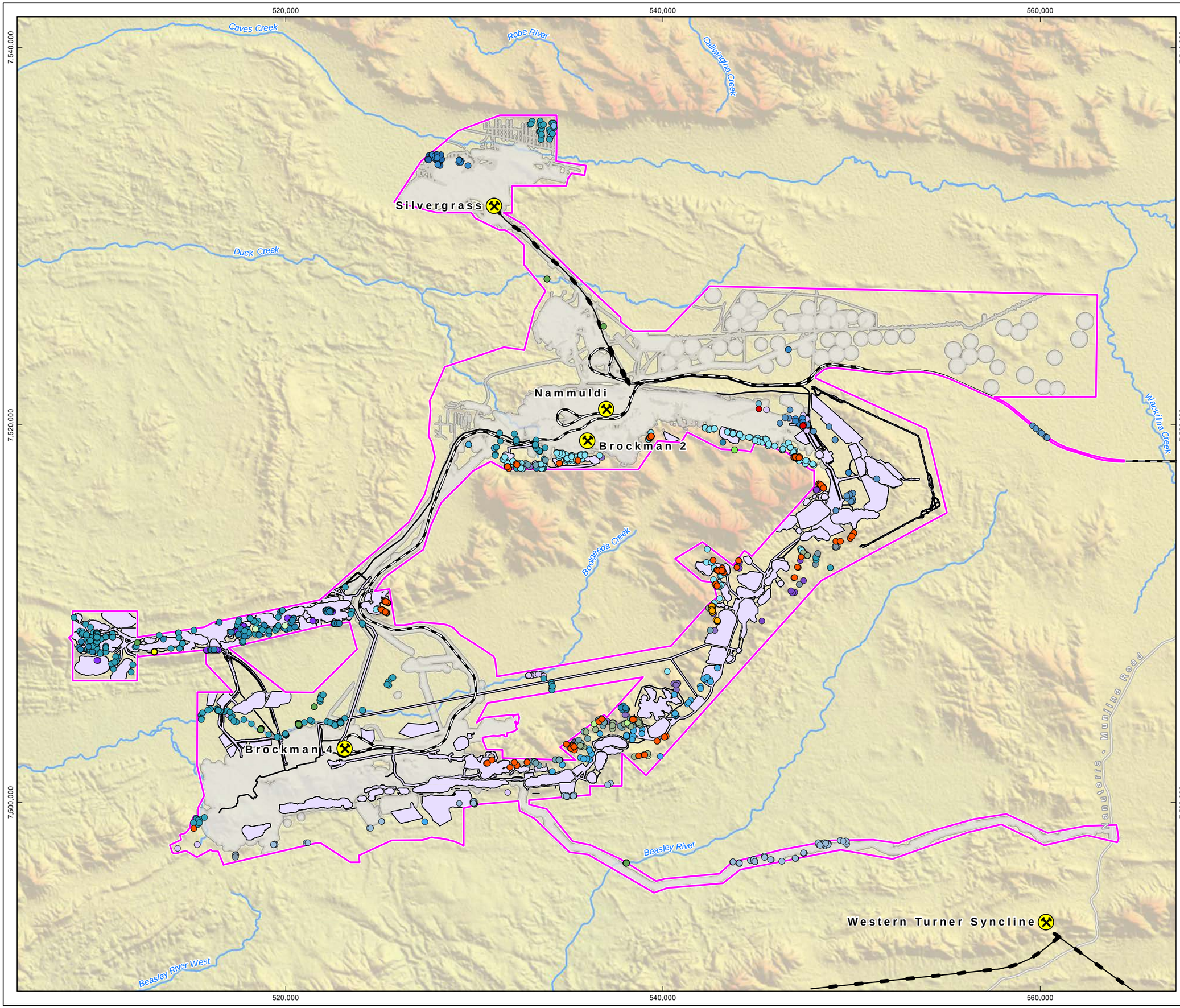

Figure 7-19
Conceptual Footprint in the Context of Significant Flora Overview

Drawn: L.Fuentes
Plan: PDE0191155v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Major Creek

Significant Flora Species

Priority 1 (P1)

- *Euphorbia inappendiculata* var. queenslandica
- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)
- *Tetratheca butcheriana*

Priority 2 (P2)

- *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Oxalis* sp. Pilbara (M.E. Trudgen 12725)
- *Pentalepis trichodesmoides* subsp. *hispida*

Priority 3 (P3)

- *Aristida jerichoensis* var. *subspinulifera*
- *Astrebla lappacea*
- *Dampiera anonyma*
- *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)
- *Eremophila magnifica* subsp. *velutina*
- *Grevillea saxicola*
- *Gymnanthera cunninghamii*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Ptilotus subspinescens*
- *Rhagodia* sp. Hamersley (M. Trudgen 17794)
- *Rostellularia adscendens* var. *latifolia*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)
- *Triodia basitricha*

Priority 4 (P4)

- *Acacia bromilowiana*
- *Eremophila magnifica* subsp. *magnifica*
- *Goodenia nuda*
- *Lepidium catapycnon*

N

0 2 4 6 8 10
Kilometres
Map units in metres

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Figure 7-19
Conceptual Footprint in the Context of Significant Flora Map A

Drawn: L.Fuentes
Plan: PDE0191155v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Caves Creek
Robe River
Duck Creek
Silvergrass
Nammuldi
Brockman 2

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Creek

Significant Flora Species

Priority 1 (P1)

- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)

Priority 2 (P2)

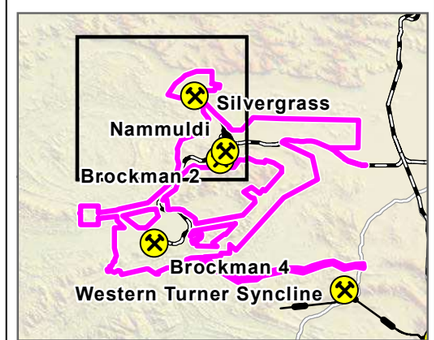
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*

Priority 3 (P3)

- *Astrebla lappacea*
- *Eremophila magnifica* subsp. *velutina*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Rostellularia adscendens* var. *latifolia*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)
- *Triodia basitricha*

Priority 4 (P4)

- *Acacia bromilowiana*



N

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Kilometres
Map units in metres

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Figure 7-19
Conceptual Footprint in the Context of Significant Flora Map B

Drawn: L.Fuentes
Plan: PDE0191155v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Creek

Significant Flora Species

Priority 1 (P1)

- *Euphorbia inappendiculata* var. queenslandica
- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)

Priority 2 (P2)

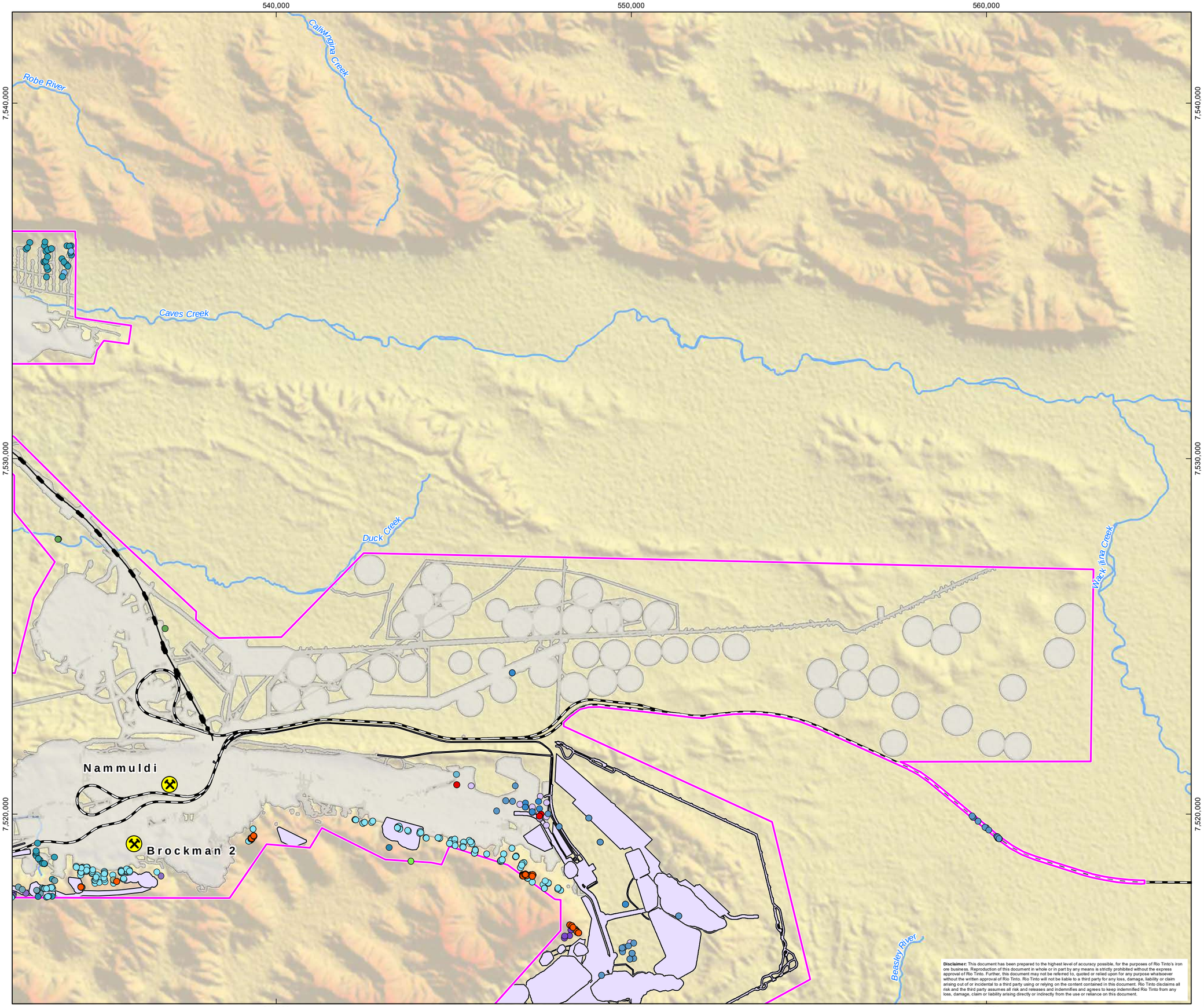
- *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Oxalis* sp. Pilbara (M.E. Trudgen 12725)

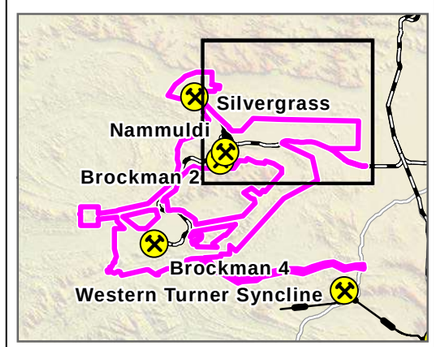
Priority 3 (P3)

- *Aristida jerichoensis* var. *subspinulifera*
- *Eremophila magnifica* subsp. *velutina*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794)
- *Rostellularia adscendens* var. *latifolia*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)

Priority 4 (P4)

- *Acacia bromilowiana*
- *Goodenia nuda*
- *Lepidium catapycnon*





N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 7-19
Conceptual Footprint in the Context of Significant Flora Map C

Drawn: L.Fuentes
Plan: PDE0191155v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek

Significant Flora Species

Priority 1 (P1)

- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)
- *Tetratheca butcheriana*

Priority 2 (P2)

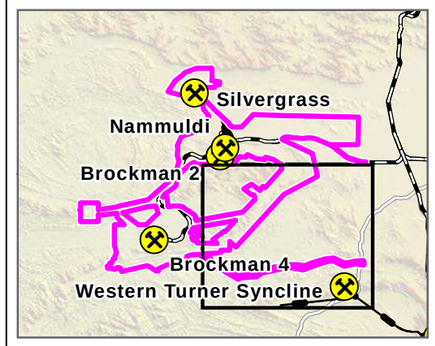
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Oxalis* sp. Pilbara (M.E. Trudgen 12725)
- *Pentalepis trichodesmoides* subsp. *hispida*

Priority 3 (P3)

- *Dampiera anonyma*
- *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)
- *Eremophila magnifica* subsp. *velutina*
- *Grevillea saxicola*
- *Gymnanthera cunninghamii*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Ptilotus subspinescens*
- *Rhagodia* sp. Hamersley (M. Trudgen 17794)
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)
- *Triodia basitricha*

Priority 4 (P4)

- *Acacia bromilowiana*
- *Eremophila magnifica* subsp. *magnifica*
- *Goodenia nuda*
- *Lepidium catapycnon*



N

0 1 2 3 4 5

Kilometres
Map units in metres

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Figure 7-19
Conceptual Footprint in the Context of Significant Flora Map D

Drawn: L.Fuentes
Plan: PDE0191155v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Boolgeeda Creek
Beasley River West
Brockman 4

Legend

- Development Envelope
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek

Significant Flora Species

Priority 1 (P1)

- *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)

Priority 2 (P2)

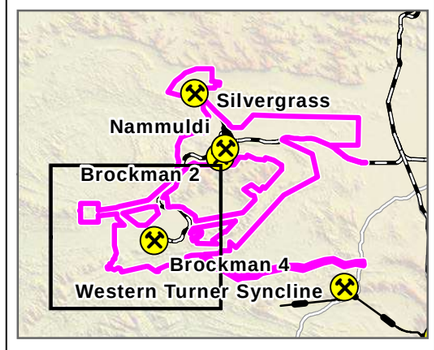
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)
- *Ipomoea racemigera*
- *Pentalepis trichodesmoides* subsp. *hispida*

Priority 3 (P3)

- *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)
- *Eremophila magnifica* subsp. *velutina*
- *Grevillea saxicola*
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)
- *Ptilotus subspinescens*
- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Sida* sp. Hamersley Range (K. Newbey 10692)
- *Triodia basitricha*

Priority 4 (P4)

- *Acacia bromilowiana*
- *Eremophila magnifica* subsp. *magnifica*
- *Goodenia nuda*



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Kilometres
Map units in metres

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7.4.2. Indirect impacts

Potential indirect impacts of the Proposal on Flora and Vegetation have been identified as:

- Degradation/alteration of surface water dependent ecosystems as a result of altered surface catchments
- Loss of or Degradation to Significant Species due to Changes to the Surface Water Environment
- Impacts to groundwater dependent ecosystems as a result of groundwater drawdown
- Impacts to riparian vegetation as a result of surplus water discharge to surface water systems
- Degradation of vegetation condition due to increased abundance and diversity of weeds
- Degradation of vegetation from dust deposition and the potential increase in bushfire risk.

7.4.2.1. Degradation/Alteration of Surface Water Dependent Ecosystems as a Result of Altered Surface Catchments

Pool ecosystems within the Development Envelope are predominantly surface water dependent and biological surveys have not identified other surface water dependent ecosystems within the Development Envelope (as outlined in Section 6). The Proposal will result in changes to catchments and associated reduction in surface flows during intermittent flood events. Impacts to altered surface water catchments and associated alterations to hydrological regimes are described in Inland Waters (Section 6). The Proposal is anticipated to reduce the Duck Creek catchment by less than 10.0% at the confluence with Caves Creek, with the change diminishing downstream (Rio Tinto 2021b. The estimated mean annual surface water flow at Boolgeeda Creek is anticipated to reduce by less than 10.0% due to the Proposal.

Catchment changes will have a small corresponding effect on the depth and velocity of flood flows; however, catchment runoff is generally high in these rocky tributaries, so the frequency of flooding is unlikely to be affected. Riparian vegetation utilises soil moisture from infiltration of both rainfall and concentrated runoff (i.e., surface flows), which is not expected to be significantly affected. As such the Proposal is not expected to result in indirect impacts to riparian vegetation and will not be discussed further in this Chapter. Vegetation type P33 occurs within the Caves Creek catchment, where no additional mining or infrastructure is proposed. Therefore, no indirect impacts to this vegetation type due to altered surface catchments are anticipated.

7.4.2.2. Loss of or Degradation to Significant Species due to Changes to the Surface Water Environment

Establishment of the proposed project would result in changes to the existing surface water (hydrological) environment in the areas immediately surrounding infrastructure. The resultant changes in surface water flows may impact established vegetation that is no longer receiving adequate resources to support growth, or vegetation may become inundated through ponding of stormwater. Inundation causes stress and plant death when prolonged in those species not adapted to flooded conditions by decreasing oxygen levels within soils and impeding root respiration.

7.4.2.3. Impacts to Groundwater Dependent Ecosystems as a Result of Groundwater Drawdown

Two GDE (Feature 109 in Duck Creek Catchment and Feature 355 Plunge Pool) and nine potential GDE features of high and moderate potential groundwater dependence were identified within the broad hydrogeological development zone. Seven of these potential GDE features are within, or close to, the modelled groundwater drawdown area.

Of the seven GDE's in the modelled groundwater drawdown area, two of these (Feature 90 - Ridge Pool and Feature 355 – Plunge Pool) are not predicted to be impacted by groundwater drawdown in the broader aquifer. Ridge Pool is not in connection with the deposit aquifers (Section 6.4), and no changes

to its catchment is proposed. The Proposal has been modified to ensure that the groundwater levels at Plunge Pool are not affected by mining and this is anticipated to be a condition of approval (Section 6.6). This Proposal modification was made after the August 2021 modelling that the GDE assessment utilised. These features have not been discussed further.

More details regarding the conceptual hydrogeological model and effect of the Proposal on groundwater levels are provided in Section 6. Key outcomes of the hydrogeological investigations relevant to GDEs include:

- Drawdowns are naturally restricted from extending around the syncline as a result of dolerite dykes forming barriers to groundwater flow
- Drawdowns are greatest in the BS2 assessment area, with dolerite dykes limiting their propagation
- As recharge rates are low, groundwater recovery is slow and long-term drawdowns are predicted to stabilise after several hundred years.

There are five GDE features (40.7 ha) that have been identified that may be impacted by groundwater drawdown over and above direct impacts (Table 7-17).

7.4.2.4. Impacts on Riparian Vegetation as a Result of Surplus Water Discharge to Surface Water Systems

Dewatering volumes exceed operational water demand during the mine life, so surplus water management will be required, including discharge to pits, irrigated agriculture in the approved NAP (as approved under MS 925) and discharge to creeks (as approved under MS 925 and 1000) until pit void capacity is available.

Surplus water discharge may impact vegetative cover, structure, and health within the length of creekline that may experience flow during natural no flow conditions, known as the wetting front. Increased water availability can increase vegetation cover. However prolonged shallow groundwater levels associated with discharge can cause prolonged waterlogging in the root zone and root truncation, where oxygen stress in the saturated zone results in root death (AQ2 2021). This can then lead to the vegetation being less resilient to the absence of water.

Surplus water discharge will be through existing discharge locations at Duck Creek and Boolgeeda Creek (refer to Section 6). Potential impacts to riparian vegetation have been previously assessed and approved under the following:

- MS 1000, which permits up to 6.4 GL/yr of surface discharge of water to Boolgeeda Creek, with discharge to extend no further than 37 km along the designated watercourses from the discharge point. No material change to this existing approval and associated conditions of MS 1000 is proposed
- MS 925, which permits surface discharge of water to Duck Creek. The ERD associated with this approval considered impacts to riparian vegetation resulting from up to 200 ML/day with a discharge footprint extending 157 km along Duck Creek from the point of discharge. The EPA decision report for this approval (Report 1457, November 2012) considered that discharges in excess of 20 ML/day are unlikely and a steady state discharge of this rate would travel over 80 km down the creek. No material change to this existing approval is proposed for the Proposal. However, to modernise the approval and align the conditions with those of MS 1000, the Proponent proposes an additional condition to limit the discharge extent to no further than 67 km along Duck Creek from the discharge point.

Table 7-17: Potential for Indirect Impacts as a Result of Hydrogeological Changes on Potential GDE Features

Potential GDE Feature ID	Location	Predicted Maximum Drawdown* (m)	Total Extent of Feature (ha)	Total Area Impacted by Land Clearing	Total Area Impacted by Drawdown (ha)	Cumulative Proportion of Feature Impacted (%)	Comment
Moderate to Low Biological Significance							
109	BS2 (Duck Creek catchment)	89.0	10.5	0.0	10.5	100.0	In Proposal Development Envelope
Low Biological Significance							
108	BS2 (Duck Creek catchment)	107.0	0.6	0.0	0.6	100.0	In Proposal Development Envelope
117	BS2 (Boolgeeda Creek catchment)	52.0	7.5	0.0	7.5	100.0	Within Existing and Proposal Development Envelopes
118	BS1 (Boolgeeda Creek catchment)	85.0	56.4	11.0	12.1	41.0	In Proposal Development Envelope
119	BS1 (Boolgeeda Creek catchment)	89.0	28.0	18.0	10.0	100.0	In Proposal Development Envelope

**Modelled predicted maximum drawdown at the end of mining with FMG Eliwana Project included.*

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Figure 7-20
Groundwater Dependant Ecosystems that may be impacted by Groundwater Drawdown or Direct Impacts

Drawn: L.Fuentes
Plan: PDE0191156v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Groundwater Contour (mAHD)

- Groundwater Contour (mAHD)
- Conceptual Footprint
- Part IV Indicative Approved Footprint
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

Riparian Vegetation

High Local Significance

- C28
- C3
- C6

Moderate Local Significance

- C1
- C27
- C3

Low Local Significance

- AcExLW AppSsGrMSS CcCdEcMOTG
- AcLOW AssAppHllTOS CcLTG TeLSHG
- C10
- C11
- C12
- C15
- C20
- C23
- C24
- C25
- C26
- C5
- C7
- C8
- C9
- EcrEvMOW MgAppGrMSS CaEaMSTG
- EvCcdChMOW AcAppAssTOS CcEuTtMOTG
- EvEcrMOW AcLST AppAssPlTSS CcTtEa MSTG
- EvExMOW AcAcpAbTOS EaCcTtMSTG

0 2 4 6 8 10
Kilometres

Map units in metres

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7.4.2.5. Fragmentation due to Land Clearing

Fragmentation of vegetation occurs when pockets of vegetation become isolated through clearing for infrastructure. The resultant potential impacts of the creation of fragmented or islands of vegetation including:

- Increased degradation as a result of 'edge effect' where cleared areas become vectors for weeds, changes to surface drainage and dust deposition. This degradation may indirectly result in reduction of habitat quality for other flora and fauna.
- Reduced floral reproduction and genetic diversity resulting from the reduction of corridors for pollinators to travel between islands.

The impact of fragmentation as a result of clearing for the Proposal has the potential to be most apparent within the BS1 assessment area as a cumulative effect, given the proximity to the adjacent Eliwana Iron Ore Project, and is discussed in Section 7.4.3. Additionally, three areas which are entirely surrounded by the proposed Development Envelope and conceptual footprint may lead to fragmentation, namely a small area north of BS4 (1,480 ha), Mount Brockman south of BS2 (17,485 ha) and the surrounding area near Ridge Pool (1,873 ha). These areas total 20,838 ha in total.

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

Weeds can spread by several mechanisms, including wind, water, vehicles, machinery and fauna (including native fauna and livestock). 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.

The most relevant mechanisms for weed spread or introduction concerning the Proposal's implementation are vehicle and earthmoving activities, seeds spreading from the NAP and surplus water discharge (refer to Section 7.5.1).

7.4.2.1. Degradation of Vegetation from Dust Deposition and Potential Increase in Bushfire Risk

Dust deposition from the Proposal is expected during vegetation clearing activities and some 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, with dust deposition on vegetation expected to be localised immediately adjacent to vegetation (ETA 2021).

The Development Envelope has a history of fire (Section 7.3.3.3). Given the increase in ignition sources (i.e., vehicle movement, clearing and railway maintenance), there is 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 mining areas compared to the surrounding areas.

7.4.3. Cumulative Impacts

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

- Clearing of native vegetation
- Clearing of priority flora.

Projects located within 100.0 km of the Development Envelope and used to assess cumulative impacts are detailed in Section 2.3.4.

7.4.3.1. Cumulative Impacts on Native Vegetation

Detailed vegetation mapping has been completed for the Development Envelope; however, this is not broadly available for the Pilbara bioregion. Therefore, identifying and assessing potential cumulative impacts to vegetation requires the use of broader mapping available across the region.

Cumulative impacts have thus been considered within the bounds of the Hamersley IBRA subregion, based on an assessment of proposed and undeveloped major mine projects located within the same pre-European vegetation associations (Beard 1975) as the Development Envelope (Figure 2-5).

Impacts from pastoral and/or grazing activities have not been quantified and, therefore, cannot be included in cumulative impacts calculations.

The cumulative effect of native vegetation clearing at the regional scale (i.e., the Pilbara region and Hamersley subregion) is presented in Table 7-18. The current (2019) extent of vegetation within the Pilbara bioregion and Hamersley subregion is 17.7 million ha and 5.6 million ha, respectively (GoWA 2020a). Based on the above predicted impacts, the cumulative impact will contribute a further approximately 0.04% and 0.14% to vegetation clearing in the bioregion and subregion, respectively.

The approved clearing footprint proposed under the FMG Eliwana Iron Ore Project, adjacent to the north of the Development Envelope, is 7,900.0 ha and covers three vegetation associations as mapped by Beard (1975). Two of these are Hamersley 18 and Hamersley 82, also present in the Development Envelope (FMG 2018a). The relative disturbance to each vegetation association is not presented in the Eliwana ERD; therefore, a conservative approach was undertaken for this assessment by assuming the entire disturbance is equally divided between associations 18 and 82. The Eliwana Railway Project quantifies the clearing of all five vegetation associations present within the Proposal's Development Envelope (FMG 2018b).

The approved clearing footprints for Rio Tinto's Western Turner Syncline, 15 km south-east of the Development Envelope, and the Mineral Resource's Pilbara Iron Ore Project, 15 km to the north of the Development Envelope, cover 4,350.0 ha and 2,435.0 ha, respectively. However, the occurrence or relative disturbance to each vegetation association are not presented in respective publicly available impact assessment documentation and therefore have not been included in the cumulative calculations for approved projects outlined in Table 7-18 (Rio Tinto 2015; Preston Consulting 2015). Although associations 18 and 175 were indicated to occur within the Solomon Project Development Envelope, 70 km to the north-east of the Development Envelope, and ten other units, no indication of their coverage within the 18,459.0 ha Development Envelope was provided (FMG 2015). As such this project has also not been included in cumulative impact calculations due to lack of data.

The conceptual footprint of the Rio Tinto Greater Paraburdoo Iron Ore Hub proposal, 85 km south-east of the Development Envelope, intercepts two vegetation associations shared with the Proposal (Rio Tinto 2020b).

The potential cumulative impacts on vegetation associations within the Hamersley subregion are presented in Table 7-18 as preliminary estimates only.

The Brockman Cracking Clay (Priority 1) community is present within the Development Envelope only in the Silvergrass area (vegetation type P33). Impacts to this PEC will only occur in relation to the approved project under MS 925; therefore, there are no cumulative impacts to be considered as part of this proposal.

7.4.3.2. Cumulative Impacts on Conservation Significant Flora

Thirteen species of significant flora have the potential to be impacted cumulatively by the Proposal when taking projects within 100.0 km from the Proposal into consideration (Table 7-19). The estimate of the number of plants potentially impacted by the other projects includes all individuals within their Development Envelopes, not the disturbance footprints indicated by publicly available information and

are considered conservative. The Pilbara Iron Ore Project may potentially disturb two Priority Flora species (*Sida* sp. Barlee Range [S. van Leeuwen 1642] [P3] and *Lepidium catapycnon* [P4]) that also occur within the Proposal Development Envelope; however, an estimate of the number of individuals at that project is not available (Preston Consulting 2015).

Table 7-18: Cumulative Impacts on Beard (1975) Vegetation Associations within the Hamersley Subregion

Vegetation Association	Pre-European Extent	Current Extent	Extent within the Development Envelope	Clearing from this Proposal	Clearing from Existing Operations	Clearing from Reasonably Foreseeable Projects*	Cumulative Clearing
Unit	**Area (ha)**		**Area (ha) (% of current extent)**			**Approved clearing footprint (ha) (% current extent)**	**Area (ha) (% of current extent)**
Hamersley 18	580,512.3	575,807.9	7,452.9 (1.3)	718.8 (0.1)	1,894.3 (0.3)	4,493.3 (0.8)	7,106.4 (1.2)
Hamersley 29	151,150.8	149,832.8	7,439.3(5.0)	9.8 (< 0.1)	3,448.1(2.3)	756.1 (0.5)	4,214.0 (2.8) ^
Hamersley 82	2,158,862.8	2,146,707.9	13,226.7 (0.6)	4,237.5 (<0.1)	4,177.6 (0.2)	12,845.6 (0.6)	21,260.7 (1.0) **
Hamersley 175	92,899.8	92,611.1	5,202.5 (5.6)	1,751.4 (1.9)	2,847.0 (3.1)	378.0 (0.4)	4,976.3 (5.3)
Hamersley 567	776,824.0	774,213.0	10,312 .2(1.3)	1,177.7 (< 0.1)	1,362.7(< 0.1)	4,284.7 (0.6)	6,825.1 (0.9) ^
Total	**3,760,248.6**	**3,739,172.7**	**43,633.6**	**7,895.2**	**13,729.7*** **	**22,757.7**	**44,382.5**

Areas proposed to be cleared for each vegetation association are based on the area of the approved clearing limits for approved projects listed in Section 7.4.1.1where information is available. **Note the areas indicated are likely to overestimate cumulative clearing as part of the Eliwana Railway Project intersects the Development Envelope * Discrepancies in total clearing from MS 1000 and MS 925 are from historical vegetation clearing and secondary approvals (i.e., NVCP).*

Table 7-19: Cumulative Impacts on Significant Flora Species

Status	Species	Project	No. of Individuals Potentially Disturbed*	No. of Known Individuals in State	Cumulative Impact to Known Individuals (%)
Priority 1	*Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)	Proposal	750	7,491	11.5
		Western Turner Syncline	112		
Priority 2	*Ipomoea racemigera*	Proposal	102	1,001	20.5
		FMG Eliwana	2		
		FMG Eliwana Railway	101		
	Pentalepis trichodesmoides subsp. *hispida*	Proposal	3	863	10.7
		FMG Eliwana	36		
		FMG Eliwana Railway	53		
Priority 3^	*Aristida jerichoensis var. subspinulifera*	Proposal	1	67,094	<0.1
		FMG Eliwana Railway	10		
	Astrebla lappacea	Proposal	299	8,199	75.6
		FMG Eliwana Railway	5,984		
	Eremophila magnifica subsp. *velutina*	Proposal	1,520	4,559	40.7
		FMG Eliwana	283		
		Western Turner Syncline	53		
	Grevillea saxicola	Proposal	137	4,853	17.7
		FMG Eliwana Railway	58		
		Greater Paraburdoo	547		
		West Turner Syncline	122		

Status	Species	Project	No. of Individuals Potentially Disturbed*	No. of Known Individuals in State	Cumulative Impact to Known Individuals (%)
	Indigofera rivularis	Proposal	4,221	28,979	21.2
		FMG Eliwana	1,428		
		FMG Eliwana Railway	504		
	Ptilotus subspinescens	Proposal	12,117	28,848	43.1
		FMG Eliwana Railway	314		
	Rhagodia sp. Hamersley (M. Trudgen 17794)	Proposal	51	51,818	0.1
		FMG Eliwana Railway	19		
	Rostellularia adscendens var. latifolia	Proposal	173	4,507	4.5
		FMG Solomon Expansion	33		
	Sida sp. Barlee Range (S. van Leeuwen 1642)	Proposal	2,411	10,963	29.0
		Greater Paraburdoo	576		
		Western Turner Syncline	194		
	Sida sp. Hamersley Range (K. Newbey 10692)	Proposal	880	4,835	20.3
		FMG Eliwana	103		
	Themeda sp. Hamersley Station (M.E. Trudgen 11431	Proposal	817	146,014	26.8
		FMG Eliwana Railway	38,401		
	Triodia basitricha	Proposal	6,237	115,211	63.2
		FMG Eliwana	59,226		
		FMG Eliwana Railway	7,398		
Priority 4^	*Acacia bromilowiana*	Proposal	700	3,050	28.5

Status	Species	Project	No. of Individuals Potentially Disturbed*	No. of Known Individuals in State	Cumulative Impact to Known Individuals (%)
		FMG Eliwana	170		
	Eremophila magnifica subsp. *magnifica*	Proposal	900	10,722	13.1
		FMG Eliwana	258		
		FMG Solomon Expansion	238		
	Goodenia nuda	Proposal	393	16,637	3.5
		FMG Eliwana	106		
		FMG Eliwana Railway	54		
		FMG Solomon Expansion	37		

** Proposal impacts are based on the total number of known individuals within the development envelopes for the reasonably foreseeable projects listed in Table 2-7.*
^ The number of individual Priority 3 and Priority 4 species impacted by the Proposal is 100% to provide the Proponent with a level of Project flexibility and demonstrate the maximum impact of the Proposal

7.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids or minimises, where practicable, impacts on locally significant vegetation types (including riparian vegetation and GDEs) and Priority flora species present in the Development Envelope.

7.5.1. Mitigation Hierarchy

The Proponent has implemented the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) during the Proposal design process to develop mechanisms to address the potential impacts on the key flora and vegetation values within the Development Envelope. The mechanisms applied to each value is discussed below and summarised in Table 7-20.

7.5.2. Avoidance and Minimisation

7.5.2.1. High Value Vegetation Types

The approximate clearing extents of the Proposal are outlined in Section 7.4.1.1; however, the Proposal includes flexibility to alter the location of the Proposal elements within the Development Envelope. To ensure that the impact on high value vegetation types is minimised and not greater than assessed, the Proponent will impose upper clearing limits for four vegetation types (C3 (DkCk), G3, H35 and H36). These upper limits are outlined in Table 7-11. There are no potential impacts on P27 and C6 as these vegetation types occur only in the Silvergrass area and NAP, and no new Proposal elements will be implemented in these areas. Impacts will be avoided within C28 as this vegetation type is associated with Plunge Pool, which is protected by a MEZ (Section 6.4.1.1).

The Proponent will enforce these clearing limits through the continual implementation of their internal Approvals Request System, the preferential utilisation of existing disturbed areas where practicable for the construction of infrastructure and site induction programs emphasising the protection of these vegetation types.

Additional mitigation measures developed with reference to the EPA's mitigation hierarchy are shown in Table 7-20.

7.5.2.2. Priority 1 and 2 Flora Species

Tetratheca butcheriana is a Priority 1 flora species listed by DBCA. There are 3,787 known individuals in seven populations, restricted to the Brockman Syncline landform (Rio Tinto 2021a). Under the relevant IUCN definition, this species would be listed as Critically Endangered. The Proponent has avoided one population of this species (2,057 individuals) by re-designing the Development Envelope to exclude this area (Figure 2-8). The two populations within the Development Envelope will be avoided by applying a 100 m MEZ buffer around the mapped population extent within which no disturbance will occur. A spatial representation of the MEZ is presented in Figure 7-21, with oblique views of the MEZs provided in Figure 7-21 a and b.

For all other Priority 1 and Priority 2 flora species, the approximate number of individuals which will be impacted are presented in Section 7.4.1.2. To provide the Proposal with a level of flexibility to alter the location of Proposal elements without changing the level of impact to these species the Proponent will implement upper clearing limits. These are outlined in Table 7-16 and will be enforced through the Proponent's Approval Request System, with record information stored in the Proponents GIS database.

No specific limits are proposed for Priority 3 and 4 species as these species are known to be widespread outside of the Development Envelope and the Proposal is not expected to cause a change to the conservation status of any of these species.

Additional mitigation measures, developed with reference to the EPA's mitigation hierarchy are shown in Table 7-20.

542,000
544,000
546,000
7,512,000
7,510,000

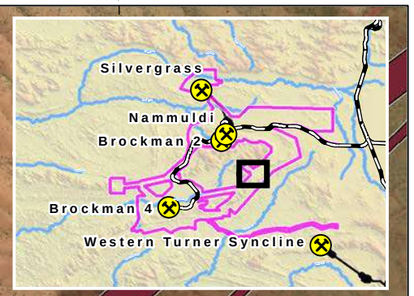

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Figure 7-21
MEZ Around Population of *Tetratheca butcheriana* (P1)

Drawn: L.Fuentes
Plan: PDE0191319v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:20,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Mine Exclusion Zone (*Tetratheca Butcheriana*)
- *Tetratheca butcheriana* (P1)

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

N

0 200 400 600 800

Metres

Map units in metres

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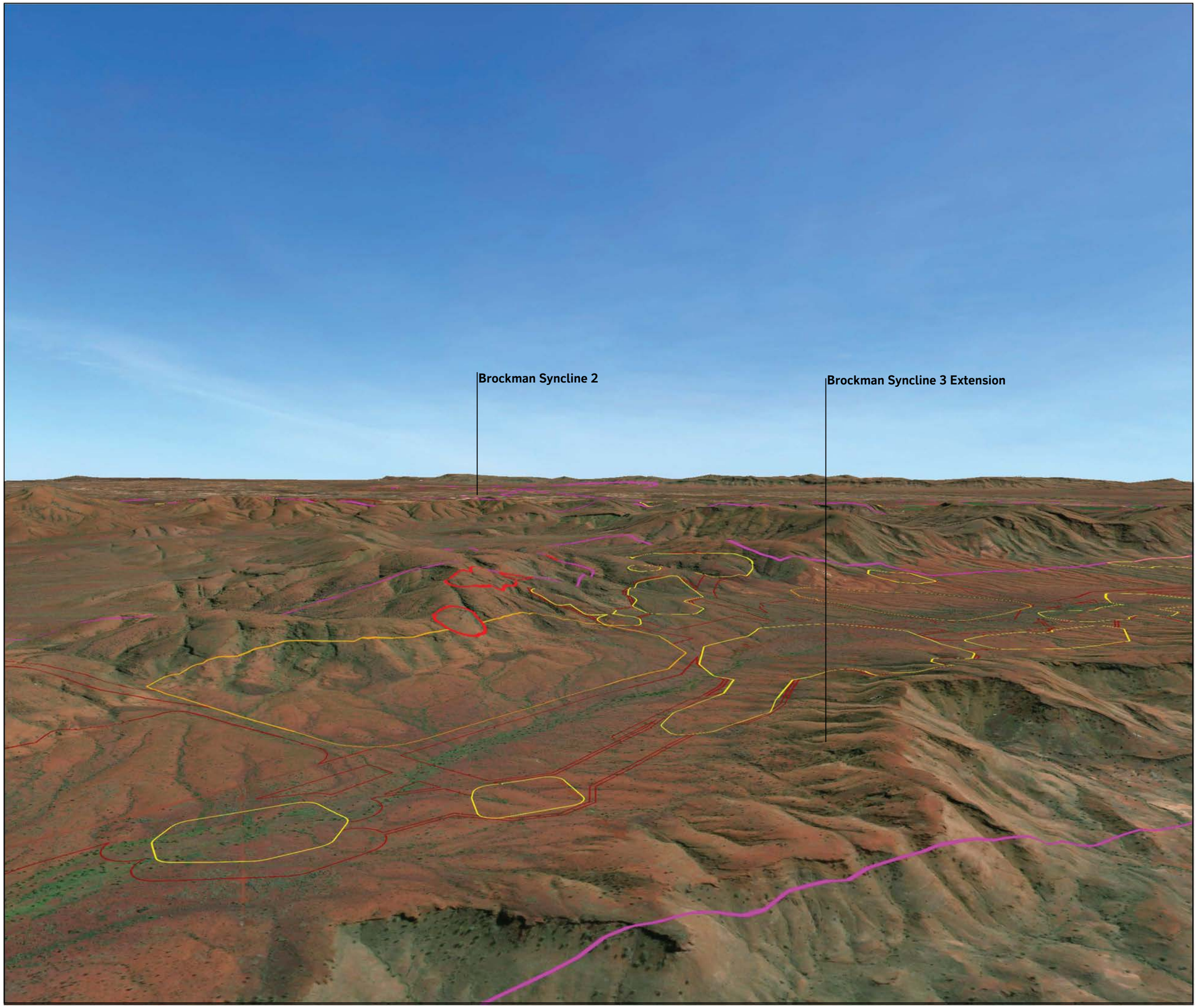

RioTinto

Figure 7-21a
MEZ Around Population of *Tetratheca butcheriana* (P1)
Looking North

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Mine Exclusion Zone (*Tetratheca Butcheriana*)

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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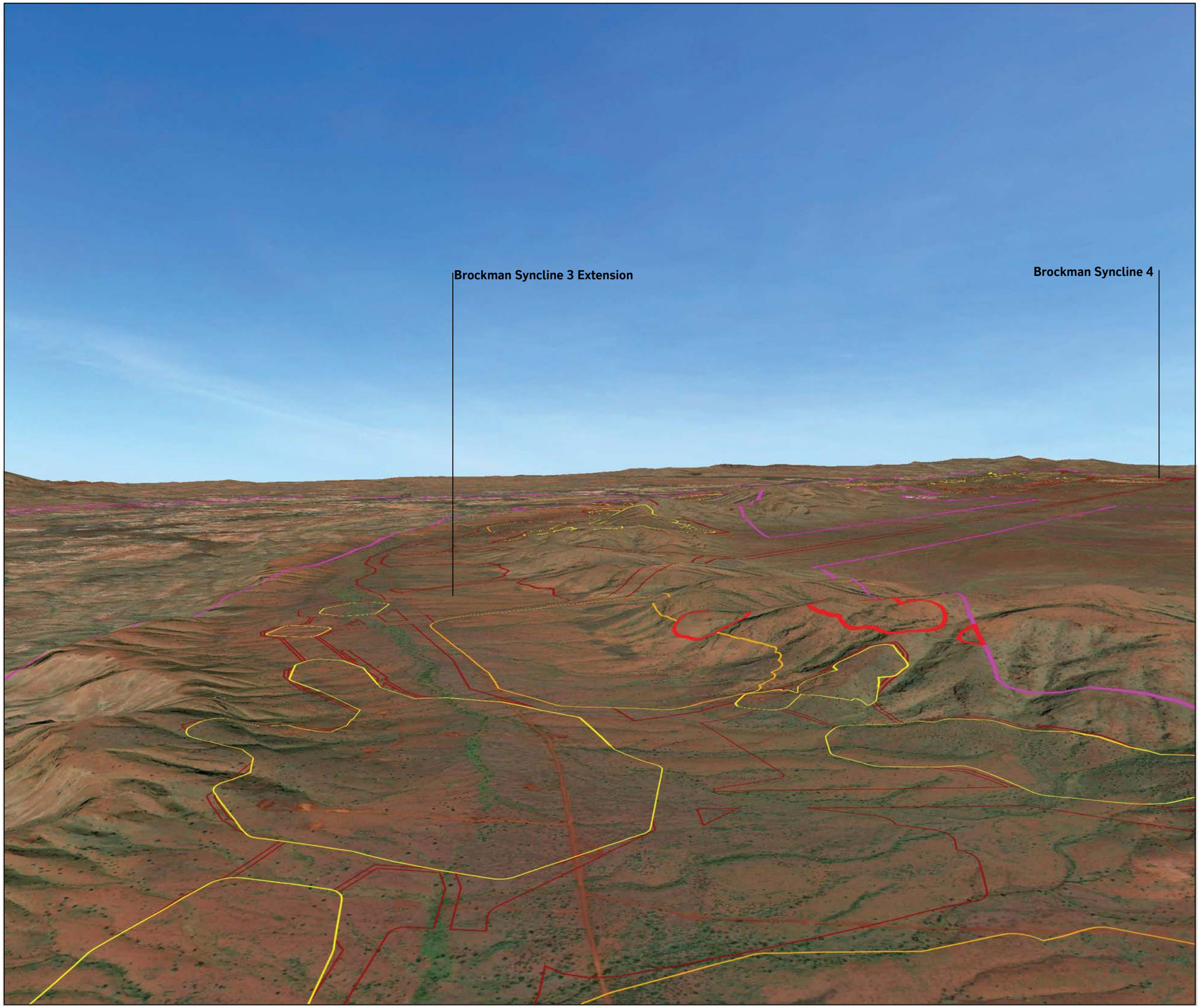

RioTinto

Figure 7-21b
MEZ Around Population of *Tetratheca butcheriana* (P1)
Looking West

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
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Legend

- Development Envelope
- Mine Exclusion Zone (*Tetratheca Butcheriana*)

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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7.5.2.3. Groundwater Dependent Vegetation

The Development Envelope contains several GDV types which have the potential to be impacted by clearing and groundwater drawdown from BWT mining. Proposal infrastructure has been sited to avoid clearing within potential GDEs where practicable. Additionally, the Proponent will take measures to avoid groundwater drawdown affecting GDV's as much as practicable. These measures are:

- All operational water demands will be supplied from water extracted from the pits, thus negating the need for a borefield
- Limiting mining at BS3 deposit to AWT due to its potential connectivity to the culturally and environmentally significant Plunge Pool water body. Limiting mining will ensure the GDV around this water body will not be impacted by groundwater drawdown.

Additional mitigation measures developed with reference to the EPA's mitigation hierarchy, are shown in Table 7-20.

7.5.2.4. Riparian Vegetation

Surplus water will continue to be discharged to Boolgeeda Creek and Duck Creek. There will be no substantive change to the discharge regime to these creeks (with respect to volume, water quality or wetting front), as approved under MS 925 and MS 1000. Monitoring triggers, thresholds and management actions in relation to this outcome are included in the EMP. The discharge and cessation of dewatering will be managed to ensure there are no irreversible impacts to riparian vegetation. These management measures, developed with reference to the EPA's mitigation hierarchy are shown in Table 7-20.

7.5.2.5. Vegetation Quality

The Proponent is committed to continuing to implement their *Iron Ore (WA) Pilbara Weed Management Strategy* to avoid introducing new weed species. The occurrence of bushfires will also be minimised by ensuring all potential fire risk activities, such as vegetation clearing, do not occur when the fire danger rating is severe or above.

The Proponent will also implement the following measures to minimise impacts on the quality of the vegetation:

- Dust suppression techniques to minimise the dust deposited on the remnant vegetation within the Development Envelope (i.e., the use of water trucks, use of a conveyor to move ore from BS1 to BS4 assessment areas, use of dust suppression technologies on processing plants (sprays and collection systems) and selective use of dust suppression products on stockpiles and open areas)
- Iron Ore (WA) Pilbara Weed Management Strategy to minimise the likelihood of weed species being introduced or spread within the Development Envelope. The key actions will include the periodic spraying of cleared areas and the management of vehicle, machinery and equipment hygiene
- Fire management measures to minimise the likelihood of activities associated with the Proposal resulting in the outbreak of bushfires. These measures include the monitoring and management of hot works, vehicle movement and the disposal of fire-starting wastes, such as cigarette butts. The Proponent will also provide firefighting equipment in vehicles and infrastructure.

These mitigation measures, developed with reference to the EPA's mitigation hierarchy, are shown in Table 7-20.

7.5.3. Rehabilitation and Closure

7.5.3.1. Mitigation of Risks at Closure

The proposed end 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 adversely 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 rock landforms. Therefore, it will 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 before closure during the final planning phases and in consultation with relevant stakeholders.

General rehabilitation practices will include:

- Topsoil (where available) will be spread over rehabilitated areas to act as a seed source, while vegetation (including woody debris) will be planted/spread to protect the soil from erosion
- Local provenance seed and propagated material will be used (if required) to rehabilitate disturbed areas
- Weed spraying will occur after areas are rehabilitated over the Life of Mine
- Backfilling of the BS3 Extension deposits (MM-J and Creekside) to above post mining recovered water levels
- The Proponent intends to conduct pollination and genetic studies of *Tetratheca butcheriana* in 2022 - 2023 to inform future management of the species.

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
- Diversity and abundance of weed species recorded within rehabilitation areas will be no higher than within established reference sites.

The Proponent has prepared a progressive rehabilitation summary regarding current practice and outcomes at the existing operations (Appendix D.8). Rehabilitation at the existing operations is conducted in accordance with the Proponents 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 guides rehabilitation activities such as seed list development and rehabilitation quality assessment.

Anticipated closure outcomes for the Proposal specific to Flora and Vegetation are presented in MCP (Appendix B.4.

7.5.4. Summary of the Application of the Mitigation Hierarchy

As described above, the Proposal has been designed to avoid and mitigate impacts. Table 7-20 summarises the mitigation hierarchy for this Proposal.

Table 7-20: Application of the Mitigation Hierarchy for Vegetation and Flora

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Clearing of native vegetation	**Measure to Avoid**			
	• Locations of significant vegetation types to be avoided by the Proposal will be included in the Proponents GIS system. • The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System.	Proposal specific	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.
	Measure to Minimise			
	The proposed clearing has been minimised through project optimisation to reduce the total extent of clearing required from 9,977.0 ha to 7,896.3 ha. To minimise the impact on native vegetation, the Proponent will: • Implement upper clearing limits for four high local significance vegetation types (C3(DkCk), G3, H35 and H36), as outlined in Table 7-11. • Ensure clearing occurs only in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Ensure clearing occurs only in approved ground disturbance areas through survey, pegging and/or flagging of areas to be cleared prior to the commencement of clearing • Utilise existing disturbed areas wherever practicable	Proposal specific	No	• The use of upper clearing limits will ensure that the Proposal's impact on these vegetation types does not exceed the upper limits proposed. These limits will be enforced through the Proponent's Approval Request System and site induction programs giving it a high level of certainty. • Vegetation clearing will not exceed 7,896.3 ha, • The utilisation of existing disturbed areas for the construction of Proposal elements minimises the amount of vegetation that will be cleared.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Conduct a site induction program to provide information on vegetation protection and ground disturbance authorisation procedures.			
	Measure to Rehabilitate			

	• The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's
	• The Proponent commits to undertake progressive rehabilitation to minimise cleared areas and revegetate using local native species, where practicable.
	• The MCP (Appendix B.4) 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 Proposal specific MCP has been developed, based on RTIO standard approach to closure planning, that includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use.	No	• Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020ab. The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b.
				• Rehabilitation success across existing Greater Brockman operational areas has been variable to date. Some areas indicate positive performance and very good rehabilitation, but 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.

	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Upper clearing limits for high local significance vegetation		Ministerial condition with upper clearing limits for high local significance vegetation	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Clearing of Priority Flora Species	**Measure to Avoid**			
	The Development Envelope and Conceptual Footprint have been modified as far as practicable to avoid impacts on individuals of significant flora species. For *Tetratheca butcheriana* (P1), all known individuals will be avoided, with MEZs set up around all known populations of this species. All MEZs will be captured in the Proponents GIS mapping system.	Proposal specific	No	• These measures will ensure that the Proposal will not directly impact on any *Tetratheca butcheriana* (P1) individuals within the Development Envelope. This will be enforced by implementing the Proponent's Approval Request System and the data will be stored within the Proponents GIS database. • The complete avoidance of an impact always has a high level of certainty and is the first and preferred strategy in the EPA mitigation hierarchy.
	Measure to Minimise			
	The Development Envelope and Conceptual Footprint have been modified as far as practicable to avoid impacts on individuals of significant flora species. The Proponent will implement upper clearing limits for the named species below, as outlined in Table 7-16 • *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354) (P1) • *Ipomoea racemigera* (P2) • *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708)) P2) • *Oxalis* sp. Pilbara (M.E. Trudgen MET 1570) (P2) • *Pentalepis trichodesmoides* subsp. hispida (P2).	Proposal specific	No	• The use of upper clearing limits will ensure that the Proposal's impact on these Priority 1 and 2 flora species is not significant. These limits will be enforced through the Proponent's Approval Request System and the information will be stored in the Proponents GIS database. • The measures give it a high level of certainty.
	Measure to Rehabilitate			
	The Proponent commits to undertake progressive rehabilitation to minimise cleared areas' extent and restore vegetation using recovered topsoil and seed of local provenance, where practicable.	A Proposal specific MCP has been developed based on RTIO standard approach to closure	No	• 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 Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
		planning, that includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use.		• Moderate certainty. Rehabilitation will be required to provide a 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.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• MEZ's will be applied to all populations of *Tetratheca butcheriana* (P1) within the Development Envelope • Upper clearing limits will be implemented for one Priority 1 and five Priority 2 flora species within the Development Envelope.		• A ministerial condition regarding MEZ and requirement to implement the EMP in relation to *Tetratheca butcheriana* • A ministerial condition limiting the extent of impact to one Priority 1 and five Priority 2 flora species as described in Section 7.5.2.2.	
Indirect Impacts				
Impacts to groundwater dependent ecosystems as a result of groundwater drawdown	**Measure to Avoid**			
	Mining of the BS3 deposit will be limited to AWT to avoid the need to dewater close to Plunge Pool.	Proposal specific	Yes – Groundwater Licence Operating Strategies associated with Groundwater Licences requires Proponents to provide detail on those pits to be mined BWT.	Groundwater levels at Plunge Pool will not be affected by the Proposal. This avoidance strategy removes the potential impact pathway and therefore has a high level of certainty. Avoidance is the first and preferred strategy in the EPA mitigation hierarchy.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measure to Rehabilitate			
	The mine closure strategy includes backfilling of the BS3 Extension deposits (MM-J and Creekside) to above post mining recovered water levels to minimise the long-term drawdown in aquifers that are 9 km upgradient of Plunge Pool.	A Proposal specific MCP has been developed, which commits the Proponent to backfill BS3 extension deposits (MM-J and Creekside).	No	• Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020ab. The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b. • Moderate certainty. Rehabilitation will be required to provide a stable landform with habitat features.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• Mining at BS3 deposit will be AWT only • Backfilling of BS3 Extension deposits (MM-J and Creekside) to prevent formation of pit lake at closure • No impact on the groundwater levels in the Plunge Pool aquifer as a result of mining • Annual limit on groundwater abstraction.		• Ministerial condition requiring preparation and implementation of an MCP, including provision for pit backfilling for BS3 • Ministerial condition identifying permitted BWT pits • Outcome based provision in the EMP for Plunge Pool	
Impacts to riparian vegetation as a result of surplus water discharge to surface water systems	**Measure to Avoid**			
	Riparian vegetation within Boolgeeda and Duck Creek will not be impacted by surplus water discharge beyond prescribed distances.	Proposal specific	No	• These measures are consistent with existing approvals (MS 995 and MS 1000) and the water use hierarchy (refer to Section 6) and will not impact any riparian vegetation beyond the wetting front of each surface water system. • The avoidance of an impact always has a high level of certainty and is the first and preferred strategy in the EPA mitigation hierarchy.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measure to Minimise			
	• Abstracted groundwater will be used on-site for operational, environmental and management purposes to minimise discharge as far as practicable. • Discharge to surface water systems will be minimised as discharge to complete mine pits (once available) and to the NAP as approved under MS 925 will be utilised first, where practicable. • Controlled discharge to Boolgeeda Creek will be managed such that the wetting front as a result of discharge remains at or below 37.0 km in accordance with existing approval under MS 1000. • Discharge into Duck Creek will be managed to ensure the wetting front does not extend beyond 67.0 km.	Proposal specific	No	• The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b). • The water management strategy was developed in conjunction with the water use hierarchy and provided a robust decision-making framework to achieve outcomes. • Rehabilitation will be required to provide a 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
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• No increase in the approved Boolgeeda Creek wetting front • Discharge to Duck Creek limited to within 67.0 km wetting front.		• A ministerial condition limiting the wetting front in Boolgeeda Creek to 37.0 km from the point of discharge under natural no flow conditions • A ministerial condition limiting the wetting front in Duck Creek to 67.0 km from the point of discharge under natural flow conditions.	
Fragmentation due to land clearing	**Measure to Avoid**			
	• The Development Envelope and Conceptual Footprint have been modified during the design phase to avoid, where possible the fragmentation of significant vegetation and flora.	Standard business practice	No	• The Proponent's Iron Ore (WA) Pilbara Weed Management Strategy has been developed to meet the current industry standards for managing the potential introduction of new weeds.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• The Proponent will avoid introducing new weeds species entering the Development Envelope by implementing the Iron Ore (WA) Pilbara Weed Management Strategy thus reducing the likelihood of fragmentation			• The management strategy will ensure that no new weed species will be introduced to the Development Envelope • These Management Strategies have been implemented across the Proponents operations in the Pilbara and are regarded as having a high level of certainty.
	Measure to Minimise			
	• Mining will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to pollination. • The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system. • Utilise existing disturbed areas wherever practicable	Proposal specific	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 thus reducing the likelihood for fragmentation.
	Measure to Rehabilitate			
	• The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's • The Proponent commits to undertake progressive rehabilitation to minimise cleared areas where practicable and to revegetate using local native species, where practicable. • The MCP (Appendix B.4) includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use, including:	A Proposal specific MCP has been developed based on RTIO standard approach to closure planning.	No	• Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a, b). 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 Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	○ Topsoil and vegetation (including woody debris) will 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. • Weed spraying of progressive rehabilitation areas over the life of the mine • The Proponent will include indicative closure completion criteria to ensure that weed species recorded within rehabilitation areas are also present within the local uncleared area.			• Rehabilitation will be required to provide a vegetated and stable landform with habitat features. However, the uncertainty in relation to the re-creation of habitat values following mining is acknowledged. Therefore, clearing is treated as a long-term or permanent impact for this assessment. • Weed control during rehabilitation is an established standard practice within the mining industry. • The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through standard industry practices		N/A	
Introduction/spread of weeds	**Measure to Avoid**			
	The Proponent will avoid introducing new weeds species entering the Development Envelope by implementing the *Iron Ore (WA) Pilbara Weed Management Strategy*	Standard business practice	No	• The Proponent's *Iron Ore (WA) Pilbara Weed Management Strategy* has been developed to meet the current industry standards for managing the potential introduction of new weeds. • The management strategy will ensure that no new weed species will be introduced to the Development Envelope

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
				• These Management Strategies have been implemented across the Proponents operations in the Pilbara and are regarded as having a high level of certainty.
	Measure to Minimise			
	The Proponent will take measures to minimise the threat of new weeds entering the Development Envelope and the spread of existing weed species through continued implementation of the *Iron Ore (WA) Pilbara Weed Management Strategy* which includes but is not limited to: • The development and/or implementation of vehicle and equipment clean on entry/exit procedures. • All personnel will be inducted prior to their commencement on site; including weed identification and weed hygiene training. • Any machinery used in the removal of weed-infested topsoil will be cleaned down before entering or leaving the work site to prevent the introduction and spread of weeds into new areas • Any soil or materials imported onto the worksite will be from weed-free areas • Weed contaminated topsoil stockpiles shall be quarantined from uncontaminated / clean topsoil stockpiles, clearly signed in the field and identified on a site plan • Areas temporarily disturbed are to be revegetated and stabilised.	Standard business practice	No	• The Proponent's *Iron Ore (WA) Pilbara Weed Management Strategy* has been developed to meet the current industry standards for managing the potential introduction and spread of weeds. The management strategy 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 having a high level of certainty.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measure to Rehabilitate			
	• Weed spraying of progressive rehabilitation areas over the life of the mine • The Proponent will include indicative closure completion criteria to ensure that weed species recorded within rehabilitation areas are also present within the local uncleared area.	Standard business practise	No	• Weed control during rehabilitation is an established standard practice within the mining industry. • The MCP must 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. However, there is uncertainty in relation to the recreation of habitat values following mining. Therefore, clearing is treated as long-term or permanent impact for this assessment.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No new weeds introduced, attributable to the Proposal.		Implementation of Weed Management Strategy.	
Degradation of vegetation through dust deposition	**Measure to Minimise**			
	• 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.	Standard business practice	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 Development Envelope as a result of the Proposal. • 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 Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Avoid vegetation clearing, grubbing and earthworks during high winds. • Restrict vehicles to within designated roads and laydown areas			
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through industry standard practice.		N/A.	
Degradation of vegetation through the potential increase in bushfire risk	**Measure 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 effective and as such provides a high level of certainty.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measure 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.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through industry standard practice.		No limits proposed – managed through industry standard practice.	

7.6. Assessment and Significance of Residual Impact

7.6.1. Assessment of Direct Residual Impacts

7.6.1.1. Loss of Native Vegetation (including Riparian Vegetation)

The Proposal will clear up to 7,896.3 ha of native vegetation across 104 mapped vegetation types (Table 7-11). Up to 457.4 ha (28.1%) of vegetation with high local significance across four vegetation types (C3 (DkCk), G3, H35 and H36) will be removed due to Proposal implementation. The vegetation of high local significance that occur only in the Silvergrass and NAP areas (P33, C6) will not be impacted by the Proposal as none of the Proposal elements will be implemented in this area. An assessment of direct impacts on high local significance vegetation is provided in Table 7-21.

The moderate local significance vegetation types within the Development Envelope are of a lower priority for conservation when contrasted with the high local significance vegetation types. As such, no specific upper clearing limits have been proposed for any of these vegetation types. However, the overall clearing of vegetation types of moderate local significance will not exceed the total authorised extent for the Proposal. The assessment of the direct impacts to the moderate significance vegetation types is presented in Table 7-22. No significant impacts to moderate significance vegetation types are expected.

Fifteen of the thirty-five moderate significance vegetation types within the Development Envelope have over 30.0% of their mapped extent outside of the Development Envelope and are expected to be well represented sub-regionally. As such, even if the majority of the vegetation types were cleared within the Development Envelope, this would still not change the assessment outcomes and would still not be a significant impact. The vegetation types are A1, A3, A9, A10, C3, C13, G4, H3, H15, H17, P5, P7, P8, P9 and P16.

Table 7-21: Assessment of Direct Impacts on High Local Significance Vegetation

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped Extent in the Development Envelope (ha)	Assessment of Impacts
C3 (DkCk)	26.4	25.7	This vegetation type includes riparian vegetation and occurs along Duck Creek. The conceptual footprint does not include any of this vegetation type but to ensure the Proposal has sufficient flexibility for water management measures a 5.1 ha upper limit of impact, has been assumed for assessment purposes. The 5.1 ha upper limit of impact comprises 19.3% of the mapped extent in the survey area and 20% of that mapped within the Development Envelope. This is not expected to significantly impact this vegetation type.
C6	123.9	55.9	This vegetation type occurs along Caves Creek in the Silvergrass area. As the Proposal does not include new activities in this area, no impacts to this vegetation type are anticipated.
C28	0.3	0.3	This vegetation type is associated with Plunge Pool. Impacts will be avoided via implementation of a MEZ and AWT mining only at BS3 deposit. Therefore, no impacts to this vegetation type are anticipated.
G3	994.3	424.9	This vegetation type was identified as high local significance as it contains the flora species *Tetratheca butcheriana* (P1) and *Hibiscus* sp. Mt Brockman (P1) and represents an EAR. The Proposal will remove no more than 124.5 ha of this vegetation type (approximately 12.5% of the mapped extent in the survey area and 30.0% of that mapped within the Development Envelope). Clearing within this vegetation type will not result in the loss of any *Tetratheca butcheriana* (P1) and upper limits are proposed separately for impacts to *Hibiscus* sp. Mt Brockman (P1) individuals. Given that more than 70.0% of the vegetation type will be retained in the Development Envelope and no *Tetratheca butcheriana* (P1) individuals will be impacted, the proposed clearing of this vegetation type is not expected to significantly impact this vegetation type.
H35	277.3	223.3	This vegetation type was identified as high local significance as it contains the flora species *Hibiscus* sp. Mt Brockman (P1). The Proposal will remove approximately 111.5 ha of this vegetation type (approximately 40.2% of its mapped extent within the survey area and 50.0% within the Development Envelope). Upper limits of clearing of *Hibiscus* sp. Mt Brockman (P1) individuals are proposed separately. Given the retention of 50.0% of the vegetation type in the Development Envelope and 59.8% within the survey area, the proposed clearing of this vegetation type is not expected to significantly impact this vegetation type.
H36	1,572.4	720.9	This vegetation type was identified as high local significance as it contains the flora species *Hibiscus* sp. Mt Brockman (P1).

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped Extent in the Development Envelope (ha)	Assessment of Impacts
			The Proposal will remove no more than 216.3 ha of this vegetation type (approximately 13.8% of its mapped extent within the survey area and 30.0% within the Development Envelope). Upper limits of clearing of *Hibiscus* sp. Mt Brockman (P1) individuals are proposed separately. Given the retention of 70% of the vegetation type in the Development Envelope, the proposed clearing of this vegetation type is not expected to result in significant impacts to this vegetation type.
P27	264.8	217.2	This vegetation type was identified as of high local significance as it is similar to the Priority 1 PEC as it also supports populations of *Astrebla elymoides* and *A. pectinata* and contains *Rostellularia adscendens* var *latifolia* (P3), *Astrebla lappacea* (P3) and *Themeda* sp. Hamersley Station (M.E.Trudgen 11431) (P3). This vegetation type occurs only in the Silvergrass and NAP areas. As the Proposal does not include new activities in this area, no impacts to this vegetation type are anticipated.

Table 7-22: Assessment of Direct Impacts to Moderate Local Significance Vegetation

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
A2	3,202.1	2,827.9	This vegetation type was identified as an EAR, due to the presence of Mulga (*Acacia aneura* complex) communities. The Proposal will remove approximately 772.7 ha (approximately 24.1% within the survey area and 27.3% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. This vegetation type is anticipated to occur in the wider region, as 374 ha was mapped as occurring outside the Development Envelope. Additionally, it was recorded at the edge of the Development Envelope in the Lens G and NAP areas and is likely to extend to adjacent parts; however, these areas were not surveyed. The occurrence of this vegetation type outside of the Development Envelope indicates that the proposed clearing is not expected to result in a significant impact.
A4	0.9	0.9	This vegetation type was identified as an EAR due to the presence of Mulga (*Acacia aneura* complex) and Snakewood (*Acacia xiphophylla)* Communities. The Proposal does not impact this vegetation type, but given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
			as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. The mapped occurrence of this vegetation type only occurs within a narrow strip on the boundary of the MS 100 infrastructure corridor and is expected to occur more widely in the local area outside of the current survey area. This vegetation type is likely to occur more broadly in the region as it supports both Mulga and Snakewood communities. Both of which are widespread in the Pilbara and are commonly associated with NVIS Major Vegetation subgroups 23 and 24 (Kendrick 2001) Given the likely wide occurrence of this vegetation type within the region the potential clearing of 1 ha is **not** expected to be a significant impact**.**
A5	90.3	90.3	This vegetation type was identified as an EAR, due to the presence of Mulga (*Acacia aneura* complex) communities. The Proposal does not impact on this vegetation type but given project flexibility, the amount cleared of each type could be greater. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. The vegetation type is likely to occur more broadly within the region as it supports Mulga communities which are widespread in the Pilbara and are commonly associated with NVIS major mapping subgroups 23 and 24 (Kendrick 2001). Given the likely wide occurrence of this vegetation type within the Pilbara region the potential clearing of 90.3 ha is not expected to be a significant impact.
A6	931.9	700.1	This vegetation type was identified as supporting populations of *Aristida jerichoensis* var. *subspinulifera* (P3), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Rostellularia adscendens* var. *latifolia* (P3), *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3) and *Goodenia nuda* (P4) The Proposal will remove approximately 104.4 ha (approximately 11.2% within the survey area and 14.9% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. This vegetation type is anticipated to occur in the wider region as an additional 231.8 ha was recorded as occurring outside the Development Envelope. All of the priority flora found within the vegetation type has also been recorded in other vegetation types within and outside the Development Envelope.

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
			The occurrence of this vegetation type outside of the Development Envelope and none of the Priority species being restricted to this vegetation types indicates that the proposed clearing is not expected to result in a significant impact.
A8	1.2	1.2	The vegetation type was identified as supporting populations of *Grevillea saxicola* (P3) and as an EAR, due to the presence of Mulga (*Acacia aneura* complex) communities. The Proposal does not impact this vegetation type but given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. The vegetation type is likely to occur more broadly within the region as it supports Mulga communities which are widespread in the Pilbara and are commonly associated with NVIS major mapping subgroups 23 and 24 (Kendrick 2001). Given the likely wide occurrence of this vegetation type within the Pilbara region and the occurrence of *Grevillea saxicola* (P3) within other vegetation types within and outside of the Development Envelope the potential clearing of 1.2 ha is not expected to be a significant impact.
C1	122.0	68.9	This vegetation type was identified as supporting riparian vegetation as well as populations of *Indigofera rivularis, Ipomoea racemigera* and *Ptilotus subspinescens* all of which are Priority 2 species. *Ipomoea racemigera* does not occur, and *Indigofera rivularis* and *Ptilotus subspinescens* are very well represented outside of, the Development Envelope (Table 7-10). The Proposal will remove approximately 15.2 ha (approximately 12.5% within the survey area and 22.1% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Over 40.0% of the vegetation type will not be impacted by the Proposal and is expected to extend further outside of the Development Envelope, as it has been recorded along several Creeklines in the BS1 area and intersects the MS 1000 infrastructure corridor. Due to the likely widespread nature of the vegetation type outside of the Development Envelope and the limited impact on the Priority flora species present, the proposed clearing is not expected to result in a significant impact to this vegetation type.
C14	1,592.2	1,389.8	This vegetation type was identified as supporting clusters of Priority flora, *Indigo rivularis* (P3) and *Goodenia nuda* (P4).

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
			The Proposal will remove approximately 112.6 ha (approximately 7.1% within the survey area and 8.1% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. The vegetation type is likely to extend outside of the current survey area as it is a dominant vegetation type along the Boolgeeda Creek Valley. Given the lower priority nature of these species, their representation outside the Development Envelope and its likely extension along the creek beyond the Development Envelope, any impact on this vegetation type is not expected to result in a significant impact to this vegetation type.
C16	581.5	542.5	This vegetation type was identified as being an EAR due to the presence of Mulga (*Acacia aneura* complex) communities and has the potential to support GDV. The Proposal does not impact on this vegetation type, but given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. The vegetation type is likely to extend along creekline formations outside of the current survey area as it has been recorded in the NAP area and intersects with the MS 100 infrastructure corridor. Additionally, the Mulga communities present within the vegetation type are widespread in the Pilbara as they are commonly associated with NVIS major mapping subgroups 23 and 24 (Kendrick 2001). Given GDV (Section 7.3.2.6) and Mulga communities are well represented outside the Development Envelope any impact on this vegetation type is not expected to result in a significant impact.
C22	90.3	80.9	This vegetation type was identified as supporting populations of *Ipomoea racemigera* (P2). The Proposal will remove approximately 5.4 ha (approximately 6.0% within the survey area and 6.7% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. The vegetation type is common along creeklines within the local area and is truncated by the survey area boundary, thus is expected to be present outside of the current survey area. Given that the *Ipomoea racemigera* (P2) is known to occur within other vegetation types within the survey area and the vegetation type is present outside of the Development Envelope, any impact on this vegetation is not expected to result in a significant impact.

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
C27	137.2	105.8	This vegetation type was identified as supporting Riparian vegetation within a moderate drainage line system. The Proposal will remove approximately 25.1 ha (approximately 18.3% within the survey area and 23.7% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. This vegetation type has been recorded as occurring in BS1 and BS2 assessment areas and is present along creeklines which extend outside of the survey area. Given the representation of riparian vegetation and the likely further representation of this vegetation type outside the Development Envelope, the proposed clearing is not expected to result in a significant impact.
G1	0.8	0.8	This vegetation type covers approximately 1 ha within the survey area and the Development Envelope. This vegetation type was identified as an EAR, due to the presence of Mulga (*Acacia aneura* complex)) communities. The Proposal does not impact this vegetation type, but given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. This vegetation type is likely to occur more broadly in the region as it supports Mulga communities which are widespread in the Pilbara and are commonly associated with NVIS Major Vegetation subgroups 23 and 24 (Kendrick 2001). Given the likely wide occurrence of this vegetation type within the region the potential clearing of 1 ha is **not** expected to result in a significant impact
H4	823.9	816.2	This vegetation type was identified as supporting populations of *Eremophila magnifica* subsp. *velutina* (P3), *Sida sp*. Barlee Range [S. van Leeuwen 1642] (P3) and *Sida* sp. Hamersley Range [K. Newbey 10692]) (P3). The Proposal will remove approximately 120.2 ha (approximately 14.6% within the survey area and the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Considerable sections of this vegetation type, which tend to occur on high steep areas of the BS in the Lens G/Diesel and BS3 assessment areas, abut the Development Envelope boundary and can be expected to extend beyond.

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
			Given all the Priority flora species occur within other vegetation types the proposed clearing of this vegetation type is not expected to result in a significant impact.
H6	473.6	380.5	This vegetation type was identified as supporting populations of *Indigofera rivularis* (P3). The Proposal will remove approximately 300.2 ha (approximately 63.4% within the survey area and 78.9% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Extensive sections of this vegetation type occur against the boundary of the Development Envelope and are likely to extend into adjacent areas. Given all the Priority flora species occur within other vegetation types within the survey area and is likely represented outside of the Development Envelope, the proposed clearing of this vegetation type is not expected to result in a significant impact.
H7	167.2	125.1	This vegetation type was identified as an EAR due to the presence of Mulga (Acacia aneura complex)) communities. It also supports populations of *Eremophila magnifica* subsp. *velutina* (P3)*, Indigofera rivularis* (P3) and *Sida* sp. Hamersley Range (K. Newbey 10692) (P3). The Proposal will remove approximately 91.8 ha (approximately 54.9% within the survey area and 73.4% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Large patches of it abut the boundary of the BS1 survey area and thus are expected to extend further into the local area. Additionally, the vegetation type supports Mulga communities which are widespread in the Pilbara and are commonly associated with NVIS Major Vegetation subgroups 23 and 24 (Kendrick 2001). Given the vegetation type occurs outside the Development Envelope, of all Priority flora and Mulga communities being present within other vegetation types within the survey area, any impact on this vegetation type is **not** expected to result in significant impacts to this Moderate local significance vegetation type.
H13	631.8	604.8	This vegetation type was identified as supporting populations of *Pentalepis trichodesmoides* subsp. *hispida* (P2). The Proposal will remove approximately 522.3 ha (approximately 82.7% within the survey area and 86.4% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes.

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
			Given that the vegetation type is known to occur outside of the Development Envelope and the Priority flora species present occur within other vegetation types (and impacts to this species are assessed separately), the Proposal is not expected to represent a locally significant impact.
H21	300.5	267.5	This vegetation type was identified as supporting large populations of *Triodia basitricha* (P3). The Proposal will remove approximately 124.9 ha (approximately 41.6% within the survey area and 46.7% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Given that the vegetation type is known to occur outside of the Development Envelope and the Priority flora species present outside the Development Envelope as well as within other vegetation types, the Proposal is not expected to represent a locally significant impact to this Moderate significant vegetation type
H26	8,903.9	6,333.1	This vegetation type was identified as supporting populations of *Hibiscus* sp. Mt Brockman [E. Thoma ET 1354] (P1) and *Tetratheca butcheriana* (P1), two Priority 2 species (*Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708) and *Pentalepis trichodesmoides* subsp. *hispida*), six Priority 3 species and three Priority 4 species. The Proposal will remove approximately 1,123.9 ha (approximately 12.6% within the survey area and 17.7% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Given that the vegetation type and the Priority flora it supports are known to occur extensively outside of the Development Envelope, the proposed clearing is not expected to represent a locally significant impact.
H28	6.3	6.3	The vegetation type was identified as supporting large populations of *Triodia basitricha* (P3). The Proposal does not impact on this vegetation type but given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Given the scale of the area and the presence of the Priority 3 species within other vegetation types within and outside of the Development Envelope, the proposed clearing is not expected to represent a locally significant impact.
P10	1,931.7	1,605.9	This vegetation type was identified as an EAR, due to the presence of Mulga (*Acacia aneura* complex)) communities. It also supports population of *Ipomoea racemigera* (P2).

Vegetation Type	Mapped Extent in Survey Area (ha)	Mapped extent in the Development Envelope (ha)	Assessment of Impacts
			The Proposal will remove approximately 526.8 ha (approximately 27.3% within the survey area and 32.8% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. This vegetation type is likely to occur more broadly in the region as it supports Mulga communities which are widespread in the Pilbara and are commonly associated with NVIS Major Vegetation subgroups 23 and 24 (Kendrick 2001). Given the vegetation type is likely to occur more widely in the region and the presence of the Priority flora species within other vegetation types within the survey area, the proposed clearing is not expected to result in significant impacts.
P15	178.6	153.5	This vegetation type was identified as an EAR due to the presence of Snakewood (*Acacia xiphophylla*) communities. The Proposal does not impact this vegetation type, but the amount cleared of each type could be greater given project flexibility. Still, it would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. This vegetation type is likely to occur more broadly in the region as it supports snakewood communities which are widespread in the Pilbara and are commonly associated with NVIS Major Vegetation subgroups 23 and 24 (Kendrick 2001). Given this vegetation type is likely to occur more widely within the region, any impact on this vegetation type is not expected to result in a significant impact.
P19	1,024.5	927.5	This vegetation type was identified as supporting populations of *Ptilotus subspinescens* (P3). The Proposal will remove approximately 73.8 ha (approximately 7.2% within the survey area and 8.0% within the Development Envelope). Given project flexibility, the amount cleared of each type could be greater but would not exceed the maximum authorised extent. No specific clearing limit is proposed as clearing of the majority of the vegetation type in the Development Envelope would not affect the assessment outcomes. Given this vegetation type is known to occur outside of the Development Envelope and the Priority flora occurs within other vegetation types within the survey area, any impact on this vegetation type is not expected to result in a significant impact.

Riparian Vegetation

Approximately 104.7 ha of Good to Excellent condition riparian vegetation associated with local major, moderate and minor drainage systems occur within the Conceptual Footprint (Table 7-13). This includes up to 40.3 ha of vegetation rated as having a moderate local significance, with the remainder considered to be low.

Additionally, an upper limit of clearing for C3 (DkCk), comprising riparian vegetation of high local significance, has been adopted. The clearing of this vegetation type also considered under vegetation of high local significance in Table 7-21 is a significant residual impact and will be required to be offset (Section 13).

Potential Groundwater Dependent Ecosystems

Three potential GDEs of moderate potential groundwater dependence (Feature 89, 118 and 119), comprising 370 ha in total, occur within the Conceptual Footprint and will be directly impacted by the Proposal. The biological significance of these GDEs was assessed as 'low' to 'very low' by Biologic (2021a). However, the significance rating applied in the GDE assessment is based on a regional hierarchy of significance. As such, low ratings in this scale represent low-moderate significance rating at a local scale (as compared to the rating hierarchy presented for the baseline survey work conducted).

Proposed clearing (47 ha) within these potential GDEs represents 0.3% of the 11,904.5 ha of mapped GDEs within the assessment area and 7.0% of the 663.4 ha of mapped GDEs within the broad hydrological development zone. Given the small extent of clearing of low-moderate local significance potential GDEs and the extent of GDEs that will remain undisturbed by the Proposal in and around the Development Envelope, the Proponent considers that direct impacts to GDEs are not significant.

Vegetation Condition

The Proposal will result in the clearing of up to 7,896.3 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 (Section 13).

7.6.1.2. Loss of Priority Flora Individuals

The Proponent has taken measures to avoid and minimise all impacts to Priority flora as far as practicable. No Threatened species have been recorded within the Development Envelope and the Priority 1 species *Tetratheca butcheriana* will not be impacted by the Proposal (Section 7.4.1.2).

Clearing will result in the direct loss of individuals from one Priority 1, five Priority 2 and 20 Priority 3/4 flora taxa. However, implementation of the Proposal is not expected to significantly impact any Priority flora species or cause any Priority flora to become threatened.

Hibiscus sp. Mt Brockman (E. Thoma ET 1354) (Priority 1)

A total of 1,445 known individuals occur within the Development Envelope, and 249 known individuals occur within the Conceptual Footprint. There are over 7,491 known individuals of *Hibiscus* sp. Mt Brockman (E. Thoma ET 1345) recorded State-wide (WAH 1998-2021; DBCA 2022; Rio Tinto 2021g). Therefore, the Proposal has an upper limit of clearing up to 51.9% (750 known individuals) of the species within the Development Envelope, accounting for 10% of all known individuals in the State. Given the extent of this impact and representation of the species regionally, including some representation within conservation tenure, the Proponent does not anticipate that the Proposal will affect the conservation status or the viability of this species. Therefore, the Proposal is not expected to significantly impact this species.

***Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (Priority 2)**

A total of 219 individuals have been recorded from the Development Envelope of which 64 occur within the conceptual footprint (Table 7-10). This species has a wide range of occurrence that stretches from the Pilbara to the northern Kimberley with approximately 362 known records of this species (WAH 1998-2021; DBCA 2022; Rio Tinto 2021g).

The Proposal has been designed to avoid occurrences of this species where possible. However, to allow flexibility during implementation, a direct impact of up to 18% of known individuals in the State has been assumed. This impact is not expected to affect its conservation status or viability of the species. Therefore, the Proposal is not expected to significantly impact this species.

***Ipomoea racemigera* (Priority 2)**

A total of 198 known individuals have been recorded from the Development Envelope (Table 7-10). This species has a wide range of occurrence that stretches from the Pilbara to the northern Kimberley with approximately 1,001 known records of this species (WAH 1998-2021; DBCA 2022; Rio Tinto 2021g).

The Proposal is expected to impact 51.5% (102 known individuals) of the species within the Development Envelope based upon upper limits of clearing, accounting for 10% of all known individuals in the State. Given the extent of this impact and representation of the species regionally, including some representation within conservation tenure, the Proponent does not anticipate that the Proposal will affect the conservation status or the viability of this species. Therefore, the Proposal is not expected to significantly impact this species.

***Oxalis* sp. Pilbara (M.E. Trudgen MET 1570) (Priority 2)**

A total of 54 individuals have been recorded from the Development Envelope (Table 7-10). This species has a moderate range of occurrence extending from the Pilbara to the Little Sandy Dessert, with approximately 485 known records of this species (WAH 1998-2021; DBCA 2022; Rio Tinto 2021g).

The Proposal has been designed to avoid occurrences of this species. However, to allow flexibility during implementation, a direct impact of up to 11.1% of known individuals in the State has been assumed. This impact is not expected to affect its conservation status; therefore, the Proposal is not expected to significantly impact this species.

***Pentalepis trichodesmoides* subsp. *hispida* (Priority 2)**

Three individuals of *Pentalepis trichodesmoides* subsp. *hispida* have been recorded from within the Development Envelope (Table 7-10). This species has an estimated range of approximately 270.0 km (DBCA 2007-2021). There are approximately 863 known records of *Pentalepis trichodesmoides* subsp. *hispida* (DBCA 2022; Rio Tinto 2021g).

Given there are only three individuals within the Development Envelope, all plants have the potential to be disturbed by the final footprint of the Proposal; however, as this represents less than 0.3% of all known records, the Proposal is not expected to significantly impact this species.

***Oxalis* sp. Pilbara (M.E. Trudgen MET 1570)**

No individuals are recorded as occurring within the current Conceptual Footprint. However, even with project flexibility potentially impacting all known individuals of this species within the Development Envelope this species will not experience a loss greater than 15% of known individuals. This level of impact is considered to be minor and is not expected to significantly impact this species.

Priority 3 and Priority 4 Species

The Development Envelope contains 16 Priority 3 and four Priority 4 flora species, presented in Table 7-23. For all of these species, the total number of individuals present within the Development Envelope represents less than 35.0% of the total number of individuals within the State. In addition,

implementation of the Proposal will not result in impacts greater than 15% to any single species within the state or greater than 50% to any single species within the Development Envelope. The impact would not be considered significant even if the Proposal removes all known individuals within the Development Envelope. Therefore no specific limits are proposed.

The total number of known individuals within the State, presented in Table 7-23, is likely to under-represent actual populations as many of these species are not well surveyed. More individuals are expected to occur within the wider Pilbara region. Therefore, the maximum impact of the Proposal is likely to be significantly less than currently presented.

Table 7-23: Impacts on Priority 3 and Priority 4 Flora Species within the Development Envelope

Species	Number of Individuals in the Development Envelope	Total Number of Individuals in the State	Maximum Potential Impact to Known Individuals in State (%)
Priority 3			
Aristida jerichoensis var. *subspinulifera*	1	6,709	< 0.1
Astrebla lappacea	299	8,199	3.6
Dampiera anonyma	74	408	18.1
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	51	4,931	1.0
Eremophila magnifica subsp. *velutina*	1,520	4,559	33.3
Grevillea saxicola	137	1,097	12.5
Gymnanthera cunninghamii	1	194	0.5
Indigofera gilesii	59	4,868	1.2
Indigofera rivularis	4,221	28,979	14.6
Ptilotus subspinescens	12,117	28,848	42.0
Rhagodia sp. Hamersley (M. Trudgen 17794)	51	51,818	0.1
Rostellularia adscendens var. *latifolia*	173	4,507	3.8
Sida sp. Barlee Range (S. van Leeuwen 1642)	2,411	10,963	22.0
Sida sp. Hamersley Range (K. Newbey 10692)	880	4,835	18.2
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	817	146,014	0.6
Triodia basitricha	6,237	115,211	5.4
Priority 4			
Acacia bromilowiana	700	3,050	23.0
Eremophila magnifica subsp. *magnifica*	900	10,722	8.4
Goodenia nuda	393	16,637	2.4
Lepidium catapycnon	255	38,091	0.7

7.6.2. Assessment of Indirect Residual Impacts

7.6.2.1. Loss of or Degradation to Significant Species due to Changes to the Surface Water Environment

The Pilbara has an arid and variable climate with irregular episodic rainfall events as outlined in Section 2.3.1.1. Unless they form part of surface water dependent or groundwater dependent vegetation units, Priority flora species in the region, like other well represented species outside these specialised vegetation communities, are expected to be well adapted to this dynamic and stochastic rainfall regime – i.e. they rely on infrequent direct rainfall rather than constant access to groundwater or other sources (i.e. not direct rainfall) of surface water inflow and are resilient to extended periods of both dry (most of the time) and saturated soil (irregularly). Species with higher water use/demand tend to be trees to large shrub species that occur in riparian/GDV communities. All Priority flora species identified within the Development Envelope are smaller plants (i.e., grasses, herbs or small shrubs) or otherwise not restricted to the creekline habitats that can be expected to be most vulnerable to surface water flow. Changes to surface water flows attributable to the Proposal are therefore not expected to have any potential to have a significant effect on these species.

Notwithstanding the above the Proposal has been designed to maximise the maintenance of existing surface water flow pathways, reducing the changes to existing hydrology as far as possible whilst also limiting the potential for discharge of waters that have been in contact with mine and process materials.

7.6.2.2. Impacts to Groundwater Dependent Ecosystems as a Result of Groundwater Drawdown

Twenty-three of the 28 identified potential GDE features in the Development Envelope (Biologic 2021a) are unlikely to be impacted by the groundwater drawdown associated with the Proposal, as a result, 612.2 ha (92.2%) of the 663.4 ha of mapped GDEs will remain intact within the broad hydrological development zone area.

A total of five potential GDE features covering a combined total of 40.7 ha may be affected by groundwater drawdown associated with dewatering undertaken for the Proposal. Four of these occur entirely within the groundwater drawdown zone and one (GDE 118) occurs partly within the groundwater drawdown zone. Of the four GDE's potentially affected, two (GDE 119 and GDE 118) occur within the Conceptual Footprint and are likely to be directly impacted by the Proposal and three (108, 109 and 117) occur within the approved project Development Envelopes.

The biological significance of the GDEs was assessed by Biologic (2021a), and all were assessed within the GDE assessment as having low significance. However, the significance rating applied in the GDE assessment is based on a regional hierarchy of significance. As such, low ratings in this scale represent at least low-moderate local significance ratings as compared to the rating hierarchy presented for the baseline survey work conducted.

Given only small scale, moderate local significance potential GDEs will be impacted and the number and extent of GDEs that will remain undisturbed by the Proposal in and around the Development Envelope, the Proponent considers that overall impacts to GDEs are not significant.

An assessment of the impact to each of the five GDE features is provided in Table 7-24. Conclusions regarding drawdown are derived from the latest available hydrogeological model (November 2021; RPS 2021a).

Table 7-24: Assessment of Impacts to GDEs

Feature ID	Location	Area of Potential Impact from Groundwater Drawdown (ha)	Assessment of Impact
108	BS2 (Duck Creek catchment)	0.6	This feature is considered to have a moderate dependence on groundwater, with the watertable estimated to be within 5.0 m of the surface. The feature was rated of low-moderate local significance due to its small size and as it consists of only low density GDV. As maximum drawdown due to dewatering is expected to be approximately 107 m, with groundwater levels not expected to recover in the long term this feature is expected to be impacted by groundwater drawdown associated with the Proposal. Given the features moderate groundwater dependence, scale and low value this impact is not expected to represent a significant impact.
109	BS2 (Duck Creek catchment)	10.5	This feature is considered to have a high dependence on groundwater due to the presence of GDV indicator species, high NDVI persistence and the natural watertable occurring within 5.0 m of the surface. The feature was rated of moderate local significance. As maximum groundwater drawdown due to dewatering is expected to be approximately 89.0 m at this location, with groundwater levels not expected to recover in the long term, this feature is expected to be impacted by groundwater drawdown associated with the Proposal. The vegetation structure is expected to gradually adapt to a drier riparian vegetation structure with lower density and canopy cover. Given the deeply incised nature of the creek, it is likely that this feature will continue to have higher water availability than the surrounding environment and some *Eucalyptus camaldulensis* would likely persist. The ecological impact is anticipated to be somewhat diminished by the occurrence of nearby (<1.0 km) GDE features that are not expected to be affected by groundwater drawdown (GDEs 111, 206 and 207). Given the above the impact on this feature is not expected to represent a significant impact.
117	BS2	7.5	Within the MS 1000 approved Development Envelope. This feature is 7.5 ha and contains scattered *Eucalyptus xerothermica* over tall mixed shrubland and tussock grasses. The vegetation is not considered to represent GDV; however, the feature was assessed as a GDE due to the depth to watertable being less than 15.0 m in this area. The modelled drawdown of 52.0 m in this area means that this GDE could be affected by drawdown. Given the feature does not contain GDV and is associated with calcrete, impacts are likely to be minor. The GDE has a low-moderate local significance and any impacts not expected to represent a significant impact.

Feature ID	Location	Area of Potential Impact from Groundwater Drawdown (ha)	Assessment of Impact
118	BS1 (Boolgeeda Creek catchment)	12.1	This feature is considered to have a moderate dependence on groundwater with the watertable estimated to be within 15.0 m of the surface. This feature was rated of low value due to the scattered, low density of GDV. It should be noted that this GDE coincides with calcrete aquifers (that occur in detrital/alluvial sequences over deeper and larger regional aquifers), suggesting its GDV species may be more dependent on the calcrete aquifers, that are replenished by rainfall (i.e. inflow dependent). The maximum drawdown due to dewatering is expected to be approximately 85.0 m and groundwater levels not expected to recover in the long term at this location. However, given the feature's moderate groundwater dependence and the fact that the GDV species may be more dependent on calcrete aquifers as well as its low-moderate local value this impact is not expected to represent a significant impact.
119	BS1 (Boolgeeda Creek catchment)	10.0	This feature is considered to have a potential moderate dependence on groundwater with the water table estimated to be within 15.0 m of the surface. This feature was rated of low value due to the scattered, low density of GDV. It should be noted that this GDE coincides with calcrete aquifers (that occur in detrital/alluvial sequences over deeper and larger regional aquifers), suggesting its GDV species may be more dependent on the calcrete aquifers, that are replenished by rainfall (i.e. inflow dependent). As such this feature may not be impacted by mine dewatering. Given the features moderate groundwater dependence and the fact that the GDV species may be more dependent on calcrete aquifers as well as its low-moderate local value this impact is not expected to represent a significant impact.

7.6.2.3. Impacts to Riparian Vegetation as a Result of Surplus Water Discharge to Surface Water Systems

Discharge to surface water systems is a common practice at many operations in the Pilbara. Vegetation within the Boolgeeda Creek and Duck Creek discharge extents is expected to respond with increased vegetation vigour and recruitment. This increased biomass may then die off when surface water discharge ceases. The majority of vegetation responses are short-term, with assemblages returning to baseline condition following the cessation of surplus water discharge. These effects would be limited to the wetting fronts downstream of the Boolgeeda and Duck creek discharge locations of up to 37.0 km and 67.0 km.

Root truncation has been observed to occur at another mine site (75.0 km to the east of Duck Creek) after 12 months of consistent saturation due to discharge (AQ2 2021). Monitoring at this location showed that at the same time that root truncation may occur, the increased water availability and, therefore the total leaf area would be expected to increase through the increased canopy and potentially recruitment.

Modelling of the effect of increased water availability was conducted by AQ2 (2021) for Duck Creek based on an assumed constant discharge regime. This assessment indicated that transpiration and stem basal area could increase by between 20.0% and 60.0% within the wetting front. When discharge ceases, the groundwater levels would broadly revert to the pre-discharge regime and seasonality in levels will be re-introduced. Modelling under this scenario indicated that vegetation would then revert to close to pre-discharge cover. It is likely that the post-discharge adjustment to vegetation will appear aesthetically more marked because the starting point for that change would be the increased vegetation density that is likely to result from discharge. This effect may also be exacerbated by high mortality in *E. victrix* from issues of RAM exhaustion. From this artificially dense start point, the decline in stem basal area (as a proxy for total cover) may be in the order of 25% (AQ2 2021).

The modelling undertaken by AQ2 (2021) is useful to determine the potential effects of constant discharge. In the reaches of Duck Creek and Boolgeeda Creek, where intermittent discharge is expected, increased water availability and root truncation from waterlogging are likely to be less pronounced.

These changes are expected to be temporary, and riparian vegetation communities are expected to gradually revert to a condition similar to pre-discharge conditions (depending on the climate) over time. According to the current mine plan, Duck Creek and Boolgeeda Creek discharges are expected to be required only during the proposal's early stages until around 2030.

The predicted maximum wetting fronts and the key flora values that exist within each zone are presented in Table 7-24. No new areas of Boolgeeda will be affected. Boolgeeda Creek supports groundwater dependent vegetation and permanent pools from approximately 40.0 km downstream of the discharge point (Biologic 2020a) so these will not be affected by discharge.

The upper reaches of Duck Creek (above the confluence with Caves Creek) will be affected by discharge in both summer and winter. Discharge occurs to this section of the creek when NAP is unavailable. The upper reaches of Duck Creek do not support mesic indicator species (Biologic 2020a), indicating the creek is naturally drier in this area and representative of the higher-order streams that occur more extensively in the Pilbara than those that support GDEs and permanent pools. The discharges extending to 67.0 km are not expected to substantially change hydrological regimes in a creek system adapted to a highly variable existing condition.

A total of eleven Priority flora species (three Priority 2, four Priority 3 and four Priority 4) occur within the wetting font of the surface water systems discussed above. While alterations to the natural hydrological regime is likely to cause changes to the species composition and dominance within the vegetation types, it is not expected that any of these species will become absent within these vegetation types.

The riparian environments in Duck and Boolgeeda Creeks within the discharge wetting fronts will continue to be modified in the short term but are not expected to be permanently affected. Therefore, the impacts are not anticipated to be significant.

7.6.2.4. Fragmentation due to Land Clearing

Development of the Proposal would result in the clearing of approximately 7,896 ha of native vegetation, representing approximately 12% of the area surveyed as presented in Table 7-11 and Table 7-12, whilst Figure 7-15 shows the indicative site layout over the vegetation types.

Clearing of vegetation in the Development Envelope would have some impact to biological diversity and ecological integrity on a very local scale, but little impact on a regional scale, with areas of similar vegetation in excellent condition remaining intact beyond the Development Envelope.

Land clearance does not result in the creation of small and/or disconnected islands or fragments within or across vegetation associations and as such connectivity throughout the mapped vegetation associations would largely remain during and after the project. This is particularly evident for vegetation units of regional or local high significance as can be seen in Figure 7-16.

Three areas which are entirely surrounded by the proposed Development Envelope and identified as being potentially isolated, and which could be at risk of fragmentation by the Proposal have a combined size of 20,838 ha (the small area north of BS4 (1,480 ha), Mount Brockman south of BS2 (17,485 ha) and the surrounding area near Ridge Pool (1,873 ha)).

These patch sizes are vast and are able to support larger and more stable populations of vegetation than smaller areas. Larger areas such as these have better rates of reproduction, harbour greater genetic diversity and have less inbreeding than smaller areas.

Development of some linear infrastructure may result in minor, extremely localised fragmentation of some vegetation associations, however the separation distances involved are unlikely to be large enough to affect processes such as pollination or dispersal. Acacia, Eucalyptus and Corymbia species are generally pollinated by insects, birds or bats, and these would be expected to easily traverse the cleared areas. Grasses including Triodia species are wind pollinated; the Proposal infrastructure will not disrupt wind flows to the extent that significant disruptions to pollination would occur.

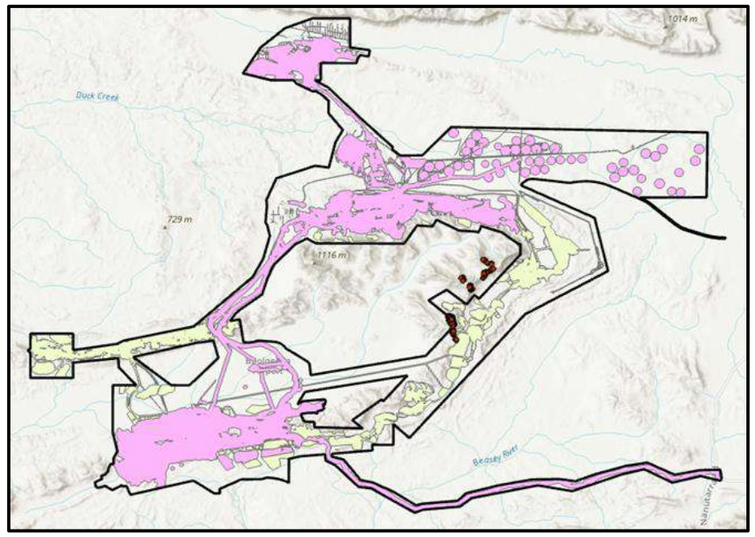
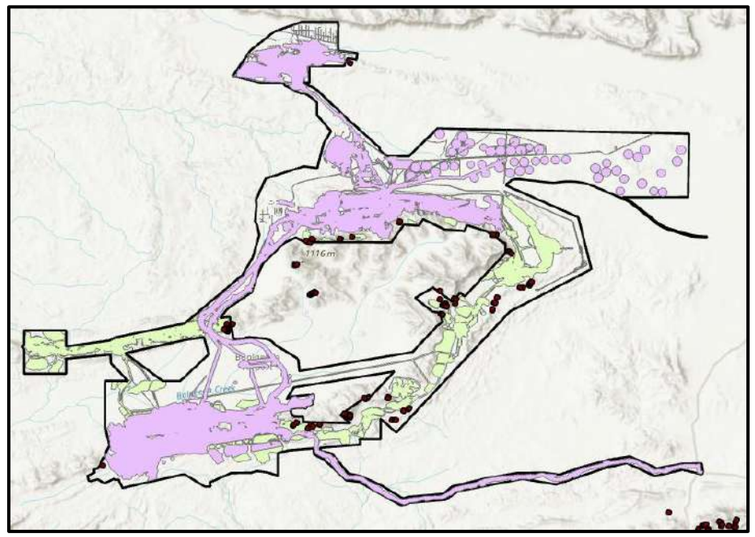
The impacts of fragmentation to vegetation, if any, are not considered to be significant.

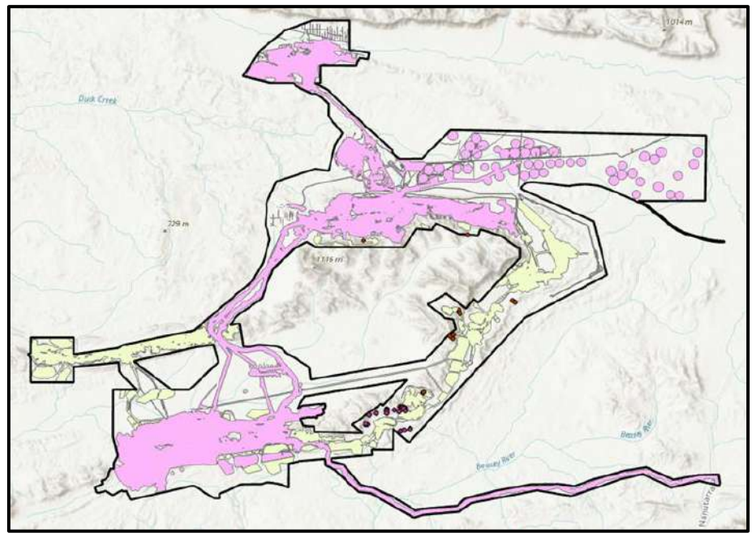
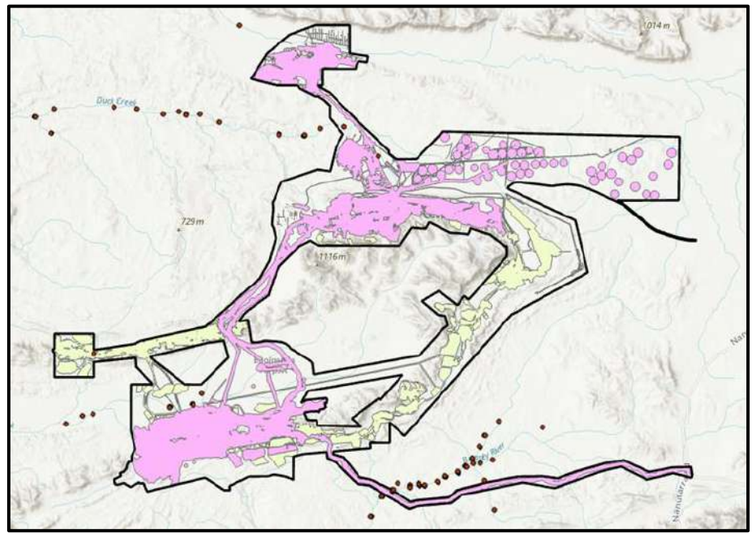
The impact of fragmentation to populations of significant flora taxa is difficult to quantify at a site level. A brief qualitative assessment of the significance of potential impacts of fragmentation by the Proposal has been undertaken in Table 7-25 in relation to Priority 1 and 2 species, which are inherently expected to be at greater risk due to their priority status. It is not considered that the Proposal will result in further fragmentation that impacts the viability of Priority 1 and 2 species.

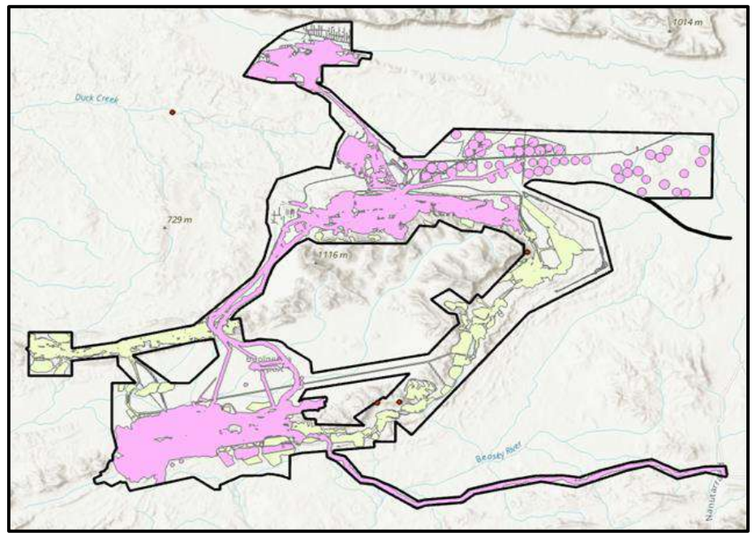
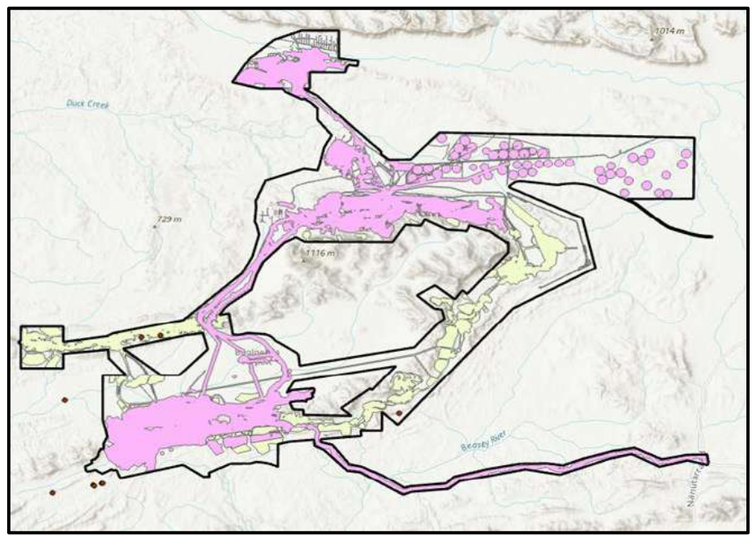
It should be noted that further targeted survey both inside and outside of the Development Envelope are likely to provide additional records of these Priority 1 and 2 species with suitable habitat for each taxon often occurring between currently known locations. There is limited survey coverage across areas outside the Development Envelope due to heritage access limitations, tenure ownership constraints, the significant size of the respective areas and the fact that there was no intent to impact these areas.

The long-term impacts of fragmentation, if any, are unlikely to be significant for the remaining 20 Priority 3 and 4 taxa, due to the close proximity of other populations, likely further extent of potentially impacted populations outside of known locations and/or the presence of appropriate habitat that is likely provide linkage between populations.

Table 7-25: Assessment of Impacts of Fragmentation on Significant Flora

Taxon	Population Characteristics	Potential Impacts to Local Populations	Extent within Proximity to the Proposal
Priority 1 (potential to be listed as Critically Endangered)			
Tetratheca butcheriana	Typically, this species occupies areas high within the landscape, on breakaways and cliff faces. Within its current distribution *Tetratheca butcheriana* occurs as several geographically distinct subpopulations with further genetic work underway. A total of 202 individuals have been recorded from within the Development Envelope. Limited surveys have occurred outside the Development Envelope, whilst it's likely that more individuals occur its unlikely to be a significant number or deviate from the current range.	The proposed development is not expected to increase the separation that currently naturally exists between these geographically distinct subpopulations.	
Priority 1			
Hibiscus sp. Mt Brockman (E. Thoma ET 1354)	Typically, this species occurs on steep slopes, gully's, ridge tops and breakaways, on the main range and surrounding smaller ranges in the Brockman area. A total of 1,445 individuals have been recorded from within the Development Envelope. Due to the limited surveys outside the Development Envelope, it's likely that more individuals occur in the area and subpopulations are more continuous than currently identified	There is potential for the development to separate some areas of *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354). However, the majority of populations and suitable habitat is relatively consistent across the main range, with some levels of connectivity to surrounding areas to be expected in sections where the proposed footprints are only narrow corridors.	

Taxon	Population Characteristics	Potential Impacts to Local Populations	Extent within Proximity to the Proposal
Priority 2			
Hibiscus aff. Sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	Typically, this species occurs on steep slopes, gully's, ridge tops and breakaways, and occurs on the main range and surrounding smaller ranges in the Brockman area. A total of 219 individuals, representing eight potential subpopulations have been recorded from within Development Envelop. Due to the limited surveys outside the Development Envelope, it's likely that more individuals occur in the area and subpopulations are more continuous than currently identified.	There is potential for the development to separate two subpopulations of *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708). These subpopulations will be separated by a narrow infrastructure corridor, with some connectivity to still be expected.	
Ipomoea racemigera	This species occupies sandy soils along watercourses and floodplains with records at Brockman being typical of this. A total of 198 individuals, have been recorded from within the Development Envelope. Due to the limited surveys outside the Development Envelope, it's likely that more individuals occur in the area and subpopulations are more continuous than currently identified	There is potential for the development to separate one area of *Ipomoea racemigera*, however the remainder of the subpopulations are expected to retain some level of connectivity.	

Taxon	Population Characteristics	Potential Impacts to Local Populations	Extent within Proximity to the Proposal
Oxalis sp. Pilbara (M.E. Trudgen 12725)	Typically, this species occurs on steep slopes, gullies and breakaways. At the Brockman DE it has only been recorded from the main range. A total of 54 individuals have been recorded from within the Development Envelope. Due to the limited surveys outside the Development Envelope, it's likely that more individuals occur in the area and subpopulations are more continuous than currently identified.	Given the naturally large distance between the known populations of *Oxalis* sp. Pilbara (M.E. Trudgen MET 1570) in the area, the proposed development is not expected to increase the level of separation that currently exists between these subpopulations.	
Pentalepis trichodesmoides subsp. *hispida*	Typically, this species occurs on basaltic soils on summits and low hills. A total of three individuals have been recorded from within the Development Envelope. Due to the limited surveys outside the Development Envelope, it's likely that more individuals occur in the area and populations are more continuous than currently identified.	Given the large distance between the known populations of *Pentalepis trichodesmoides* subsp. hispida at Brockman, the proposed development is not expected to increase the level of separation that currently exists between these subpopulations.	

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

The Proponent has well-established project specific strategies for managing weeds at its Pilbara operations to minimise weed ingress and spread risks. This includes the management of weeds associated with the discharge of surplus water in creeklines. Weed monitoring and active management strategies have been and will continue to be implemented to minimise the risk of weed ingress.

On this basis, the Proposal is not expected to significantly impact the condition of native vegetation through the spread or introduction of weed species. Any impacts are predicted to be localised to disturbed areas and will have no impact on vegetation in surrounding areas. As a result, no significant residual impacts on vegetation conditions from the spread of weeds are expected from the Proposal.

7.6.2.6. Degradation of Vegetation from Dust Deposition and Potential Increase in Bushfire Risk

Dust

The deposition rates and concentrations at which vegetation is impacted are dependent on many variables including the vegetation type, the nature and concentration of the deposition, and the meteorological environment. Critical dust loads that result in significant alterations in the most sensitive plant functions have been found to vary with the particle size distribution and the colour of the dust, from around 1 g/m^2 for ultra-fine carbon black particles to about 8 g/m^2 for coarser road or limestone particles with a median diameter of greater than 50 µm (Doley 2006). Farmer (1993) showed that direct physical effects of mineral dusts on vegetation become apparent only at relatively high surface loads (greater than 7 g/m^2).

Analysis of roadside dust deposition has found that vegetation near unpaved roads can be subjected to up to 10 g/m^2 /day of dust deposition (Everett 1980, cited in Farmer 1991). Thomson *et al* (1984) found that around 5 g/m^2 /day was required to cause a reduction in photosynthesis of roadside vegetation, and a dust load of 10 g/m2 reduced photosynthesis by between 18% and 30%.

A controlled study undertaken in the Mojave Desert subjected a desert plant species (*Astragalus Jaegerianus*) to varying levels of dust deposition to assess decreases in vigour, via measurements of leaf level net photosynthesis, mid-day water potentials and plant shoot growth (Upekala *et al* 2009). At dust concentrations of between 20 and 40 g/m2, neither shoot growth nor leaf production differed between dusted plants and control plants. In field experiments the same effects were observed with deposited dust concentrations in the control vegetation of around 1.1 – 2.8 g/m^2 and in the dusted plants at around 4 – 9 g/m^2.

Based upon the above it can be surmised that impacts to vegetation as a result of dry deposition and dust accumulation begin to occur at deposited concentrations of around 5 – 10 g/m^2. The nature of arid area vegetation, and in particular the characteristics of their stomata, suggest that they are, in general, more tolerant of higher dust concentrations than vegetation in other, more temperate climates. This is supported by the few studies that have investigated dust deposition effects on desert vegetation. The nominated criterion for this assessment has been conservatively assumed to be approximately in the middle of the indicated range, at 7 g/m^2.

AQEG (2012) observed that there appears to be few direct effects of dry particles on vegetation except where a leaf surface is covered by dust. The potential maximum dust deposited on vegetation surrounding the proposed project is therefore important in quantifying the potential for vegetation impacts. Dust deposition rate does not, however, necessarily describe the net rate of dust accumulation on leaf surfaces and the consequent effects. Leaf orientation, size and shape, age, roughness and wettability of the leaf surface all influence dust interception and retention (Doley, 2006 and Prajapati, 2012). Dust loss as a result of wind and rain actions is difficult to predict and there is a general lack of data to draw any firm conclusions. This means that coarse approximations between dust concentration

or deposition rate and dust load on vegetation remain the most appropriate assumption (Doley, 2006). Keller and Lamprecht (1995, cited in Prajapati, 2012) reported that dust levels near an unpaved highway in Alaska were relatively invariable over much of the summer growing season and that up to 85 percent of the dust falling on vegetation surfaces may be removed. It is therefore assumed, in practice, that the movement of vegetation from interaction with the wind and other leaves is likely to mean that a proportion of the dust would be 'shaken' free.

Dust deposition is expected to be of higher values correspond to sites located directly adjacent to operational areas (specifically WRDs or adjacent to crushers). Sites further away from dust-generating activities are expected to receive significantly less dust deposition. Based on this, it is expected that significant dust deposition-related impacts to native vegetation would be extremely localised, confined to the areas immediately adjacent to the dust-generating activities, with little, if any, impacts beyond these areas.

The Proponent has well-established strategies for managing dust emissions at its Pilbara operations. These strategies will continue to be implemented to manage dust emissions. Monitoring will assess dust management performance and refined strategies to manage dust emissions where necessary.

The Proposal may result in a minor, temporary increase in localised dust deposition on vegetation but is not expected to significantly impact vegetation. Furthermore, introduction of a 100 m MEZ around significant vegetation such as *Tetratheca butcheriana* and vegetation type C28 will limit the potential for dust generation in proximity to these values. As shown in Figure 7-21 a and b *Tetratheca butcheriana* is also located on ridges above potential indirect impacts from dust.

Bushfire

The highest risk of bushfire ignition occurs during construction activities while undertaking hot works activities. Effective management of construction activities would prevent the incidence of bushfire. The increased road network resulting from the proposed project, and maintenance of firebreaks would also help to control the extent and size of potential bushfires. Appropriate work procedures would be employed to reduce the risk of fires starting from activities associated with the proposed project.

Because of the nature of the vegetation throughout the Development Envelope, it is impossible to exclude fire from the area. With construction of the proposed project's access track network there is, however, the opportunity to develop and implement a Fire Management Plan which can dramatically reduce risks to personnel and infrastructure, as well as achieving good environmental outcomes. A prescribed burning program can also enable a dramatic reduction in risk from unplanned bushfires and offers strong possibilities in facilitating the development of collaborative partnerships with Traditional Owners and interested government agencies. This option would be considered in consultation with the relevant stakeholders.

With carefully managed and monitored hot works, vehicle movement, and disposal of potential fire-starting waste (e.g., cigarette butts), the Proposal is not expected to alter the fire regime within the area after implementing fire management measures.

7.6.3. Assessment of Cumulative Residual Impacts

7.6.3.1. Cumulative Impacts on Native Vegetation

Clearing for the Proposal will reduce up to 7,896 ha of native vegetation, of which approximately 7,715 ha is in Good to Excellent condition. Vegetation to be cleared within the Development Envelope comprises five vegetation associations as mapped by Beard (Hamersley 18, 29, 82, 175 and 567). Each vegetation association within the Development Envelope represents approximately 1.3%, 4.9%, 0.6%, 5.6% and 1.3% of the current pre-European extent within the Hamersley subregion

The assessment shows that the Proposal will have negligible cumulative effects at these scales, with 96.2% or more of pre-European extents remaining within the Hamersley subregion following the

implementation of the Proposal and reasonably foreseeable projects. The maximum impact of clearing will be associated with Hamersley 175 at 3.5%, with the Proposal contributing 1.9% (Table 7-17). There are no significant impacts to any vegetation associations from the cumulative disturbance of reasonably foreseeable projects. This is owing to less than 4.0% of each vegetation association in the Hamersley subregion is contained within the Conceptual Footprint of the Proposal and the relevant project development envelopes.

The National Objectives and Targets for Biodiversity Conservation include avoiding clearance of existing vegetation with a pre-European extent of below 30.0% (Commonwealth of Australia 2001). Following the implementation of the Proposal and cumulative impacts from approved projects, at least 96.0% of pre-European extent for each vegetation association will remain in the State (Table 7-18).

Clearing of vegetation in good to excellent condition is considered a significant impact even though the remaining extent of vegetation associations potentially impacted by the Proposal and their representation in areas managed for conservation indicates no significant residual impacts on vegetation at the regional scale.

7.6.3.2. Cumulative Impacts on Priority Flora Individuals

Approximately 11.5% of known *Hibiscus sp. Mt Brockman (E. Thoma ET 1354)* (P1), 18% of known *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2), 20.5% of known *Ipomoea racemigera* (P2), 10.7% of known *Pentalepis trichodesmoides* subsp. *hispida* (P2) and 10.1% of known *Oxalis* sp. Pilbara (M.E. Trudgen MET 1570) individuals will be removed from the region following the implementation of the Proposal and other considered projects. The known extent of these species has been calculated based off the Rio Tinto Database, which includes records of Priority flora species across the Pilbara region. Given over 70% of these species' records will remain intact in the region, these cumulative impacts are not considered significant.

Cumulative impacts to known records of *Aristida jerichoensis var. subspinulifera* (P3), *Eremophila magnifica* subsp. *velutina* (P3), *Grevillea saxicola* (P3), *Indigofera rivularis* (P3), *Ptilotus subspinescens* (P3), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Rostellularia adscendens var. latifolia* (P3), *Sida* sp. Barlee Range (S. van Leeuwen 1642) (P3), *Sida* sp. Hamersley Range (K. Newbey 10692) (P3), *Themeda sp*. Hamersley Station (M.E. Trudgen 11431) (P3), *Acacia bromilowiana* (P4), *Eremophila magnifica* subsp. *magnifica* (P4) and *Goodenia nuda* (P4) will be less than 30.0% across regional records following the Proposal. Given that over 70.0% of the species records will remain intact in the region these cumulative impacts are not considered significant.

Approximately 63.5% of known *Triodia basitricha* (P3) and 75.6% of known *Astrebla lappacea* (P3) have the potential to be removed from the region, following the implementation of the Proposal and other reasonably foreseeable projects. Most of the records which have the potential to be removed occur within the Development Envelopes of other proposals. Only 4.0% and 1.0% of the total known *Triodia basitricha* and *Astrebla lappacea* populations, respectively, have the potential to be impacted by the Proposal. The majority of *Triodia basitricha* occur within the FMG Eliwana Iron Ore Project development envelope (34% of known individuals) and the majority of *Astrebla lappacea* occur within the FMG Eliwana Railway Project development envelope (39.0% of known individuals). However, the Proponent of these projects has committed to avoiding or minimising the impacts on these species. The FMG Eliwana Railway Project MS 1109 includes a condition requiring the Proponent to avoid, where possible, or minimise impacts, to this species. Thus, it can be anticipated that disturbance will be kept to a minimum such that the conservation status of the species will not be affected.

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.

7.6.4. Significance of Residual Impacts

7.6.4.1. Non-Significant Residual Impacts

The proposed avoidance and management measures associated with the Proposal, the demonstrate non-significant residual impact to Flora and Vegetation include:

- The closest TEC is the *Themeda* grasslands on cracking clays (Hamersley Station, Pilbara), located approximately 1.2 km west of the Development Envelope. This TEC will not be directly or indirectly impacted by the Proposal
- One vegetation type (P33) was considered to represent the Brockman Iron Cracking Clay Priority Ecological Community (PEC) of the Hamersley Ranges (P1). This vegetation type occurs within the Silvergrass area and will not be impacted by the Proposal
- Based upon upper limits of clearing and proposed conditions for high local significance vegetation units, which are also considered riparian as defined in Table 7-11, post implementation of the Proposal it is predicted that:
    - 5.1 ha (20%) of the vegetation type C3 (DkCk) will be impacted within the Development Envelope
- Based upon upper limits of clearing and proposed conditions for high local significance vegetation units as defined in Table 7-11, post implementation of the Proposal it is predicted that:
    - 124.5 ha (30%) of the vegetation type G3 will be impacted within the Development Envelope
    - 111.5 ha (50%) of the vegetation type H35 will be impacted within the Development Envelope
    - 216.3 (30%) of the vegetation type H36 will be impacted within the Development Envelope
- No GDEs (Table 7-8) are considered to be of regional or high local significance
- Direct impacts to potential GDE feature 355 (of high potential groundwater dependence) and Vegetation type C28 (of high local significance and riparian) and which are associated with Plunge Pool will be avoided as Plunge Pool has been placed within a MEZ and will not be impacted from groundwater drawdown (Section 6.6)
- Given only small scale, moderate local significance potential GDEs will be impacted and the number and extent of GDEs that will remain undisturbed by the Proposal in and around the Development Envelope, the Proponent considers that overall impacts to GDEs are not significant
- No surface water dependent vegetation has been identified within the survey area
- Direct impacts will avoid the Priority 1 flora species *Tetratheca butcheriana* which has been placed within a 100 m MEZ within the Development Envelope. Indirect impacts from dust are considered unlikely and are addressed in the EMP
- Based upon upper limits of clearing and proposed conditions for Priority flora species as defined in Table 7-16, post implementation of the Proposal it is predicted that:
    - 750 (51.9%) of known individuals of *Hibiscus* sp. Mt Brockman (E. thoma ET 1354) (P1) will be impacted within the Development Envelope. Taking into consideration cumulative impacts this represent a total loss of 862 (11.5%) of known individuals outside of the Development Envelope.
    - 64 (30%) of known individuals of *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2) will be impacted within the Development Envelope. This represents an impact of 18% of known individuals outside of the Development Envelope
    - 102 (51.5%) of known individuals of *Ipomoea racemigera* (P2) will be impacted within the Development Envelope. Taking into consideration cumulative impacts this represents a total loss of 1,001 (20.5%) of known individuals outside of the Development Envelope.

- 54 (100%) of known individuals of *Oxalis* sp. Pilbara (M.E. Trudgen MET 1570) (P2) will be impacted within the Development Envelope. This represents an impact of 10.1% of known individuals outside of the Development Envelope
- 3 (100%) of known individuals of *Pentalepis trichodesmoides* subsp. hispida (P2) will be impacted within the Development Envelope. Taking into consideration cumulative impacts this represents an impact of 2% of known individuals outside of the Development Envelope.

- The impacts of fragmentation to vegetation and/or significant species, if any, are not considered to be significant.
- The riparian environments in Duck and Boolgeeda Creeks within the discharge wetting fronts will continue to be modified in the short term but are not expected to be permanently affected. Therefore, the impacts are not anticipated to be significant.
- The Proposal is not expected to significantly impact the condition of native vegetation through the spread or introduction of weed species

7.6.4.2. Significant Residual Impacts

After application of mitigation hierarchy, the following significant residual impacts are predicted to Flora and Vegetation:

- Clearing of up to 7,716 ha of native vegetation in good to excellent condition. 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 Section 13
- Clearing of up to 5.1 ha of vegetation type C3 (DkCk) considered to be of high local significance as a vegetation type and as a potential GDE (note this occurs within the 7,716 ha of native vegetation in good to excellent condition discussed above). This clearing is proposed to be offset as per Section 13.

7.6.5. Summary of Assessment and Proposed Regulatory Mechanisms

A summary of the Flora and Vegetation assessment and the Proposed conditions, EMP requirement and applicable DMA regulations is provided in Table 7-26.

Table 7-26: Assessment Findings and Proposed Regulatory Mechanisms for Flora and Vegetation

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
Direct Impacts		
Clearing of up to 7,896.3 ha of vegetation in good to excellent condition	• The clearing associated with the Proposal represents 10.0% of the remaining vegetation within the Development Envelope • Vegetation types of similar conditions are also well represented outside of the Development Envelope • Clearing vegetation in good to excellent condition is considered a significant residual impact that is expected to be counterbalanced by the provision of offsets (Section 13).	Proposed to be regulated through implementation of: • Ministerial condition requiring offset (Section 13) • JTSI - State Agreement Act (*Iron Ore (Hamersley Range) Agreement Act 1963*)
Clearing of high local significance and moderate	• The Themeda grasslands on cracking clay TEC is outside the Development Envelope and no direct or indirect impacts are anticipated	Proposed to be regulated through implementation of:

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
local significance vegetation types	• The Proposal will not result in impacts to the Priority 1 PEC (Brockman Cracking Clays) or vegetation type P33 which is considered representative of this PEC • The Conceptual Footprint avoids direct impacts to vegetation type C 28 (associated with Plunge Pool) and a MEZ will be implemented to further reduce the risk of impacts • The clearing associated with the Proposal will impact 450.7 ha of high local significance and 4,110.9 ha of moderate local significance vegetation within the Development Envelope • Clearing of vegetation considered of High local significance vegetation will be restricted to four vegetation types (C3 (DkCk), G3, H35 and H36) with upper clearing limits as outlined in Section 7.5.	• Ministerial conditions limiting the extent of clearing of high local significance native vegetation types • JTSI - State Agreement Act (Iron Ore (Hamersley Range) Agreement Act 1963) • Offset for vegetation type C3(DkCk) which is of high local significance as a vegetation type and potential GDE (Section 13) • Ministerial conditions on implementation of MEZs • EMP.
Clearing of good to excellent condition riparian vegetation associated with local major, moderate and minor drainage systems	• The Proposal will result in clearing 104.7 ha of riparian vegetation in good to excellent condition, equating to approximately 11.0% of all riparian vegetation within the Development Envelope • A maximum of 5.1 ha (0.5%) of the clearing will occur within riparian vegetation of high value • This is considered to be a significant residual impact that is expected to be counterbalanced by the provision of offsets as outlined in Section 13.	Proposed to be regulated through implementation of: • Ministerial conditions limiting the extent of clearing of high value riparian vegetation • Offsets (Section 13) • JTSI - State Agreement Act (*Iron Ore (Hamersley Range) Agreement Act 1963*)

Impacts to Priority flora species	• The Development Envelope contains 27 Priority flora species
	• The Proponent will avoid all known individuals of *Tetratheca butcheriana* (P1), through the implementation of MEZs around all individuals/subpopulations.
	• The Proponent will also not impact more than:
	  ○ 51.9% of all known individuals of *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)
	  ○ 10.2% of all known individuals of all Priority 2 species within the State
	• The Proponent has not proposed upper clearing limits for Priority 3 and Priority 4 species as they are expected to be widespread. Additionally, less than 42% of the total known individuals for these species exist within the Development Envelope
	• Indirect impacts are not expected to have a significant impact on any Priority flora
	• The Proposal is expected to be consistent with the EPA's objective.
		Regulated by:
		• Ministerial conditions limiting the extent of clearing of Priority 1 and Priority 2 within the Development Envelope
		• Ministerial conditions on implementation of MEZs
		• Prepare and implement EMP for management of *Tetratheca butcheriana* (P1)

GDE features covering a combined total of 663.4 ha	• The Conceptual Footprint has been modified to avoid direct impacts on most potential GDEs	No limits proposed

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
	• Two potential GDEs of limited local significance occur within the Conceptual Footprint. Clearing of these features is not considered to be a significant residual impact, and as such, the Proposal is expected to be consistent with EPA's objectives.	
Indirect Impacts		
Groundwater drawdown impacting GDE features covering a combined total of 40.7 ha	• The Proposal has been modified to ensure there is no impact to groundwater levels in the Plunge Pool aquifer, as a result of mining. Therefore, no impacts on GDE Feature 355 (associated with Plunge Pool) are anticipated • The Development Envelope contains eleven potential GDE features, of which five may be impacted by groundwater drawdown due to the Proposal • The five GDEs are of limited local significance and the impact on them is not expected to represent a significant residual impact. As such the Proposal is expected to be consistent with EPA's objectives.	Refer to Table 6-9 in Section 6 which outlines proposed regulatory conditions for Inland Waters to ensure this finding is achieved. No limits proposed
Impact to riparian vegetation as a result of surplus water discharge	• Surplus water will be discharged to Boolgeeda and Duck Creek until approximately 2030 • Riparian vegetation in the designated wetting fronts of both creeks (37 km and 67 km, respectively) is expected to be affected while discharge occurs. However, the modification is not anticipated to be permanent and will return to natural state over time • The transient nature of the changes to the riparian vegetation is not a significant residual impact and is expected to be consistent with the EPA's objectives.	Regulated by: • Ministerial condition limiting the wetting front in Boolgeeda Creek to 37.0 km under natural no flow conditions • Ministerial condition limiting wetting front associated with Duck Creek discharge to 67.0 km.
Fragmentation of vegetation and/or significant species	• The impacts of fragmentation to vegetation, if any, are not considered to be significant. • The long-term impacts of fragmentation, if any, are unlikely to be significant for Priority species, due to the close proximity of other subpopulations, likely further extent of potentially subpopulations outside of known locations and/or the presence of appropriate habitat that may provide linkage between subpopulations. • The Proposal is expected to be consistent with the EPA's objective.	No limits proposed
Risk of spread of weeds	• The Proponent has proposed mitigation measures in the Iron Ore (WA) Pilbara Weed Management Strategy to manage indirect impacts that weeds can have on vegetation. These mitigation measures are expected to be consistent with the EPA's objectives.	Regulated by: • The implementation of the Iron Ore (WA) Pilbara Weed Management Strategy • JTSI - State Agreement Act (*Iron Ore (Hamersley Range) Agreement Act 1963*)
Risk of dust deposition	The Proponent has proposed mitigation measures, including:	No limits proposed

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
	• Dust suppression techniques such as sprayers on crushers and water tanks utilising surplus water from groundwater abstraction • Ensuring the amount of disturbed land is as small as reasonable, reducing the amount of dust generating surfaces • The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Implementation of a MEZ around *Tetratheca butcheriana* individuals/populations and vegetation type C3. These mitigation measures are expected to be consistent with the EPA's objectives.	
Risk of the potential increase in bushfire incidence	The Proponent has proposed mitigation measures, including: • Ensuring no clearing activities are undertaken when fire danger rating is severe or above, with all clearing activities ceasing at this point • Ensuring fire management measures are implemented, including management and monitoring of hot works, vehicle movement and disposal of potential fire-starting waste • Ensuring firefighting equipment is present around the site and within vehicles and implementing fire response training to all personnel. These mitigation measures are expected to be consistent with the EPA's objectives.	Regulated by: • JTSI - State Agreement Act (Iron Ore (Hamersley Range) Agreement Act 1963)

7.7. 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 significant residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Flora and Vegetation are set out below:

- The Proponent shall not clear the Priority 1 PEC (Brockman Cracking Clays) or vegetation type P33 mapped within the development envelope
- The Proponent shall not clear more than:

  - 5.1 ha of vegetation unit C3 (DkCk)
  - 124.5 ha of vegetation unit G3
  - 111.5 ha of vegetation unit H35
  - 216.3 ha of vegetation unit H36
- The Proponent shall not clear more than:
  - 10% of known individuals in the State of the P1 flora species *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354)
  - 18% of known individuals in the State of the P2 flora species *Hibiscus* aff. sp. Gurinbiddy Range (M.E. Trugden MET 15708)
  - 11% of known individuals in the State of the P2 flora species *Ipomoea racemigera*
  - 12% of known individuals in the State of the P2 flora species *Oxalis* sp. Pilbara (M.E Trudgen 12725)
- No direct impacts to the known individuals of *Tetratheca butcheriana* within the Development Envelope
- No measurable change in the presence or condition of the known *Tetratheca butcheriana* individuals within or surrounding the Development Envelope as a result of implementing the Proposal.

The Proponent will implement the EMP as per Appendix B.3 to achieve these outcomes.

After implementing the mitigation hierarchy, the significant residual impact is the clearing up to 7,896.3 ha of native vegetation in good to excellent condition, including 5.1 ha of riparian vegetation, which is considered to be of High local significance. Environmental offsets are proposed for this clearing of native vegetation and are discussed in Section 13. Subject to conditions recommended in Table 7-26 and implementation of offsets (Section 13), 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.

8. TERRESTRIAL FAUNA

8.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021b) lists the following for their objective for Terrestrial Fauna:

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained

For this EIA, terrestrial fauna are defined as animals living on land or using land for all or part of their lives. Terrestrial fauna includes vertebrates (birds, mammals including bats, reptiles and amphibians) and invertebrates (arachnids, crustaceans, insects, molluscs and worms) (EPA 2016c). Aquatic fauna are addressed in the Inland Waters Chapter (Section 6).

All conservation significant fauna species relevant to the Proposal are discussed in this chapter, and additional information on MNES species is provided in the MNES Chapter (Section 14).

8.2. Relevant Policy and Guidance

Table 8-1 presents relevant policy and guidance for terrestrial fauna and demonstrates how this has been considered for the Proposal.

Table 8-1: Relevant Policy and Guidance for Terrestrial Fauna

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 2021b)	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)	The information required for impact assessment has been considered in the scope of this chapter.
Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020b)	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 2021d)	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 2021f)	Considered during the development of this document and the EMP (Appendix B.3)
Instructions on how to prepare *Environmental Protection Act 1986* Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports (EPA 2021h)	Considered during the development of this document and the IRP
Template for EP Act Part IV Reconciliation Procedures (2021i)	
Cumulative environmental impacts of development in the Pilbara region – Advice of the Environmental	Considered in understanding cumulative impacts and supports conclusions on significance, and therefore

Policy or Guidance (If relevant)	Explain How the Policy and Guidance has been Considered
Protection Authority to the Minister for Environment under Section 16(e) of the *Environmental Protection Act 1986* (EPA 2014)	offsets required for clearing, of vegetation based on its condition
Other State or Commonwealth	
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. It addresses matters related to Terrestrial Fauna Habitat rehabilitation (Appendix B.4)
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).	
EPBC Act Environmental Offsets Policy (DSEWPaC 2012a)	Considered in the impact assessment and offset strategy for terrestrial fauna
Commonwealth of Australia Guidelines for Biological Survey and Mapped Data (DotEE 2018)	Considered in the design (methods and approach) of the fauna surveys
EPBC Act referral guideline for the endangered Northern Quoll (*Dasyurus hallucatus*) (DoE 2016a)	
Guidelines for surveys to detect the presence of Bilbies and assess the importance of habitat in Western Australia (DBCA 2019c)	
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)	
Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DoE 2013)	Considered during the development of this document
National Light Pollution Guidelines for Wildlife, including Marine Turtles, Seabirds and Migratory Shorebirds (DotEE 2020)	Considered during the development of this document

8.3. Receiving Environment

8.3.1. Studies and Survey Effort

Table 8-2 summarises the ten Proposal-specific and other relevant regional surveys and studies undertaken for Terrestrial Fauna. Key studies and survey reports are provided in Appendix E.1 to E.3, Figure 8-1 illustrates the spatial extent of the various surveys, whilst Figure 8-2 depicts the survey effort per habitat type.

The total survey area refers to a 75,397 ha area and covers the entirety of the Development Envelope (63,343 ha).

An extrapolated mapping exercise was undertaken up to 10 km from the survey area to provide additional regional context for the habitat values within the Development Envelope (Biologic 2021c). The mapped extrapolation area covered approximately 332,568.8 ha (it does not include the Development Envelope).

Table 8-2: Summary of Technical Studies for the Terrestrial Fauna

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Brockman Syncline Proposal Detailed Fauna Survey 2019 (Stantec 2020a; Appendix E.1) Prepared for Rio Tinto.	**Study/Survey area:** BS1 and BS3 assessment areas. The survey area comprised 15,455 ha. **Type:** Two-phase detailed fauna survey and Short-Range Endemic (SRE) assessment. The survey method included eight systematic sites with 5,824 trap nights. **Timing:** 16 to 28 May and 8 to 21 September 2019 (Level 2 survey); 13 to 23 August 2019 (Level 1 and Targeted).	Survey meets relevant EPA and EPBC Act policy and guidance. The survey approach and method undertook with consideration of the following: • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c) • Technical Guidance: Sampling methods for terrestrial vertebrate fauna (EPA 2016e) • Technical Guidance: Terrestrial fauna surveys (EPA 2020b) • Technical Guidance: Sampling of short-range endemic invertebrate fauna for environmental impact assessment in WA (EPA 2016d) • EPBC Act referral guideline for the endangered Northern Quoll (Dasyurus hallucatus) (DoE 2016a). Field work was conducted by two teams lead by qualified and experienced zoologists comprising Samantha Lostrom (Stantec), Mike Brown and Ray Lloyd. All team leads have extensive experience monitoring Pilbara fauna, including the identification of significant fauna and the deployment of survey equipment.
Greater Brockman and Nammuldi-Silvergrass Hub: Consolidated Fauna Habitat Mapping (Stantec 2021b; Appendix E.2) Prepared for Rio Tinto.	**Survey area:** Greater Brockman Operation. Consolidated area comprised 75,087 ha. **Type:** Consolidate previous fauna habitat mapping. Includes desktop assessment to consolidate available habitat mapping, ground-truthing to validate or refine the delineation of fauna habitat and refine mapping into a single mapping layer. **Timing:** May, August and September 2019.	There is no specific guidance for desktop fauna habitat consolidation. The desktop assessment consolidates fauna habitat mapping within the whole Development Envelope as originally referred (i.e., the mapping now also extends outside the Development Envelope due to reductions in the size of the Development Envelope). Field work (ground truthing) was led by experienced zoologists comprising Samantha Lostrom (Stantec), Mike Brown (Red Dog Environmental) and Ray Lloyd (Fauna Track).
Brockman Syncline Targeted Vertebrate Fauna Survey (Biologic 2020d) Prepared for Rio Tinto	**Survey area**: Greater Brockman Operations. The survey area comprised 73,707 ha. **Type**: Targeted vertebrate fauna assessment. **Timing:** 27 August to 09 September 2019, 03 October to 10 October 2019, 04 November to 12 November 2019 and 19 November 2019 to 27 November 2019.	This survey was conducted following relevant EPA and EPBC Act policy and guidance. The survey approach and method were undertaken with consideration of the following: • Technical Guidance: Sampling methods for terrestrial vertebrate fauna (EPA 2016e) • Technical Guidance: Terrestrial fauna surveys (EPA 2020b) • Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a) • Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b)

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
		• Matters of National Environmental Significance – Significant Guidelines 1.1 EPBC Act (DoE 2013) • EPBC Act referral guideline for the endangered Northern Quoll (Dasyurus hallucatus) (DoE 2016a) • Survey Guidelines for Australia's Threatened Bats (DEWHA 2010a).
Brockman 2 Deposits: Detailed Fauna Survey Phase 1 and 2 (Biota 2019d; Appendix E.3) Prepared for Rio Tinto	**Survey area:** BS2, BS4 and Lens G/Diesel comprising 10,928 ha. **Type:** Two-phase detailed fauna survey and SRE assessment. The sampling effort included systematic trapping at 11 locations, with a total of 2,083 trap nights. **Timing:** 13 to 24 November 2018 and 7 to 18 March 2019.	This survey was conducted following relevant EPA and EPBC Act policy and guidance. The survey approach and method were undertaken with consideration of the following: • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c) • Technical Guidance: Sampling methods for terrestrial vertebrate fauna (EPA 2016e) • Technical Guidance: Terrestrial fauna surveys (EPA 2020b) • Technical Guidance: Sampling of short-range endemic invertebrate fauna for environmental impact assessment in WA (EPA 2016d) • Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a) • Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b) The two phases of field work were led by Dan Kamien (Principal Zoologist - 20 years' experience). The following limitations and constraints associated with this survey are detailed below: • Not every section of the study area was ground-truthed or systematically sampled. Parts of the study area were inaccessible by vehicle, so installation and regular checking of fauna traps in these areas was not possible. Systematic fauna sampling was, however, completed in all habitats considered to represent the range of landforms and land systems present in the study area. • Hotter and drier than average weather conditions occurred during the October components of the survey (the nature of climate is stochastic and cannot be controlled). This may have resulted in lower species richness being recorded. • Parts of the study area were affected by fire in October 2018. This had some impact on selection of sampling sites with four camera traps being located in burnt areas, but overall did not affect the efficacy of the study or prevent representative habitat from being sampled. • The survey timing for Northern Quoll was not ideal (but did follow guidelines).

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
		The number of species recorded was comparable to other surveys conducted within the vicinity of the Survey area. The species accumulation curves suggest that additional survey effort would not substantially increase the species list recorded in the Survey area. This survey is considered as additive to the already large body of surveys conducted in the local area over a 30+ year period. It should be considered as an important building block which adds to the extensive collective of surveys which has helped build the fauna knowledge of the local area. The results of this survey are incorporated into the substantial body of work completed by Biologic 2022 (Brockman Syncline 2020-2021 Fauna Matters of National Environmental Significance Study). On this basis, there is adequate information to allow assessment against the EPAs objective for terrestrial fauna
Brockman Syncline 4 Marra Mambas: Level 2 Fauna Survey (Biota 2016b; Appendix E.4) Prepared for Rio Tinto	**Survey area:** BS4 Marra Mambas. Covered a 5,806 ha study area, including. 2,436 ha surveyed in 2015 to ensure the total area was surveyed at Level 2 standard (i.e., the remainder was based on previous surveys). **Type**: Single season Level 2 Vertebrate Fauna Survey. The sampling effort included systematic trapping at five locations, with a total of 960 trap nights. **Timing:** 30 July to 9 August 2015.	This survey was conducted following relevant EPA and EPBC Act policy and guidance, including: • Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a) • Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b) • Matters of National Environmental Significance – Significant Guidelines 1.1 EPBC Act (DoE 2013). The field work was led by Dan Kamien (Principal Zoologist - 17 years' experience).
Brockman Syncline Stage 1 Cave Sound and Vibration Review (Bat Call WA 2021a; Appendix E.5) Prepared for Rio Tinto	**Survey area:** Development Envelope **Type:** Desktop assessment. An assessment of conservation status values and limits of vibration and sound relevant to caves based on their importance as bat roosts. **Timing:** August 2021	There is no specific guidance for a desktop sound and vibration review
Brockman Syncline Fauna Habitat Extrapolation Mapping (Biologic 2021c; Appendix E.6) Prepared for Rio Tinto	**Survey area:** A 10 km buffer from the survey area, comprising approximately 332,568.79 ha **Type**: Extrapolation mapping **Timing**: 2021	There is no specific guidance for extrapolation mapping, however qualified fauna specialists with experience in the Pilbara and high-quality aerial imagery were utilised to undertake the extrapolation mapping.
Greater Brockman Proposal Noise and Vibration Impact Assessment	**Survey area:** Brockman Syncline Proposal Development Envelope **Type:** A noise and vibration assessment	The assessment was conducted following the *Environmental Protection Regulations (Noise) 1997.*

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
(Wood 2021; Appendix E.7) Prepared for Rio Tinto	**Timing:** 2021	
Brockman Syncline 2020-2021 Fauna Matters of National Environmental Significance Study (Biologic 2022c; Appendix E.8) Prepared for Rio Tinto	**Survey area:** Greater Brockman Operation comprising 75,086 ha **Type:** Two-phased targeted MNES survey **Timing:** 5 trips between – November March 2020 and 5 trips between February - June 2021	This survey was conducted following relevant EPA and EPBC Act policy and guidance. The survey approach and method were undertaken with consideration of the following: • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c) • Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020b) • Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a) • Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b) • Survey Guidelines for Australia's Threatened Bats (DEWHA 2010a) • Significance Impact Guidelines 1.1: Matters of National Environmental Significance (DoE 2013) • EPBC Act Referral Guideline for the Endangered Northern Quoll (*Dasyurus hallucatus*) (DoE 2016a). The field survey was undertaken by experienced zoologists, whom collectively have over 40 years of experience undertaking fauna surveys within the Pilbara region, including targeted surveys for the MNES that were the focus of this study. It included nine field surveys that were led by Thomas Rasmussen (Senior Zoologist), Andrew Hide (Senior Zoologist) and Hannah Anderson (Senior Zoologist.
Matters of National Environmental Significance Consolidation Report Brockman (Biologic 2022a; Appendix E.9) Prepared for Rio Tinto	**Survey area:** Greater Brockman Operation comprising 75,086 ha **Type:** A literature review to consolidate information on MNES species from previous studies. **Timing:** February 2022	There is no specific guidance for a literature review consolidation report. The work was led by Chris Knuckey, who is a qualified and experienced zoologist (Manager Vertebrate Zoology) to provide a consolidated report for the purpose of this ERD. This is a substantial and important report which synthesises all known local knowledge (based on previous surveys) of Fauna Matters of National Environmental Significance. On this basis, there is adequate information to allow assessment against the EPAs objective for terrestrial fauna

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Figure 8-1
Spatial Extent of Terrestrial Fauna Surveys Conducted for the Proposal

Drawn: L.Fuentes
Plan: PDE0189717v4
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,520,000
7,500,000

Mount Brockman Road
Nanutarra - Munjina Road

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

Legend

Development Envelope

Fauna and Fauna Habitat Surveys

Single-phase detailed survey
Astron Environmental Services 2014

Multiple-phase Detailed Survey
Biota Environmental Sciences 2016;
Stantec 2020;
Biologic Environmental Survey 2014, 2020

Targeted Survey
Biota Environmental Sciences, 2013;
Bat Call WA, 2017;
Biologic Environmental Survey, 2020

Fauna Habitat: Biota Environmental Sciences, 2012, 2013, 2014, 2016; Eco Logical Australia, 2013, 2014; Astron Environmental Services, 2014; Bat Call WA, 2017; WRM, 2015, 2017, 2018, 2019, 2020; Rio Tinto, 2015, 2017, 2018, 2020, 2021; Stantec, 2020, 2021

Rio Tinto Mine
Rio Tinto Railway
Conveyor
Major Road
Minor Road
Site Access Road

N

0 2 4 6 8 10
Kilometres

Map units in metres

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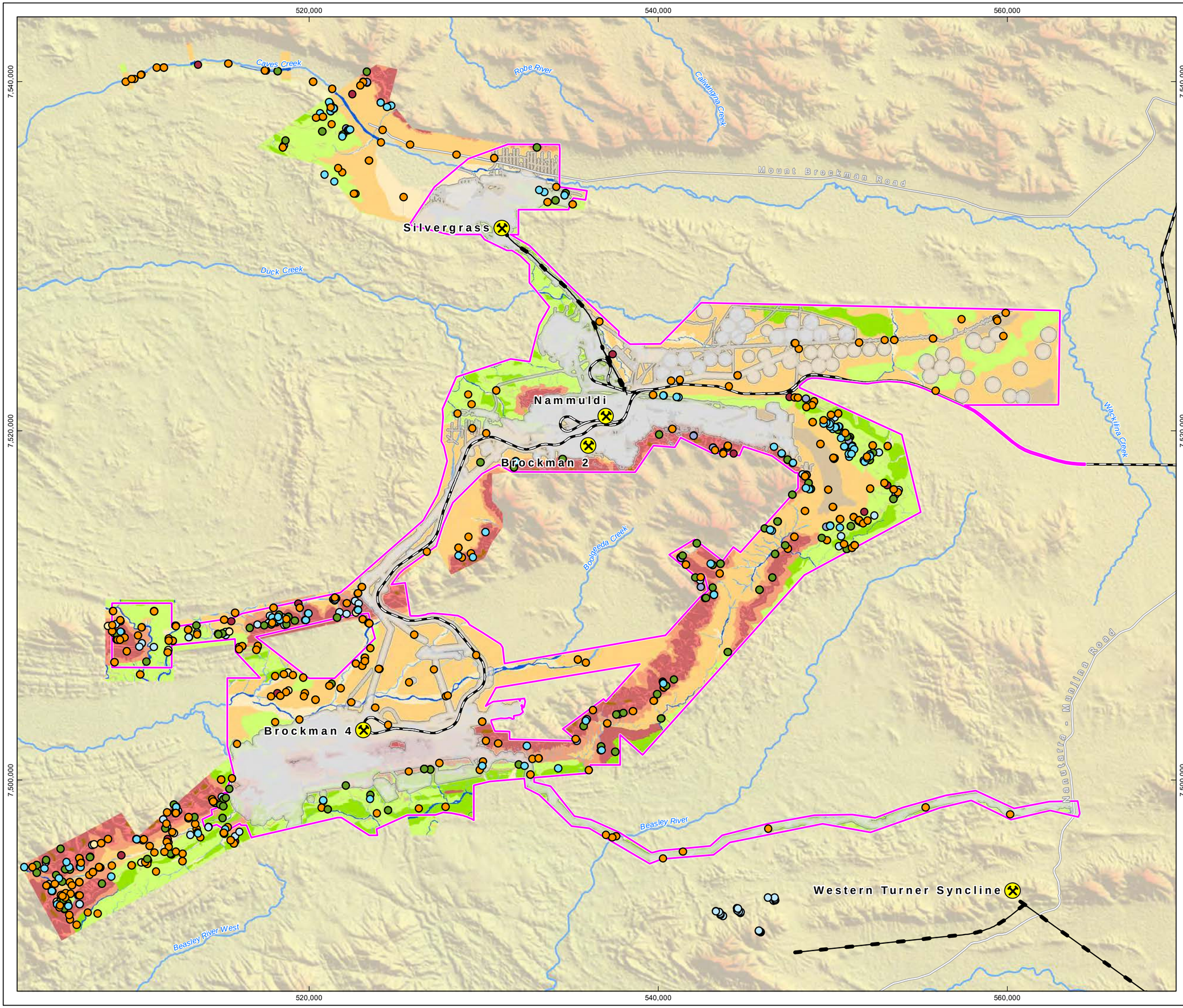

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Figure 8-2
Survey Effort per Habitat Type for the Proposal

Drawn: L.Fuentes
Plan: PDE0189718v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
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Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Survey Effort

- Accoustic recording
- Active foraging
- Avifauna census
- Cage Trap
- Camera
- Echolocation recording
- Elliott trap
- Funnel trap
- Habitat assessment
- Pitfall trap
- Targeted SRE searches
- Targeted searches
- Other

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Hillslope
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plains
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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8.3.2. Fauna Habitat

Over 30 terrestrial fauna surveys have been conducted across the Development Envelope and surrounds. Findings of these surveys have been reviewed with reference to the current EPA guidance and where relevant, consolidated into a single report encompassing an area of 76,198 ha (Stantec 2021b).

Twelve broad fauna habitat types were identified within the survey area. All occur within the Development Envelope. These fauna habitats were identified based on observations in the field, vegetation mapping and interpretation of high quality aerial photography (Table 8-4 and Figure 8-3) (Stantec 2020b; Biologic 2022a). A detailed understanding of local species occurrence and habitat use in the survey area has been used to assign habitat significance ratings based on their value to Threatened fauna species listed under the EPBC Act or BC Act (Biologic 2020d). Table 8-3 describes the criteria used to inform the significance rating for each habitat.

Table 8-3: Fauna Habitat Significance Assessment Criteria for Threatened Species

Habitat Significance	Criteria
High	Provides core breeding/refugia/shelter sites (i.e., denning, roosting or permanent 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 moderate significance supporting habitat, when they are within the home range of the fauna species' breeding activities. These habitats are more widespread 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.

Source: Biologic 2020d

Of the 12 habitat types identified within the survey area, two are considered to provide high significance habitat:

- **Gorge/Gully habitat**: Collectively comprises 1,650 ha (2%) of the survey area, including 944.9 ha (1%) within the Development Envelope, and is considered the most important fauna habitat at a local scale due to the microhabitats it provides, such as caves, overhangs and crevices (Stantec 2020b; Biologic 2022a). The rocky shelter and retention of surface water and moisture in this habitat type provides refuge for fauna from harsh climatic conditions. This habitat type is suitable for denning, shelter, roosting and foraging for MNES species such as the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python. It also comprises suitable habitat for the Long-tailed Dunnart (P4) and Gane's Blind Snake (P1).
- **Debris Slope/Rocky Outcrop habitat**: Collectively comprises 638 ha (1%) of the survey area, including 514.7 ha (1%) within the Development Envelope, and is considered of high significance to fauna as it can form shelters such as caves and alcoves (Biologic 2020d, Stantec 2020b, Biologic 2022a). Rocky outcrops provide denning and foraging habitat for MNES species such as the Northern Quoll and Ghost Bat. The Pilbara Olive Python may also utilise the habitat, particularly when it occurs near creek lines or Gorge/Gully habitat (Biologic 2020d; Stantec 2020b). It also comprises suitable habitat for the Long-tailed Dunnart (P4).

None of the identified fauna habitats are confined to the Development Envelope, and all are widespread throughout the wider Hamersley subregion (Biota 2019d, e, Biologic 2022a).

In addition to broad-scale fauna habitat mapping, desktop extrapolated fauna habitat mapping was completed within a 10 km buffer of the survey area to define additional potential habitat for significant fauna species (Table 8-5; Figure 8-4) (Biologic 2021c). The same level of detail was not possible via desktop extrapolation, so changes to scale, nomenclature, and habitat categories occurred.

Table 8-4: Fauna Habitat Types within the Survey Area and Development Envelope

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)	Extent within Development Envelope (ha)*	Representative Photograph
High Significance							
Gorge/Gully • Limited extent • Of high significance • High SRE potential	Gorge/Gully habitat is characterised by large rock faces and gorges usually associated with ridges, with high potential to support caves, overhangs, crevices and alcoves. These areas, particularly gorges, also have the potential to hold temporary water sources during inundation owing to the presence of bedrock. This habitat was predominantly located adjacent to the Midslope /upper slope habitats. However, it also occurred adjacent to the Footslopes and Gently Sloping Rise habitats.	Vegetation within this habitat type tended to include *Eucalyptus* and *Grevillea* species over *Triodia* and tussock grasses.	Microhabitats are provided in this habitat type in the form of rocky crevices, cracks, caves, semi-permanent water sources and dense vegetation.	**Critical breeding/roosting habitat for:** • Northern Quoll • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python **Suitable habitat for:** • Long-tailed Dunnart • Gane's Blind Snake	1,654.6	944.9	
Debris Slope/Rocky Outcrop • Limited extent • Of high significance • High SRE potential	The Debris Slope/Rocky outcrop habitat comprised rocky areas ranging from large boulders forming crevices and shelters to small rock faces. This habitat contains conglomerates, ironstone and shale, which may form a shelter for fauna, and caves or alcoves; however, not to the extent of the Gorge /Gully habitat. This habitat generally occurred near Gently Sloping Rise habitat.	Vegetation within the upper and mid storey contains a low to sparse cover of trees and shrubs, including *Eucalyptus*, *Acacia*, and occasionally *Ficus*. In areas where exposed bedrock is absent, lower vegetation includes *Triodia.* hummock grassland. In shaded areas, this is replaced with sparse cover of *Cymbopogon* tussock grassland.	Microhabitats are provided in this habitat type in the form of rocky crevices and shelters. Leaf litter and woody debris is present within some locations.	**Critical breeding/roosting habitat for:** • Northern Quoll • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python **Suitable habitat for:** • Long-tailed Dunnart • Gane's Blind Snake	637.7	514.7	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)	Extent within Development Envelope (ha)*	Representative Photograph
Moderate Significance							
Major Creekline • Limited extent • Of moderate significance • Moderate SRE potential	The major creekline habitat supported an upper story of relatively tall and mature *Eucalyptus* or *Corymbia*. Lower vegetation comprised soft *Triodia* sp. and tussock grasses (e.g., Buffel Grass), which are both considered palatable to livestock, often leading to degradation	Relatively tall and mature *Eucalyptus* or *Corymbia*. Lower strata of soft *Triodia* and tussock grasses (e.g., Buffel Grass).	Semi-permanent and ephemeral water sources are important temporary resources for aquatic and terrestrial fauna. Mature trees would provide shelter and roosting habitat for avifauna, whilst the increased leaf litter and woody debris may also provide shelter for small mammals.	**Critical breeding/nesting habitat for:** • Grey Falcon **Supporting foraging/dispersal habitat for**: • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python • Northern Quoll **Suitable habitat for:** • Peregrine Falcon	766.0	572.5	
Minor Creekline • Limited extent • Of moderate significance • Moderate SRE potential	Minor creekline habitat usually lacked a tall dense upper storey but with a dense mid storey. Substrate was typically sandy channels or clay banks, with relatively dense fringing vegetation including sparse *Eucalyptus* sp., and *Acacia* sp. over tussock grasses including *Cenchrus ciliaris* (Buffel Grass) and *Triodia* sp hummock grasses. Limited extent The substrate typically comprises sandy channels or clay banks with relatively dense fringing vegetation.	A dense mid storey of vegetation, including sparse *Eucalyptus* and *Acacia* over tussock grasses and *Triodia* hummock grasses.	Larger *Eucalyptus* trees may potentially provide hollows and nesting opportunities in Mature trees. Microhabitats would be found in areas that have an abundance of leaf litter and woody debris.	**Critical breeding/nesting habitat for:** • Grey Falcon **Supporting foraging/dispersal habitat for**: • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python • Northern Quoll	904.2	766.7	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)	Extent within Development Envelope (ha)*	Representative Photograph
Alluvial Plain • Widespread • Of moderate significance • Low/Moderate SRE potential	The Alluvial Plain habitat occurs in flat areas in association with creeklines and depressions. The habitat generally supports increased shrub cover, tussock grasses and clay-based soils.	Vegetation comprised of Mulga, *Acacia*, *Hakea* and *Eucalyptus*. Areas prone to inundation will support tussock grasses, and hummock grasses dominate the remaining areas.	Woody debris and leaf litter were common within this habitat type compared to others which may result in some microhabitats.	**Critical foraging/dispersal habitat for:** • Pilbara Leaf-nosed Bat • Ghost Bat • Grey Falcon **Suitable habitat for:** • Lined Soil-crevice Skink • Short-tailed Mouse	3,361.4	2,611.0	
Colluvial Plain • Widespread • Of moderate significance • Low/Moderate SRE potential	Colluvial Plain habitat is usually associated with Alluvial Plains or drainage lines, which provide depositional surfaces. Substrates within this habitat are typically less stony than that of the adjacent pediment slopes and tend to have a higher shrub cover owing to the increased influence of drainage.	Vegetation comprises *Eucalyptus leucophloia*, or *Corymbia deserticola,* over scattered *Acacia* and a lower story dominated by *Triodia*.	This habitat type may result in some formation of microhabitats due to woody debris and leaf litter availability.	**Supporting foraging/dispersal habitat for:** • Pilbara Leaf-nosed Bat • Ghost Bat • Grey Falcon **Suitable habitat for:** • Western Pebble-mound Mouse	25,299.0	21,516.1	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)	Extent within Development Envelope (ha)*	Representative Photograph
Gently Sloping Rise • Widespread • Of moderate significance • Low SRE potential	The Gently Sloping Rise habitat type occurs at the base of the Footslope habitat. Typically, the substrate is dominated by coarse fragments.	Vegetation within this habit type contains sparse *Eucalyptus* and *Corymbia* over shrubs, including *Hakea* and *Acacia* over a high cover of *Triodia* hummock grassland.	As this habitat type contains very little woody debris and leaf litter and only occasionally hosts exposed bedrock it is of limited to no value in the formation of microhabitats.	**Suitable habitat for:** • Western Pebble-mound Mouse	14,243.0	11,073.2	
Hardpan Plain • Limited extent • Of moderate significance • Low SRE potential	Hardpan habitats comprise flat clay-based plains dominated by stands of mulga, with a high proportion of the substrate comprising bare soil. This habitat type would experience sheet flow following rain.	Vegetation comprises mulga and *Hakea* and a lower storey of shrubs, *Triodia* and tussock grasses.	Due to the large amount of woody debris this habitat type would provide shelter for mammals and reptiles.	**Supporting foraging/dispersal habitat for:** • Pilbara Leaf-nosed Bat • Ghost Bat • Grey Falcon	1,175.3	1,175.3	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)	Extent within Development Envelope (ha)*	Representative Photograph
Midslope/ Upper Slope • Widespread • Of moderate significance • Low SRE potential	The Midslope/Upper Slope habitat type comprised steep slopes leading into lower footslopes. This habitat was characterised by steep slopes with a high proportion of coarse fragments dominated by ironstone.	Vegetation within this habitat types comprises a sparse upper storey of *Eucalyptus leucophloia*, over sparse *Grevillea, Hakea* and *Acacia* shrubs, with a high cover of *Triodia* hummock grassland.	The presence of *Eucalyptus leucophloia* occasionally provided small or rarely large hollows, which may be used by nesting or roosting birds. Gullies, crevices, alcoves and outcropping may also provide suitable microhabitats.	**Suitable habitat for:** • Western Pebble-mound Mouse	6,898.8	4,840.5	
Low Significance							
Footslope • Widespread • Of limited significance • Low SRE potential	The Footslope habitat is typically downslope from the steeper midslope/upper slope habitat. This habitat type is characterised by gently to moderately inclined slopes with coarse fragments dominated by ironstone. Gently to moderately inclined slopes with coarse fragments dominated by ironstone. Aside from reduced slope angle, Footslope habitat differed from midslope/upper slope areas by having less rocky areas and a high *Triodia* cover.	Vegetation in this habitat type tended to comprise a sparse upper story of *Eucalyptus leucophloia* over a low to sparse cover of shrubs and trees, including *Hakea* sp. and *Acacia* sp., over a high cover of *Triodia* hummock grassland.	Microhabitats are generally not found within the habitat type as it contains limited rocky areas and is sparse in tree cover.	**Suitable habitat for:** • Western Pebble-mound Mouse	4,761.1	3,562.1	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)	Extent within Development Envelope (ha)*	Representative Photograph
Pediment Slope • Widespread • Of limited significance • Low SRE potential	The Pediment Slope habitat is characterised by gently sloping or flat areas, usually associated with low rises or footslopes. Most areas of this habitat would be influenced by laminar sheet flow but would be unlikely to support ponding.	The upper and mid-story of this habitat type typically contains *Acacia*, *Grevillea* and *Hakea* shrubs over a stony substrate with a high cover of *Triodia*.	Microhabitats tend not to form within this habitat type due to the lack of dense shrubs and stony substrate.	**Suitable habitat for:** • Western Pebble-mound Mouse	5,336.1	4,733.2	
Plateau • Limited extent • Of limited significance • Low SRE potential	The plateau habitat represents the most elevated habitat in the survey area and is either flat or crested, with gently sloping spinifex hummock grasslands over a substrate with coarse fragments dominated by ironstone. This habitat tends to be more exposed and only supports a sparse vegetation cover in the mid and upper stratum, with limited debris for shelter by fauna.	This habitat type is composed of a sparse cover of vegetation in the mid and upper layers with spinifex grasslands covering the lower stratum.	Due to the rocky substrate, which is not conducive to forming crevice's, cracks and caves and the limited woody debris or dense vegetation found within this habitat type it is considered to provide limited to low value to the formation of microhabitats.	**Suitable habitat for:** • Western Pebble-mound Mouse	205.6	101.4	
Total					**65,242.8**	**52,411.6**	**-**

** Extent in Development Envelope excludes approved footprint. Photos from Stantec 2020b)*

Table 8-5: Extrapolated Fauna Habitat Mapping within 10 Kilometres from the Survey Area

Extrapolated Habitat Type	Value to fauna species	Corresponding Broad Scale Habitat Type/s	Extent in the Extrapolated Mapping Area	
			ha	%
Gorge/Gully	High Significance	• Gorge/Gully • Debris Slope/Rocky Outcrop	11,491	3.5
Hillslope	Low Significance	• Footslope • Midslope/Upper Slope • Plateau	83,263	25.0
Gentle Slope Rising	Low Significance	• Gently Sloping Rise • Pediment Slope (some instances) • Minor Creekline (some instances)	74,960	22.5
Major Creekline	Moderate Significance	• Major Creekline	4,270	1.3
Plains	Moderate Significance	• Alluvial Plain • Colluvial Plain • Hardpan Plain • Minor Creekline (some instances) • Pediment Slope (some instances)	158,585	47.7
Total			**332,569**	**100**

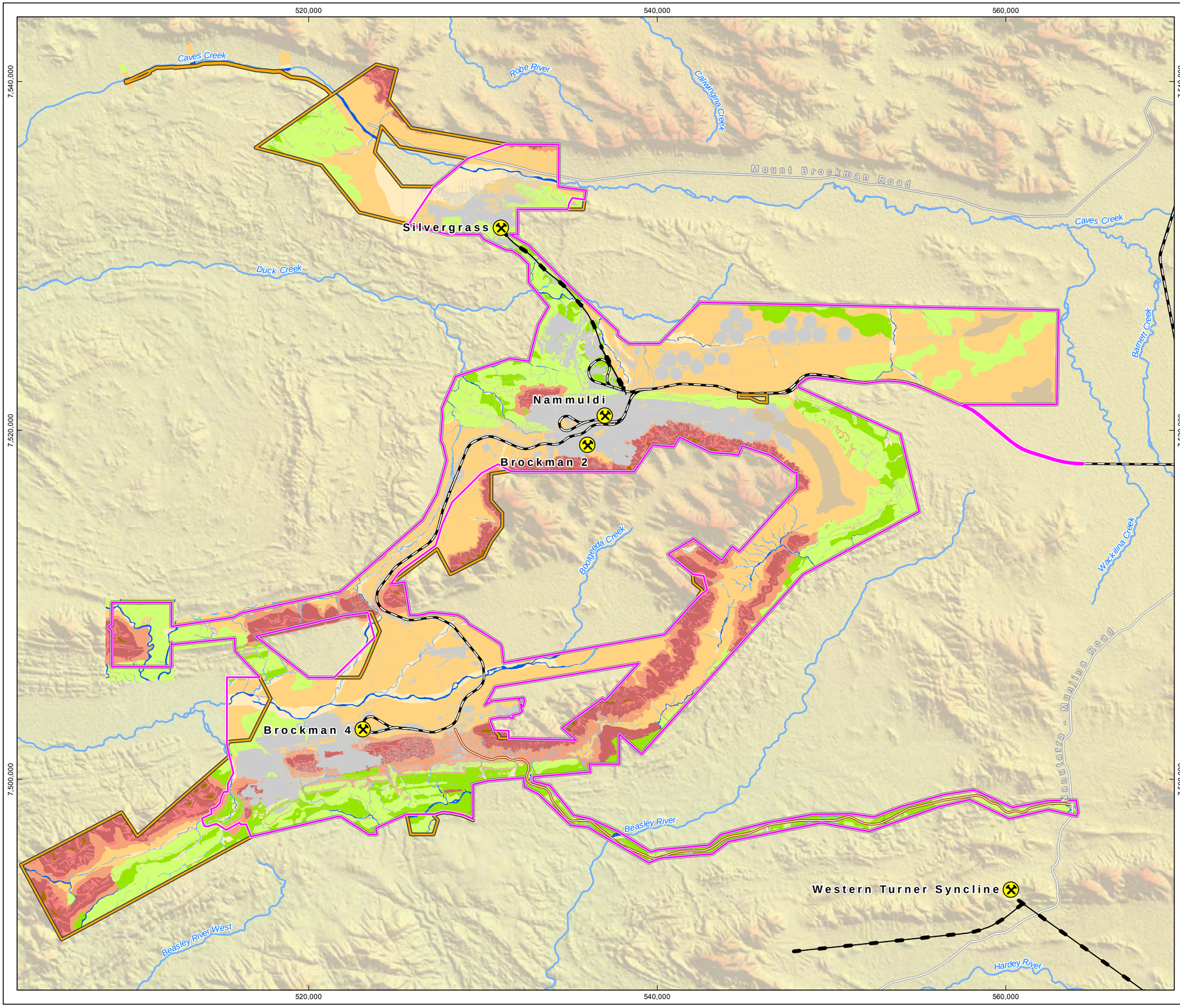

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Figure 8-3
Fauna Habitat Types Within the Survey Area Overview

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres
Map units in metres

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Figure 8-3
Fauna Habitat Types Within the Survey Area
Map A

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000
520,000
530,000
540,000
7,540,000
7,530,000
7,520,000

Caves Creek
Robe River
Duck Creek
Silvergrass
Nammuldi
Brockman 2

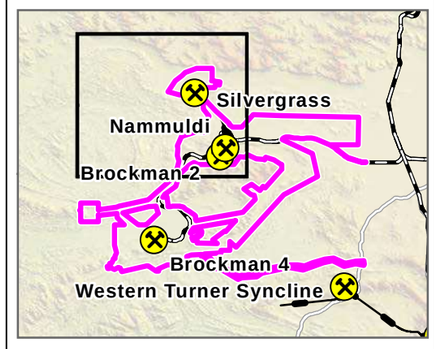
Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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Figure 8-3
Fauna Habitat Types Within the Survey Area
Map B

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

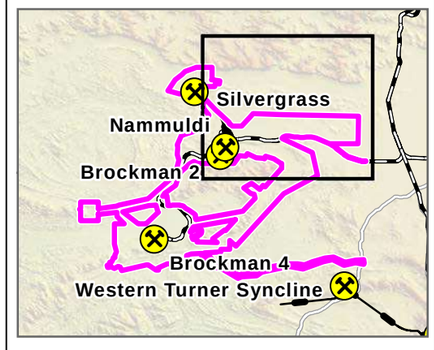
Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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Figure 8-3
Fauna Habitat Types Within the Survey Area
Map C

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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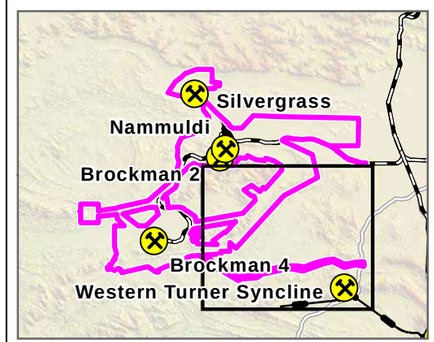
Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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Figure 8-3
Fauna Habitat Types Within the Survey Area
Map D

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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Legend

- Development Envelope
- Survey Area

Fauna Habitat

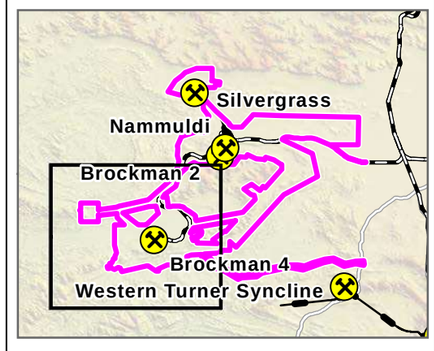
- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek

510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Brockman 4

Beasley River West



N

0 2 4 6
Kilometres

Map units in metres

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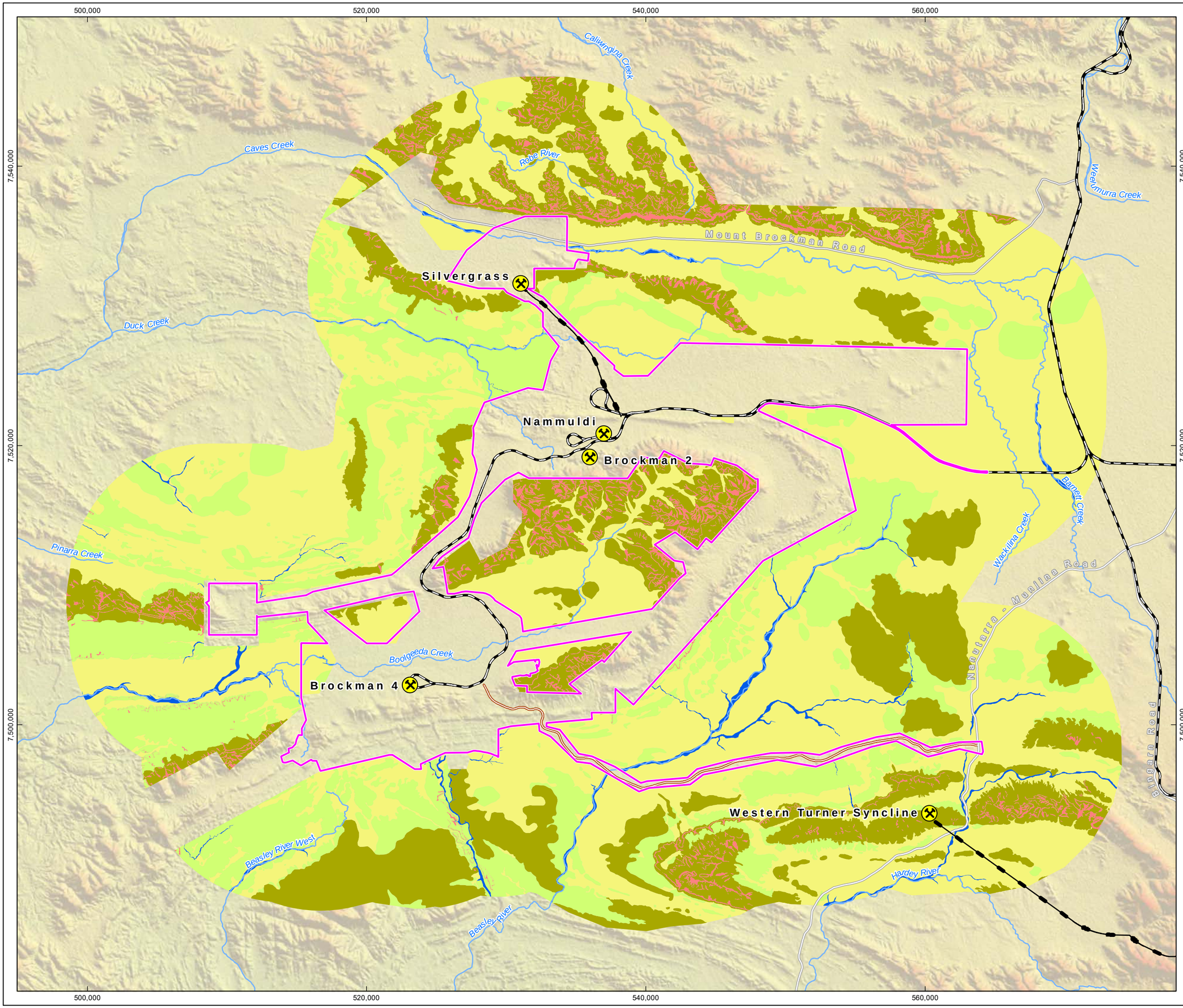

RioTinto

Figure 8-4
Extrapolated Fauna Habitat Mapping within 10 km of the Development Envelope

Drawn: L Fuentes
Plan: PDE0189720v1
Date: July 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Fauna Habitat - Extrapolated

- Gently Sloping Rise
- Gorge Gully and Free Face
- Hillslope
- Major Creekline
- Plains
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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8.3.2.1. 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 MNES species; Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, and Pilbara Olive Python. A total of 208 caves have been recorded from the survey area, 131 occur within the Development Envelope. The caves vary in complexity from small, shallow overhangs to deep, complex caves (which include a secondary chamber) with a higher range of habitat values (Table 8-6 and Figure 8-5). A further 28 caves are also known from the extrapolation area.

Regarding the Development Envelope, the highest concentration of caves (77) (including complex caves (19)) occurs at the BS2 through to the BS3 assessment area. BS1 and BS4 assessment areas had a lower number (18, 13 and 34) and concentration of caves (Figure 8-5). These differences in cave numbers and concentration are most likely due to the geological attributes of each area. Within the Development Envelope, most caves occur in Gorge/Gully (86) and Debris Slope/Rocky Outcrop (36) habitat types (Biologic 2022a). Further detailed information relating to cave usage and suitability to MNES species is provided in Section 8.3.3.6.

Water Features

There is only one permanent groundwater sustained water feature within the Development Envelope; Plunge Pool in the BS3 assessment area. A further 24 water features are known from the survey area, of which 21 occur within the Development Envelope. Of these water features, 19 are ephemeral and two are year-round artificial water bodies (discharge points) (Figure 8-6). A further 12 water features are known from the wider extrapolation area, comprising four permanent pools, three ephemeral pools (including Ridge Pool which is located 140 m from the Development Envelope), two year-round artificial water bodies and three of unknown value (Table 8-7 and Figure 8-6). There are likely to be many more ephemeral water features that occur after rainfall but do not persist for more than a few weeks.

Two water features, Plunge Pool and Ridge Pool are considered highly significant to fauna locally as they provide drinking and foraging resources for all (Plunge Pool), or most (Ridge Pool), of the year. All remaining water features are still likely to provide habitat for fauna species, though this will be limited to periods when inundated with water, primarily following large rainfall events.

Table 8-6: Caves within and Surrounding the Proposal

Cave Name	Image	Cave Name	Image	Cave Name	Image
Inside Development Envelope					
B2BAT06	-	BS4MM-Aug16-18	-	B4jul16-26-27	-
BS4MM-Aug16-19	-	B4jun16-09	-	BS4MMJul16-11	-
B4jun16-36	-	BS4MMJul16-13	-	B4June16-26	-
BS4MMJul16-14	-	BS4MM-Aug16-03	-	BS4MMJul16-15	-
BS4MM-Aug16-04	-	BS4MMJul16-17	-	BS4MM-Aug16-13	-
BS4MMJul16-30	-	BS4MM-Aug16-15	-	C1	
C2		C8	-	CBRK-000	

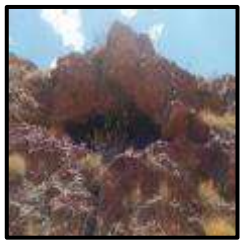
Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-006		CBRK-045		CBRK-052	
CBRK-053		CBRK-055		CBRK-057	
CBRK-059		CBRK-061		CBRK-063	
CBRK-065		CBRK-067		CBRK-069	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-071		CBRK-073		CBRK-074	
CBRK-075		CBRK-076		CBRK-077	
CBRK-078		CBRK-079		CBRK-080	
CBRK-081		CBRK-082		CBRK-083	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-084		CBRK-085		CBRK-086	
CBRK-087		CBRK-089		CBRK-090	
CBRK-091		CBRK-092		CBRK-093	
CBRK-094		CBRK-095		CBRK-096	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-097		CBRK-098		CBRK-099	
CBRK-100		CBRK-101		CBRK-102	
CBRK-103		CBRK-104		CBRK-105	
CBRK-106		CBRK-107		CBRK-108	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-109		CBRK-110		CBRK-111	
CBRK-113		CBRK-116		CBRK-119	
CBRK-120		CBRK-121		CBRK-122	
CBRK-123		CBRK-124		CBRK-125	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-126		CBRK-136		CBRK-137	
CBRK-138		CBRK-139		CBRK-140	
CBRK-141		CBRK-142		CBRK-143	
CBRK-144		CBRK-145		CBRK-147	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-148		CBRK-149		CBRK-150	
CBRK-151		CBRK-152		CBRK-153	
CBRK-154		CBRK-173		CBRK-174	
CBRK-199		GBS_CA_03	-	GBS_CA_04	

Cave Name	Image	Cave Name	Image	Cave Name	Image
GBS_CA_05		GBS_CA_06	-	GBS_CA_08	-
GBS_CA_09	-	GBS_CA_10	-	GBS_CA_11	-
GBS_CA_12	-	GBS_CA_14		GBS_CA_15	
GBS_CA_16		GBS_CA_17	-	GBS_CA_18	
GBS_CA_20		GBS_CA_21		GBS_CA_22	-

Cave Name	Image	Cave Name	Image	Cave Name	Image
MAMBAT81-01		MAMBAT93-01	-	MAMCAM11-01	
MMBAT01		MMBAT02		MMBAT03	
MMBAT04		MME05		MME06	
NWTBAT01	-	NWTBAT02	-		

Cave Name	Image	Cave Name	Image	Cave Name	Image
Outside Development Envelope					
C3		C4		C5	
C6		C7	-	CBRK-001	
CBRK-002		CBRK-003		CBRK-004	
CBRK-005		CBRK-007		CBRK-008	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-009		CBRK-010		CBRK-011	
CBRK-012		CBRK-013		CBRK-014	
CBRK-015		CBRK-016		CBRK-017	
CBRK-018		CBRK-020		CBRK-021	

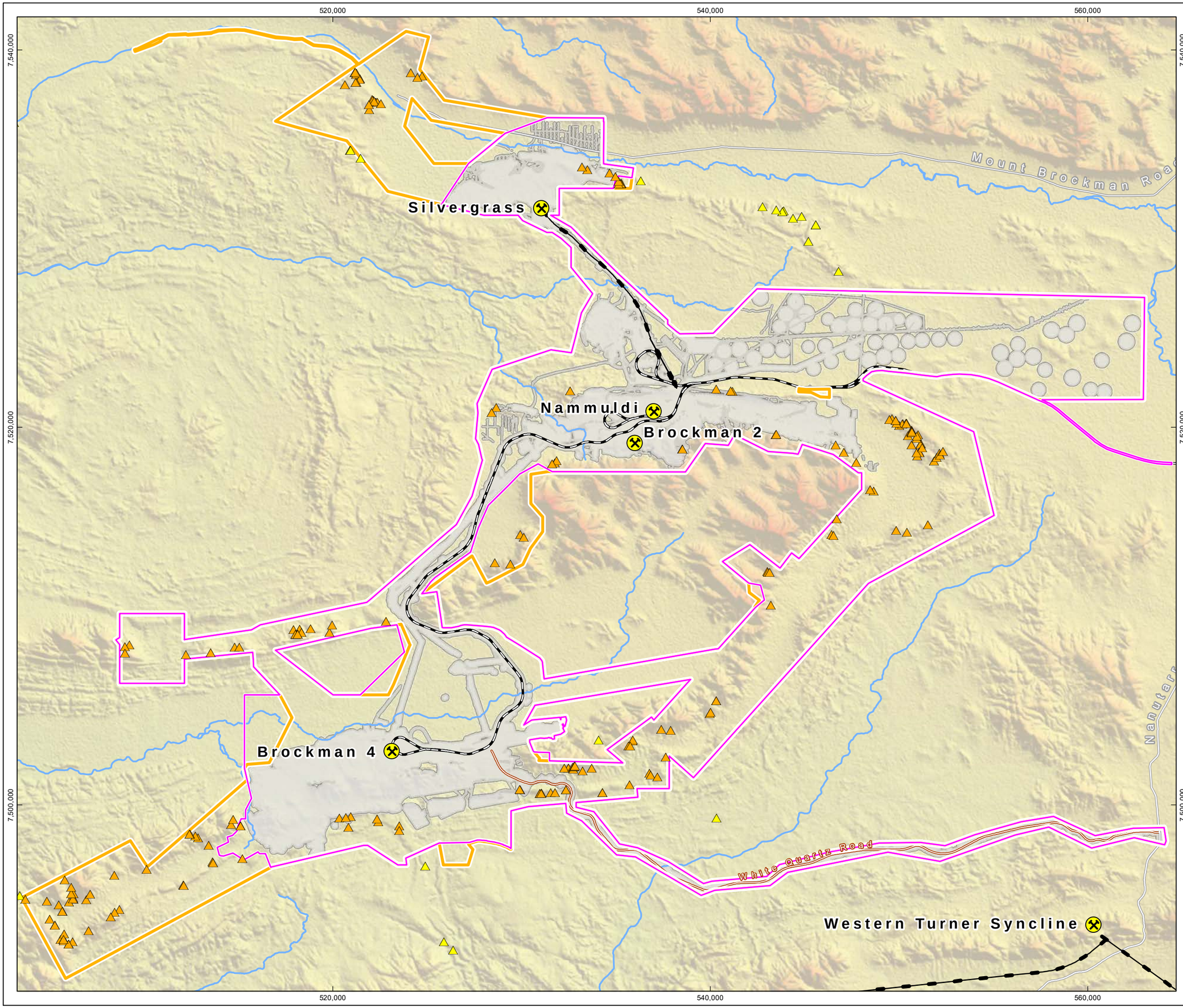
Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-022		CBRK-023		CBRK-024	
CBRK-025		CBRK-026		CBRK-028	
CBRK-030		CBRK-031		CBRK-032	
CBRK-033		CBRK-034	-	CBRK-035	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-036		CBRK-037		CBRK-038	
CBRK-039		CBRK-040		CBRK-041	
CBRK-042		CBRK-043		CBRK-044	
CBRK-046		CBRK-047		CBRK-048	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-049		CBRK-050		CBRK-051	
CBRK-054		CBRK-056		CBRK-058	
CBRK-060		CBRK-062		CBRK-064	
CBRK-066		CBRK-068		CBRK-070	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-072		CBRK-088		CBRK-112	
CBRK-114		CBRK-115		CBRK-146	
CBRK-175		CBRK-176		CBRK-177	
CBRK-178		CBKT-04		GBS_CA_01	

Cave Name	Image	Cave Name	Image	Cave Name	Image
GBS_CA_02		GBS_CA_07	-	GBS_CA_13	
GBS_CA_19		SIV15EH	-		



RioTinto

Figure 8-5
Caves Recorded within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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510,000
520,000
530,000
540,000
7,540,000
7,530,000
7,520,000

CBRK-001
CBRK-177
CBRK-015
CBRK-017
CBRK-005
CBRK-007
CBRK-003
CBRK-009
CBRK-039
CBRK-025
CBRK-011
CBRK-031
CBRK-013
CBRK-021
CBRK-027
CBRK-029
CBRK-019
CBRK-080
CBRK-078
CBRK-082
C8
CAVE 03
C7
C3 (Cave 10)
CBRK-178
C4 (Cave 06)
Silvergrass
NWTBAT02
NWTBAT01
CBRK-045
Nammuldi
CBRK-074
(NEBBAT01)
CBRK-090
Brockman 2
CBRK-086
BKEBAT03
BKEBAT01
CBRK-084
B2BAT06

RioTinto

Figure 8-5
Caves Recorded within and Surrounding the Proposal
Map A

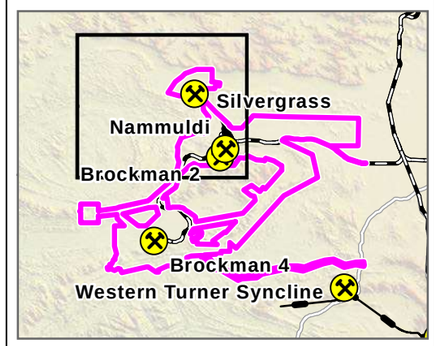
Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3
Kilometres

Map units in metres

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RioTinto

Figure 8-5
Caves Recorded within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

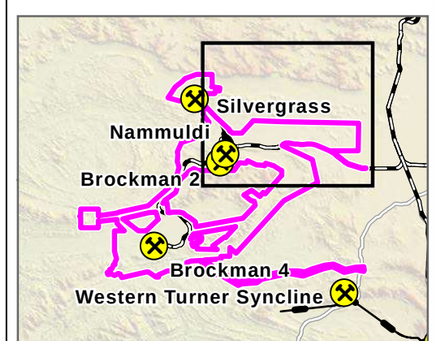
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3

Kilometres

Map units in metres

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540,000 550,000 560,000

7,540,000 7,530,000 7,520,000

Mount Brockman Road

CBRK-080 CBRK-078 CBRK-082 CAVE 03 C3 C7 C6 C5 C3 (Cave 10) C8 CBRK-178 C4 (Cave 06)

CBRK-170 CBRK-165 CBRK-168 CBRK-160 CBRK-163 CBRK-164 CBRK-167 CBRK-166 CBRK-161 CBRK-162 CBRK-171

CBRK-090 CBRK-092 CBRK-074 (NEBBAT01) Nammuldi Brockman 2 C1 C2

GBS_CA_18 GBS_CA_17 CBRK-077 CBRK-081 CBRK-076 GBS_CA_14 CBRK-083 GBS_CA_09 GBS_CBRK-087 GBS_CA_10 GBS_CA_08 GBS_CA_11 CBRK-150 GBS_CA_12 CBRK-148 CBRK-075 CBRK-085 CBRK-055 CBRK-079 CBRK-105 GBS_CA_15 CBRK-091 CBRK-097 CBRK-073 CBRK-099 CBRK-095 CBRK-057 CBRK-093 CBRK-101 CBRK-065 CBRK-061 CBRK-067 (LGBAT03) CBRK-063

BKEBAT03 BKEBAT01 CBRK-113 CBRK-149 CBRK-059 CBRK-100 CBRK-089 CBRK-102 CBRK-141

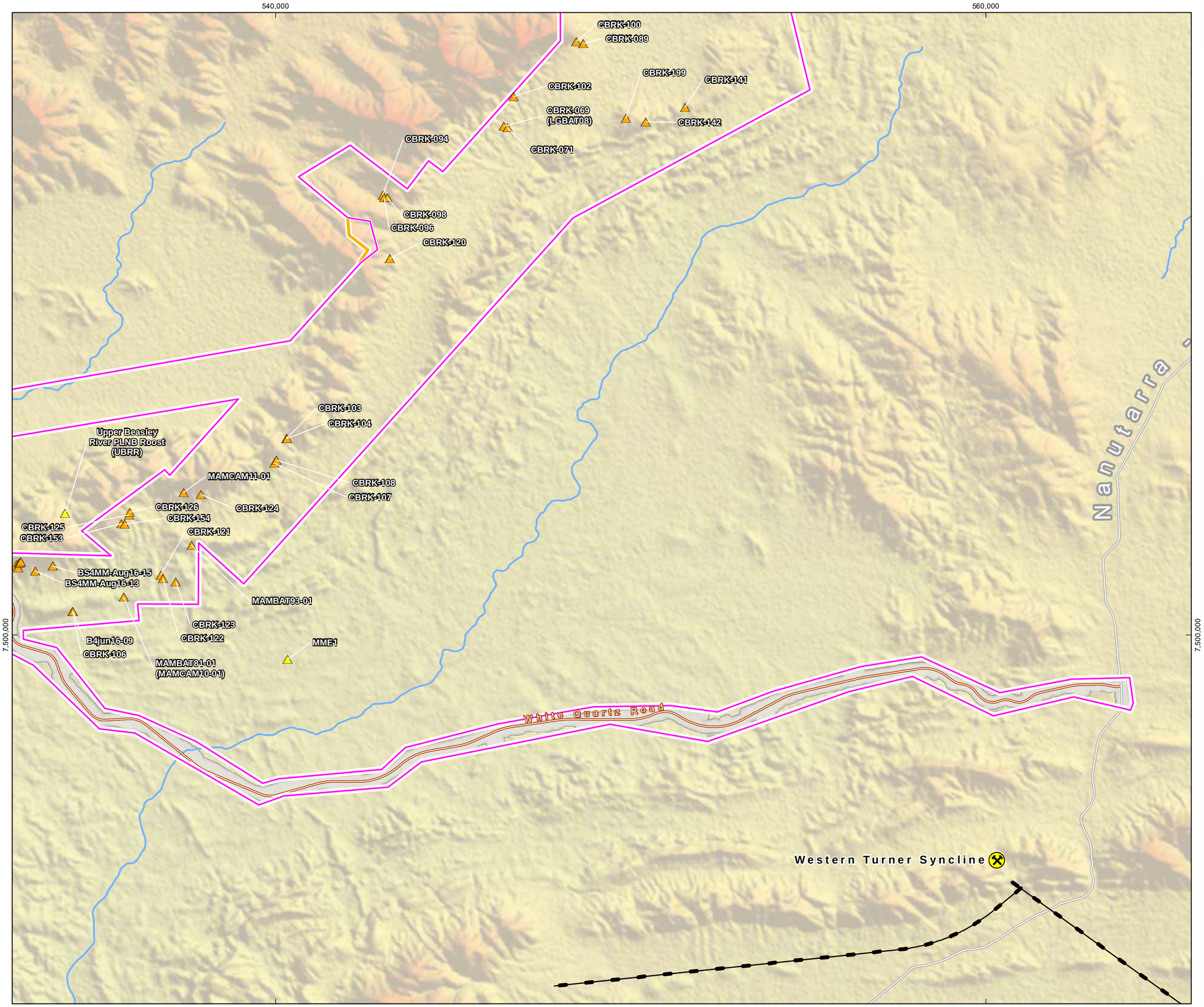


Figure 8-5
Caves Recorded within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

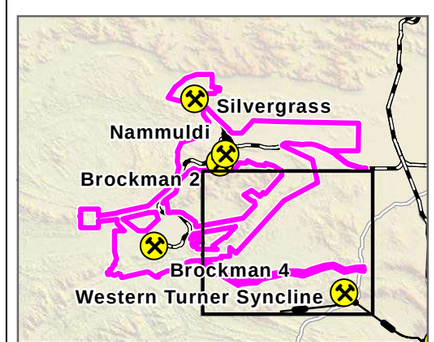
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek



N

0 1 2 3

Kilometres

Map units in metres

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Figure 8-5
Caves Recorded within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

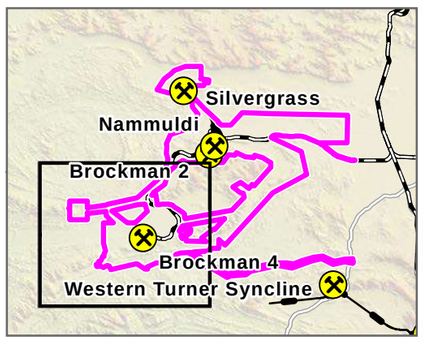
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek



N

0 1 2 3
Kilometres

Map units in metres

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Table 8-7: Water Features Recorded within and Surrounding the Proposal

Water Feature	Image	Water Feature	Image	Water Feature	Image
Inside Development Envelope					
B1		B2		B3	
B4		WBRK-01		WBRK-02 (Artificial)	
WBRK-03		WBRK-08		WBRK-09	

Water Feature	Image	Water Feature	Image	Water Feature	Image
WBRK-10 (Artificial)		WBRK-11		WBRK-12	
WBRK-13		WBRK-14		BROF	-
MAMBAT81-02		MAMCAM09-02		MAMCAM13-01	
LGCAM04	-	SGBAT04	-	Bat rec 9	

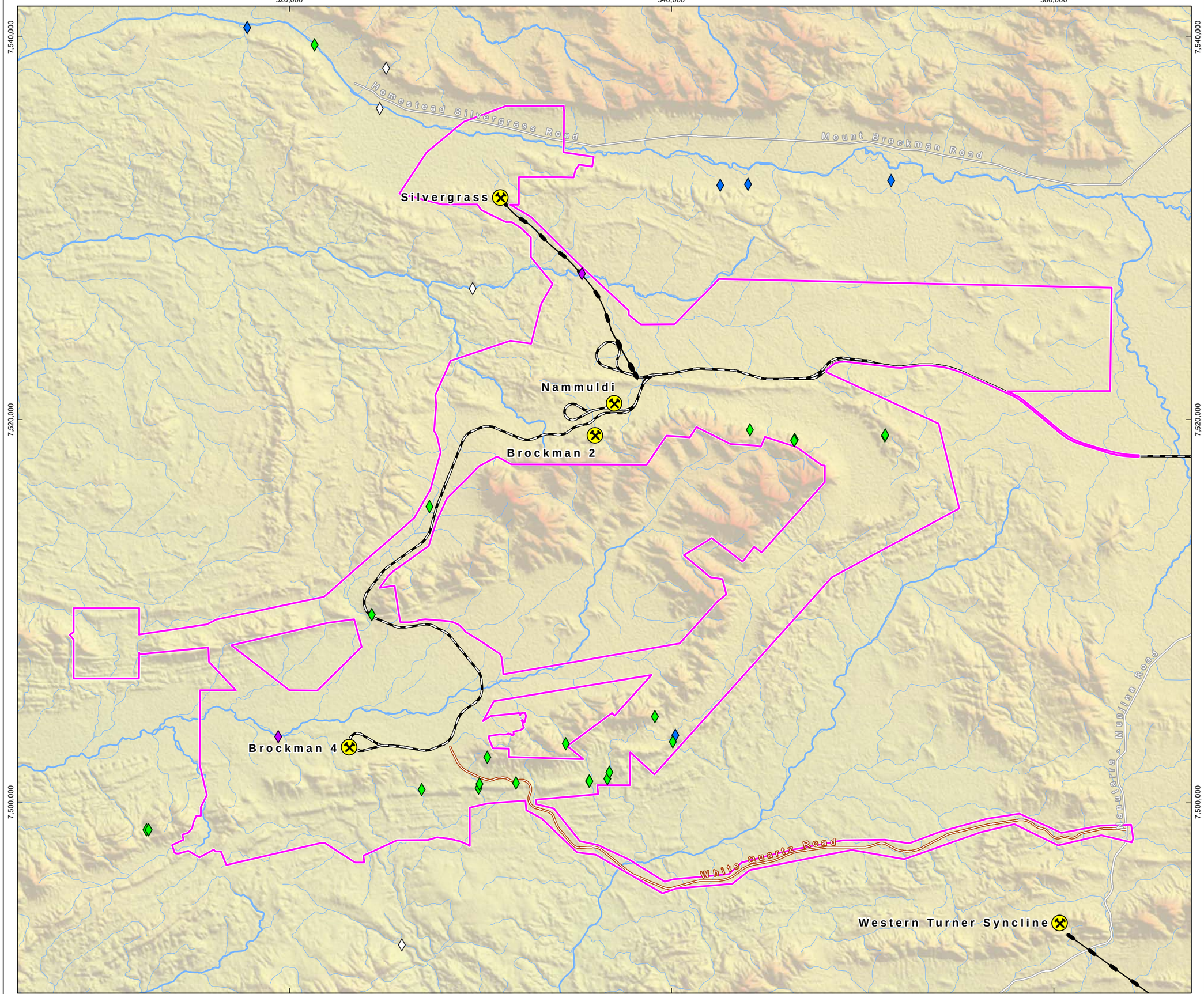
Water Feature	Image	Water Feature	Image	Water Feature	Image
No Name	-	No Name	-		
Oustside Development Envelope					
WBRK-04		WBRK-06			

RioTinto

Figure 8-6
Water Features Recorded within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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RioTinto

Figure 8-6
Water Features Recorded within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

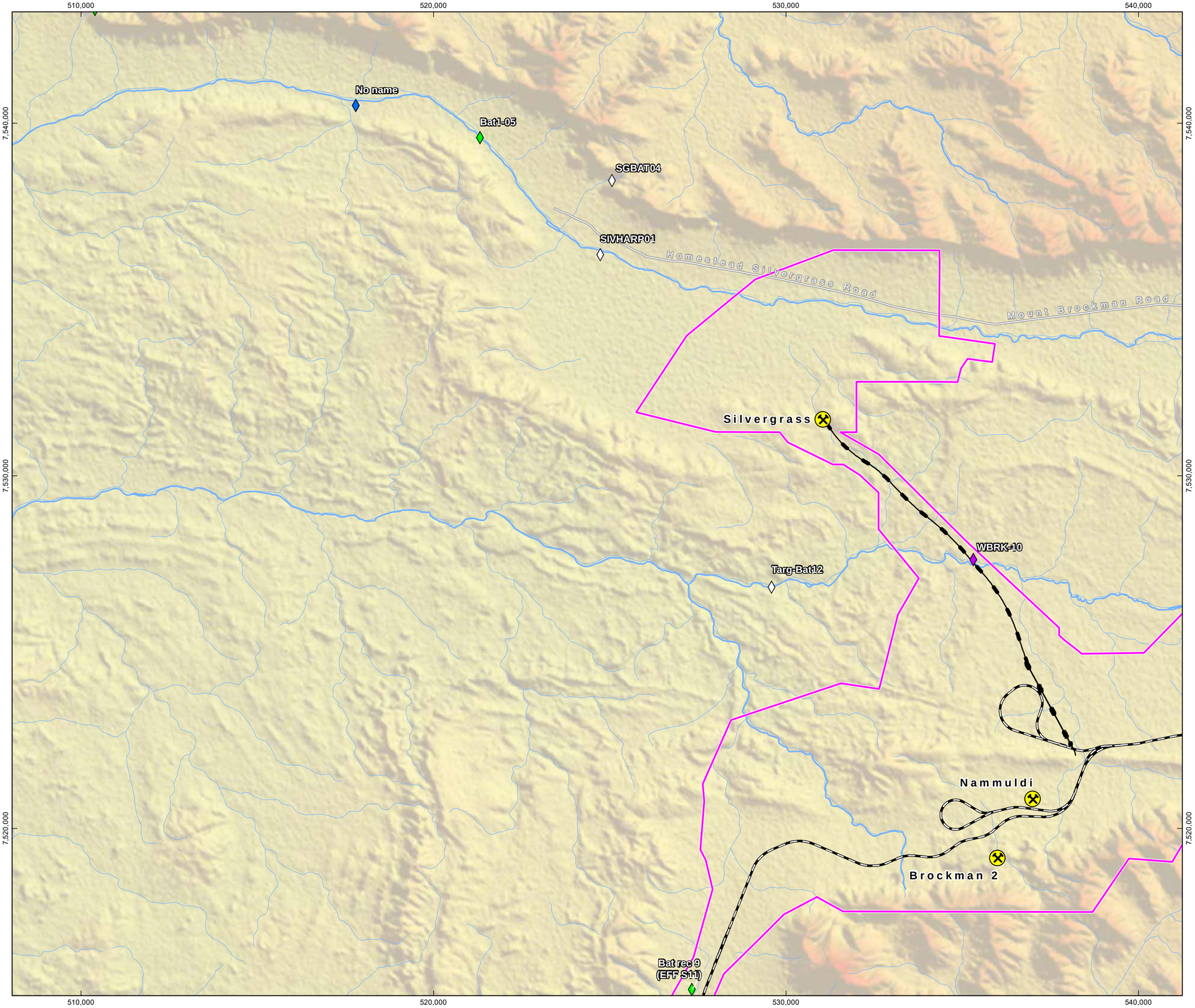
Legend

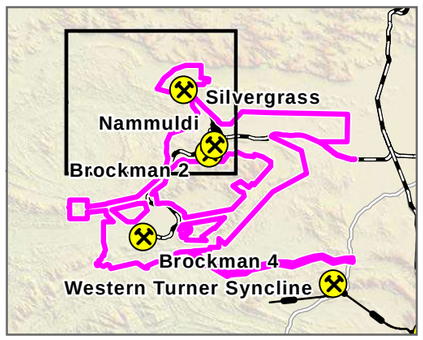
- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek





N

0 1 2 3
Kilometres

Map units in metres

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RioTinto

Figure 8-6
Water Features Recorded within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

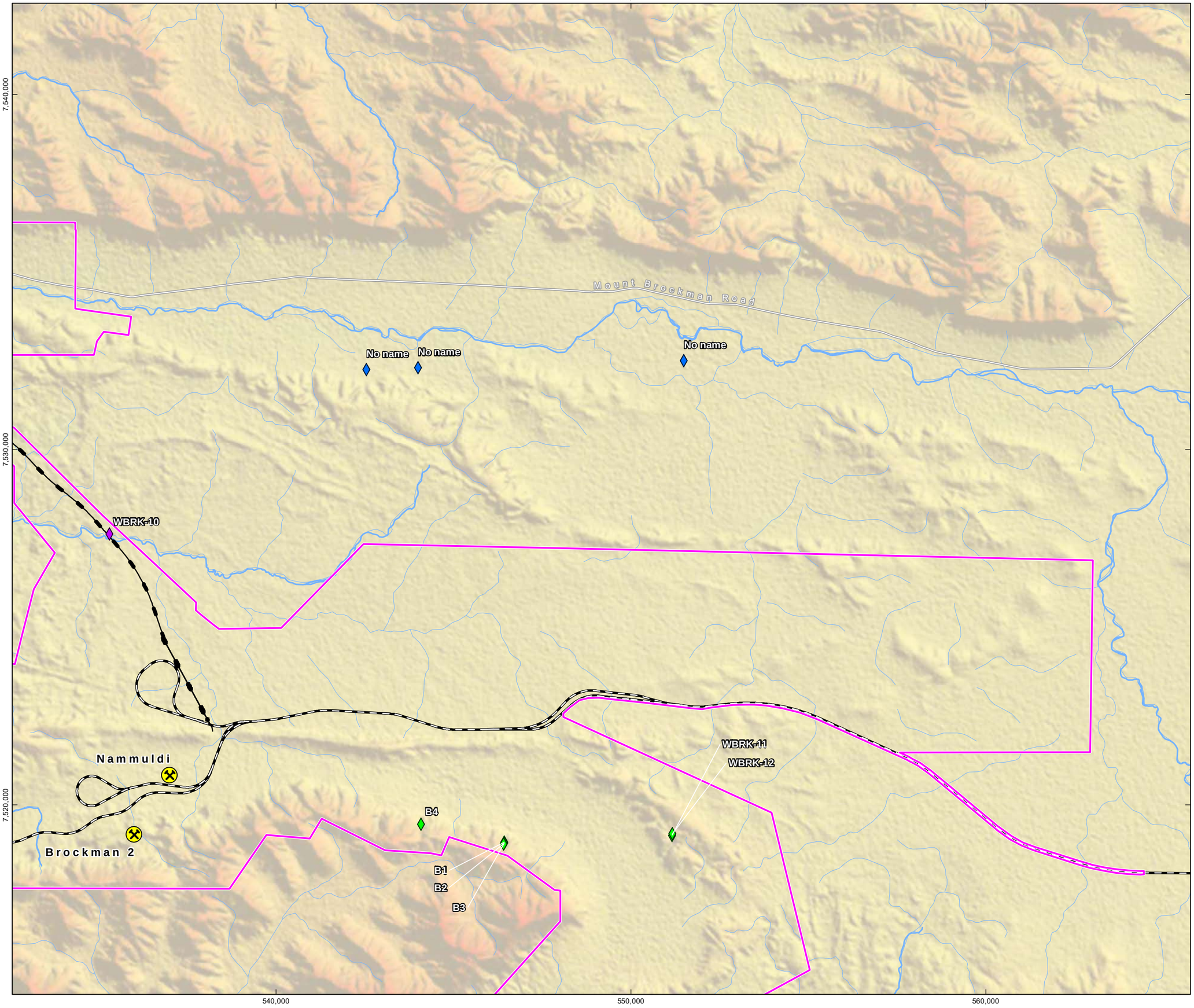
Legend

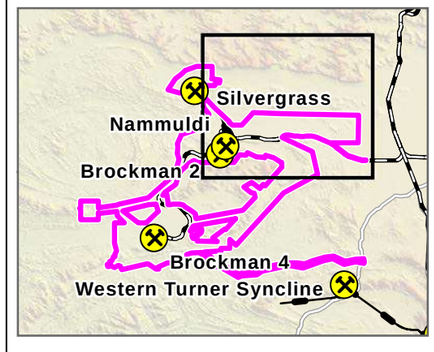
- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek





N

0 1 2 3

Kilometres

Map units in metres

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RioTinto

Figure 8-6
Water Features Recorded within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

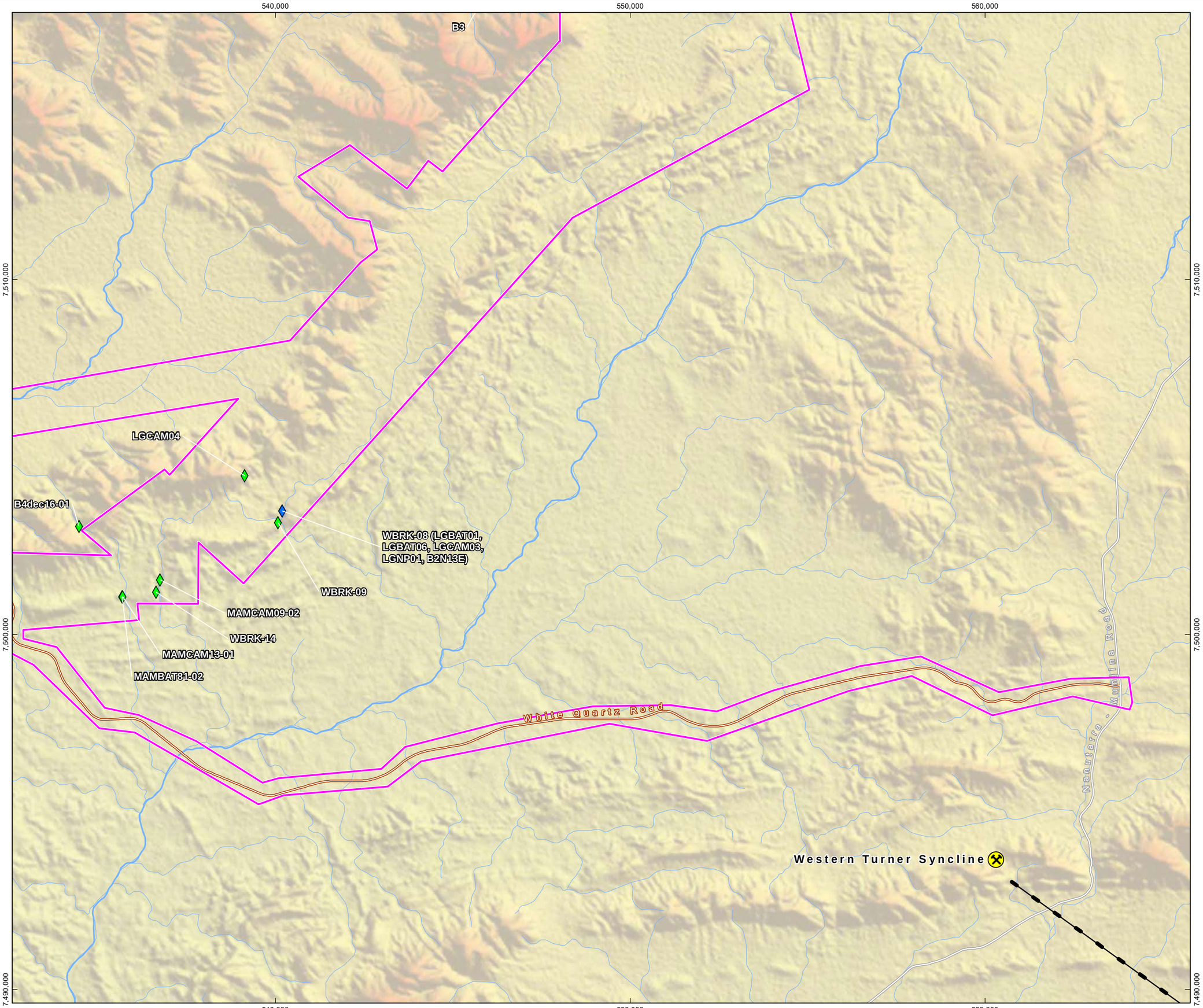
Legend

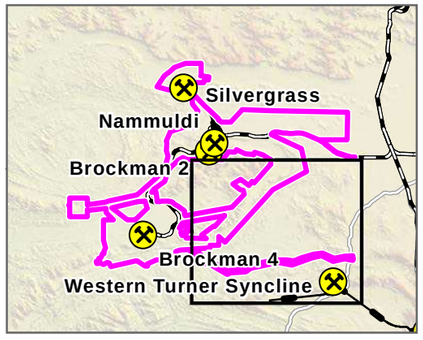
- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek
- Minor Creek





N

0 1 2 3

Kilometres

Map units in metres

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RioTinto

Figure 8-6
Water Features Recorded within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

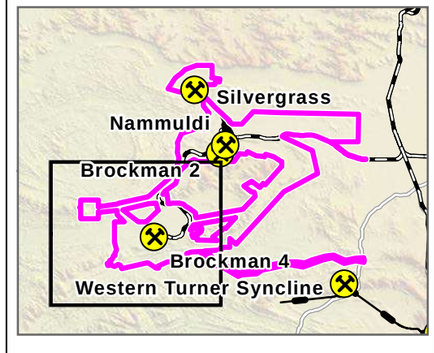
- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek
- Minor Creek

510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Bat rec 9 (EFF S11)
BROF
WBRK-02
Brockman 4
WBRK-06
WBRK-04
WBRK-01
No name
No name
White Quartz Road
MAMBAT81-02
MAMCAM13-01
WBRK-13
WBRK-03
B4dec16-01
MAMCAM03-01
MAMCAM14-01
No name
(Limonites area)



N

0 1 2 3
Kilometres

Map units in metres

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8.3.3. Fauna Assemblage and Species Diversity

The fauna assemblage in the Development Envelope is considered typical of the Hamersley subregion. A total of 179 vertebrate species have been recorded within the Development Envelope (including two amphibians, 75 bird, 33 mammal and 69 reptile species (Biota 2016b, Biota 2019d, Biologic 2020d, Stantec 2020a).

8.3.3.1. Amphibians

Two amphibian frog species were recorded within the Development Envelope:

- *Cyclorana maini*
- *Litoria rubella*.

No EPBC Act, BC Act or DBCA priority listed amphibian species were recorded within the Development Envelope, and none are known to occur within the Pilbara region (Biota 2019d, Biologic 2020d and Stantec 2020a).

8.3.3.2. Birds

A total of 75 bird species were recorded within the Development Envelope. The most common bird species recorded were the Zebra Finch (*Taeniopygia guttata*), Budgerigar (*Melopsittacus undulatus*) and Weebill (*Smicrornis brevirostris*) (Biota 2016b, Biota 2019d; Stantec 2020a).

Two listed bird species were recorded within the Development Envelope. The Fork-tailed Swift (*Apus pacifus)* (Migratory under both the EPBC Act and BC Act) was recorded within Minor Creekline habitat in BS4 assessment area, and the Peregrine Falcon (*Falco peregrinus*) (DBCA Priority species) was recorded in Gorge/Gully habitat in BS2 assessment area (Biota 2019d).

8.3.3.3. Reptiles

A total of 69 reptile species were recorded within the Development Envelope (Biota 2019d; Biologic 2020d and Stantec 2020a). The most abundant reptile groups were the skinks and geckos, with Shaded-litter Rainbow Skink (*Carlia munda*) and Bynoe's Gecko (*Heteronotia binoei*) being the most common (Biota 2019d and Stantec 2020a).

Two listed reptile species were recorded within the Development Envelope. The Pilbara Olive Python (*Liasis olivaceus barroni*) (Vulnerable under both the EPBC and BC Act) was recorded in three habitat types within BS1, BS2 and BS3 assessment areas. The Lined Soil-Crevice Skink (*Notoscincus butleri*) (Priority 4) was recorded in Alluvial Plain habitat in BS1 assessment area (Biologic 2020d, Stantec 2020a).

8.3.3.4. Mammals

Thirty-three mammal species were recorded within the Development Envelope, including five introduced species (Biota 2019d; Stantec 2020a). The most common species were the Long-tailed Planigale (*Planigale ingrami*), Common Rock Rat (*Zyzomys argurus*) and Little Red Kaluta (*Dasykaluta rosamondae*). All three species are common and widespread in the Pilbara region (Stantec 2020a).

Twelve bat species were recorded from bat echolocation recordings and acoustic recordings within the Development Envelope (Biota 2019d, Biologic 2020d; Stantec 2020a). Common Sheath-tailed Bat (*Taphozous georgianus*) and Gould's Wattled Bat (*Chalinolobus gouldii*) were the most commonly recorded bat species, with calls recorded at multiple sites (Biota 2019d).

Four listed mammal species were recorded within the Development Envelope. Northern Quoll (*Dasyurus hallucatus*) (Endangered under the EPBC and BC Act) was recorded within four habitats in BS2, BS3 and BS4 assessment areas. The Pilbara Leaf-nosed bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*) (both vulnerable under the EPBC and BC Act) were recorded within ten habitat

types in all assessment areas. The Western Pebble-mound Mouse (*Pseudomys chapmani*) (Priority 4) was recorded in eight habitat types in all assessment areas (Biologic 2020d, Stantec 2020a).

8.3.3.5. Feral Animals

Five feral mammal species were recorded and included the Cat (*Felis catus*), Dingo (*Canis familiaris*), European Cattle (*Bos taurus*), Horse (*Equus caballus*) and House Mouse (*Mus musculus*).

8.3.3.6. Significant Fauna

Of the 179 vertebrate fauna species, eight species of significance were recorded within the Development Envelope, whilst an additional four species were considered likely to occur within the Development Envelope (Table 8-8).

These are discussed in further detail in the following subsections.

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

Species	EPBC Act Listing	BC Act Listing	DBCA Priority Species
Known to Occur within the Development Envelope			
Northern Quoll (*Dasyurus hallucatus*)	Endangered	Endangered	-
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	Vulnerable	Vulnerable	-
Ghost Bat (*Macroderma gigas*)	Vulnerable	Vulnerable	-
Pilbara Olive Python (*Liasis olivaceus barroni*)	Vulnerable	Vulnerable	-
Fork-tailed Swift (*Apus pacificus*)	Migratory	Migratory	-
Peregrine Falcon (*Falco peregrinus*)	-	-	Other Specifically Protected
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	-	Priority 4
Lined Soil-crevice Skink (*Notoscincus butleri*)	-	-	Priority 4
Likely to Occur within the Development Envelope			
Grey Falcon (*Falco hypoleucos*)	Vulnerable	Vulnerable	-
Gane's Blind Snake (*Anilios ganei*)	-	-	Priority 1
Long-tailed Dunnart (*Sminthopsis longicaudata*)	-	-	Priority 4
Short-tailed Mouse (*Leggadina lakedownensis*)	-	-	Priority 4
Unlikely to Occur, however Habitat Exists within the Development Envelope			
Greater Bilby (*Macrotis lagotis*)	Vulnerable	Vulnerable	-

Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll (Plate 8-1) 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 (DotEE 2019).



Source: Nature 2018

Plate 8-1: 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 (DotEE 2019). In the Pilbara, the most recent records have come from the Rocklea, Macroy and Robe land systems (DotEE 2019). 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 (DotEE 2019). 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).

Northern Quolls have been recorded on 62 occasions within the survey area between 2019 and 2021 via a variety of sampling methods, including trapping (34), camera traps (10) and secondary evidence (comprising scats (27) and tracks (1)). Of the 34 captures, 18 were considered unique individuals (seven females, eight males and three unidentified) (Biologic 2022a) (Figure 8-7).

The EPBC Act referral guideline (DoE 2016a) defines critical habitat for the Northern Quoll as; a habitat within the modelled distribution for the species that provide shelter for breeding, refuge from fire and/or

predation and potential predation poisoning from Cane Toad (*Rhinella marina*). Critical denning habitat within the survey area has been classified by Biologic (2022a) as Gorge/Gully and Debris Slope/Rocky Outcrop habitats (Figure 8-8).

The referral guidelines (DoE 2016a) include dispersal and foraging habitat associated with or connecting important populations as critical habitat. However, these habitats are of greatest importance when near rocky denning habitat; therefore, foraging and dispersal habitat within 1 km of critical breeding habitat is defined as supporting habitat for Northern Quoll. Critical Foraging and dispersal habitat has been classified by Biologic (2022a) as Major and Minor Creekline habitat. Individuals may also utilise the remaining habitats Footslope, Gently Sloping Rise, Midslope/Upper Slope, Pediment Slope and Plateau; however, this use is likely to be temporary, confined to areas close to critical habitat and for foraging or dispersal (Biologic 2022a (Figure 8-8).

Despite considerable sampling effort throughout the survey area to date, records of the species are relatively sparse with only 11 scats being recorded within the Development Envelope. The exception to this is the population occurring outside of the Development Envelope at Vivash (southwest of BS4 assessment area), which is considered a high-density population based on the number of individuals recorded over several sampling events and, therefore, an important population as defined by DoE (2016a). In total, there were 32 northern quoll captures of 16 individuals (seven females, six males and three undetermined). Overall, the population in the Vivash trapping area was estimated to be approximately 19 individuals, though this is regarded as a large underestimate based on limitations with the statical analysis and the sampling regime.

For the remainder of the survey area, including the areas within the Development Envelope, the population should be considered a low-density population in accordance with DoE (2016a; Biologic 2022a).

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Figure 8-7
Northern Quoll Records Within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189723v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

Legend

- Development Envelope
- Survey Area

***Dasiyurus hallucatus* (Northern Quoll)**

Sampling Method

- Cage trap
- Elliott trap
- Motion Camera (active)
- Motion Camera (passive)
- Opportunistic
- Secondary observation
- Other

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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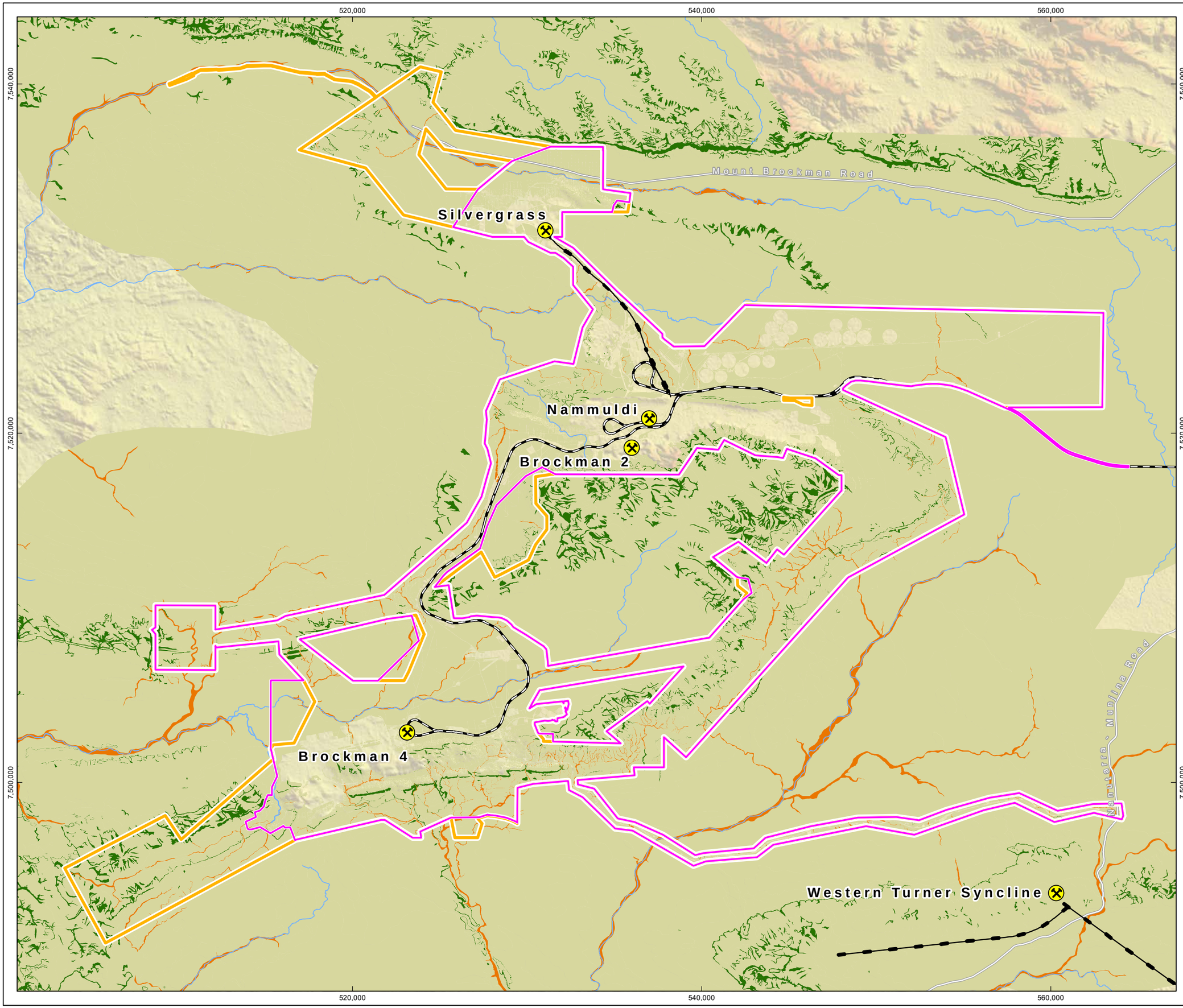

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Figure 8-8
Potential Northern Quoll Habitat within and Surrounding the Proposal
Overview

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
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Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 8-8
Potential Northern Quoll Habitat within and Surrounding the Proposal Map A

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Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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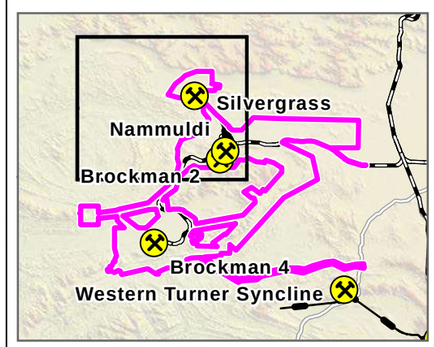
Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 8-8
Potential Northern Quoll Habitat within and Surrounding the Proposal Map B

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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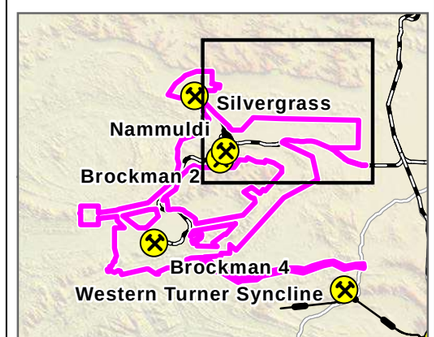
Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 8-8
Potential Northern Quoll Habitat within and Surrounding the Proposal Map C

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 8-8
Potential Northern Quoll Habitat within and Surrounding the Proposal Map D

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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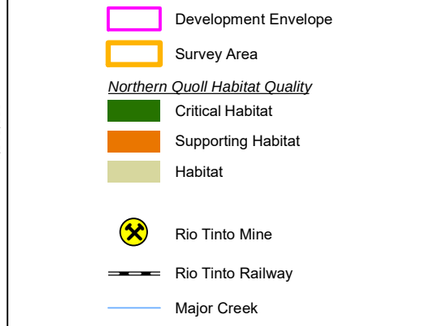
Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Boolgeeda Creek
Brockman 4
Beasley River West
Beasley River

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The Pilbara Leaf-nosed Bat (Plate 8-2) 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 2016a). Currently, there are 48 confirmed permanent diurnal (category 1 and 2) roost sites within the Pilbara region. Thirty-eight of these roosts are in banded iron formations 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 8-2: Pilbara Leaf-nosed Bat

Pilbara Leaf-nosed Bats typically roost in undisturbed caves, deep fissures or abandoned mine shafts (Armstrong, 2000, 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, 2000, 2001; Bullen & 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, 2000, 2001; Bullen & McKenzie, 2011).

Since sampling for the Pilbara Leaf-nosed Bat began in 2005 within the survey area, 70 records of the species have been detected by ultrasonic recorder. Additionally, in the tracking program undertaken for the Proposal, ten individuals tagged by Biologic (2022c) were recorded from 1,972 detections within the survey area by VHF tracking (Biologic 2022a). The tracking program revealed that most of the bats foraged within 11 km of the Upper Beasley River Roost (located within an excised area approximately 670 m outside of the Development Envelope). Foraging occurred within various habitats, including Major

and Minor Creeklines, Alluvial and Colluvial Plains and Gorge/Gully and Debris Slope/Rocky Outcrop surrounding the Upper Beasley River Roost both inside and outside of the Development Envelope. During the tracking program, one individual was recorded foraging at Plunge Pool. The individuals were recorded at 12 non-cave sites within Gorge/Gully, Debris Slope/Rocky Outcrop and Major Creekline habitats (Biologic 2022c). This program suggests that while bats can travel larger distances, they prefer to forage in habitat close to their associated diurnal roost, in this instance the Upper Beasley River Roost (Biologic 2022c).

There have been 97 records of the Pilbara Leaf-nosed Bat within the extrapolated fauna habitat mapping area i.e., a 10 km buffer of the survey area (comprising 11 individuals trapped and 86 records of calls) (Biologic 2022c).

Pilbara Leaf-nosed Bat records were primarily located within the vicinity or entrance of known roosts, particularly the Upper Beasley River Roost complex, a known permanent diurnal roost, located approximately 670 m outside the Development Envelope (Biologic 2022a), most of the records within the survey area are likely to represent individuals originating and roosting within the Upper Beasley River Roost (Figure 8-9) (Biologic 2022a). Records from the Silvergrass and Vivash areas may also be representative of individuals originating from two currently undiscovered roosts; the Lower Caves Creek Roost and the Vivash Gorge Roost.

Caves within the ERD have been classified according to Bat Call (2021a, Appendix E.5).

Of the 208 caves known from the survey area, one is a potential transitory diurnal roost (category 3) roost according to Bat Call WA (2021a), 22 are nocturnal refuges (category 4 roost), 150 are potential nocturnal refuges (category 4 roost), and 35 are not suitable (Figure 8-9) (Bat Call WA 2021a).

Of the 208 caves known from the survey area, 131 occur within the Development Envelope consisting of 12 nocturnal refuges (category 4 roosts), 90 potential nocturnal refuges (category 4 roost), and 29 that are not suitable (Table 8-9). All of the roosts within the Development Envelope have been categorised as category 4 roosts which are not considered critical habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021a). Gorge/Gully and Debris Slopes/Rocky Outcrop habitat types are regarded as critical priority foraging habitat for the species. Supporting foraging and dispersal habitat is represented by the Major and Minor Creekline habitats and Plains (combined Alluvial, Colluvial and Hardpan Plain habitats) (TSSC 2016a) when within 10 km of the Upper Beasley River Roost and Plunge Pool, based on the average distance observed from the VHF tracking program at Brockman (Biologic 2022a; 254]) (Figure 8-10).

According to the definition prescribed by the TSSC (2016a), the entire Pilbara represents one interbreeding population, meeting the requirements of an ‘important population’ as defined by DoE (2013). Most records from the study area are likely to represent individuals originating and roosting within the Upper Beasley River Roost, which is approximately 670 m outside the Development Envelope (Biologic 2022a). This population is considered an important population “necessary for a species’ long-term survival and recovery” based on the DoE (2013) definition of a key source population either for breeding or dispersal.

Of the 25 known water features within the survey area, all may provide foraging and drinking resources for the species. However, those naturally more persistent and closer to the Upper Beasley River Roost are likely to be of increased significance (i.e., Plunge Pool and Ridge Pool). Plunge is located approximately 6 km east of the UBRR within the Development Envelope and is consider as critical habitat for the Pilbara Leaf-nosed Bat. Ridge pool is located approximately 500 m south-east of the UBRR outside of the Development Envelope. Further information on Plunge and Ridge Pool is provided in Section 6.3.4.4.

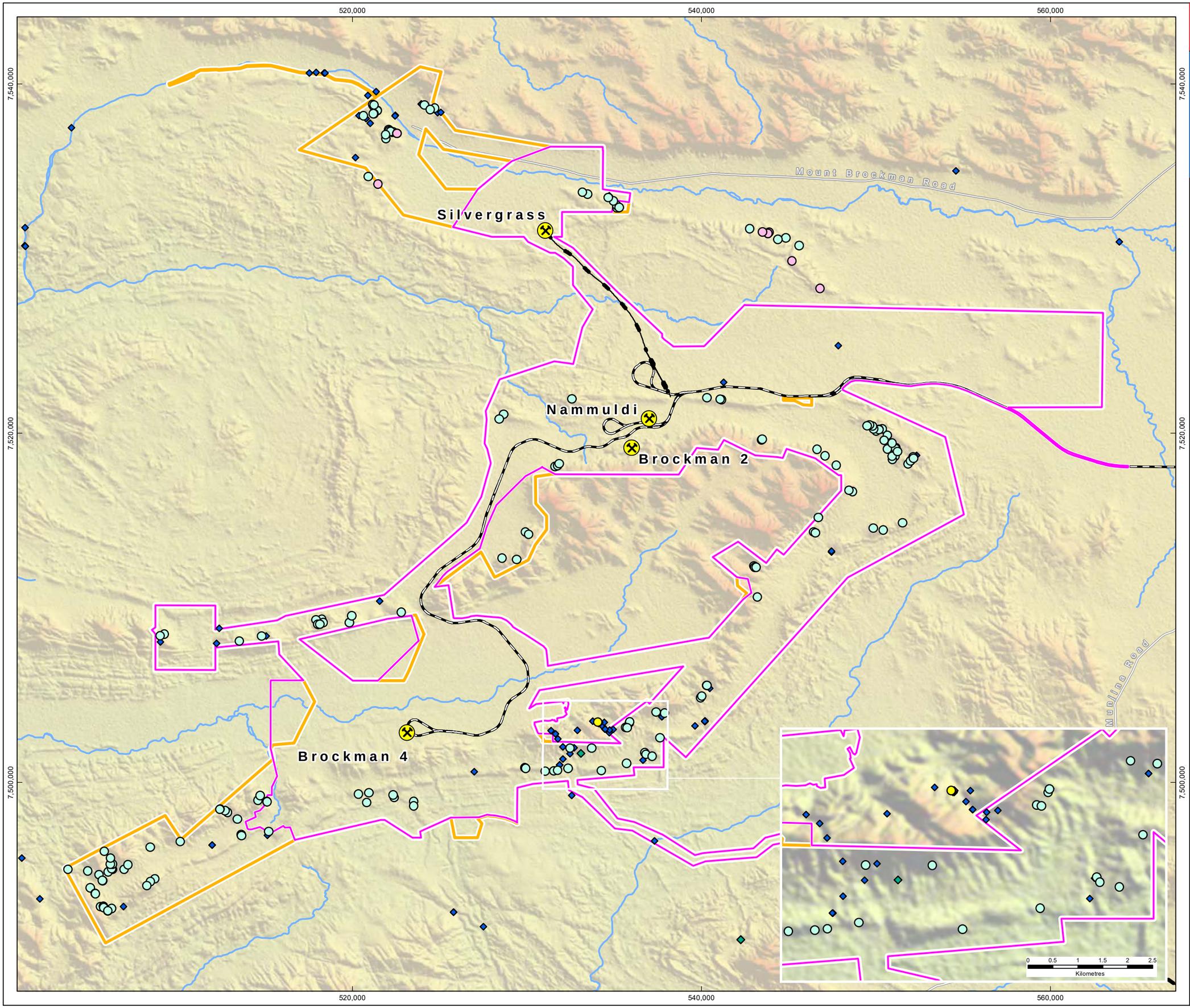

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Figure 8-9
Pilbara Leaf-nosed Bat Records and Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189725v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey

Pilbara Leaf-nosed Bat Roost

- Category 2 (Upper Beasley River Roost)
- Category 3
- Category 4

Rhinonicteris aurantia (VU)
(Pilbara Leaf-nosed Bat)

Sampling Method

- Audio Recording
- Echolocation Recording
- Other

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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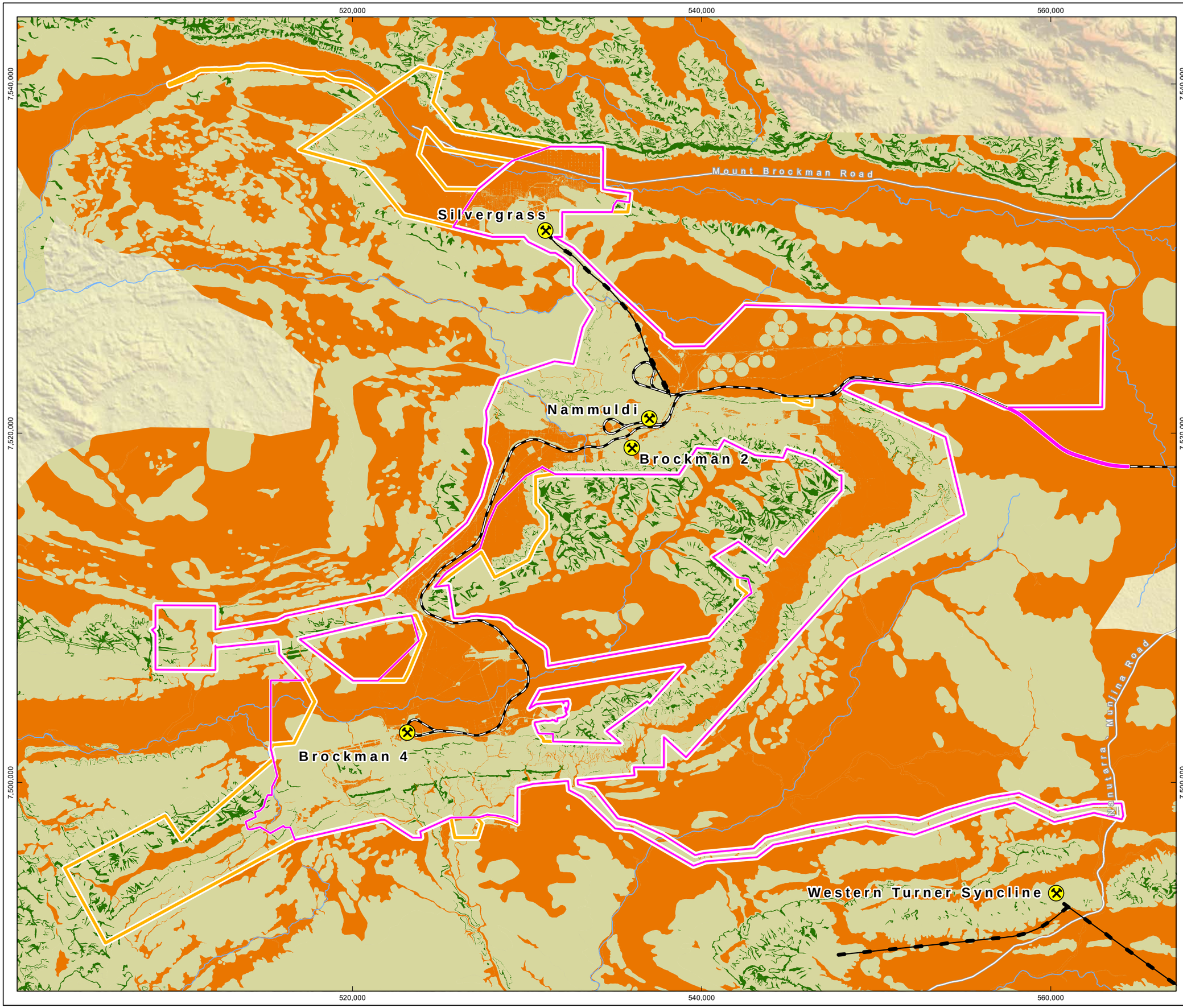

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Figure 8-10
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal
Overview

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 8-10
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

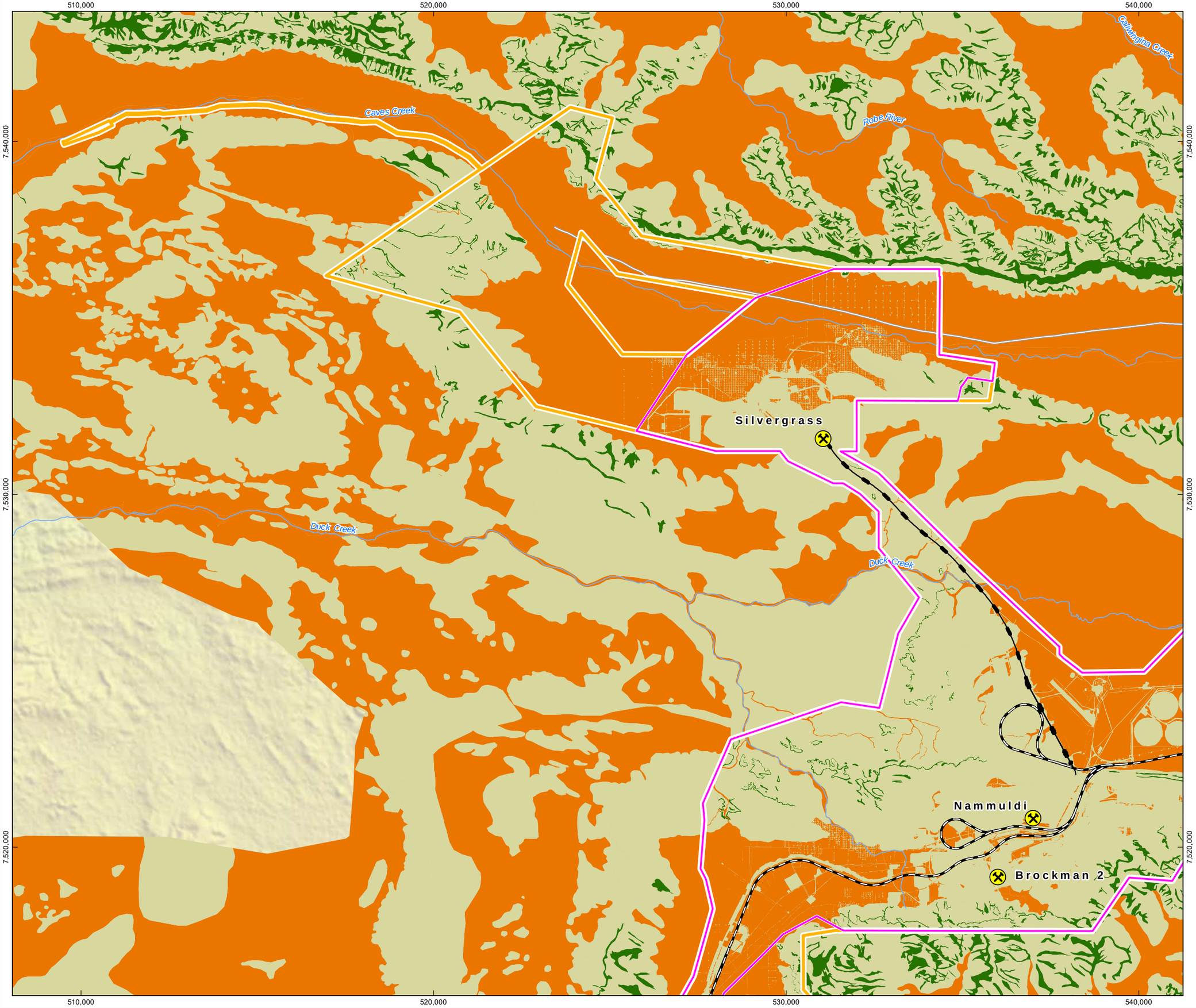
Legend

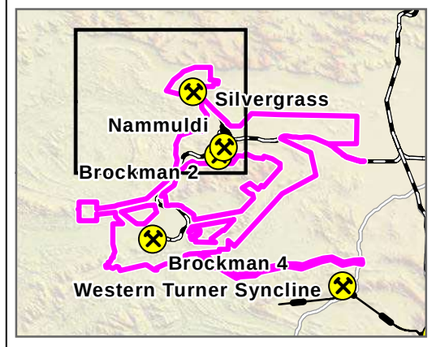
- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek





N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 8-10
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

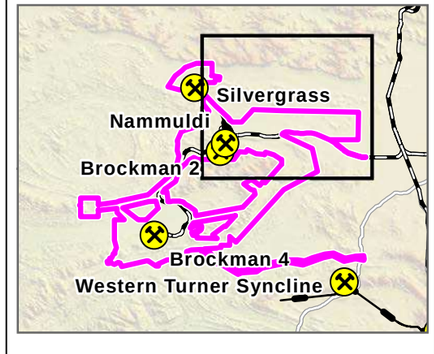
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



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Kilometres

Map units in metres

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Figure 8-10
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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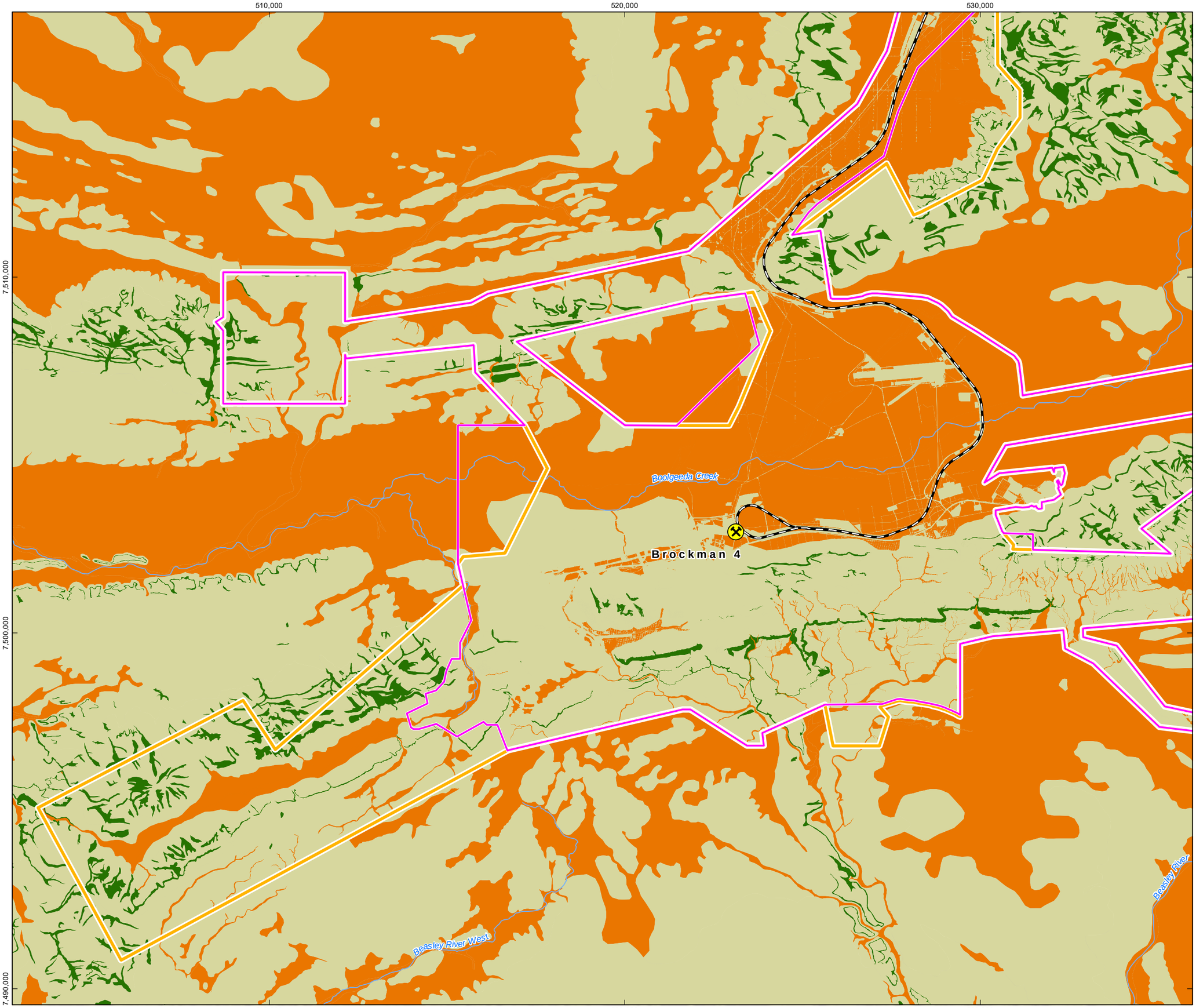

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Figure 8-10
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal Map D

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

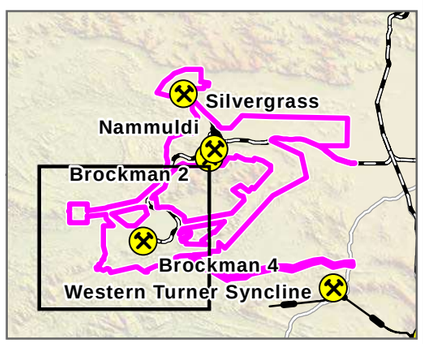
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Ghost Bat (*Macroderma gigas*)

The Ghost Bat (Plate 8-3) 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 2016b).



Source: Perth Zoo, 2022

Plate 8-3: Ghost Bat

The Pilbara population has recently been estimated to comprise between 1,300 and 2,000 individuals (TSSC 2016b). 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 2016b).

A total of 173 records of Ghost Bat have been observed within the survey area through several methods, including ultrasonic recordings (35), trapping using white sheets (9), scats (117) and direct observations (comprising both alive (11) and deceased individuals (1)) (Biologic 2022a). Seven records of the Ghost Bat from scats are within the extrapolated area (Biologic 2022a) (Figure 8-11). Additionally, Biologic (2022a) tagged nine individuals and recorded the species from 5,910 detections within the survey area and 29 detections within the extrapolated area by VHF tracking towers in tracking programs relevant to this Proposal.

Genetic analysis of scats identified 75 unique individuals within the survey area, although Biologic (2022a) considers this to be an underestimation of the number of individuals. Out of the individuals

identified, there was an even sex ratio, with 29 females and 29 males and 17 unidentified (Biologic 2022c).

Fauna survey reports (Biota 2016b, Biologic 2020d and Stantec 2020a) describe roost types using the previous classifications maternity, day and night roosts. Robert Bullen, a renowned Chiropterologist (from Bat Call WA), has assessed each cave in the Development Envelope and assigned each roost a category based on the following updated classifications (Bat Call WA 2021a in Appendix E.5):

- Category 1 – Maternity/diurnal roost with large and permanent occupancy
- Category 2 – Maternity/diurnal roost with regular occupancy
- Category 3 – Diurnal roost with occasional occupancy
- Category 4 – Nocturnal roost with opportunistic occupancy.

Caves within the ERD have been classified according to Bat Call (2021a, Appendix E.5).

There are no category 1 caves within the survey area. Bat Call WA (2021a) assessed all category 2 caves as critical habitat. Groupings of category 3 and 4 caves immediately surrounding higher category caves are also considered critical habitat and described as “apartment blocks” that support the viability of the category 2 caves (Bat Call WA 2021a). Bat Call WA (2021a) did not consider isolated category 3 and category 4 caves as critical habitat as these isolated caves are used opportunistically according to the methodology described in Appendix E.5. Examples of each roost category are provided in Plate 8-4, Plate 8-5 and Plate 8-6.

Of the 208 caves known from within the survey area, three are maternity (category 2) roosts, 16 are potential maternity roosts (category 2), seven represent diurnal (category 3) roosts, 86 represent potential diurnal (category 3) roosts, 42 represent night (category 4) roosts, 35 represent potential night (category 4) roosts, and 19 are unknown (however following the precautionary principal these have been classified as potential diurnal (category 3) roosts).

The presence of three category 2 and 16 potential category 2 caves within the survey area suggests that the species resides permanently within the survey area and Development Envelope. The population of Ghost Bats within the survey area forms part of a key source population for breeding and dispersal and is, therefore, an ‘important population’ as defined by DoE (2013) (Biologic 2022a).

Additional caves may be found throughout the survey area; however, it is very unlikely any further caves would provide critical habitat (i.e., category 2 caves) due to the extensive searching and ultrasonic recording results, which identify Ghost Bat activity.

Of the 208 caves known from the survey area, 131 occur within the Development Envelope consisting of one maternity roost (category 2 roost), seven potential maternity roosts (category 2 roost), six diurnal roosts (category 3 roosts), 54 potential diurnal roosts (category 3 roosts), 32-night roosts (category 4 roosts), 13 potential night roosts (category 4 roost) and 18 are unknown (precautionary classification as category 3 roosts) (Table 8-9).

Overall, 12 apartment block roost complexes (comprising a category 2 roost with several other caves, shelters and overhangs within a few hundred meters (totalling 47 roosts)) and four isolated category 2 (without a roost complex) roosts were identified within the survey area (Bat Call WA 2021 a). Of these, six apartment block roost complexes (comprising a total of 20 roosts) and two isolated category 2 roost occur within the Development Envelope (Table 8-9 and Figure 8-12).

Apartment Blocks and isolated category 2 caves are displayed on Figure 8-13. Isolated category 3 and category 4 caves are presented on Figure 8-14.

Because the majority of these roosts are located within Gorge/Gully and Debris Slope/Rocky Outcrop habitats, these habitat types are considered to provide critical breeding and roosting habitat for the species. Records 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 category 2 and category 3 roosting sites and most commonly moves small distances (approximately 6 km) between roosting sites (Biologic 2022c). For this reason, supporting foraging and dispersal habitat is represented by Alluvial Plain, Colluvial Plain, Hardpan Plain, Major Creekline and Minor Creekline habitats within 5 km of a category 2 or category 3 roost within an apartment block (Figure 8-14).



Plate 8-4: Example of Category 2 Ghost Bat Roost



Plate 8-5: Example of Category 3 Ghost Bat Roost



Plate 8-6: Example of Category 4 Ghost Bat Roost

Table 8-9: Cave Classifications for the Ghost and Pilbara Leaf-nosed Bats within and Surrounding the Proposal

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
Inside Development Envelope							
B2BAT06		X		No		X	
B4jul16-26-27			X	No			X
B4jun16-09				No			X
B4jun16-36		X		No		X	
B4June16-26			X	No			X
BS4MM-Aug16-03			X	No			X
BS4MM-Aug16-04		X		No			X
BS4MM-Aug16-13		X		No			X
BS4MM-Aug16-15		X		No		X	
BS4MM-Aug16-18		X		No			X
BS4MM-Aug16-19		X		No			X
BS4MMJul16-11		X		No			X
BS4MMJul16-13		X		No			X
BS4MMJul16-14		X		No			X
BS4MMJul16-15		X		No			X
BS4MMJul16-17		X		No			X
BS4MMJul16-30		X		No		X	
C1			X	No		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
C2			X	No		X	
C8		X		No		X	
CBRK-000		X		No		X	
CBRK-006			X	No		X	
CBRK-045		X		No		X	
CBRK-052		X		No		X	
CBRK-053		X		No		X	
CBRK-055			X	No		X	
CBRK-057			X	No		X	
CBRK-059		X		No		X	
CBRK-061		X		AB-BS-7		X	
CBRK-063		X		AB-BS-7		X	
CBRK-065		X		AB-BS-7		X	
CBRK-067	X			AB-BS-7		X	
CBRK-069	X			AB-BS-8		X	
CBRK-071			X	AB-BS-8		X	
CBRK-073		X		No		X	
CBRK-074		X		No		X	
CBRK-075			X	No		X	
CBRK-076	X			AB-BS-9		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
CBRK-077			X	No		X	
CBRK-078	X			AB-SGE-2		X	
CBRK-079		X		AB-BS-9		X	
CBRK-080			X	AB-SGE-2		X	
CBRK-081			X	AB-BS-9		X	
CBRK-082	X			No		X	
CBRK-083		X		AB-BS-9		X	
CBRK-084		X		No		X	
CBRK-085	X			AB-BS-9		X	
CBRK-086		X		No		X	
CBRK-087			X	No		X	
CBRK-089		X		No		X	
CBRK-090			X	No		X	
CBRK-091			X	No		X	
CBRK-092			X	No		X	
CBRK-093	X			AB-BS-10		X	
CBRK-094			X	No		X	
CBRK-095			X	No		X	
CBRK-096			X	No		X	
CBRK-097			X	No		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
CBRK-098			X	No		X	
CBRK-099		X		No		X	
CBRK-100		X		No		X	
CBRK-101			X	No		X	
CBRK-102			X	No		X	
CBRK-103		X		No		X	
CBRK-104		X		No		X	
CBRK-105			X	No		X	
CBRK-106		X		No		X	
CBRK-107			X	No		X	
CBRK-108		X		No		X	
CBRK-109		X		No		X	
CBRK-110		X		No		X	
CBRK-111		X		No		X	
CBRK-113			X	No		X	
CBRK-116		X		No		X	
CBRK-119		X		No		X	
CBRK-120			X	No		X	
CBRK-121		X		No		X	
CBRK-122			X	No		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
CBRK-123			X	No		X	
CBRK-124			X	No		X	
CBRK-125		X		No		X	
CBRK-126			X	No		X	
CBRK-136			X	No		X	
CBRK-137		X		No		X	
CBRK-138			X	No		X	
CBRK-139		X		No		X	
CBRK-140		X		No		X	
CBRK-141		X		No		X	
CBRK-142			X	No		X	
CBRK-143			X	No		X	
CBRK-144		X		No		X	
CBRK-145			X	No		X	
CBRK-147			X	No		X	
CBRK-148			X	No		X	
CBRK-149			X	No		X	
CBRK-150		X		No		X	
CBRK-151		X		No		X	
CBRK-152			X	No		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
CBRK-153		X		No		X	
CBRK-154		X		No		X	
CBRK-173		X		No		X	
CBRK-174		X		No			X
CBRK-199			X	No		X	
GBS_CA_03		X		No		X	
GBS_CA_04			X	No		X	
GBS_CA_05		X		No		X	
GBS_CA_06		X		No			X
GBS_CA_08		X		AB-BS-11			X
GBS_CA_09		X		AB-BS-11			X
GBS_CA_10		X		AB-BS-11			X
GBS_CA_11		X		AB-BS-11			X
GBS_CA_12		X		AB-BS-11			X
GBS_CA_14		X		AB-BS-11			X
GBS_CA_15		X		No			X
GBS_CA_16			X	No			X
GBS_CA_17	X			No			X
GBS_CA_18		X		No			X
GBS_CA_20		X		No			X

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
GBS_CA_21		X		No			X
GBS_CA_22		X		No			X
MAMBAT81-01		X		No		X	
MAMBAT93-01		X		No		X	
MAMCAM11-01		X		No		X	
MMBAT01		X		No		X	
MMBAT02		X		No		X	
MMBAT03		X		No		X	
MMBAT04		X		No		X	
MME05		X		No		X	
MME06		X		No			X
NWTBAT01		X		No		X	
NWTBAT02		X		No		X	
Subtotal	**8**	**78**	**45**	**N/A**	**0**	**102**	**29**
Outside Development Envelope							
C3	X			AB-SGE-1		X	
C4	X			AB-SGE-1		X	
C5		X		AB-SGE-1		X	
C6			X	AB-SGE-1		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
C7			X	AB-SGE-1			X
CBKT-04			X	No		X	
CBRK-001			X	No		X	
CBRK-002			X	No		X	
CBRK-003			X	No		X	
CBRK-004			X	No		X	
CBRK-005	X			AB-BS-2		X	
CBRK-007	X			AB-BS-2		X	
CBRK-008		X		AB-BS-3		X	
CBRK-009			X	AB-BS-4		X	
CBRK-010		X		AB-BS-3		X	
CBRK-011			X	AB-BS-2	X		
CBRK-012		X		No		X	
CBRK-013			X	No		X	
CBRK-014	X			AB-BS-5		X	
CBRK-015	X			No		X	
CBRK-016		X		AB-BS-5		X	
CBRK-017		X		No		X	
CBRK-018		X		No		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
CBRK-020			X	No		X	
CBRK-021	X			AB-BS-4		X	
CBRK-022		X		No		X	
CBRK-023			X	AB-BS-4		X	
CBRK-024			X	No		X	
CBRK-025			X	AB-BS-4		X	
CBRK-026		X		No		X	
CBRK-028		X		No		X	
CBRK-030			X	No		X	
CBRK-031		X		No		X	
CBRK-032			X	No		X	
CBRK-033		X		Ab-BS-4		X	
CBRK-034		X		No		X	
CBRK-035		X		AB-BS-4		X	
CBRK-036		X		No		X	
CBRK-037			X	AB-BS-4		X	
CBRK-038	X			No		X	
CBRK-039			X	AB-BS-4		X	
CBRK-040			X	No		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
CBRK-041			X	No		X	
CBRK-042		X		AB-BS-5		X	
CBRK-043		X		No		X	
CBRK-044		X		No		X	
CBRK-046	X			No		X	
CBRK-047		X		No		X	
CBRK-048			X	No		X	
CBRK-049			X	No		X	
CBRK-050			X	No		X	
CBRK-051		X		No		X	
CBRK-054			X	No		X	
CBRK-056		X		No		X	
CBRK-058		X		AB-BS-6		X	
CBRK-060	X			AB-BS-6		X	
CBRK-062			X	No		X	
CBRK-064			X	No		X	
CBRK-066		X		No		X	
CBRK-068			X	No		X	
CBRK-070			X	No		X	

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category		
	Category 2	Category 3	Category 4		Category 3	Category 4	No Usage
CBRK-072			X	No		X	
CBRK-088		X		No		X	
CBRK-112		X		No			X
CBRK-114		X		No		X	
CBRK-115			X	No		X	
CBRK-146		X		No		X	
CBRK-175		X		No		X	
CBRK-176		X		No		X	
CBRK-177		X		No			X
CBRK-178	X			No		X	
GBS_CA_01			X	No		X	
GBS_CA_02		X		No		X	
GBS_CA_07		X		No			X
GBS_CA_13		X		No			X
GBS_CA_19			X	No			X
SIV15EH		X		No		X	
Subtotal	**11**	**34**	**32**	**N/A**	**1**	**70**	**6**
Total	**19**	**112**	**77**		**1**	**172**	**35**

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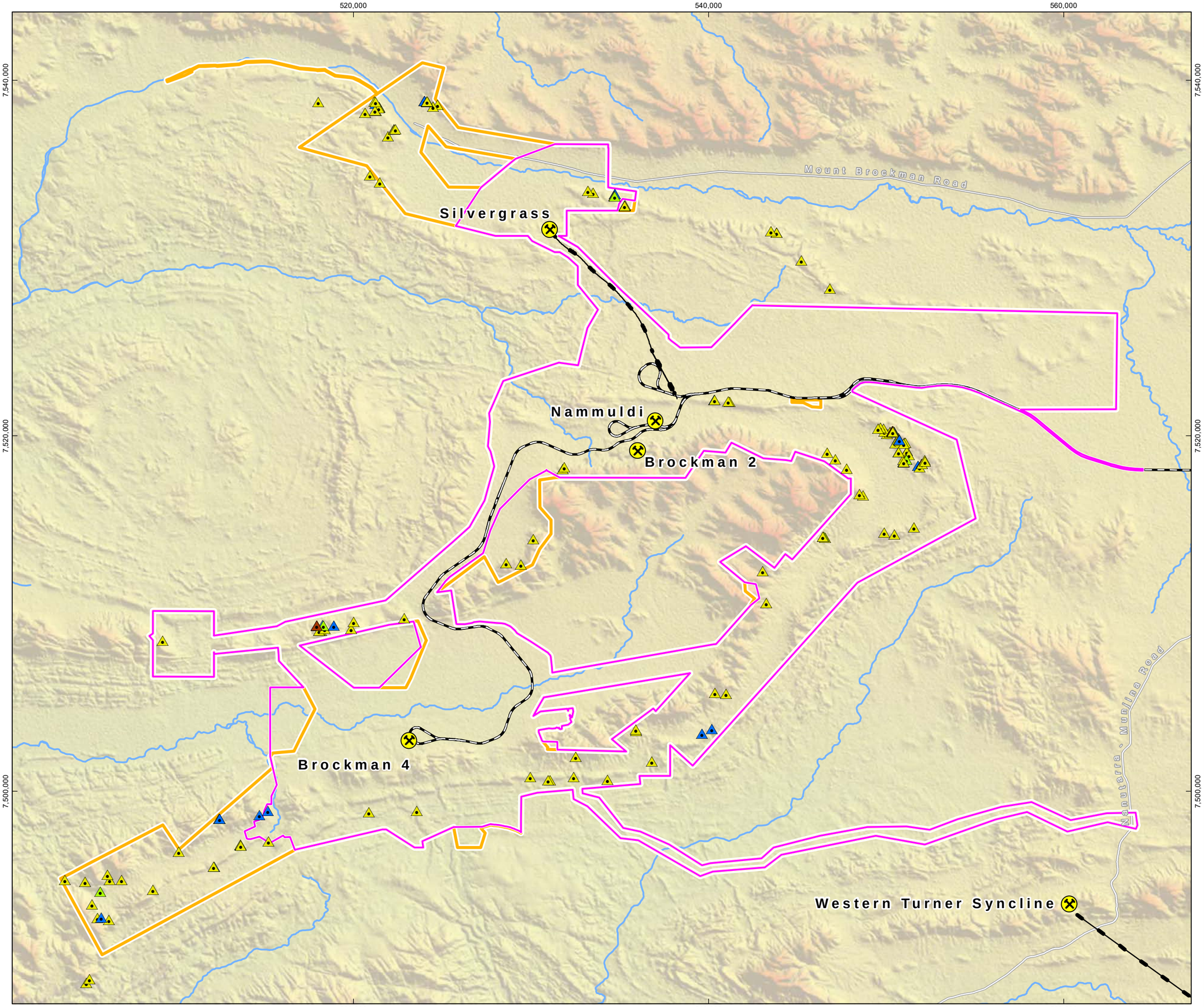
Figure 8-11
Ghost Bat Records within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189728v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope
- Survey Area
- *Macroderma gigas* (VU) (Ghost

Sampling Method

- Audio recording
- Echolocation Recording
- Opportunistic
- Secondary Observation
- Targeted Searches
- Trapping

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 8-12
Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189729v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Apartment Block

Ghost Bat Roosts

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4
- Unclassified

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

AB-BS-2
AB-BS-4
AB-SGE-2
AB-SGE-1
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
AB-BS-6
AB-BS-5
AB-BS-3
Western Turner Syncline

AB-BS-9
AB-BS-11
AB-BS-7
AB-BS-10
0 0.25 0.5 0.75 1
Kilometres

AB-BS-8
0 0.25 0.5 0.75 1
Kilometres

N
0 2 4 6 8 10
Kilometres

Map units in metres

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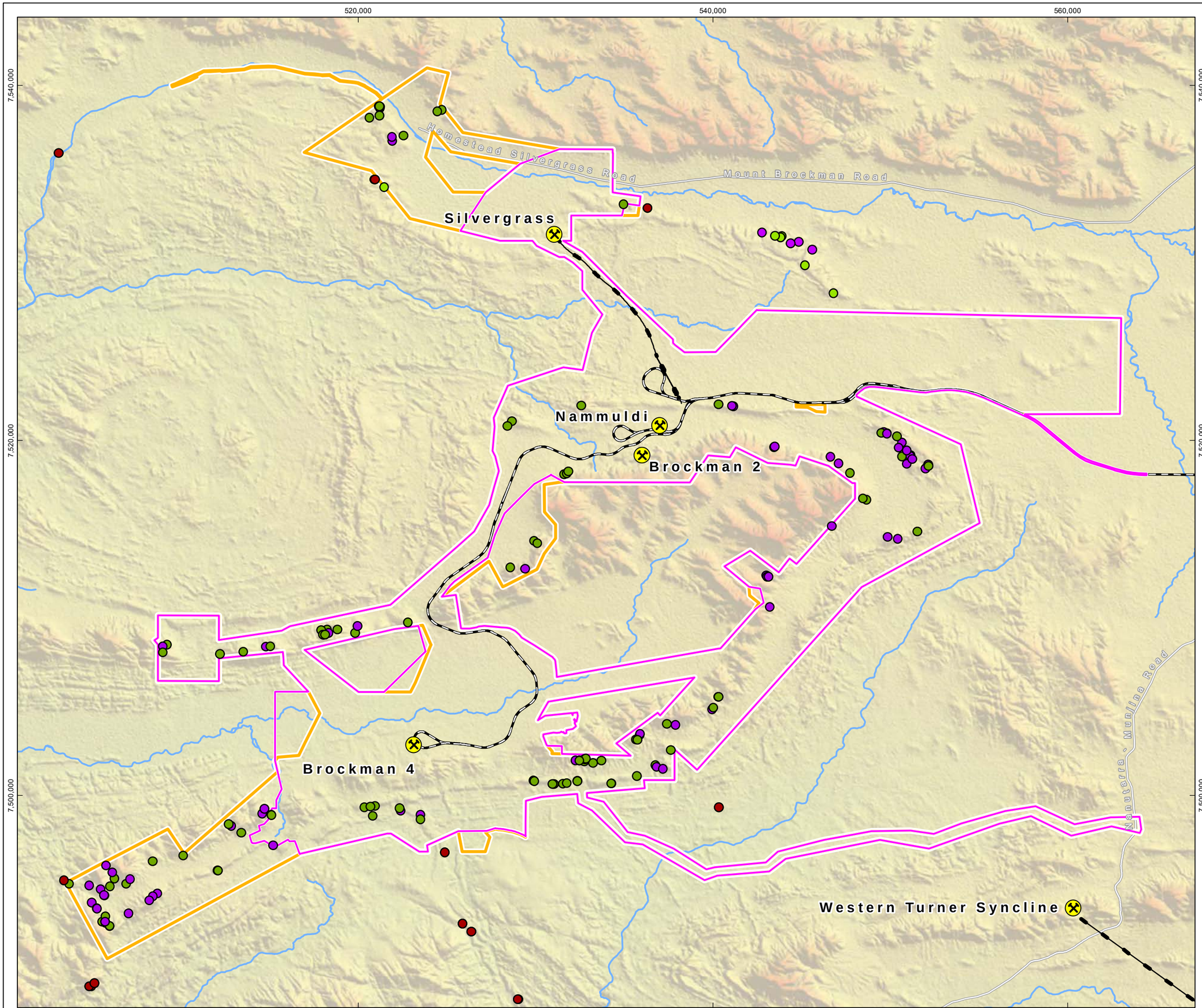
RioTinto

Figure 8-13
Category 3 and 4 Ghost Bat Roosts within and Surrounding the Proposal

Drawn: L Fuentes
Plan: PDE0189730v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com



Legend

- Development
- Survey Area

Ghost Bat Roots

- Category 3
- Category 4
- Unclassified

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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RioTinto

Figure 8-14
Potential Ghost Bat Habitat within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Nanutarra Munjina Road
Western Turner Syncline

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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RioTinto

Figure 8-14
Potential Ghost Bat Habitat within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

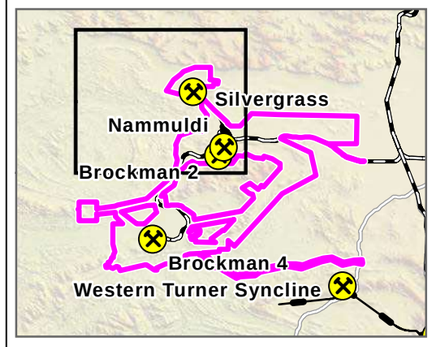
- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek





N

0 1 2 3 4 5

Kilometres

Map units in metres

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RioTinto

Figure 8-14
Potential Ghost Bat Habitat within and Surrounding the Proposal Map B

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

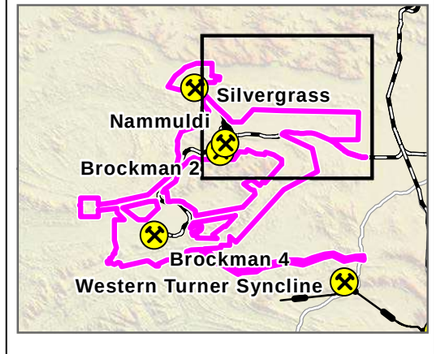
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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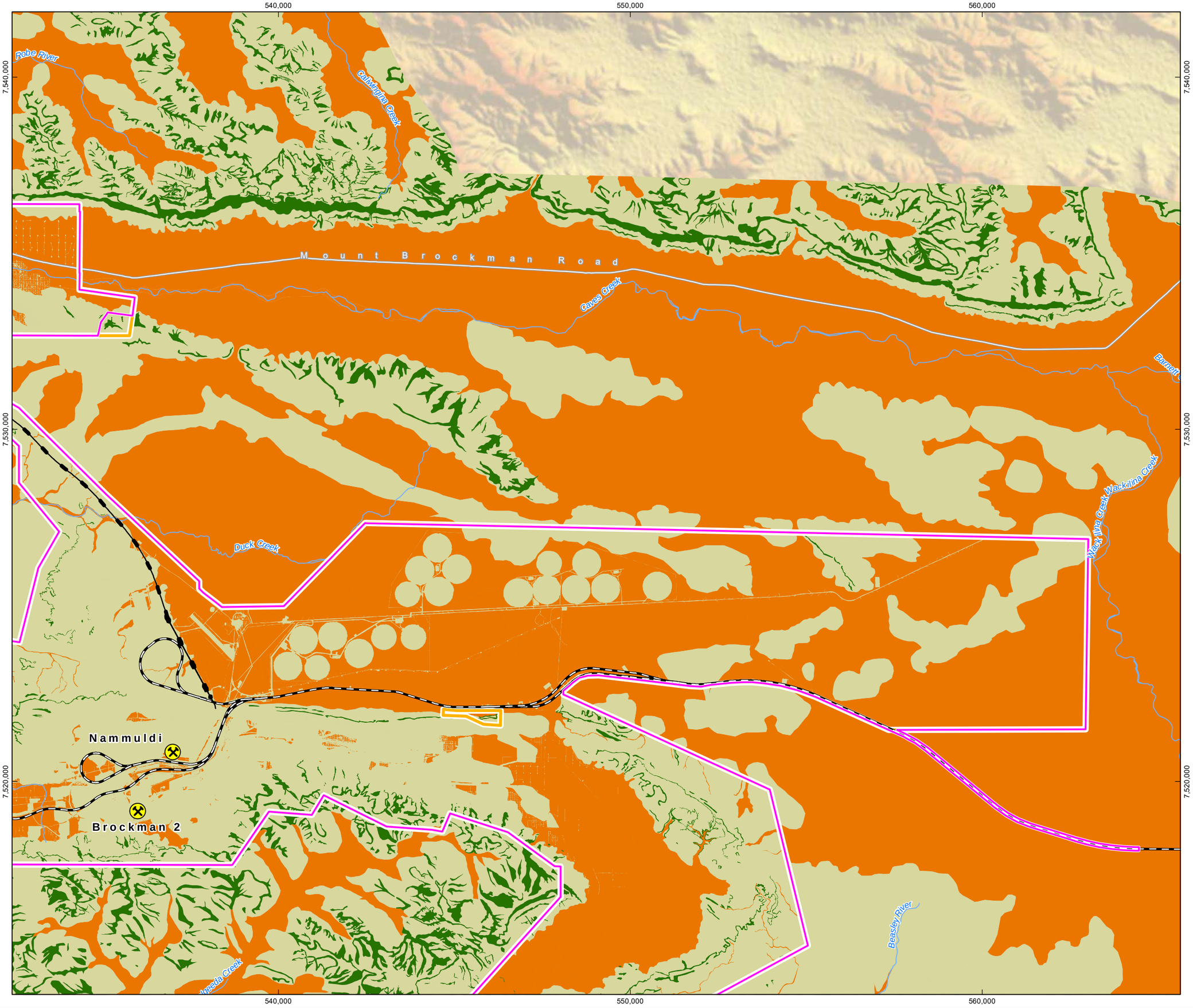

RioTinto

Figure 8-14
Potential Ghost Bat Habitat within and Surrounding the Proposal Map C

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitaat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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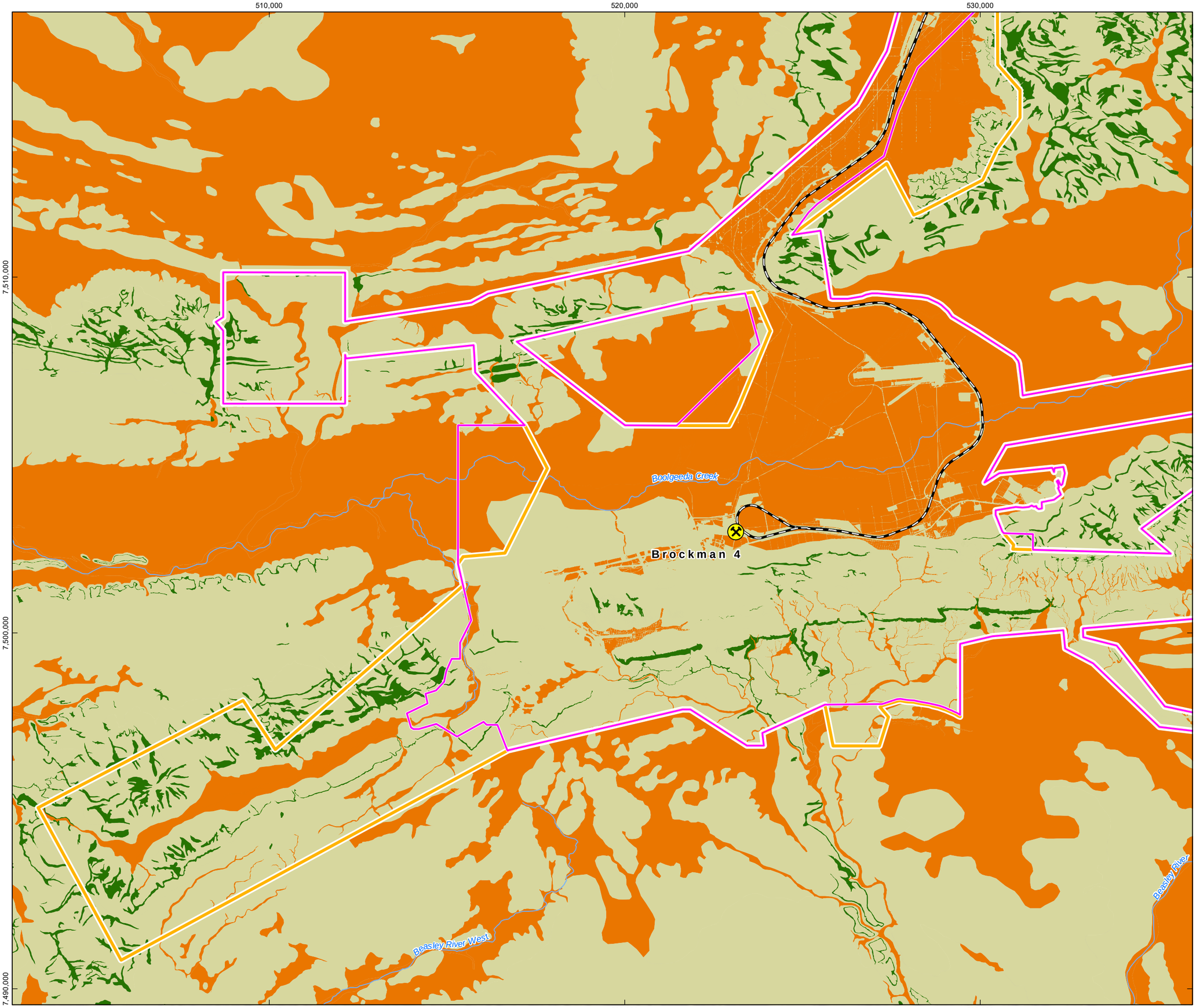


RioTinto

Figure 8-14
Potential Ghost Bat Habitat within and Surrounding the Proposal Map D

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

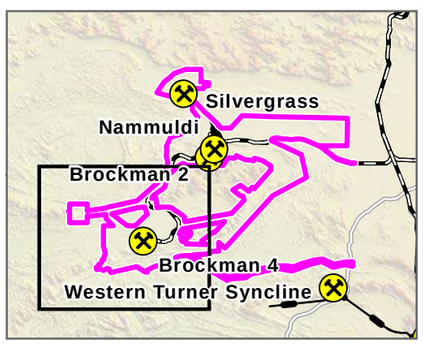
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Pilbara Olive Python (*Liasis olivaceus barroni)*

The Pilbara Olive Python (Plate 8-7) 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 8-7: Pilbara Olive Python

Pilbara Olive Pythons have been recorded on 12 occasions within the survey area from 2009 to 2021. Of the 12 records of this species, seven were direct observations (comprising six live individuals and one dead individual), and five were records of secondary evidence, comprising sloughs (3) and scats (2). Five of the live individuals were recorded at Plunge Pool. One additional scat was found 300 m northwest of the survey area. Of the live individuals recorded, one was a juvenile, and one was an adult, while the other four individuals' age was not specified (Biologic 2022a) (Figure 8-15).

Despite the low number of records, it is expected that the species will occur throughout the survey area. The survey area supports a healthy breeding population, as evident by the demographic recorded. For this reason, the Pilbara Olive Python population within the survey area is likely to represent a key source population for breeding and dispersal. Therefore, it could be regarded as an 'important population' as defined by DoE (2013) (Biologic 2022a).

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).

The Gorge/Gully and Debris Slope/Rocky Outcrop habitats provide critical breeding and shelter habitats. Additionally, Major Creekline and Minor Creekline habitats provide supporting foraging and dispersal habitat for the species, particularly in areas adjacent to or providing connectivity between Gorge/Gully and Debris Slope/Rocky Outcrop habitats (Figure 8-16). For this assessment, supporting habitat is defined as foraging and dispersal habitat within 1 km of known Pilbara Olive Python records.

Key surface water features (Figure 8-16) associated with gullies and gorges within the survey area include:

- Plunge Pool is a permanent water feature in BS4 assessment area
- Ridge Pool is a surface water driven pool (outside the Development Envelope) with reduced evaporation from shading from a nearby overhanging rock shelf.

All remaining water features are still likely to provide important habitat for the species, though this will be limited to periods when inundated with water, primarily following large rainfall events. These smaller, ephemeral pools are only present after rainfall when water is widely available and therefore not considered critical habitat.

RioTinto

Figure 8-15
Pilbara Olive Python Records within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189732v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Liasis olivaceus barroni (VU) (Pilbara Olive Python)

Sampling Method

- Secondary observation
- Opportunistic
- Systematic
- Targeted

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
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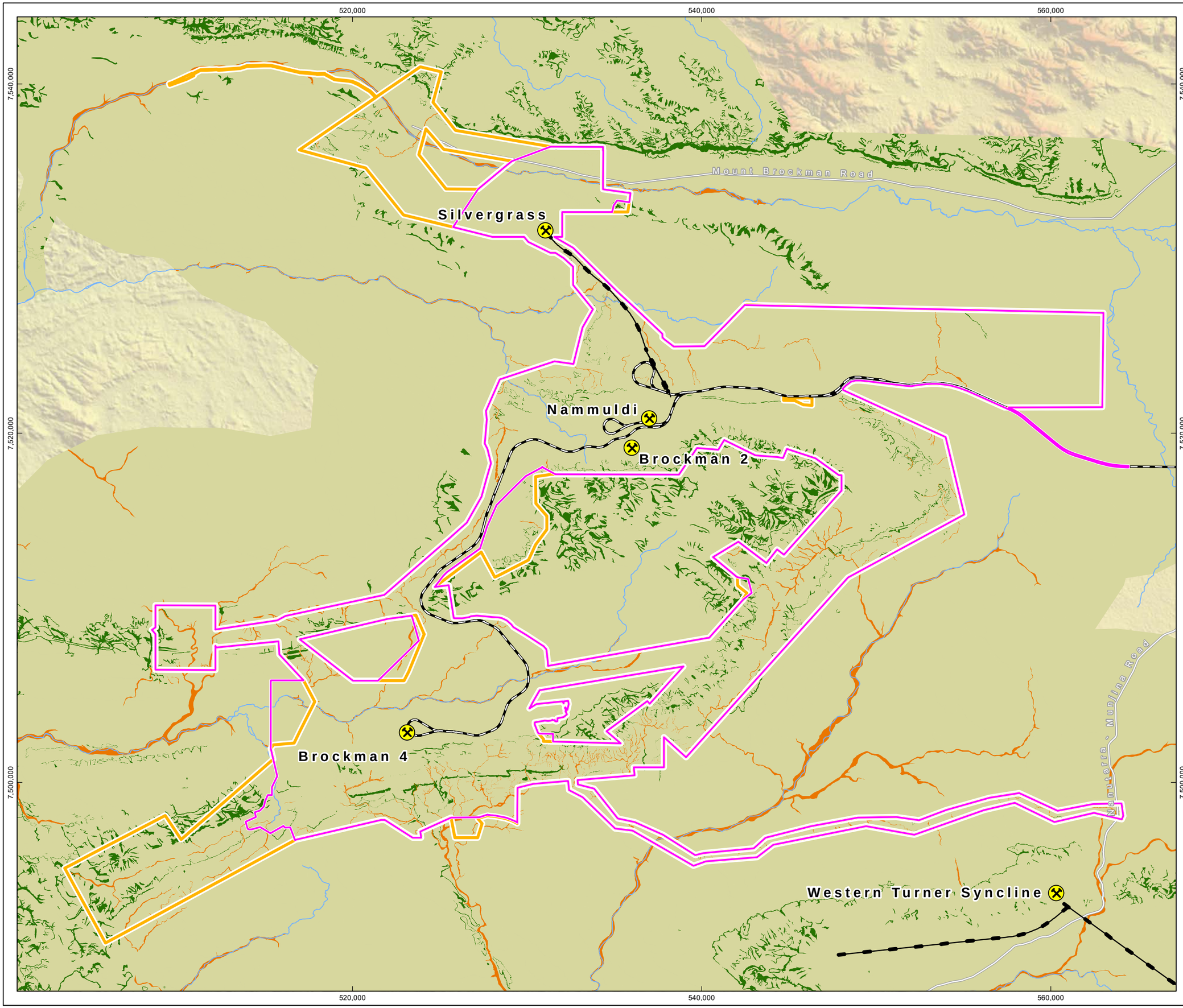
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Nanutarra - Munjina Road
Western Turner Syncline



RioTinto

Figure 8-16
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Overview

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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RioTinto

Figure 8-16
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map A

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000
520,000
530,000
540,000
7,540,000
7,530,000
7,520,000

Cajwingina Creek
Robe River
Caves Creek
Duck Creek
Silvergrass
Nammuldi
Brockman 2

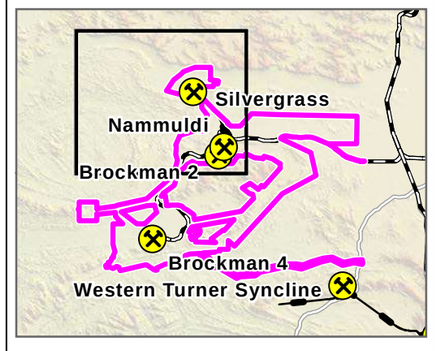
Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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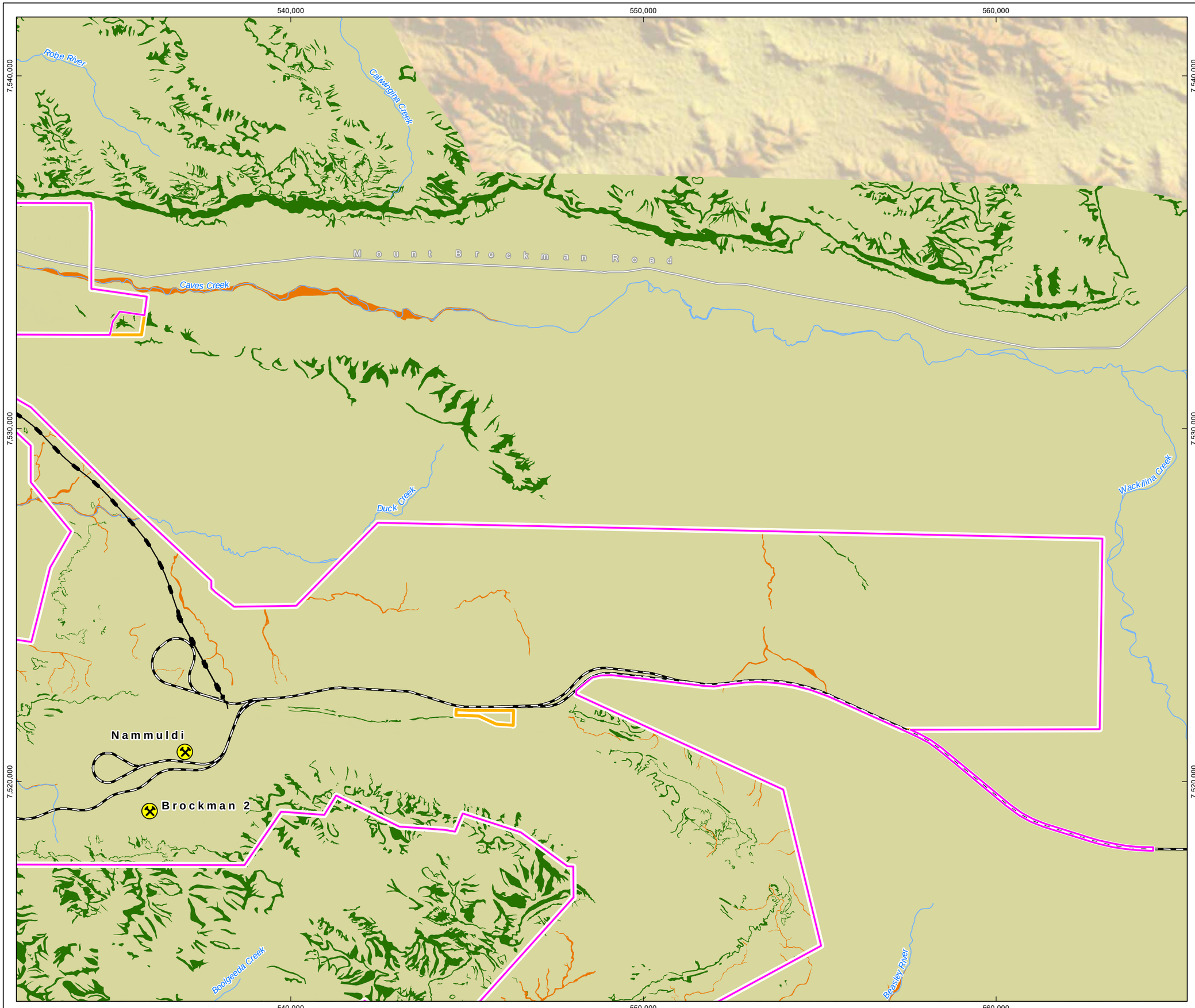


RioTinto

Figure 8-16
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map B

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

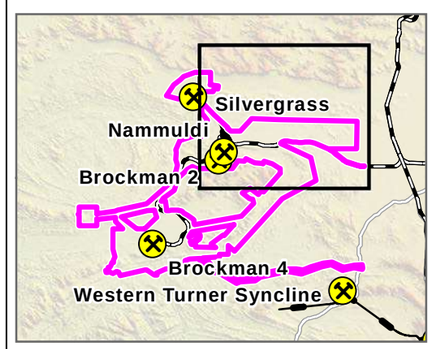
Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5

Kilometres

Map units in metres

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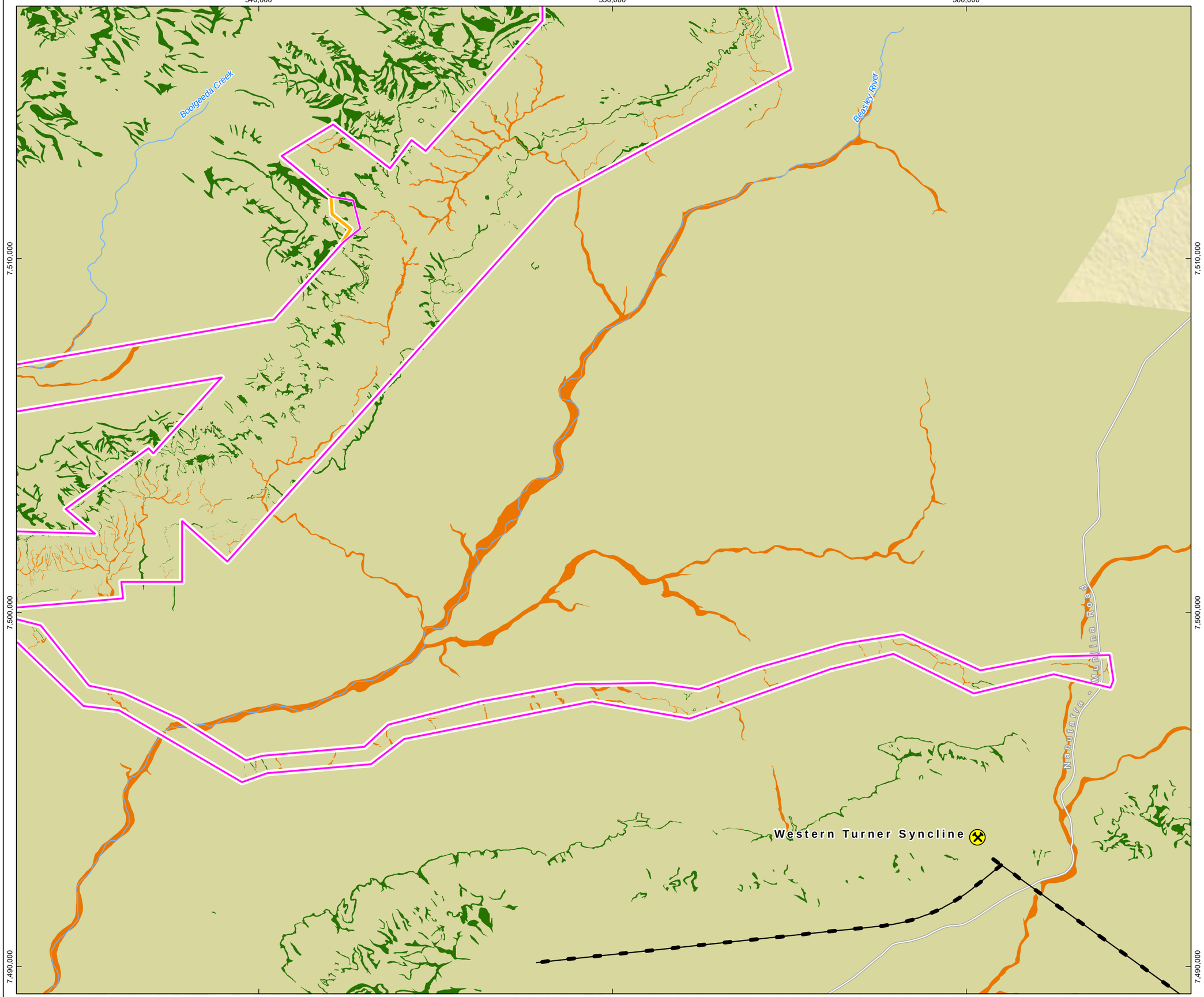
RioTinto

Figure 8-16
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map C

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

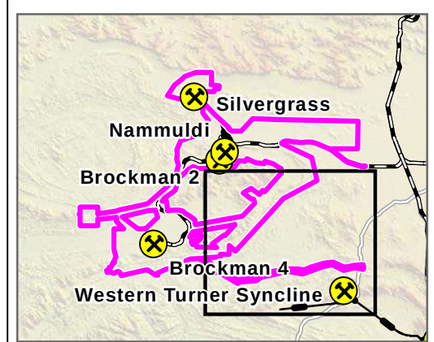


Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 1 2 3 4 5

Kilometres

Map units in metres

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RioTinto

Figure 8-16
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map D

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

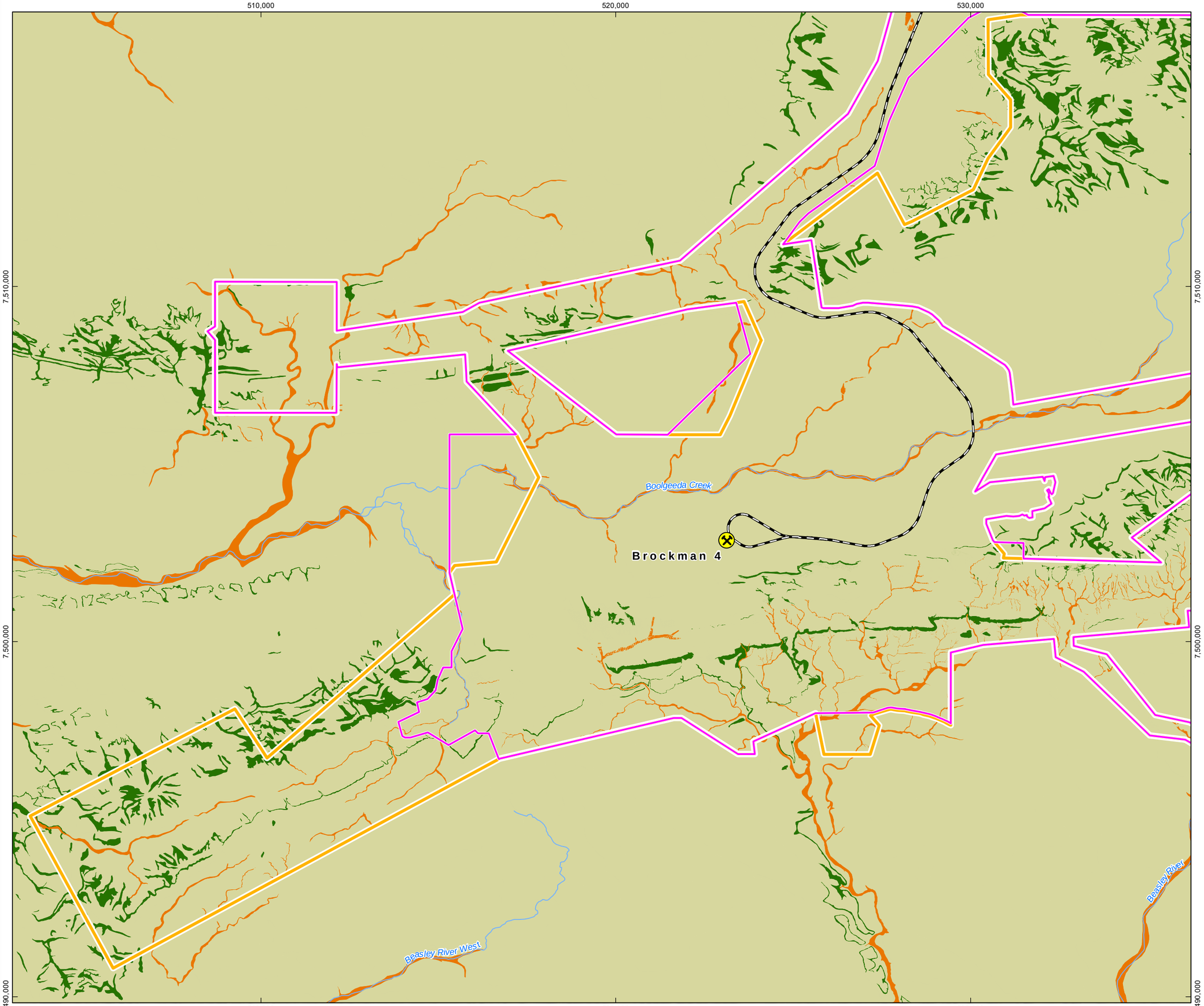
Legend

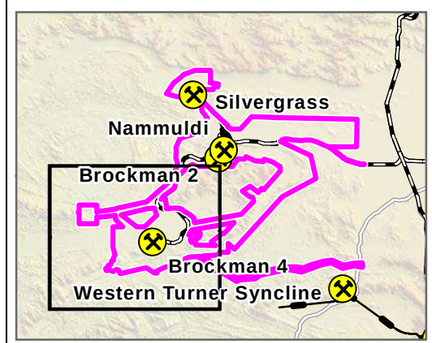
- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek





N

0 1 2 3 4 5

Kilometres

Map units in metres

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Grey Falcon (*Falco hypoleucos*)

The Grey Falcon (*Falco hypoleucos*) 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).

Despite at least 448 hours across 22 surveys conducting searches, there have been no Grey Falcon records inside the survey area. However, there is one record of three individuals (two breeding adults with a chick on a nest on top of a power line) within the Plains habitat in 2020, approximately 760 m outside the survey area (Biologic 2022a). The next closest record is approximately 37.9 km north-north-west of the survey area (Table 8-10). There are another four records within 65 km of the survey area (Figure 8-17).

Given the proximity of records to the survey area, it is highly likely that the species regularly utilise the survey area to forage and/or disperse. The species may also nest within the survey area where suitable nesting sites are present (i.e., large, tall trees and/or tall infrastructures such as power lines and transmission towers). The Major Creekline and, to a lesser extent, Minor Creekline within the survey area represent potential critical breeding and nesting habitat, particularly where suitably sized trees are present and supporting foraging and dispersal habitat for the species. Alluvial, Colluvial and Hardpan Plain habitats represent supporting foraging and dispersal habitat for the Grey Falcon; however, the species could forage within all habitat types throughout the Development Envelope and survey area.

Fork-tailed Swift (*Apus pacificus*)

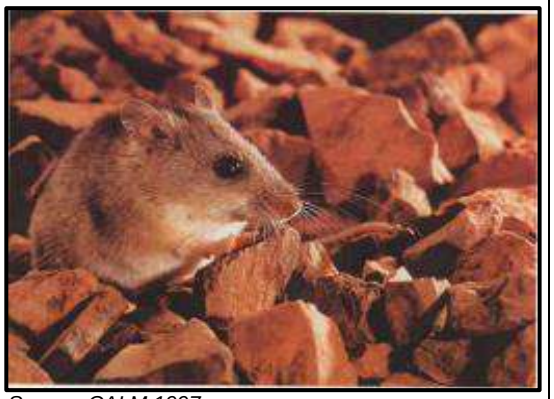
The Fork-tailed Swift is listed as migratory under the BC Act and EPBC Act. The Fork-tailed Swift occurs across much of the Australian continent from September to April, particularly in the continent's northern half. The species is most common closer to the coast but occurs over much of the Pilbara (DAWE 2021a).

The species is entirely aerial in Australia, foraging for flying insects and even sleeping on the wing. The species has been recorded once flying over Minor Creekline habitat within the survey area (Biota 2016a, 2016b; Figure 8-17).

Priority Fauna

A summary of the significant species, as listed by DBCA, recorded within the survey area is presented in Table 8-10 and Figure 8-18, whilst significant fauna that were not recorded within the survey area but have the potential to occur are presented in Table 8-11.

Table 8-10: DBCA-Listed Significant Fauna Records within the Development Envelope

Species	DBCA Listing	Broad Habitat Type	Presence within Development Envelope	Representative Photo
Birds				
Peregrine Falcon (*Falco peregrinus*)	Other Specially Protected Fauna	Inhabits various habitats, including forest, woodlands, wetlands and open country.	The Peregrine Falcon has been recorded within Gorge/Gully habitat within the BS2 assessment area (Figure 8-18; Biota 2019e). It was also recorded nearby, along Caves Creek (Biota 2019e). Suitable nesting and foraging habitat are present within the survey area and Development Envelope, including Gorge/Gully habitat for nesting and foraging and Major and Minor Creekline habitat types for foraging (Stantec 2020a).	 *Source: Birdlife 2021*
Mammals				
Western Pebble-mound Mouse (*Pseudomys chapmani*)	Priority 4	Gentle slopes of rocky ranges covered by stony mulch and vegetated by hard spinifex, with a sparse overstorey of eucalypts and scattered shrubs.	The Western Pebble-mound Mouse was recorded from numerous locations during the 2019 fauna surveys within the following habitat types: Colluvial Plain, Debris Slope/Rocky Outcrop, Footslope, Gently Sloping Rise, Midslope/Upper Slope, Minor Creekline, Pediment Slope and Plateau habitat. The species has been recorded throughout the survey area and Development Envelope in all assessment areas (Figure 8-18; Biota 2019d e; Stantec 2020a). Historical records of this species also exist from previous surveys, with over 107 pebble mounds recorded at BS2 assessment area (Biota 2019d). Populations of this species are widespread throughout the ranges of the central and southern Pilbara region (Stantec 2020a).	 *Source: CALM 1997*

Species	DBCA Listing	Broad Habitat Type	Presence within Development Envelope	Representative Photo
Reptiles				
Lined Soil-crevice Skink (*Notoscincus butleri*)	Priority 4	Spinifex areas near creek and river margins.	The Lined Soil-crevice Skink was recorded once within the survey area during the 2019 fauna surveys within Alluvial Plain habitat at BS1 assessment area (Figure 8-18). This species has been recorded multiple times in previous surveys in 2012 and 2017 (Stantec 2020a). It has also been recorded along Caves Creek in Colluvial Plain and Minor Creekline habitat types outside the Development Envelope (Biota 2019e).	 *Source: Stantec 2019a*

Table 8-11: DBCA-Listed Significant Fauna Species with the Potential to Occur within the Development Envelope, but Not Recorded

Species	DBCA Listing	Broad Habitat Type	Discussion	Representative Photo
Mammals				
Long-tailed Dunnart (*Sminthopsis longicaudata*)	Priority 4	The Long-tailed Dunnart inhabits rocky, rugged habitat within the Pilbara. Core habitat in the form of Gorge/Gully and Debris Slope/Rocky Outcrop for this species occurs within the survey area	The Long-tailed Dunnart has been recorded on multiple occasions in the vicinity of the Proposal (nearest 3 km away from the Development Envelope), and suitable habitat is present within and surrounding the Development Envelope. The species has been recorded in Major Creekline habitat in the vicinity of Silvergrass (just outside the Development Envelope) and within 3 km northwest of BS2 assessment area and recorded multiple times within 15 km of the Development Envelope (Biota 2019d,e, Stantec 2020a). Given the proximity of recent records and suitable habitat within the Development Envelope, this species is considered likely to occur.	 *Source: Western Australian Museum 2021*
Short-tailed Mouse (Lakelands Downs Mouse) (*Leggadina lakedownensis*)	Priority 4	The Short-tailed Mouse occupies diverse habitat types, including stony spinifex and tussock grasslands, samphire and sedgelands, sandy soils, and cracking clays. It shelters in burrows during the day.	The Short-tailed Mouse was recorded within the survey area near Silvergrass within Alluvial Plain habitat in 2009 but not within the Development Envelope (Biota 2019e). This species was also recorded in 2011 on gilgai clay habitat within a nearby floodplain (Biota 2019e). This species' population fluctuates throughout the year and peaks towards the end of Spring.	 *Source: National Geographic 2021*

Species	DBCA Listing	Broad Habitat Type	Discussion	Representative Photo
Reptiles				
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 gorges and gullies, mulga woodlands, and rocky slopes (Biota 2019e).	The Gane's Blind Snake was recorded within the survey area near Silvergrass and Caves Creek. However, no species records occur within the Development Envelope (Biota 2019e). This species occurs naturally in low densities and has an elusive nature.	 *Source: Jordan Vos cited in AROD 2017*

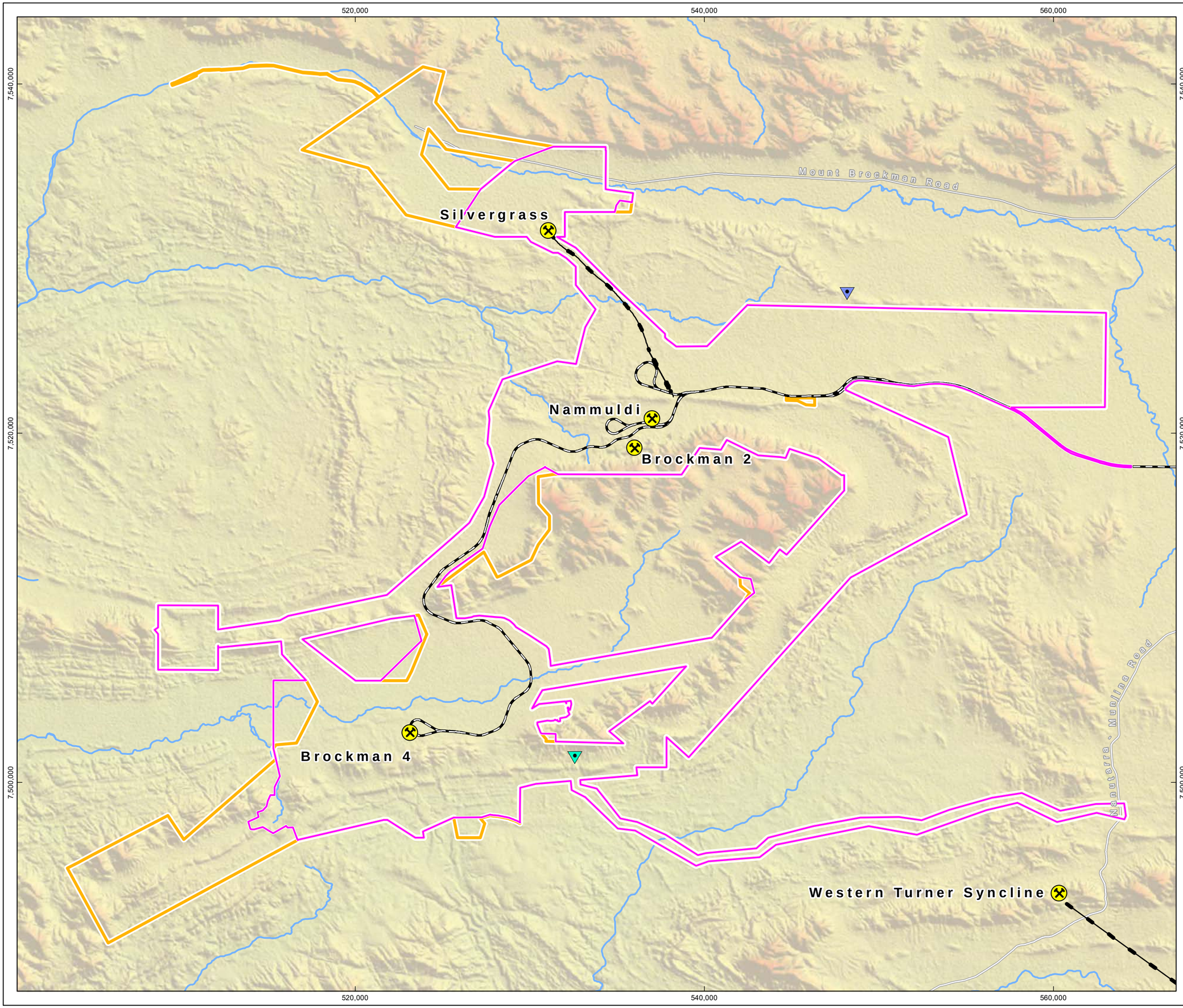


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Figure 8-17
Grey Falcon and Fork-tailed Swift Records within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189734v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- *Apus pacificus (MI)* *(Fork-tailed Swift)*
- *Falco hypoleucos (VU)* *(Grey Falcon)*
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 8-18
Priority Fauna Records within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189735v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development
- Survey Area

Significant Fauna Records

- Peregrine Falcon
- Western Pebble-mound Mouse
- Lined Soil-Crevice Skink

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Silvergrass
Mount Brockman Road
Nammuldi
Brockman 2
Brockman 4
Juna Road

0 1 2 3
Kilometers

8.3.3.7. Summary of Potentially Significant Fauna Habitat Types

The habitat types within the survey area and Development Envelope that are considered potentially significant to fauna species found within the Development Envelope are summarised in Table 8-12 and shown in Figure 8-19. Foraging and dispersal habitat is considered supporting foraging and dispersal habitat when within a species home range and is further expanded upon in Section 8.4.1.1.

Table 8-12: Potentially Significant Fauna habitat within the Survey Area and Surroundings

Species	Critical Breeding and Roosting Habitat	Supporting Foraging and Dispersal Habitat
Northern Quoll	• Gorge/Gully • Debris Slope/Rocky Outcrop	• Major Creekline • Minor Creekline
Pilbara Leaf-nosed Bat		• Major Creekline • Minor Creekline • Alluvial Plain • Colluvial Plain • Hardpan Plain
Ghost Bat		• Major Creekline • Minor Creekline • Alluvial Plain • Colluvial Plain • Hardpan Plain
Pilbara Olive Python		• Major Creekline • Minor Creekline

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Figure 8-19
Summary of Potential Significant Habitat within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra Munjina Road

Legend

- Development Envelope
- Survey Area

Habitat

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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8.3.3.8. Short-Range Endemic Fauna

Short-range Endemic (SRE) invertebrate fauna are invertebrates that, as a result of evolutionary isolation, have naturally small distributions (below 10,000 km^2) and are often characterised by low fecundity, confinement to disjunct habitats and poor dispersal capabilities (Harvey 2002). Some better-known SRE species have been listed under State or Commonwealth legislation or as Priority species by the DBCA; however, most SRE species have not been listed under the legislation, often due to lack of knowledge or scarcity of data.

Several SRE fauna assessments have been undertaken over the Development Envelope (Biota 2016b; 2019d; Stantec 2020a). Figure 8-20 illustrates the spatial extent and survey intensity of the various surveys. It should be noted that areas subject to previous approvals have limited survey coverage for SREs as terrestrial fauna (including SREs) were not considered a key environmental factor for these approvals.

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Figure 8-20
Survey Effort for Potential Short-range Endemics Species

Drawn: L.Fuentes
Plan: PDE0189757v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Survey Methodology

- Multiple-phase detailed survey
- Single-phase detailed survey
- Targeted Survey

Sampling Site Sampling Method

- Active foraging
- Leaf/soil sieving
- Pitfall trap
- Pitfall trap (dry)
- Pitfall trap (wet)
- Targeted SRE searches
- Targeted searches

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Multiple-phase Detailed survey 2020
Single-phase Detailed survey 2014
Silvergrass
Single-phase Detailed survey 2010
Nammuldi
Targeted Survey 2011
Multiple-phase Detailed survey 2020
Brockman 2
Single-phase Detailed survey 2014
Single-phase Detailed survey 2010
Targeted Survey 2010
Multiple-phase Detailed survey 2019
Multiple-phase Detailed survey 2020
Multiple-phase Detailed survey 2020
Multiple-phase Detailed survey 2019
Multiple-phase Detailed survey 2020
Brockman 4
Targeted Survey 2013
Single-phase Detailed survey 2016
Targeted Survey 2013
Single-phase Detailed survey 2009
Multiple-phase Detailed survey 2020
Western Turner Syncline
Nanutarra - Munjina Road

Short-Range Endemic Habitat

Six of the twelve habitat types mapped within the survey area are identified as moderate or high significance to SRE species (Table 8-13 and Figure 8-21). This was based on the presence of microhabitats and whether the habitat was restricted and/or isolated within the landscape (Biota 2019d), Stantec 2020a). All habitat types identified are not confined to the survey area, are common within the Pilbara region and appear to be contiguous (Biota 2016b; 2019d).

Table 8-13: Suitability of Habitat Types Likely to Support Short-Range Endemic Species Within the Survey Area and Surroundings

Habitat Type	SRE Habitat Description	Extent within the Survey Area (ha)	Extent within Development Envelope (ha)
High Significance			
Gorge/Gully	The Gorge/Gully habitat is considered highly suitable for SRE species (Stantec 2020a) as these habitats include restricted landforms, moist leaf litter and rock piles.	1,654.6	944.9
Debris Slope/ Rocky Outcrop	The habitat is considered highly suitable for SRE species (Stantec 2020a) as these habitats include restricted landforms, moist leaf litter and rock piles.	637.7	514.7
Moderate Significance			
Major Creekline	This habitat is considered to have moderate suitability for SRE species due to the increased level of vegetation and moisture in these areas compared to surrounding habitats (pers comms J. Trainer [Rio Tinto] 2020; Stantec 2020a).	766.0	572.5
Minor Creekline	This habitat is considered to have moderate suitability for SRE species due to the increased level of vegetation and moisture in these areas compared to surrounding habitats (pers comms J. Trainer [Rio Tinto] 2020; Stantec 2020a).	904.2	766.7
Alluvial Plain	Alluvial Plain habitat is considered as typically low suitability for SRE species; however, it can be characterised as moderate suitability in isolated patches where cracking clays (or similar substrate) occur (pers comms J. Trainer [Rio Tinto] 2020).	3,361.4	2,611.0
Colluvial Plain	The Colluvial Plain habitat is considered as typically low suitability for SRE species; however, it can be characterised as moderate suitability in isolated patches where cracking clays (or similar substrate) occur (pers comms J. Trainer [Rio Tinto] 2020).	25,299.0	21,516.1
Low Significance			
Footslope Gently Sloping Rise Hardpan Plain Midslope/Upper Slope Pediment Plateau	These habitats are considered low suitability for SRE species as, typically, microhabitats are scarce, and the habitat is not restricted or isolated.	32,619.9	25,485.7

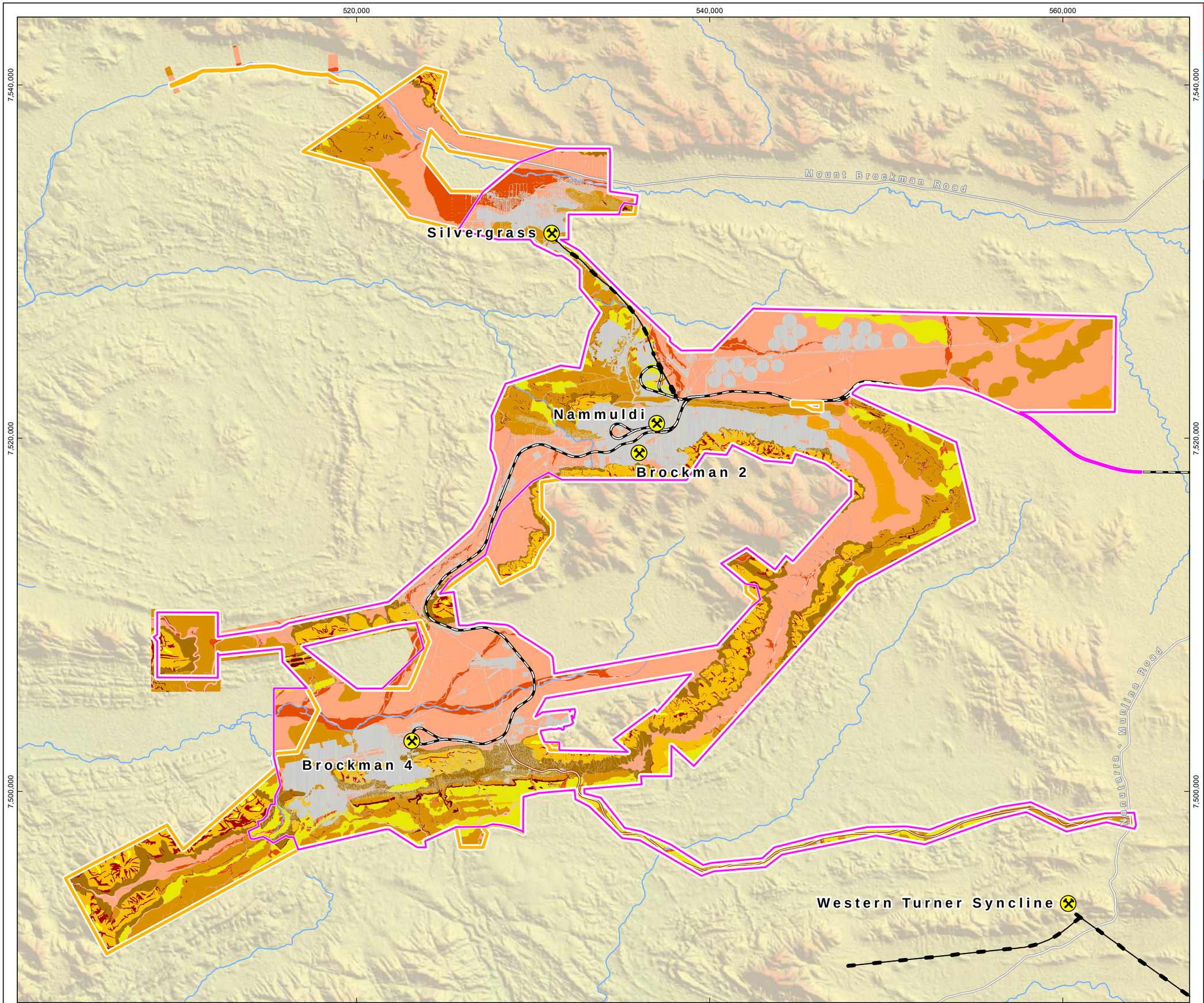

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Figure 8-21
Potential Short-range Endemic Habitat Within the Survey Area Overview

Drawn: L.Fuentes
Plan: PDE0189736v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Short Range Endemic (SRE) Habitat

High Significance
- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance
- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance
- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 8-21
Potential Short-range Endemic Habitat Within the Survey Area Map A

Drawn: L.Fuentes
Plan: PDE0189736v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Caves Creek
Robe River
Caliwingina Creek
Duck Creek
Duck Creek
Silvergrass
Nammuldi
Brockman 2

Legend

- Development Envelope
- Survey Area

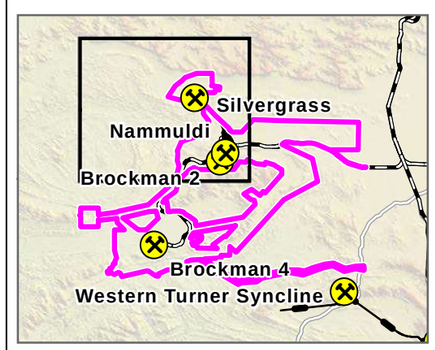
Short Range Endemic (SRE) Habitat

High Significance
- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance
- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance
- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 8-21
Potential Short-range Endemic Habitat Within the Survey Area Map B

Drawn: L.Fuentes
Plan: PDE0189736v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

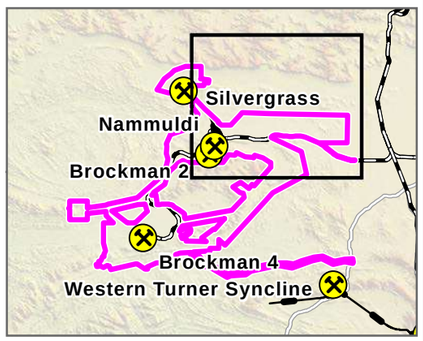
Short Range Endemic (SRE) Habitat

High Significance
- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance
- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance
- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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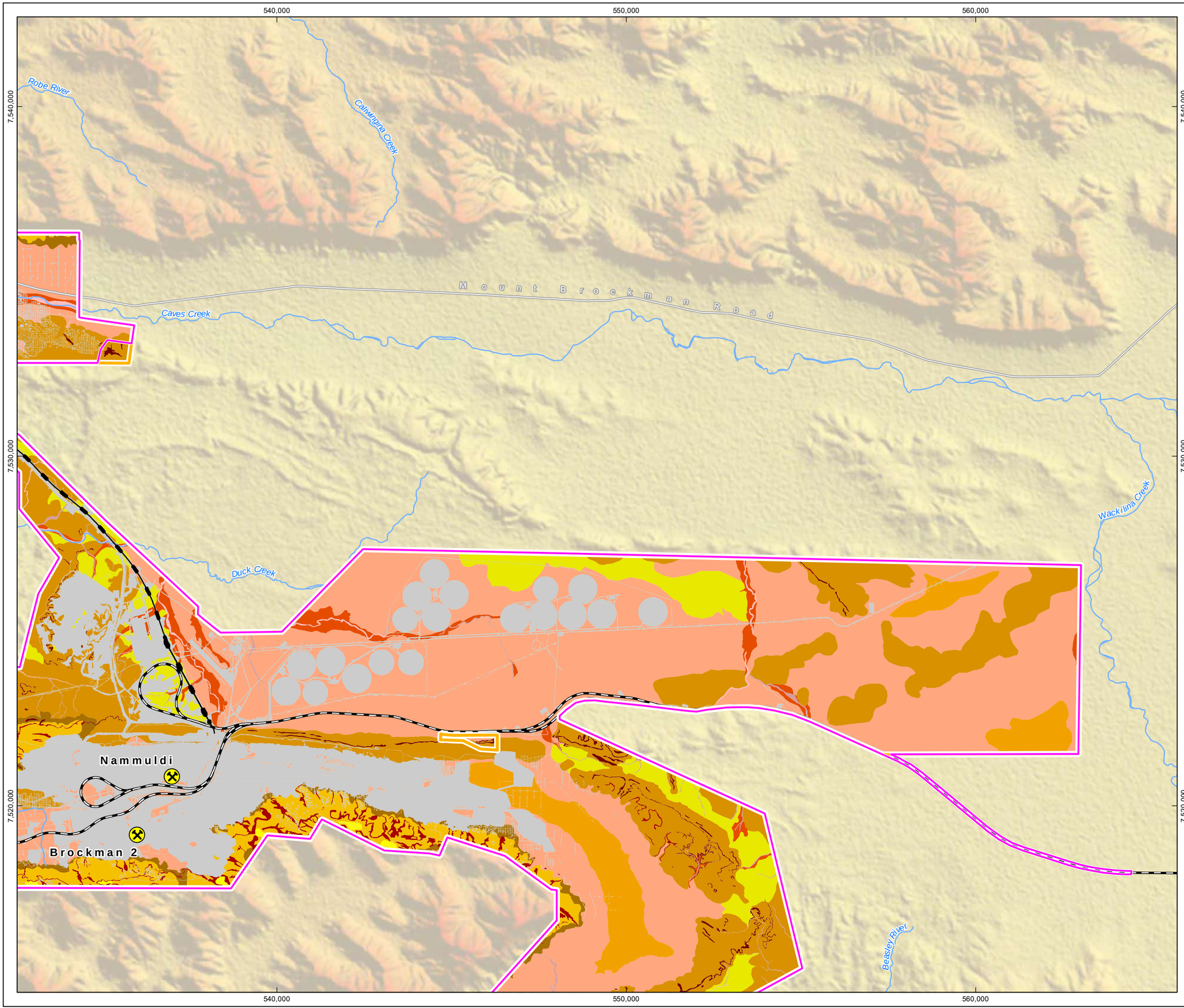


RioTinto

Figure 8-21
Potential Short-range Endemic Habitat Within the Survey Area
Map C

Drawn: L.Fuentes
Plan: PDE0189736v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

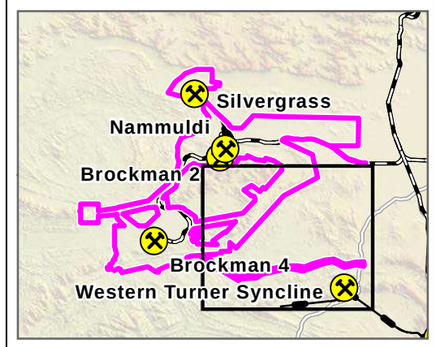
Short Range Endemic (SRE) Habitat

High Significance
- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance
- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance
- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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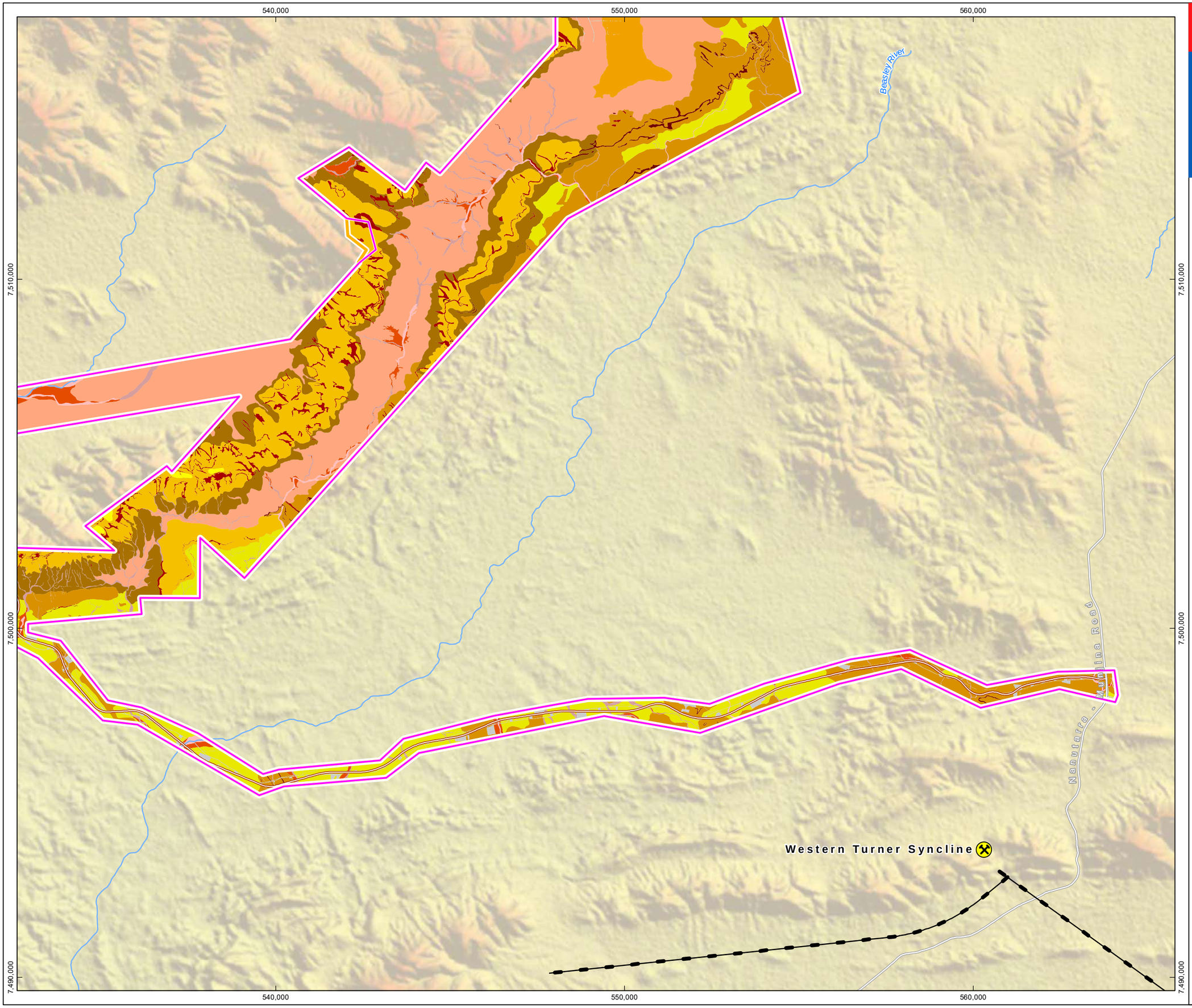




RioTinto

Figure 8-20
Short-range Endemic Habitat Within the Survey Area
Map D

Drawn: L.Fuentes
Plan: PDE0189736v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

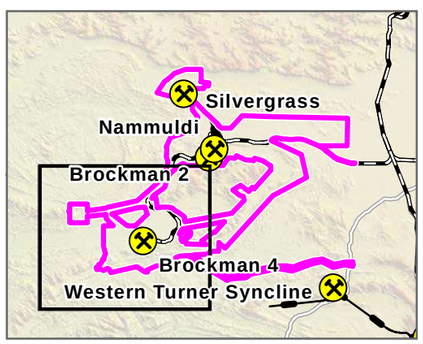
Short Range Endemic (SRE) Habitat

High Significance
- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance
- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance
- Footslope
- Gently sloping rise
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Short-Range Endemic Assemblage

A total of 90 invertebrate species from six orders and 17 families have been identified within the survey area from surveys dating back to 2005 (Biota 2005, 2006, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016b, 2019d; Stantec 2020a). Of these, 44 species have the potential to be short-range endemic (SRE) species (Table 8-14). No confirmed SRE species were recorded within the Development Envelope.

Identification of species involved the use of both morphological and DNA sequencing. The distribution of potential SRE species within the survey area is shown in Figure 8-22. All of these species were recorded from habitat types observed outside of but in proximity to the survey area, suggesting they may not be restricted to the survey area.

Table 8-14: Potential SRE Species Recorded within the Development Envelope

Class	Order	Family	Species
Arachnidae	Pseudoscorpiones	Olpiidae	*Beierolpium* `sp. 7/3 small`
			Beierolpium `sp. 8/4 lge`
			Beierolpium `sp. 8/4 small`
			Indolpium sp. indet.
			Olpiidae sp. indet.
			Xenolpium sp. indet.
			Austrohorus sp. Indet.
		Chthoniidae	*Lagynochthonius* sp. indet.
		Garypidae	*Synsphyronus* sp. indet.
		Indet	Pseudoscorpiones sp. Indet
	Scorpiones	Buthidae	*Lychas* `bituberculatus complex`
			Lychas `hairy tail complex`
			Lychas sp. indet.
		Urodacidae	*Urodacus* sp.B
			Urodacus sp.A
	Araneae	Anamidae	*Aname* `sp. 1`
			Aname `sp. N126`
			Aname `sp. N19`
			Aname sp. indet.
			Aname sp.
			Anamidae sp. indet.
			Kwonkan sp. indet.
		Barychelidae	Barychelidae sp. indet.
			I*diommata* sp. indet.
			Synothele `sp. B1`

Class	Order	Family	Species
			Synothele `sp. B35`
		Halonoproctidae	*Conothele* `sp. C8`
		Selenopidae	*Karaops* sp. indet.
		Actinopodidae	*Missulena* sp. indet.
		Nemesiidae	*Nemesiidae* `sp. sock`
Malacostraca	Isopoda	Armadillidae	*Buddelundia* `sp. 15`
			Buddelundia `47ts`
			Buddelundia `sp. 36`
			Buddelundia `sp. 63`
		Barrowdillo	*Barrowdillo* `sp. 2`
		Indet	Isopoda Gen. nov. `sp. 1`
			Isopoda Gen nov. `sp. 3`
Mollusca	Eupulmonata	Camaenidae	Camaenidae sp. indet.
			Rhagada `Pilbara banded complex`
			Rhagada `sp. small banded`
			Rhagada sp. indet.
			Quistrachia sp. indet.
		Succineidae	Succinea sp. indet.
Diplopoda	Spirobolida	Trigoniulidae	*Austrostrophus stictopygus*

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Figure 8-22
Potential Short-range Endemics Recorded Within the Development Envelope Overview

Drawn: L.Fuentes
Plan: PDE0189757v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

Legend

- Development Envelope

Short Range Endemics (SREs)

- *Anamidae* sp. indet.
- *Aname*`sp. 1`
- *Aname*`sp. N126`
- *Aname*`sp. N19`
- *Aname*sp.
- *Aname*sp. indet.
- *Austrohorus*sp. indet.
- *Austrostophus*stictopygus
- *Barychelidae* sp. indet.
- *Beierolpium*`sp. 7/3 small`
- *Beierolpium*`sp. 8/4 lge`
- *Beierolpium*`sp. 8/4 small`
- *Buddelundia*`47ts`
- *Buddelundia*`sp. 36`
- *Buddelundia*`sp. 63`
- *Camaenidae* sp. indet.
- *Conothele*`sp. C8`
- *Idiommata*sp. indet.
- *Indolpium*sp. indet.
- *Isopoda* Gen. nov.`sp. 1`
- *Isopoda* Gen. nov.`sp. 3`
- *Karaops*sp. indet.
- *Kwonkan*sp. indet.
- *Lagynochthonius*sp. indet.
- *Lychas*`bituberculatus complex`
- *Lychas*`hairy tail complex`
- *Lychas*sp. indet.
- *Missulena*sp. indet.
- *Nemesiidae* `sp. sock`
- *Olpiidae* sp. indet.
- *Pseudoscorpiones* sp. indet.
- *Quistrachia*sp. indet.
- *Rhagada*`Pilbara banded complex`
- *Rhagada*`sp. small banded`
- *Rhagada*sp. indet.
- *Succinea*sp. indet.
- *Synothele*`sp. B1`
- *Synothele*`sp. B35`
- *Synsphyronus*sp. indet.
- *Urodacus*sp.A
- *Urodacus*sp.B
- *Xenolpium*sp. indet.

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 8-22
Potential Short-range Endemics Recorded Within the Development Envelope Map A

Drawn: L.Fuentes
Plan: PDE0189757v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Short Range Endemics (SREs)

- *Aname*`sp. 1`
- *Aname*`sp. N19`
- *Aname*sp. indet.
- *Austrostrophus*stictopygus
- *Buddelundia*`sp. 36`
- *Buddelundia*`sp. 63`
- *Kwonkan*sp. indet.
- *Rhagada*`sp. small banded`
- *Rhagada*sp. indet.
- *Xenolpium*sp. indet.

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Creek

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Silvergrass
Nammuldi
Brockman 2

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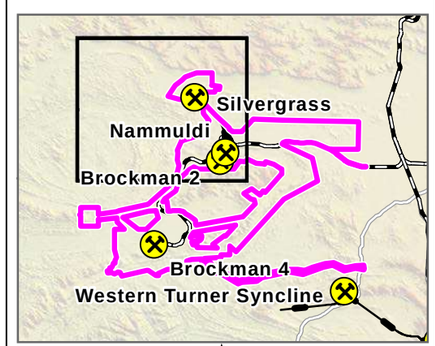

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Kilometres

Map units in metres

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Figure 8-22
Potential Short-range Endemics Recorded Within the Development Envelope Map B

Drawn: L.Fuentes
Plan: PDE0189757v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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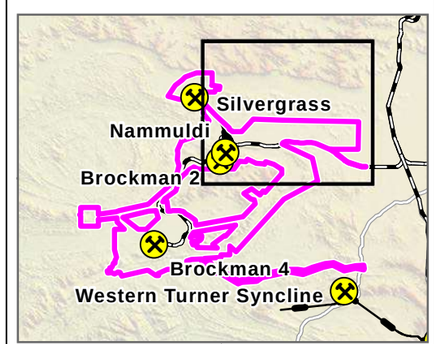
Legend

- Development Envelope

Short Range Endemics (SREs)

- *Anamidae* sp. indet.
- *Aname*`sp. 1`
- *Aname*`sp. N19`
- *Aname*sp. indet.
- *Beierolpium*`sp. 7/3 small`
- *Beierolpium*`sp. 8/4 lge`
- *Beierolpium*`sp. 8/4 small`
- *Buddelundia*`47ts`
- *Buddelundia*`sp. 36`
- *Buddelundia*`sp. 63`
- *Conothele*`sp. C8`
- *Idiommata*sp. indet.
- *Indolpium*sp. indet.
- *Isopoda* Gen. nov.`sp. 1`
- *Isopoda* Gen. nov.`sp. 3`
- *Karaops*sp. indet.
- *Kwonkan*sp. indet.
- *Lagynochthonius*sp. indet.
- *Lychas*`bituberculatus complex`
- *Lychas*`hairy tail complex`
- *Lychas*sp. indet.
- *Missulena*sp. indet.
- *Olpiidae* sp. indet.
- *Pseudoscorpiones* sp. indet.
- *Rhagada*`Pilbara banded complex`
- *Rhagada*`sp. small banded`
- *Rhagada*sp. indet.
- *Succinea*sp. indet.
- *Synothele*`sp. B35`
- *Synsphyronus*sp. indet.
- *Xenolpium*sp. indet.

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Creek



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Kilometres

Map units in metres

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Figure 8-22
Potential Short-range Endemics Recorded Within the Development Envelope Map C

Drawn: L.Fuentes
Plan: PDE0189757v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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Legend

- Development Envelope

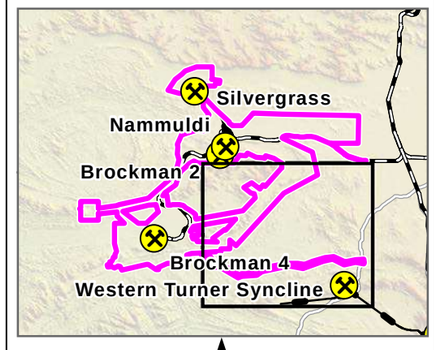
Short Range Endemics (SREs)

- *Anamidae* sp. indet.
- *Aname*`sp. 1`
- *Aname*`sp. N19`
- *Aname*sp. indet.
- *Austrostrophus*stictopygus
- *Barychelidae* sp. indet.
- *Camaenidae* sp. indet.
- *Kwonkan*sp. indet.
- *Missulena*sp. indet.
- *Rhagada*`Pilbara banded complex`
- *Synothele*`sp. B1`
- *Synothele*`sp. B35`

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek

Western Turner Syncline

Nanutarra - Wittenoom Road



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Kilometres
Map units in metres

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Figure 8-22
Potential Short-range Endemics Recorded Within the Development Envelope Map D

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Plan: PDE0189757v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Short Range Endemics (SREs)

- *Aname*`sp. N126`
- *Aname*`sp. N19`
- *Aname*sp.
- *Austrohorus*sp. indet.
- *Barychelidae* sp. indet.
- *Indolpium*sp. indet.
- *Nemesiidae* `sp. sock`
- *Quistrachia*sp. indet.
- *Rhagada*`Pilbara banded complex`
- *Rhagada*`sp. small banded`
- *Rhagada*sp. indet.
- *Urodacus*sp.A
- *Urodacus*sp.B

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek

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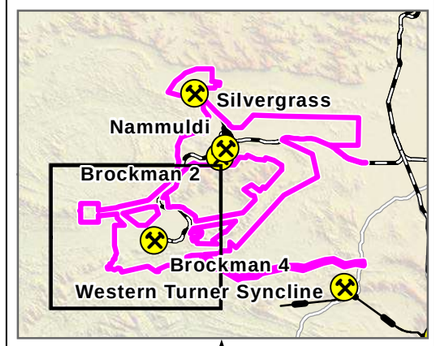
Brockman 4



0 2 4 6
Kilometres

Map units in metres

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8.3.4. Summary of Key Terrestrial Fauna Values

The key environmental values associated with Terrestrial Fauna include:

- Approximately 1,459.6 ha of critical Gorge/Gully (944.9 ha) and Debris Slope/Rocky Outcrop (514.7 ha) habitat within the Development Envelope considered to be critical denning, roosting and/or shelter habitat for the Northern Quoll (EN), Pilbara Leaf-nosed Bat (VU), Ghost Bat (VU) and Pilbara Olive Python (VU)
- Approximately 1,339.2 ha of Major (572.5 ha) and Minor (766.7 ha) Creek line habitat within the Development Envelope is considered to be supporting foraging and dispersal habitat for the Northern Quoll (EN), Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python when within the species home range
- Approximately 25,302.4 ha of Alluvial (2,611.0 ha), Colluvial (21,516.1 ha) and Hardpan (1,175.3 ha) Plain habitat within the Development Envelope is considered to be supporting foraging and dispersal habitat for the Pilbara Leaf-nosed Bat and Ghost Bat when within the species home range
- Suitable habitat for the Grey Falcon (VU), Fork-tailed Swift (MI), Peregrine Falcon (OS), Gane's Blind Snake (P1), Western Pebble-mound Mouse (P4), Lined Soil-crevice Skink (P4), Long-tailed Dunnart (P4) and Short-tailed Mouse (P4)
- One category 3 roost for the Pilbara leaf-nosed bat (Upper Beasley River Roost), located 670 m outside the Development Envelope
- 102 category 4 roosts for the Pilbara leaf-nosed bat within the Development Envelope
- Eight category 2 roosts, 78 category 3 roosts and 45 category 4 roosts for the Ghost Bat within the Development Envelope
- Plunge Pool, a permanent groundwater sustained water feature within the Development Envelope that is considered highly significant as a source of drinking water and foraging resources for significant fauna for all of the year
- Ridge Pool, an ephemeral pool located 140 m outside of the Development Envelope that is considered highly significant as a source of drinking water and foraging resources for significant fauna for most of the year
- Forty-four species which have the potential to be SREs.
- Approximately 1,459.6 ha of Gorge/Gully (944.9 ha) and Debris Slope/Rocky Outcrop (514.7 ha) habitat within the Development Envelope is considered to be of high significance to potential SRE species.

8.4. Potential Environmental Impacts

8.4.1. Direct Impacts

Potential direct impacts of the Proposal to terrestrial fauna have been identified as:

- Loss of habitat as a result of clearing and habitat fragmentation
- Loss of fauna individuals
- Loss of SRE individuals and supporting SRE habitat as a result of clearing.

8.4.1.1. Loss of Fauna Habitat as a Result of Clearing

Habitat loss can lead to the direct mortality of individuals, forced relocation of fauna and reduction of breeding and foraging habitat. Total clearing areas for each high significance habitat type are presented in Table 8-15 and each moderate to low significance habitat in Table 8-16, whilst Figure 8-23 shows a Conceptual Footprint over habitat types, which shows that:

- Development of the Proposal would result in clearing up to 7,896 ha of native fauna habitat within a 63,343 ha Development Envelope. The proposed clearing represents approximately 10% of the survey area and 12% of the Development Envelope
- Most clearing will occur within the Colluvial Plain habitat type, with approximately 3,266.1 ha (4% of the survey area and 5% of the Development Envelope) to be cleared.

Of the habitat types identified as high significance critical (breeding, denning and roosting) habitats to MNES species (Figure 8-24), up to:

- 264.0 ha of Gorge/Gully habitat will be cleared (representing 27.9% of Gorge/Gully habitat mapped within the Development Envelope)
- 67.0 ha of Debris Slope/Rocky Outcrop habitat will be cleared (representing 15% of Debris Slope/Rocky Outcrop habitat mapped within the Development Envelope)

Of the habitat types considered to be supporting (foraging and dispersal) habitat within the home range of MNES species, that being:

- 1 km from a Northern Quoll Record
- 10 km from a category 2 or 3 Pilbara Leaf-nosed Bat Roost and 10 km from a permanent water source for the Pilbara Leaf-nosed Bat (Plunge Pool)
- 5 km from an isolated category 2 Ghost Bat Roost and/or a category 2 and/ 3 Ghost Bat Roosts within an apartment block
- 1 km from a Pilbara Olive Python record

Noting the above:

- 25 ha and 114 ha of Major and Minor Creekline habitat types will be cleared (representing 4.4 and 14.9 % of this habitat type mapped within the Development Envelope)
- 65, 2,638 and 104 ha of Alluvial, Colluvial and Hardpan Plain habitat types will be cleared (representing 2.5, 12.3 and 8.8 % of these habitat types mapped within the Development Envelope).

It is noted that species home ranges overlap within the Development Envelope.

Additionally, the Proposal will result in the clearing of:

- A total of 25 roosts potential Pilbara Leaf-nosed Bat and/or Ghost Bat roosts comprising:
    - 25 category 4 Pilbara Leaf-nosed Bat roosts which are not considered critical habitat for the species (Table 8-17 and Figure 8-25)

- 14 category 3 and 11 category 4 Ghost Bat roosts which are not considered critical habitat for the species (Table 8-17 and Figure 8-26 and Figure 8-27)

- Four known ephemeral pools, considered of lower significance to fauna (Table 8-18 and Figure 8-28).

8.4.1.2. Fragmentation of Fauna Habitats due to Land Clearing

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 impact of habitat fragmentation as a result of clearing for the Proposal has the potential to be most apparent within BS1 assessment area as a cumulative effect, given the proximity to the adjacent Eliwana project, and is discussed in Section 8.4.3. Additionally, three areas which are entirely surrounded by the proposed Development Envelope and conceptual footprint may lead to fragmentation, namely a small area north of BS4 (1,480 ha), Mount Brockman south of BS2 (17,485 ha) and the surrounding area near Ridge Pool (1,873 ha). These areas total 20,838 ha in total

Table 8-15: Indicative Disturbance - High Significance Fauna Habitat Type

Fauna Habitat Type	Mapped Fauna Habitat Extent			Percentage of Survey Area Impacted by the Proposal (%)	Percentage of Development Envelope Impacted by the Proposal (%)	Upper Limit of Assessed Impact for Project Flexibility (ha (%))
	Survey Area (ha)	Development Envelope (ha)*	Approximate Impact from the Proposal (ha)			
High Significance						
Gorge/Gully	1,654.6	944.9	221	13.4	23.4	264.0 (27.9)
Debris Slope/ Rocky Outcrop	637.7	514.7	20	3.1	3.9	67.0 (13.0)
Total	**2,292.3**	**1,459.6**	**241.0**	**10.5**	**16.5**	**331.0 (22.7)**

** Extent in Development Envelope excludes the Approved Footprint*

Table 8-16: Indicative Disturbance - Moderate and Low Significance Fauna Habitat Types

Fauna Habitat Type	Mapped Fauna Habitat Extent			Approximate Percentage of Survey Area Impacted by the Proposal (%)	Approximate Percentage of Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)*	Approximate Impact from the Proposal (ha)		
Moderate Significance					
Alluvial Plain	3,361.4	2611.0	166.1	4.9	6.4
Colluvial Plain	25,299	21,516.0	3,226.1	12.9	15.2
Gently Sloping Rise	14,243.0	11,073.2	1,151.9	8.1	10.4
Hardpan Plain	1,175.3	1,175.3	104.0	8.8	8.8
Major Creekline	766.0	572.5	68.9	9.0	12.0
Midslope/Upper Slope	6,898.8	4,840.5	1,224.0	17.7	25.3
Minor Creekline	904.2	766.7	186.4	20.6	24.3

Fauna Habitat Type	Mapped Fauna Habitat Extent			Approximate Percentage of Survey Area Impacted by the Proposal (%)	Approximate Percentage of Development Envelope Impacted by the Proposal (%)
	Survey Area (ha)	Development Envelope (ha)*	Approximate Impact from the Proposal (ha)		
Low Significance					
Footslope	4,761.1	3,562.1	1,042.6	21.9	29.3
Pediment Slope	5,336.1	4,733.2	259.7	4.9	5.5
Plateau	205.6	101.4	12.8	6.2	12.6
Total	**62,950.5**	**50,951.9**	**7,442.5**	**11.9**	**14.6**

** Extent in Development Envelope excludes the Approved Footprint*

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Figure 8-23
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Overview

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
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7,540,000
7,520,000
7,500,000

Mount Brockman Road

Silvergrass

Nammuldi

Brockman 2

Brockman 4

Western Turner Syncline

Wanjarre - Munjina Road

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 8-23
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Map A

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Silvergrass
Nammuldi
Brockman 2

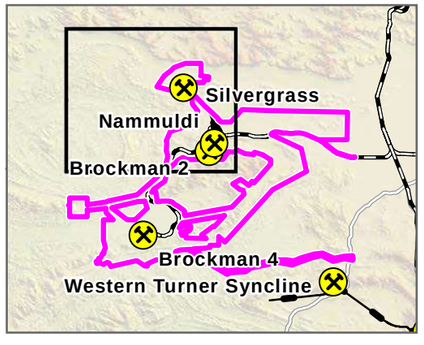
Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6

Kilometres

Map units in metres

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RioTinto

Figure 8-23
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Map B

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

540,000
550,000
560,000
7,540,000
7,530,000
7,520,000

Mount Brockman Road
Nammuldi
Brockman 2

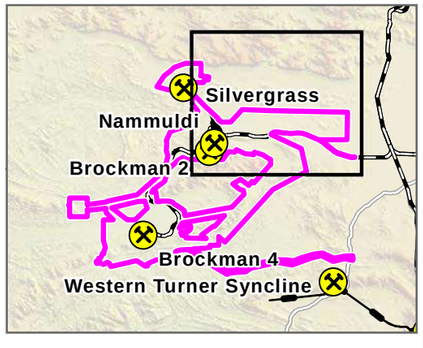
Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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RioTinto

Figure 8-23
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Map C

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

540,000
550,000
560,000
7,510,000
7,500,000
7,490,000

Nanutarra - Munjina Road

Western Turner Syncline

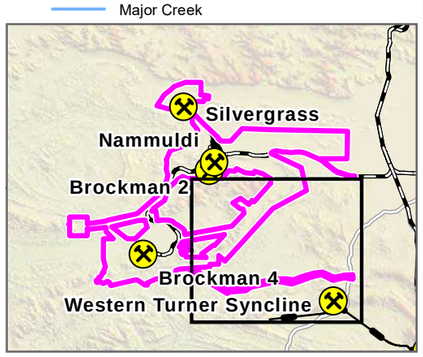
Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Brockman 4

RioTinto

Figure 8-23
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Map D

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

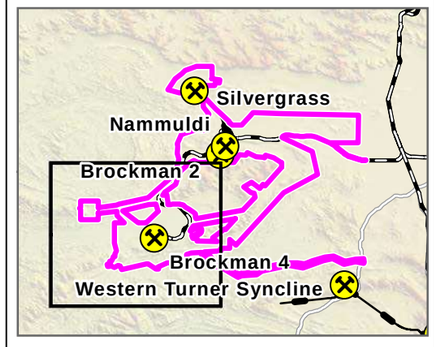
Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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RioTinto

Figure 8-24
Conceptual Footprint in the Context of Potential Significant Habitat
Overview

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Hardpan Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Mount Brockman Road
Nanutarra - Munjina Road

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

N

0 2 4 6 8 10
Kilometres

Map units in metres

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RioTinto

Figure 8-24
Conceptual Footprint in the Context of Potential Significant Habitat
Map A

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Silvergrass

Nammuldi

Brockman 2

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

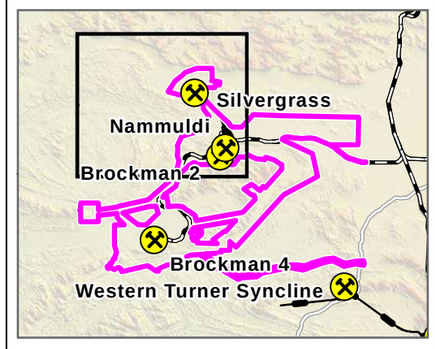
Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6

Kilometres

Map units in metres

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RioTinto

Figure 8-24
Conceptual Footprint in the Context of Potential Significant Habitat
Map B

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

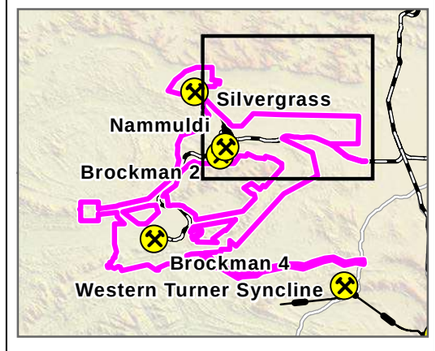
Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Hardpan Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6

Kilometres

Map units in metres

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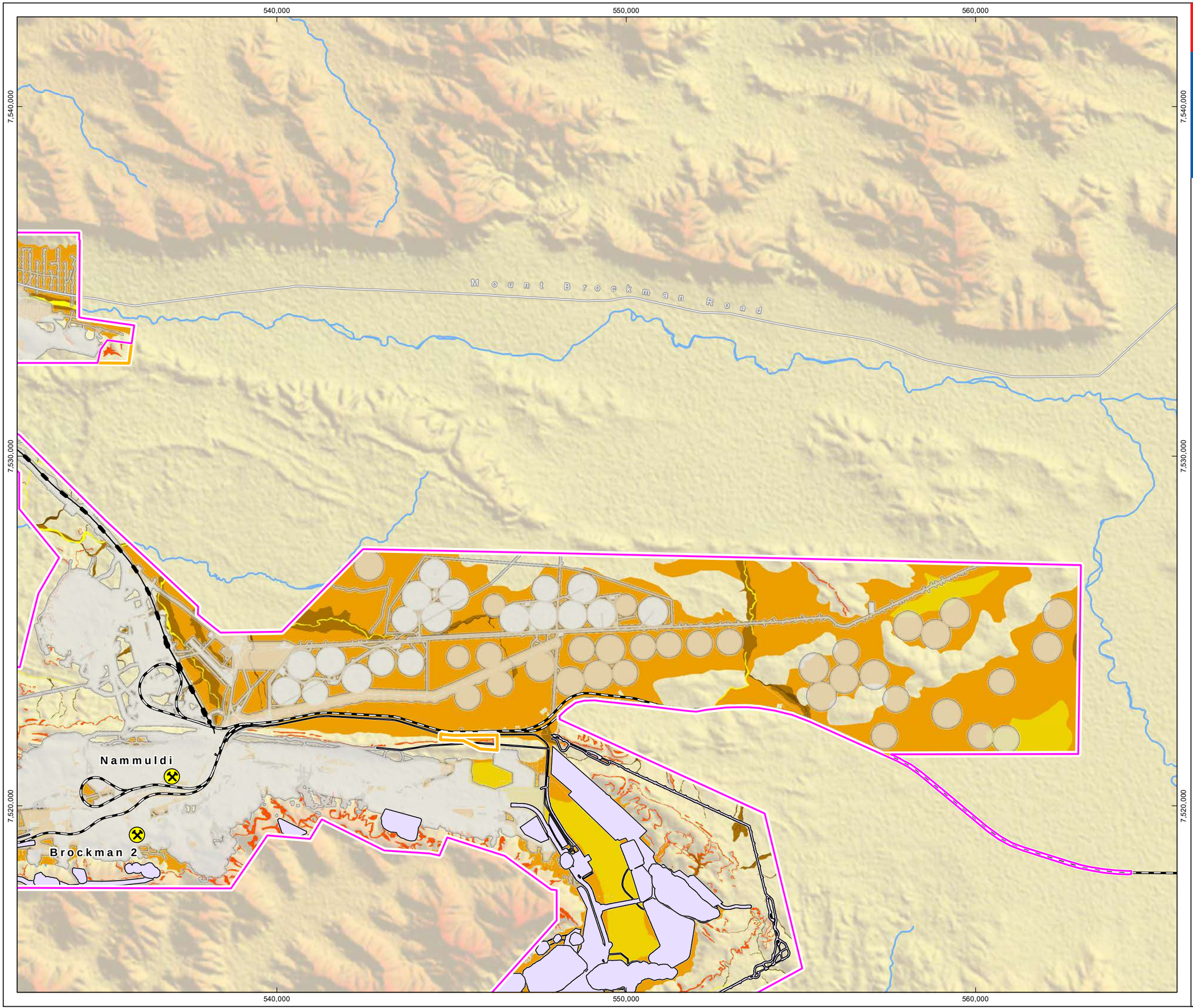


RioTinto

Figure 8-24
Conceptual Footprint in the Context of Potential Significant Habitat
Map C

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

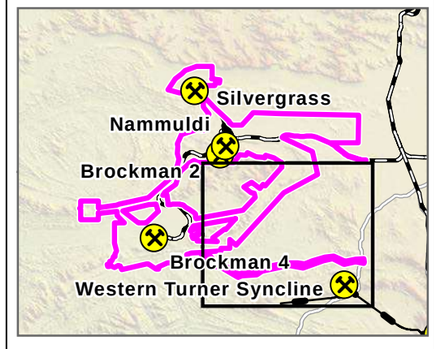
Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Hardpan Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Brockman 4

RioTinto

Figure 8-24
Conceptual Footprint in the Context of Potential Significant Habitat
Map D

Drawn: L Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

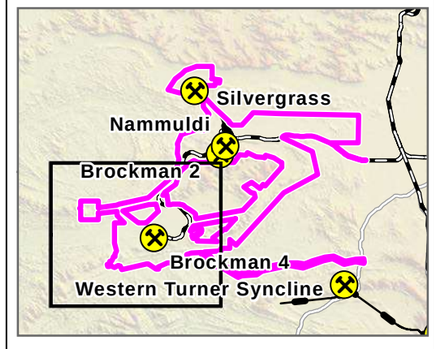
Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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Table 8-17: Caves to be Impacted within the Development Envelope and their Significance to the Ghost and Pilbara Leaf-nosed Bat

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
B2BAT06	Category 3	-	Category 4	-
BS4MM-Aug16-13	Category 3	-	No Usage	-
BS4MMJul16-11	Category 3	-	No Usage	-
C1	Category 4	-	Category 4	
C2	Category 4	-	Category 4	
CBRK-053	Category 3	-	Category 4	
CBRK-084	Category 3	-	Category 4	
CBRK-086	Category 3	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-094	Category 4	-	Category 4	
CBRK-096	Category 4	-	Category 4	
CBRK-098	Category 4	-	Category 4	
CBRK-102	Category 4	-	Category 4	
CBRK-103	Category 3	-	Category 4	
CBRK-104	Category 3	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-107	Category 4	-	Category 4	
CBRK-108	Category 3	-	Category 4	
CBRK-124	Category 4	-	Category 4	
CBRK-138	Category 4	-	Category 4	
CBRK-144	Category 3	-	Category 4	
CBRK-145	Category 4	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-151	Category 3	-	Category 4	
GBS_CA_04	Category 4	-	Category 4	
GBS_CA_06	Category 3	-	No usage	-
GBS_CA_21	Category 3	-	No usage	
MAMCAM11-01	Category 3	-	Category 4	

Table 8-18: Water Features to be Impacted within the Development Envelope

Water Feature Name	Image	Water Feature Name	Image
B4		WBRK-01	
LGCAM04	-	No Name	-

RioTinto

Figure 8-25
Conceptual Footprint in the Context of Pilbara Leaf-nosed Bat Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189725v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Mount Brockman Road

Silvergrass

Nammuldi

Brockman 2

Brockman 4

Muojina Road

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Pilbara Leaf-nosed Bat Roost

- Category 2
- Category 3
- Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

0 0.5 1 1.5 2 2.5
Kilometres

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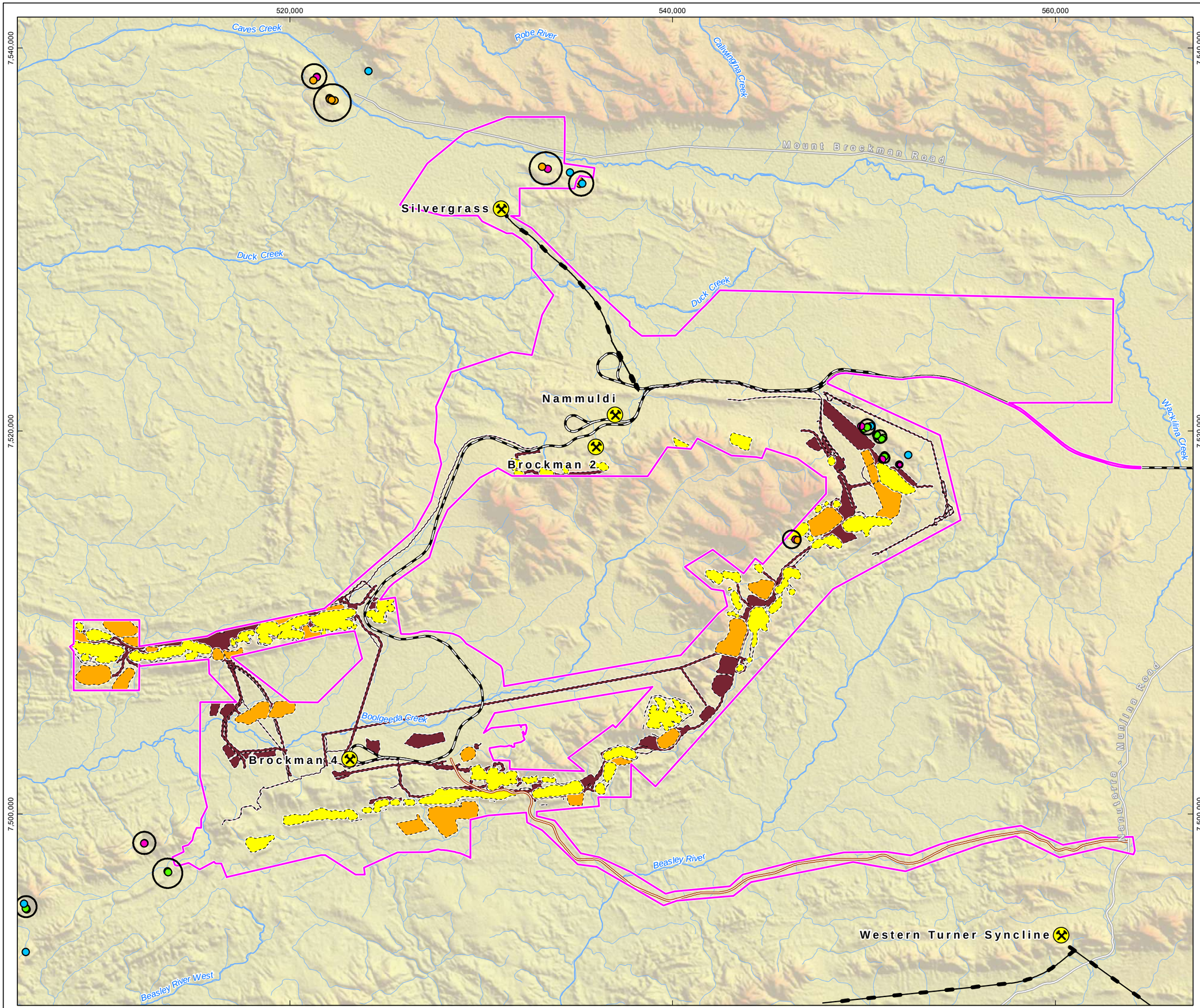

RioTinto

Figure 8-26
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Apartment Block

Ghost Bat Roots

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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RioTinto

Figure 8-26
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Caves Creek
Robe River
Duck Creek

AB-BS-2
AB-BS-4
AB-SGE-2
AB-SGE-1

Silvergrass
Nammuldi
Brockman 2

Legend

- Development Envelope
- Apartment Block

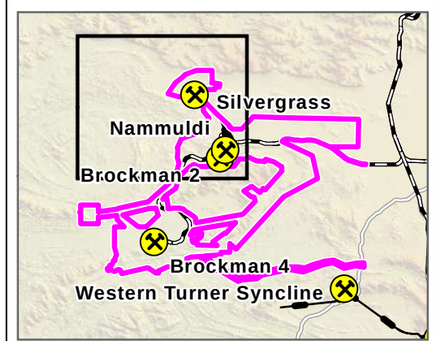
Ghost Bat Roosts

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



N

0 2 4 6

Kilometres

Map units in metres

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RioTinto

Figure 8-26
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

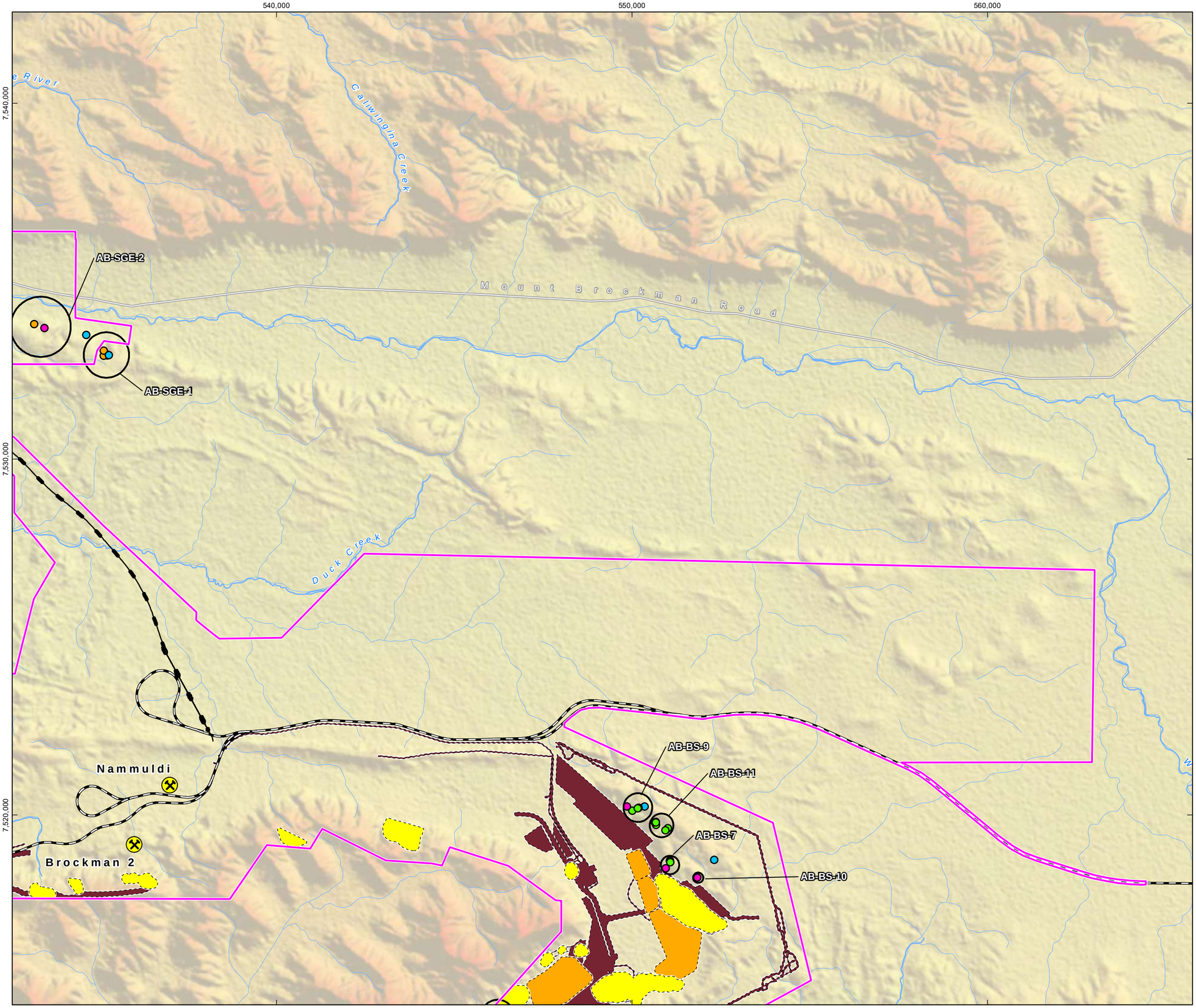
- Development Envelope
- Apartment Block

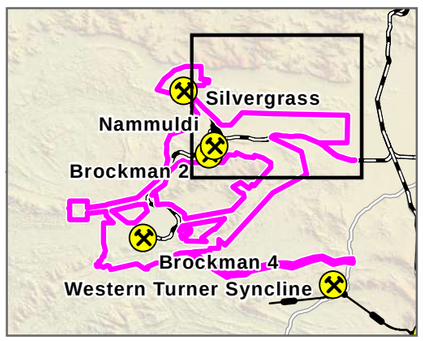
Ghost Bat Roots

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek





N

0 2 4 6

Kilometres

Map units in metres

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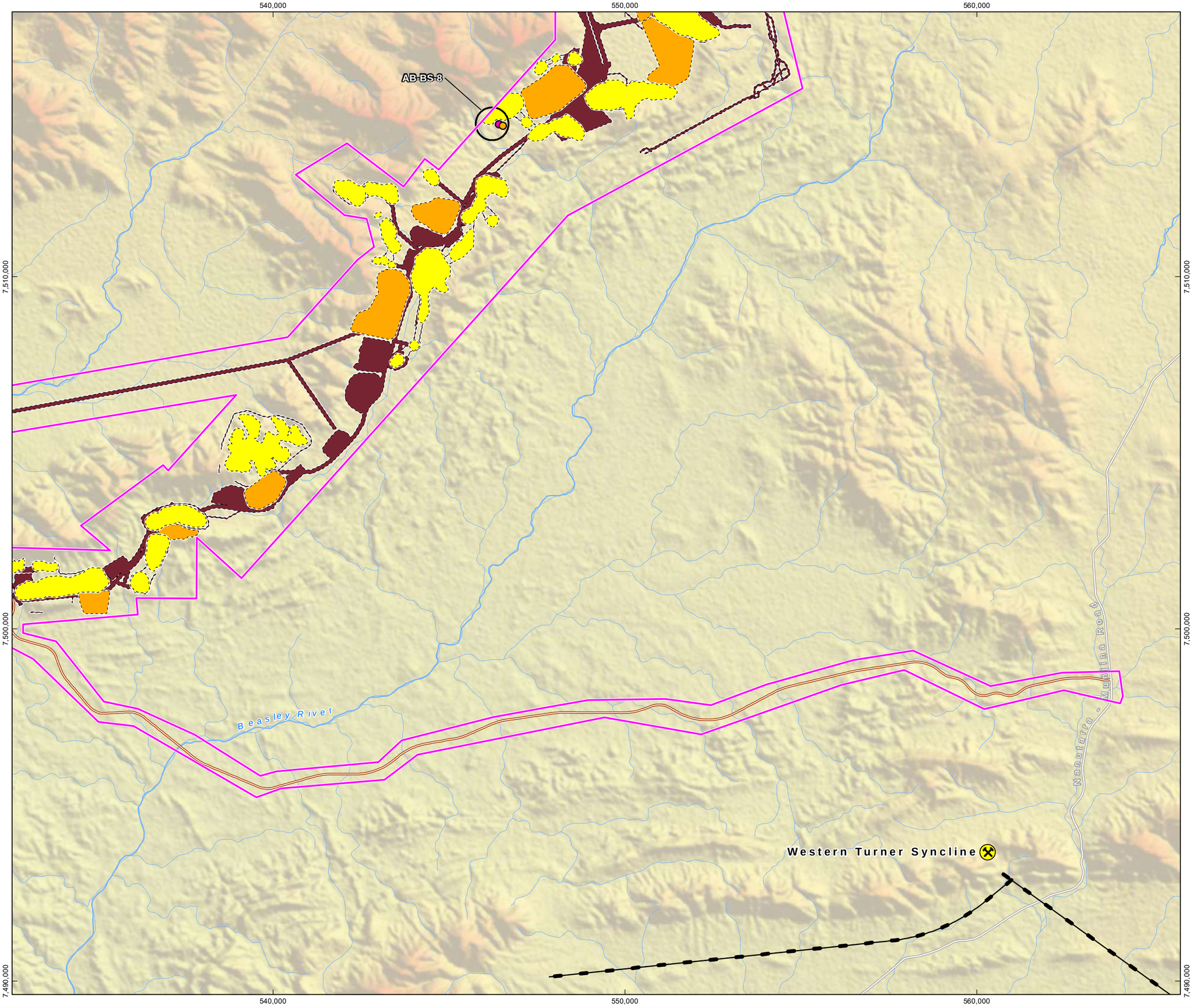
RioTinto

Figure 8-26
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope
- Apartment Block

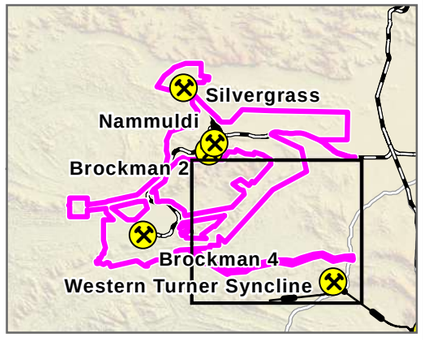
Ghost Bat Roots

- Apartment Block Category 2
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek
- Minor Creek



N

0 2 4 6
Kilometres

Map units in metres

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RioTinto

Figure 8-26
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Apartment Block

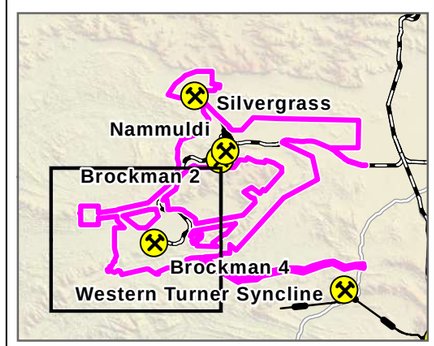
Ghost Bat Roots

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek
- Minor Creek

510,000
520,000
530,000
7,510,000
7,500,000
7,490,000
Brockman 4
AB-BS-6
AB-BS-5
AB-BS-3
Boolgeeda Creek
Beasley River West



N

0 2 4 6
Kilometres

Map units in metres

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Figure 8-27
Conceptual Footprint in the Context of Category 3 and 4 Ghost Bat Roosts

Drawn: L.Fuentes
Plan: PDE0189730v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Ghost Bat Roosts

- Category 3
- Category 4
- Unclassified

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Homestead Silvergrass Road
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Nanutarra - Munjina Road
Western Turner Syncline

RioTinto

Figure 8-28
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Homestead Silvergrass Road
Mount Brockman Road
Nanutarra - Munjina Road
White Quartz Road

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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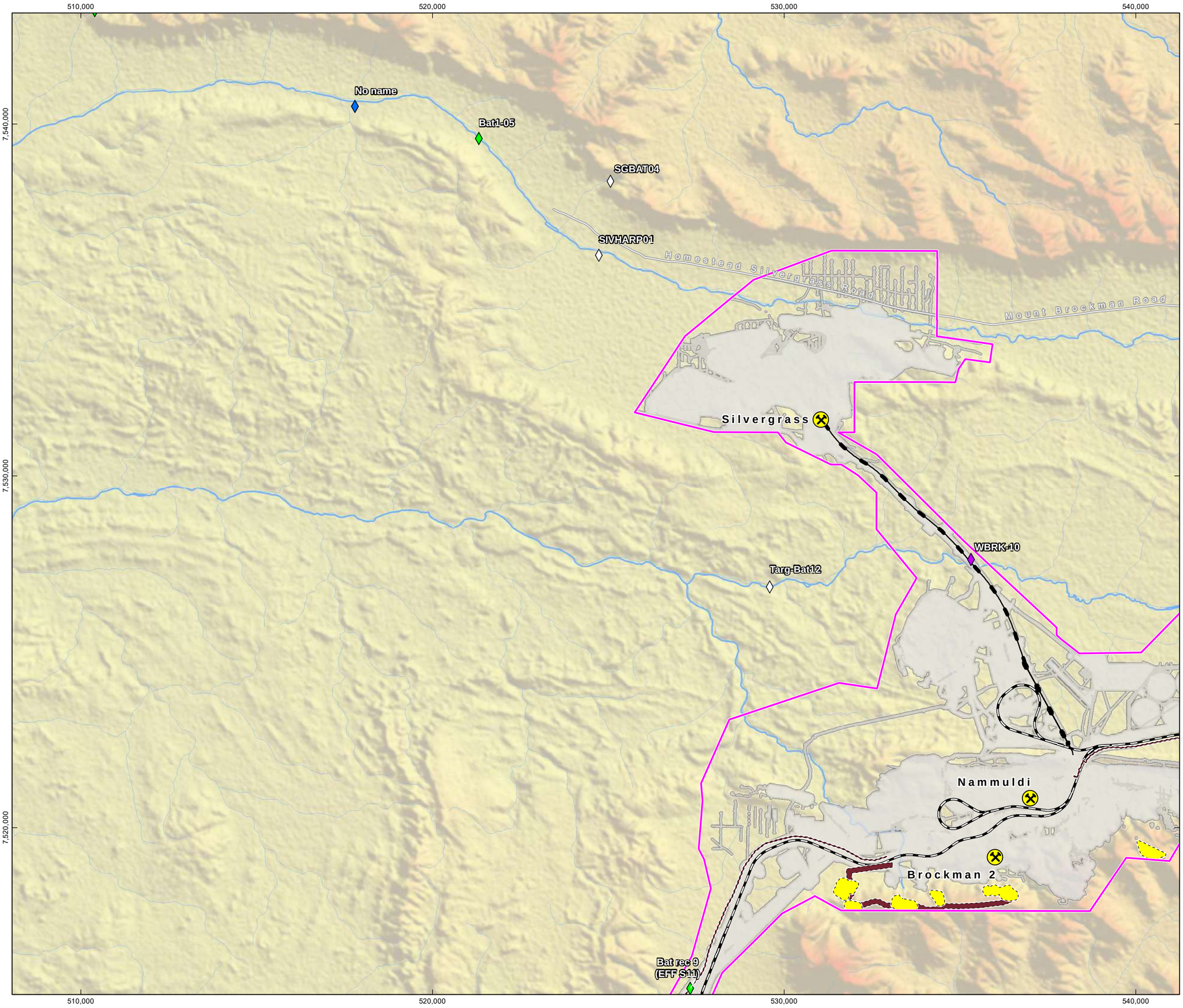


RioTinto

Figure 8-28
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal Map A

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

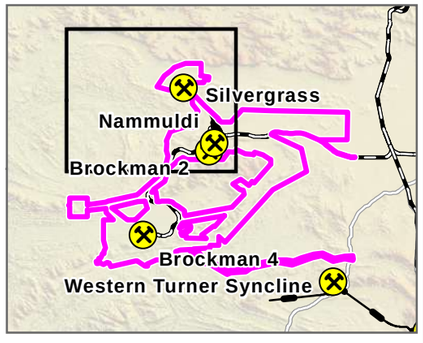
Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



N

0 1 2 3
Kilometres

Map units in metres

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RioTinto

Figure 8-28
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

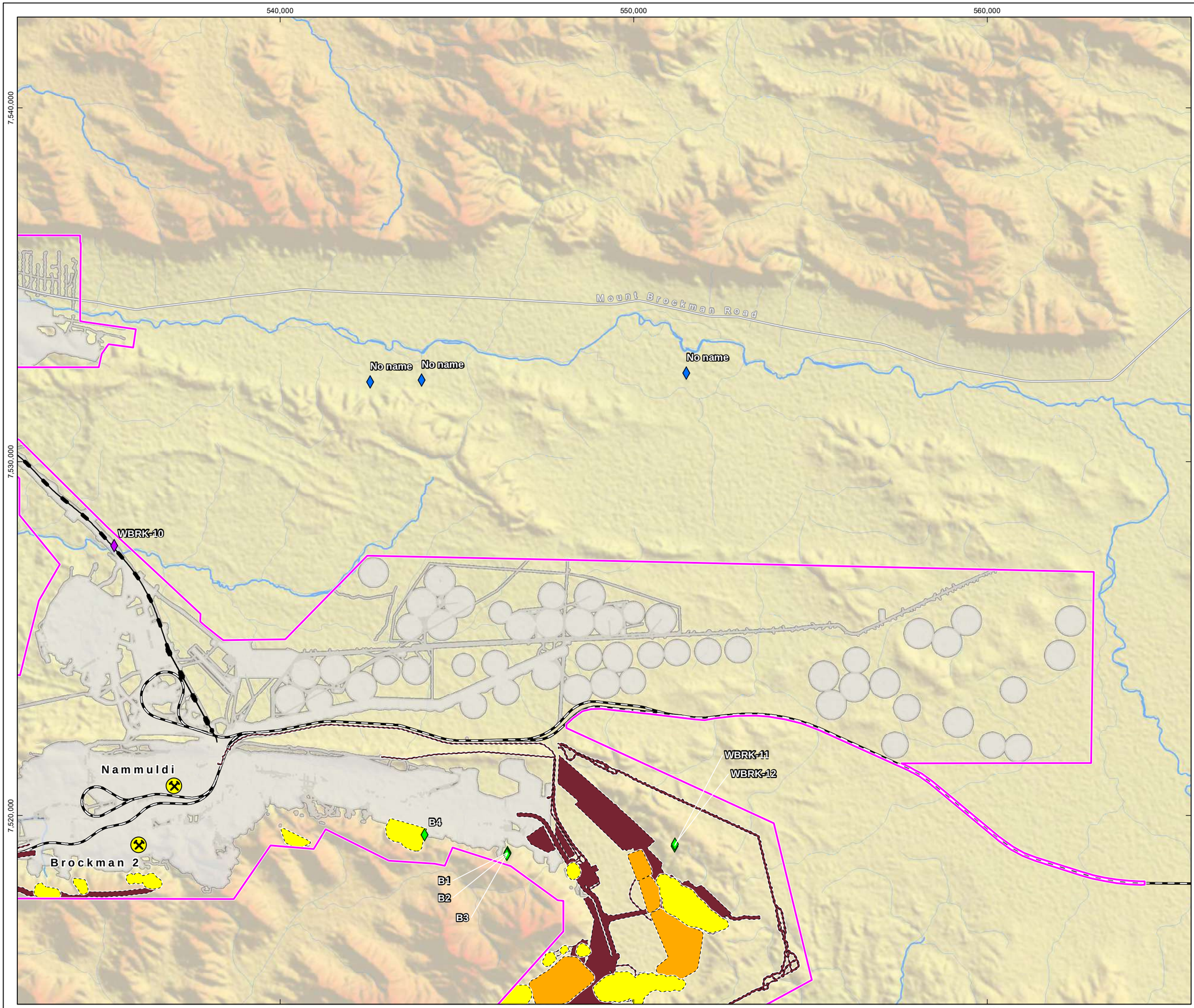
- Development Envelope
- Part IV Indicative Approved Footprint

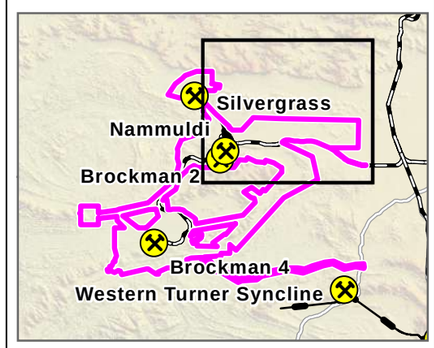
Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek





N

0 1 2 3

Kilometres

Map units in metres

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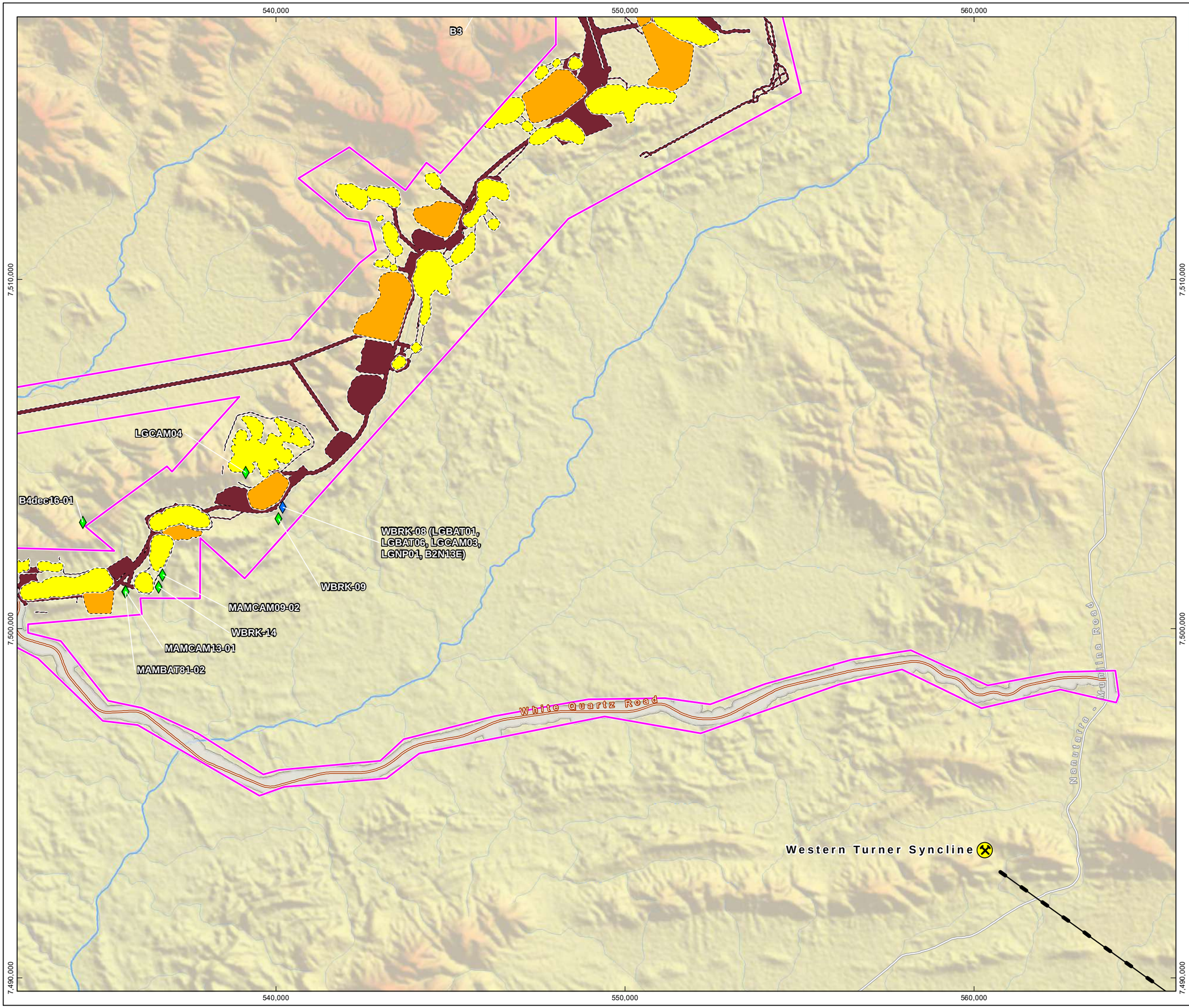


RioTinto

Figure 8-28
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

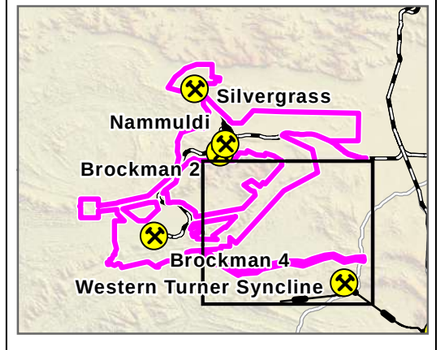
- Development Envelope
- Part IV Indicative Approved Footprint

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek
- Minor Creek



N

0 1 2 3
Kilometres

Map units in metres

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RioTinto

Figure 8-28
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

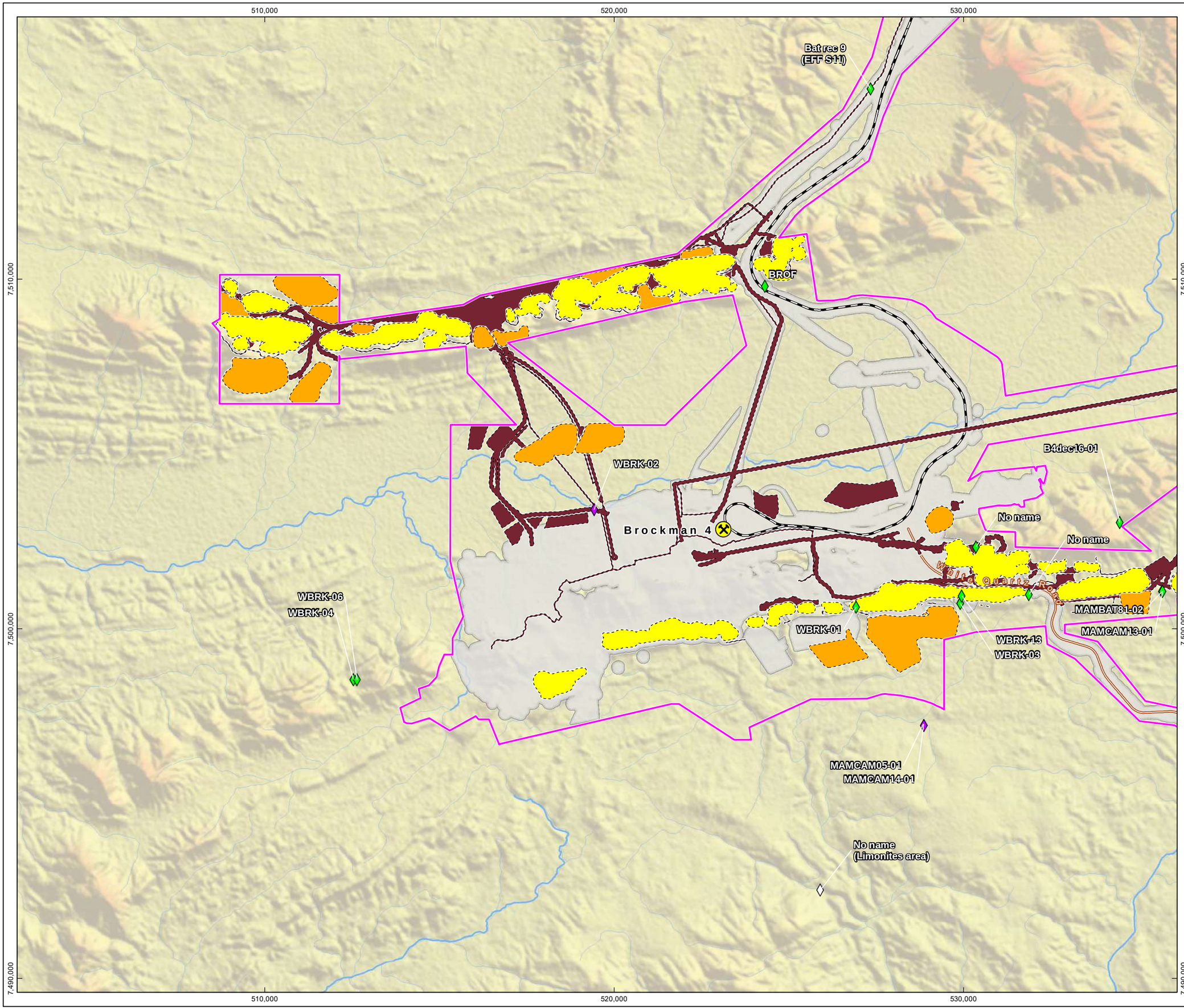
Water Features

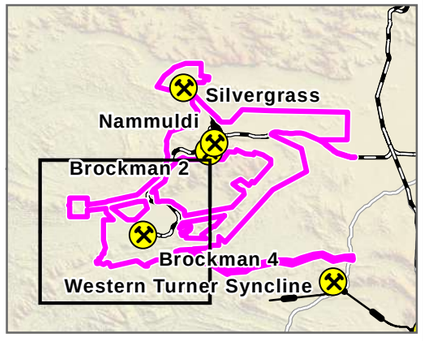
- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access
- Major Creek
- Minor Creek





N

0 1 2 3
Kilometres

Map units in metres

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8.4.1.3. Loss of Fauna Individuals

Fauna within the Development Envelope may be at risk of death, injury or displacement due to:

- Interaction with earthmoving equipment or vehicles during construction, operations and closure
- Entrapment within excavations, including lined water storages
- 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.

8.4.1.4. Loss of SRE Individuals and Habitat due to Clearing

As described above, clearing will directly impact up to 331 ha (14% of the survey area and 25% of the Development Envelope) of high suitability SRE habitat (Gorge/Gully and Debris Slope/Rocky Outcrop) and approximately 3,698 ha (12% of the survey area and 18% of the Development Envelope) of moderate suitability habitat (Major and Minor Creekline and Alluvial and Colluvial Plain) within the Development Envelope.

Of the 44 potential SRE species recorded within the Development Envelope, 15 occur within the Conceptual Footprint and may be directly impacted by clearing (Table 8-19 and Figure 8-29).

Table 8-19: Potential Short Range Endemic Species within the Conceptual Footprint

Class	Order	Family	Species
Arachnidae	Pseudoscorpiones	Olpiidae	*Beierolpium* `sp. 7/3 small`
			Indolpium sp. indet.
		Indet	*Pseudoscorpiones* sp. Indet
	Scorpiones	Buthidae	*Lychas* `hairy tail complex`
		Urodacidae	*Urodacus* sp.B
			Urodacus sp.A
	Araneae	Anamidae	*Aname* `sp. 1`
			Aname `sp. N19`
			Aname sp.
			Anamidae sp. indet.

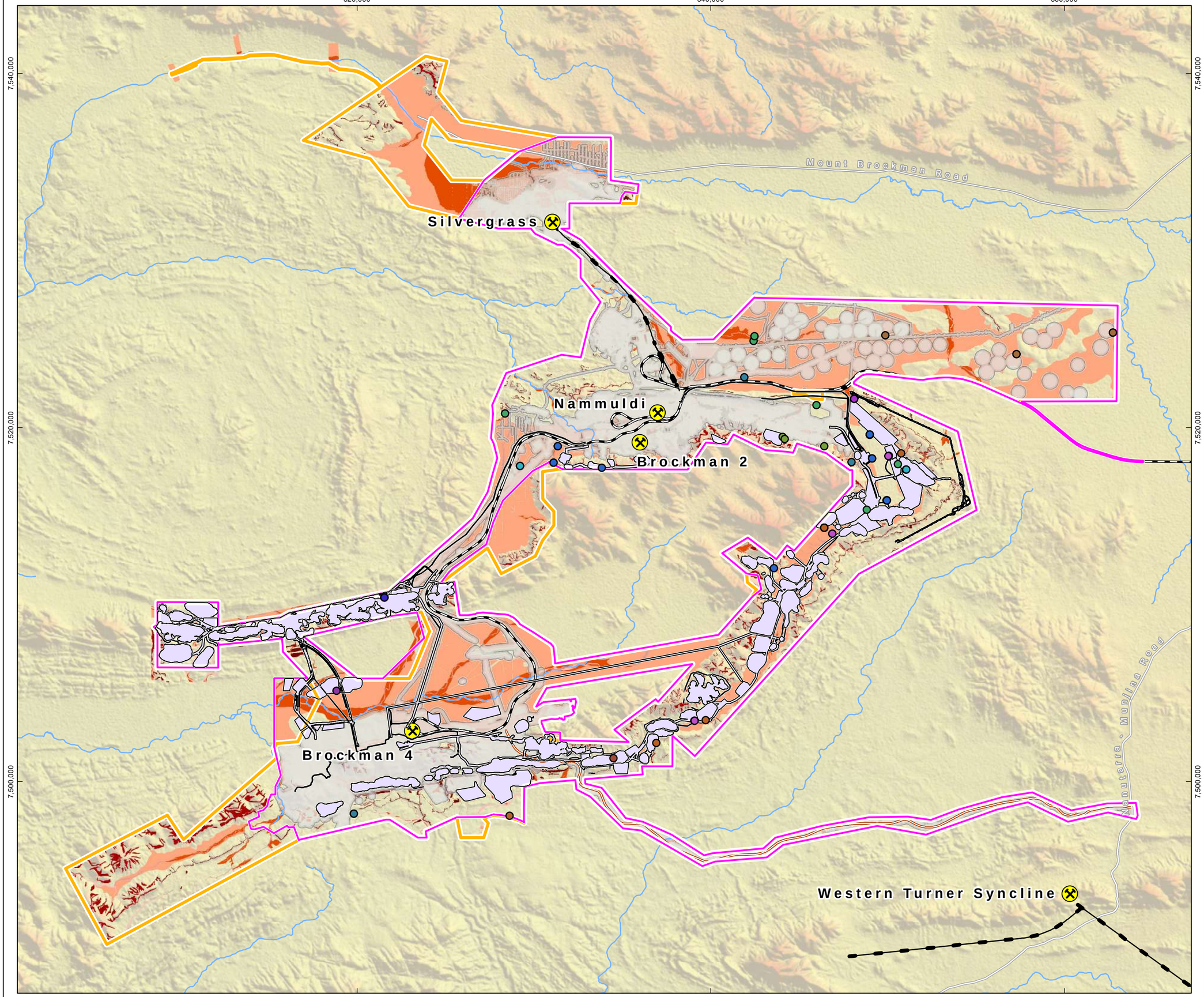
Class	Order	Family	Species
			Kwonkan sp. indet.
		Barychelidae	Barychelidae sp. indet.
Malacostraca	Isopoda	Indet	Isopoda Gen. nov `sp. 1`
			Isopoda Gen. nov `sp. 3`
Mollusca	Eupulmonata	Camaenidae	*Rhagada* `Pilbara banded complex`

RioTinto

Figure 8-29
Conceptual Footprint Depicting Potential Short-Range Endemics over Habitat Type Restricted to the Development Envelope
Overview

Drawn: L.Fuentes
Plan: PDE0191427v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Short Range Endemics (SREs)

- *Anamidae* sp. indet.
- *Aname*`sp. 1`
- *Aname*`sp. N19`
- *Aname*sp.
- *Barychelidae* sp. indet.
- *Beierolpium*`sp. 7/3 small`
- *Indolpium*sp. indet.
- *Isopoda* Gen. nov.`sp. 1`
- *Isopoda* Gen. nov.`sp. 3`
- *Kwonkan*sp. indet.
- *Lychas*`hairy tail complex`
- *Pseudoscorpiones* sp. indet.
- *Rhagada*`Pilbara banded complex`
- *Urodacus*sp.A
- *Urodacus*sp.B

Short Range Endemic (SRE) Habitat

High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 8-29
Conceptual Footprint Depicting Potential Short-Range Endemics over Habitat Type Restricted to the Development Envelope
Map A

Drawn: L.Fuentes
Plan: PDE0191427v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Silvergrass
Nammuldi
Brockman 2

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Short Range Endemics (SREs)

- *Aname*`sp. 1`
- *Aname*`sp. N19`
- *Kwonkan*sp. indet.

Short Range Endemic (SRE) Habitat

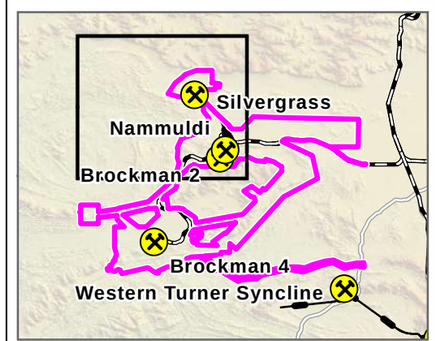
High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6

Kilometres

Map units in metres

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RioTinto

Figure 8-29
Conceptual Footprint Depicting Potential Short-Range Endemics over Habitat Type Restricted to the Development Envelope
Map B

Drawn: L.Fuentes
Plan: PDE0191427v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Short Range Endemics (SREs)

- *Anamidae* sp.
- *Aname*`sp. 1`
- *Aname*`sp. N19`
- *Beierolpium*`sp. 7/3 small`
- *Indolpium*sp. indet.
- *Isopoda* Gen. nov.`sp. 1`
- *Isopoda* Gen. nov.`sp. 3`
- *Kwonkan*sp. indet.
- *Lychas*`hairy tail complex`
- *Pseudoscorpiones* sp. indet.
- *Rhagada*`Pilbara banded complex`

Short Range Endemic (SRE) Habitat

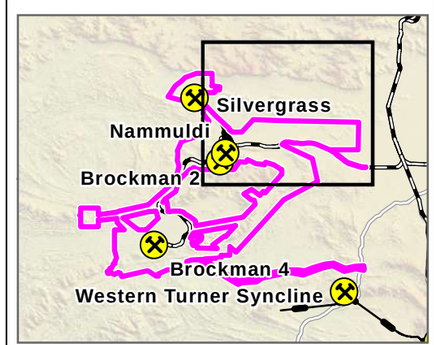
High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6
Kilometres
Map units in metres

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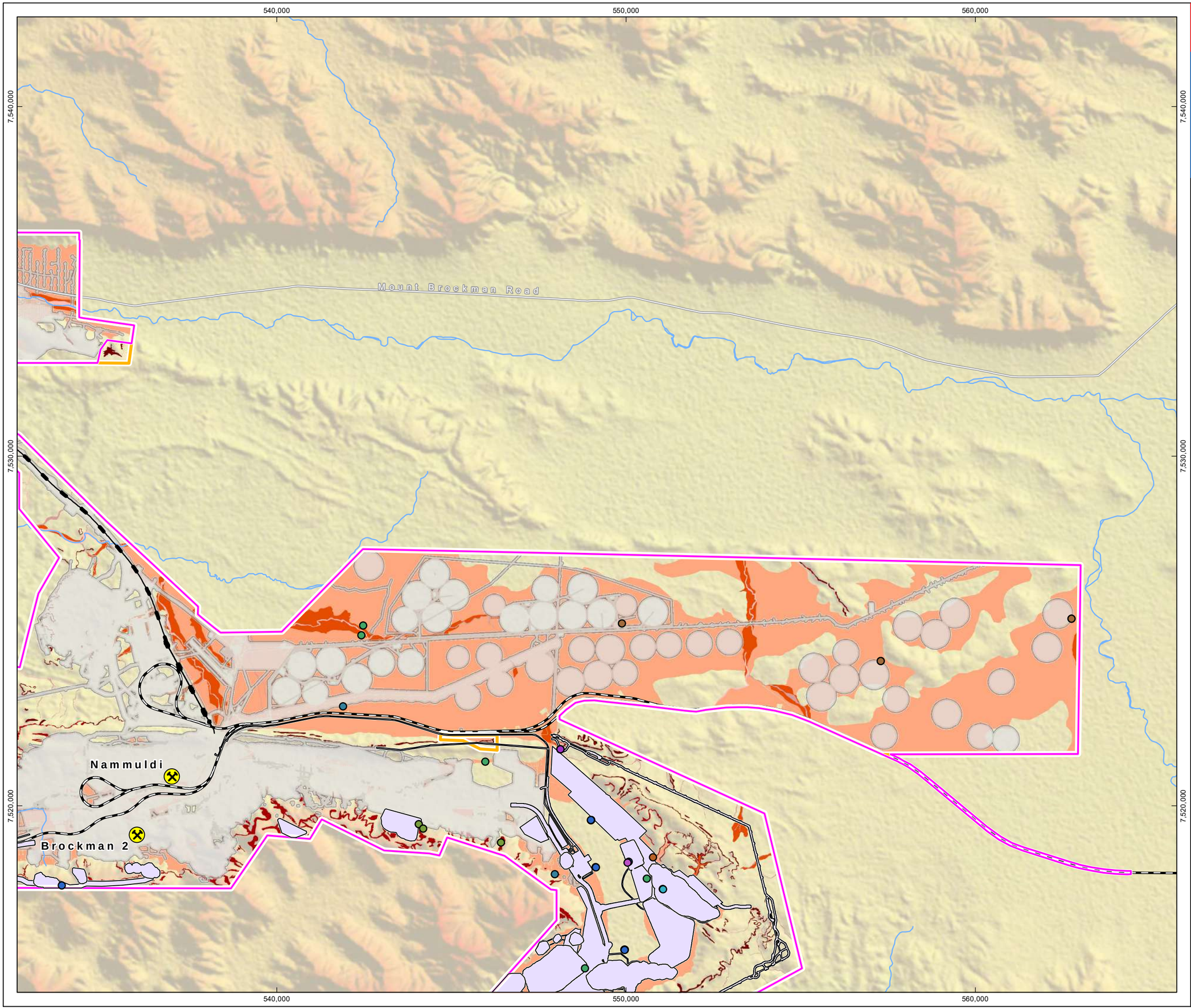

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Figure 8-29
Conceptual Footprint Depicting Potential Short-Range Endemics over Habitat Type Restricted to the Development Envelope
Map C

Drawn: L.Fuentes
Plan: PDE0191427v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Short Range Endemics (SREs)

- *Anamidae* sp.
- *Aname*`sp. 1`
- *Aname*`sp. N19`
- *Barychelidae* sp. indet.
- *Kwonkan*sp. indet.
- *Rhagada*`Pilbara banded complex`

Short Range Endemic (SRE) Habitat

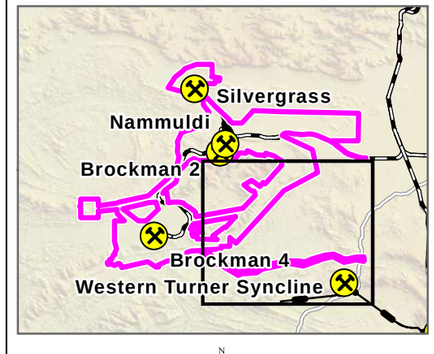
High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek



N

0 2 4 6
Kilometres
Map units in metres

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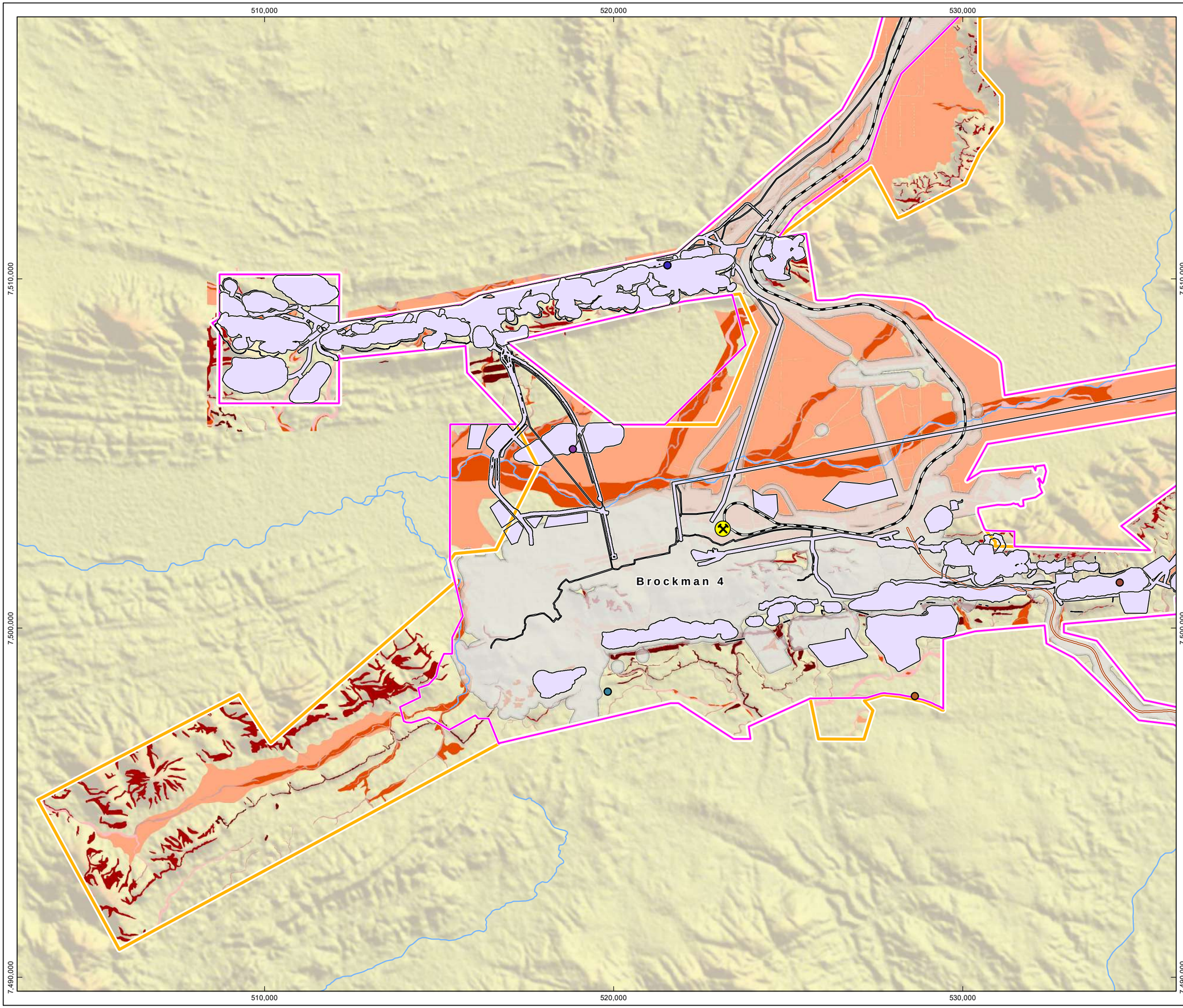


RioTinto

Figure 8-29
Conceptual Footprint Depicting Potential Short-Range Endemics over Habitat Type Restricted to the Development Envelope
Map D

Drawn: L.Fuentes
Plan: PDE0191427v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Short Range Endemics (SREs)

- *Aname*`sp. N19`
- *Aname*sp.
- *Barychelidae* sp. indet.
- *Indolpium*sp. indet.
- *Rhagada*`Pilbara banded complex`
- *Urodacus*sp.A
- *Urodacus*sp.B

Short Range Endemic (SRE) Habitat

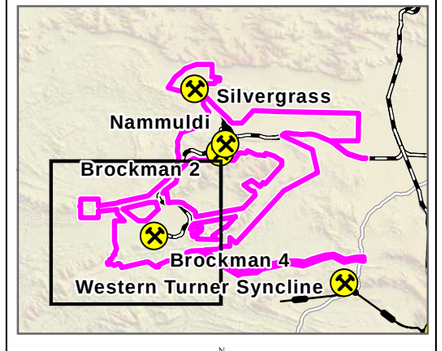
High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek



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0 2 4 6
Kilometres
Map units in metres

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8.4.2. 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
- Degradation of alteration of habitat features (caves) as a result of dewatering
- 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 pest species.

Potential impacts on aquatic fauna are addressed in Section 6 as part of the Inland Waters factor.

8.4.2.1. Degradation or Alteration of Habitat as a Result of Altered Hydrological Regimes

Surface water features within the survey area and Development Envelope provide important habitat for significant fauna, such as the Pilbara Leaf-nosed Bat and Pilbara Olive Python. Many surface water features are surface water dependent, and the potential changes resulting from catchment loss and/or discharge have been assessed in Section 6. The hydrological assessment concludes that there will not be a significant change to the hydrological regimes of the pools (including Plunge Pool and Ridge Pool) and, therefore, their habitat values will not be affected.

Discharge of surplus water to surface water systems is undertaken at many mining operations in the Pilbara. Vegetation may respond to prolonged discharge with increased growth and altered structure and provide additional temporary shelter and foraging habitat for fauna. Discharge of surplus water to creeks is expected to occur predominantly early in the mine life before mine pit storage is available.

8.4.2.2. Degradation or Alteration of Habitat Features (Caves) as a Result of Dewatering

Changes to groundwater levels due to dewatering have the potential to impact upon the suitability of caves as bat roosting habitat, particularly the Pilbara Leaf-nosed Bat which has specific temperature and humidity requirements for roosting.

8.4.2.3. Habitat Degradation Associated with Construction and Operational 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 operations, which may deposit on vegetation or pools, adversely affecting fauna habitat quality.

Fire

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).

8.4.2.4. 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

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. Noise intensity is highest within operational areas and dissipates with distance. Caves are important fauna habitat, and a noise threshold of 70 db(A) was applied at cave entrances for the noise assessment (Wood 2021; Appendix E.7). Noise modelling suggests that noise levels will be below the Assigned Noise Levels (70 dB(A)) at most bat cave entrances. Activities undertaken within 1,000 m of caves could result in noise levels that exceed the 70 dB(A) threshold (Wood 2021; Appendix E.7).

Vibrations associated with blasting can result in loss of, or damage to, cave and rocky shelter microhabitats adjacent to mining.

8.4.2.5. Increase in Abundance and Diversity of Feral Species

Five feral fauna species have been recorded in the Development Envelope, including the Cat, Dingo, European Cattle, Horse and House Mouse. These species are known from the region surrounding the Development Envelope. The development of new tracks, increased water points and production of domestic waste has the potential to attract and increase the abundance and diversity of introduced species. This may increase competition with and predation of native species.

Clearing may result in native fauna traversing cleared areas to reach suitable habitats. These altered movement patterns may result in increased predation of significant fauna by feral predators, causing injury or mortality of individuals. Where Red Foxes are scarce (as in the survey area and Development Envelope), Cats are the main cause of population declines in smaller mammals (CALM 1996).

8.4.3. Cumulative Impacts

The Proposal will contribute to cumulative regional loss of fauna habitats and species present in the Development Envelope.

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. Table 8-20 identifies the occurrence of significant species within other project areas within 100 km of the Proposal. Existing and reasonably foreseeable projects within the region that may contribute to cumulative impacts along with the Proposal are described in Section 2.

Detailed fauna habitat mapping has been completed in the Development Envelope; however, detailed mapping at the same scale is unavailable for the Pilbara region. Land System mapping at a regional level by Department of Primary Industries and Regional Developments allows for assessing cumulative impacts on broad landscape units as a surrogate for fauna habitat. The cumulative losses of land systems are shown in Table 8-21. These losses are very conservative as either the Development Envelope or the survey area has been used to calculate the other projects' cumulative loss. The maximum potential impact from cumulative losses attributable to the Proposal is associated with the Rocklea Land System (41,044 ha; 5.8%) and the Boolgeeda Land System (285,760 ha; 4.7%).

Table 8-20: Occurrence of Significant Fauna Species within Approved and Reasonably Foreseeable Projects as a Basis for Considering Cumulative Impacts

Significant Fauna	Brockman Existing Operations	FMG Eliwana (adjacent)	FMG Eliwana Railway (12 km)	Western Turner Syncline (15 km)	Flinder (15 km)	FMG Solomon (70 km)	Rio Tinto Greater Paraburdoo (85 km)
Mammals							
Northern Quoll	✓	✓	×	×	✓	✓	✓
Pilbara Leaf-nosed Bat	✓	✓	✓	✓	×	✓	✓
Ghost Bat	✓	✓	✓	✓	✓	✓	✓
Western Pebble-mound Mouse	✓	✓	✓	✓	✓	✓	✓
Long-tailed Dunnart	✓	✓	×	×	×	✓	×
Short-tailed Mouse	✓	×	✓	×	×	✓	×
Birds							
Grey Falcon	✓	×	×	×	×	×	✓
Peregrine Falcon	✓	✓	×	×	×	×	×
Fork-tailed Swift	✓	✓	×	×	×	✓	×
Reptiles							
Pilbara Olive Python	✓	✓	×	✓	✓	✓	✓
Lined Soil-Crevice Skink	✓	×	×	✓	×	✓	×
Gane's Blind Snake	✓	×	✓	×	✓	✓	×

Table 8-21: Cumulative Impacts on Land Systems within the Pilbara Region

Land System	Current Extent in Hamersley Subregion (ha)	Impact within Development Envelope		Impact in Reasonably Foreseeable Projects*		Cumulative Impact**	
		ha	% of current extent	Development Envelope (ha)	% of current extent	Area (ha)	% of current extent
Boolgeeda	607,323	1,602	0.3	19,812	3.3	28,760	4.7
McKay	80,885	114	0.1	119	0.1	119	0.1
Newman	1,856,685	3,438	0.2	32,164	1.7	38,254	2.1
Platform	217,768	1,818	0.8	6,051	2.8	6,644	3.1
River	72,468	59	0.1	689	1.0	750	1.0
Robe	102,677	236	0.2	2,901	2.8	3,921	3.8
Rocklea	711,724	315	0.0	38,853	5.5	41,044	5.8
Table	20,653	207	1.0	668	3.2	799	3.9
Wannamunna	62,357	107	0.2	107	0.2	343	0.5

**Not all reasonably foreseeable projects had suitable information regarding land systems for this purpose. Table does not include Flinders Mine (three land systems in Development Envelope) and Solomon Expansion (two relevant land systems within Development Envelope). **Cumulative loss includes this Proposal, Existing Brockman Operations, Eliwana, Eliwana Railway, Western Turner Syncline and Greater Paraburdoo*

8.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids and minimises, where practicable, impacts on significant fauna and high significance habitat types present in the Development Envelope.

8.5.1. Mitigation Hierarchy

Table 8-23 summarises how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during proposal design to develop appropriate mitigation and management strategies to address the key potential impacts on the Terrestrial Fauna. Mitigation is proposed to protect the key environmental values associated with terrestrial fauna, where mitigation is required to achieve the proposed environmental outcome.

8.5.2. Avoidance and Minimisation

8.5.2.1. High Value or Significance Habitat Types

Section 8.4.1.1 presented the approximate clearing of habitat types based on a Conceptual Footprint; 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 suggest a maximum clearing extent for habitat types of high significance, as per Table 8-15. The Proponent proposes that these limits be conditioned within the MS. Habitat types of moderate and low significance are presented as approximate clearing extents.

8.5.2.2. Ghost Bat Roosts within BS1 Assessment Area

The range within the BS1 assessment area likely acts as an east-west corridor for the movement of Ghost Bats in the region as there is no suitable roosting habitat to the north or south (plains extend to the north and south). Surveys have shown 15 roost sites along the range comprising ten category 3 and five category 4 roosts.

Removing all 15 roost sites within the BS1 assessment area could potentially prevent Ghost Bat's use of the corridor to move to and between other roosts. The Proponent has amended the Proposal to avoid and protect a cluster of seven roosts, including five category 3 and two category 4 roosts, to maintain the east-west corridor connection.

The Proponent has established MRZs and MEZs around these roosts to ensure operations do not directly impact these roosts. A MRZ refers to a demarcated zone where no mining excavation will occur, and only low impact activities associated with environmental monitoring and management may be implemented. A MEZ refers to an area where no direct disturbance is permitted. A central MEZ will surround each significant bat roost within an MRZ (Table 8-22). Management and monitoring in relation to these roosts is included within the EMP attached as Appendix B.3.

8.5.2.3. Ghost Bat Apartment Block and Isolated Category 2 Roosts

The Proponent has designed the Proposal to avoid all six apartment block roost complexes (comprising 20 roosts in total) and the two isolated category 2 roosts within the Development Envelope. To ensure these roosts are protected, the Proponent will establish MEZs within MRZs around each roost/roost complex in line with Table 8-22, as shown in Figure 8-30 and Figure 8-31a to d.

Due to the significance that apartment block roosts provide to the Ghost Bat, buffers associated with category 3 and 4 roosts in an apartment block have been extended to provide additional protection. Additionally, category 2 and 3 Ghost Bat caves located within Apartment Blocks have been assigned a seasonal PPV of 10, that applies from 1 October to 31 December. This seasonal conservative value coincides with the time period that maternity caves (such as category 2 caves) are being utilised by heavily pregnant females, and when mothers are caring for pups. Category 3 caves within apartment blocks are also assigned the same conservative value during this time period, in case the mothers need

to flee the primary category 2 cave, to the category 3 cave (e.g., during events when feeling threatened by predators)

To further avoid impacts to apartment blocks and isolated category 2 roosts, the Proponent has established minimum vibration limits in consultation with blasting experts for each roost category as per Table 8-22 which will be supported by deposit scale blast management plans. These minimum vibration limits have been informed by technical advice from Chiropterologist Bob Bullen (Bat Call WA) and will be monitored via the EMP.

8.5.2.4. Isolated Category 3 and 4 Roosts

Whilst isolated category 3 and 4 roosts are not considered critical habitat, the Proponent recognises the value they provide to support foraging and movements across the landscape for the Pilbara Leaf-nosed Bat and Ghost Bat. Up to 25 category 4 roosts for the Pilbara Leaf-nosed Bat and 14 category 3 and 11 category 4 roosts for the Ghost Bat will be directly impacted by the Proposal. The Proponent will establish MEZs within MRZs for all remaining known category 3 and 4 roosts within the Development Envelope. Vibration limits will also apply to retained category 3 roosts (Table 8-22 and Figure 8-30 and Figure 8-31). The Proponent has specifically chosen to protect these roosts across the Development Envelope in order to provide for ongoing dispersal and genetic viability across the Development Envelope and wider area.

8.5.2.5. Water Features

The Proposal has been designed to avoid potential impacts to Plunge Pool as the only known permanent groundwater fed pool within the Development Envelope by limiting mining of BS3 deposit to AWT only, backfilling the upstream BS3 extension deposits (MM-J and Creekside) post mining and protection from direct impacts by a MEZ, as described in detail in Chapter 6. This pool is significant to terrestrial fauna, particularly MNES species such as Pilbara Leaf-nosed Bat and Pilbara Olive Python, providing water resources throughout the year. In addition, 18 of the 22 known water features within the Development Envelope have been placed within MEZs within MRZs (Figure 8-30 and Figure 8-31) to provide for additional fauna habitat values.

Table 8-22: Mine Restriction and Exclusion Zones and Peak Particle Velocity Limits for Roosts

Roost Category	Mine Exclusion Zone and Mining Restriction Zone (m)	Peak Particle Velocity (PPV)
Apartment Block – Primary Roosts	• MRZ: Mining activities permitted up to 150 m of primary category 2 roosts • MEZ: Ground disturbance is restricted to within 100 m of primary category 2 roosts.	• 10 mm/s peak particle velocity (PPV) during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months.
Apartment Block – Category 3 and 4 Roosts	• MRZ: Mining activities permitted up to 150 m of secondary category 3 roost • MEZ: Ground disturbance is restricted to within 100 m of secondary category 3 roost • MRZ: Mining activities permitted up to 75 m of secondary category 4 roost • MEZ: Ground disturbance is restricted to within 65 m of secondary category 4 roosts.	• 10 mm/s PPV during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months • Category 3 roosts - 50 mm/s PPV • Category 4 roosts – N/A.

Roost Category	Mine Exclusion Zone and Mining Restriction Zone (m)	Peak Particle Velocity (PPV)
Isolated Category 2 Roosts	• MRZ: Mining activities permitted up to 150 m of isolated category 2 roosts • MEZ: Ground disturbance is restricted to within 100 m of isolated category roosts.	• 10 mm/s PPV during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months.
Retained Category 3 Roosts	• MRZ: Mining activities permitted up to 75 m of retained category 3 roosts • MEZ: Ground disturbance is restricted to within 65 m of retained category 3 roosts.	• 50 mm/s PPV
Retained Category 4 Roosts	• MRZ: Mining activities permitted up to 20 m of retained category 4 roosts.	• N/A

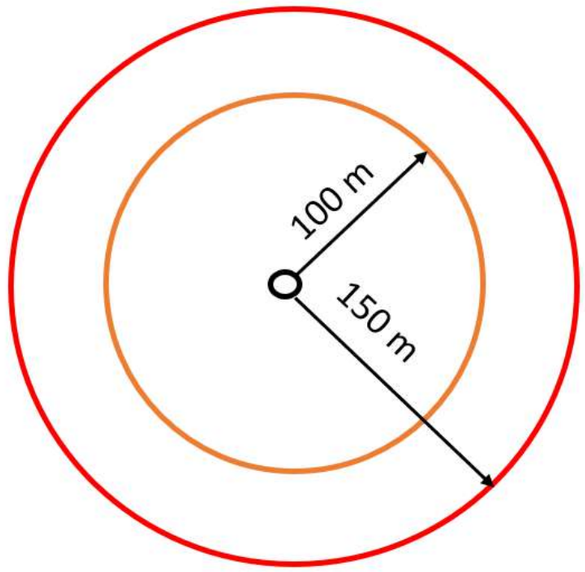
8.5.3. Mitigation of Risks at Closure

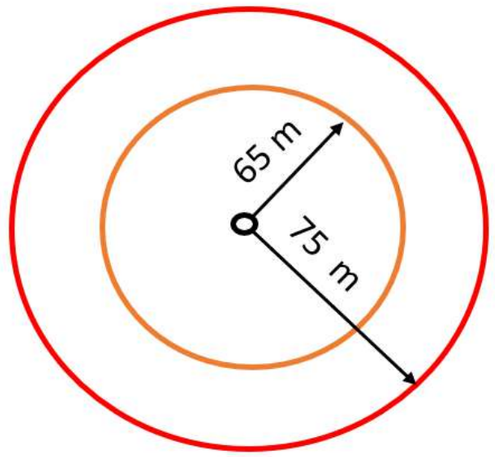
The Brockman Syncline MCP has been prepared to address closure requirements for the Proposal (Appendix B.4). The MCP will be updated regularly to ensure its objectives remain relevant and aligned to stakeholder expectations and its strategies and plan are appropriate to achieve closure outcomes

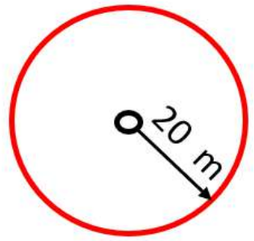
- Isolated Category 2 Roosts
- Category 2 Roosts when in an Apartment Block
- Category 3 Roosts when in an Apartment Block

- Retained Category 3 Roosts
- Category 4 Roosts when in an Apartment Block

- Retained Category 4 Roosts







- **Mining Restriction Zone (MRZ)**: Refers to a demarcated zone where no mining excavation will occur, and only low impact activities associated with environmental monitoring and management may be implemented. No more than 5% of the MRZ can be cleared for low impact activities
- **Mining Exclusion Zone (MEZ)**: Refers to an area within the Development Envelope where no direct disturbance is permitted unless in response to a contingency action associated with monitoring and management

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Figure 8-30
Ghost Bat Mine Restriction and Exclusion Zones According to Roost Category

Drawn: L.Fuentes
Plan: PDE0189741v1
Date: May 2023
Scale: Not to Scale @A3
GIS.Team@riotinto.com

Legend

- Cave
- Mine Restriction Zone
- Mine Exclusion Zone

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Figure 8-31
Mine Restriction and Exclusion Zones Roosts, Connecting Habitat and Water Features

Drawn: L.Fuentes
Plan: PDE0189741v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Roost
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,520,000
7,500,000

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Plunge Pool
Duck Creek
Wackiina Creek
Boolgeeda Creek
Beasley River West

0 0.25 0.5 0.75 1
Kilometres

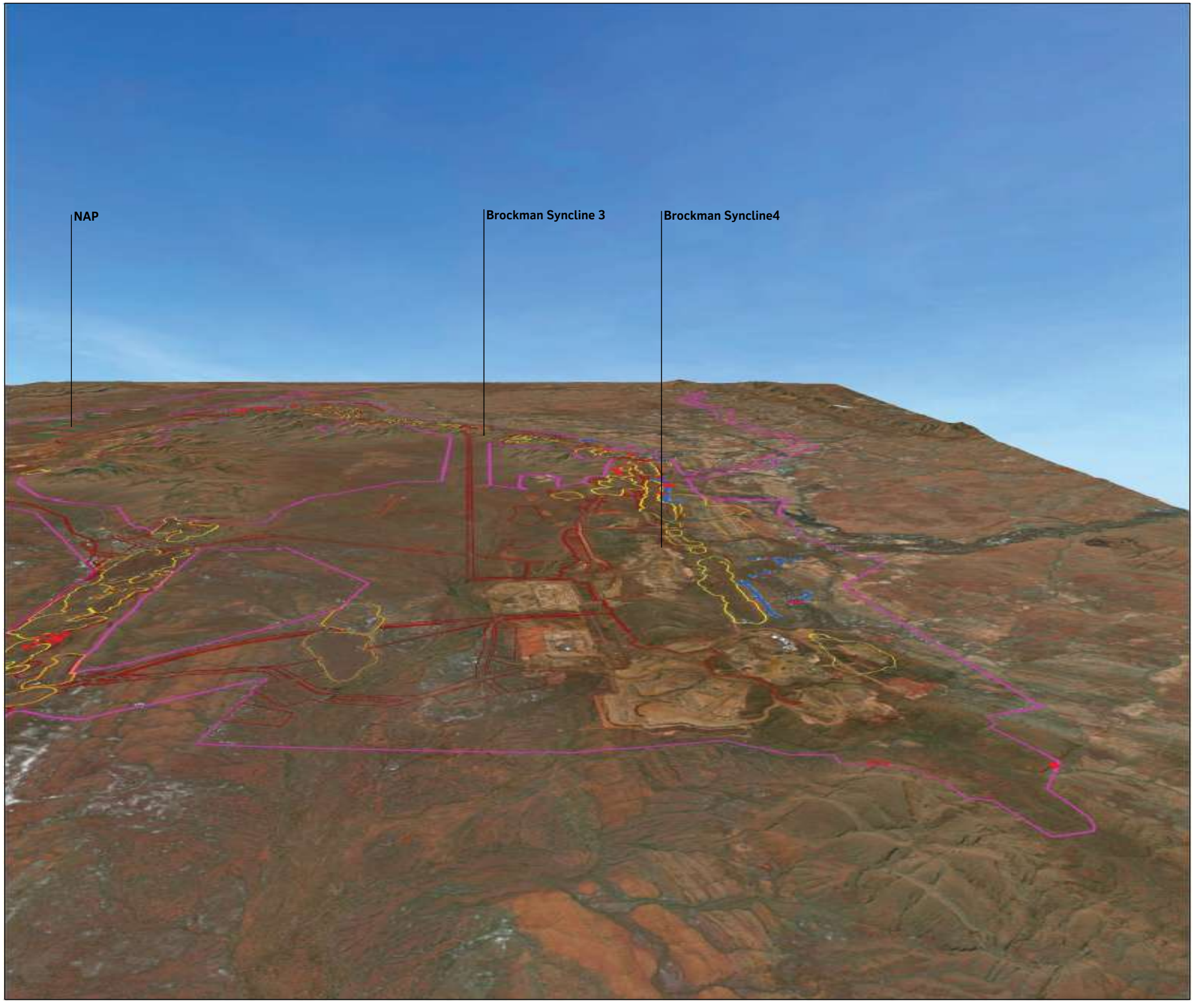

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Figure 8-31a
Mine Exclusion Zones
Roosts and Critical Habitat
Looking East

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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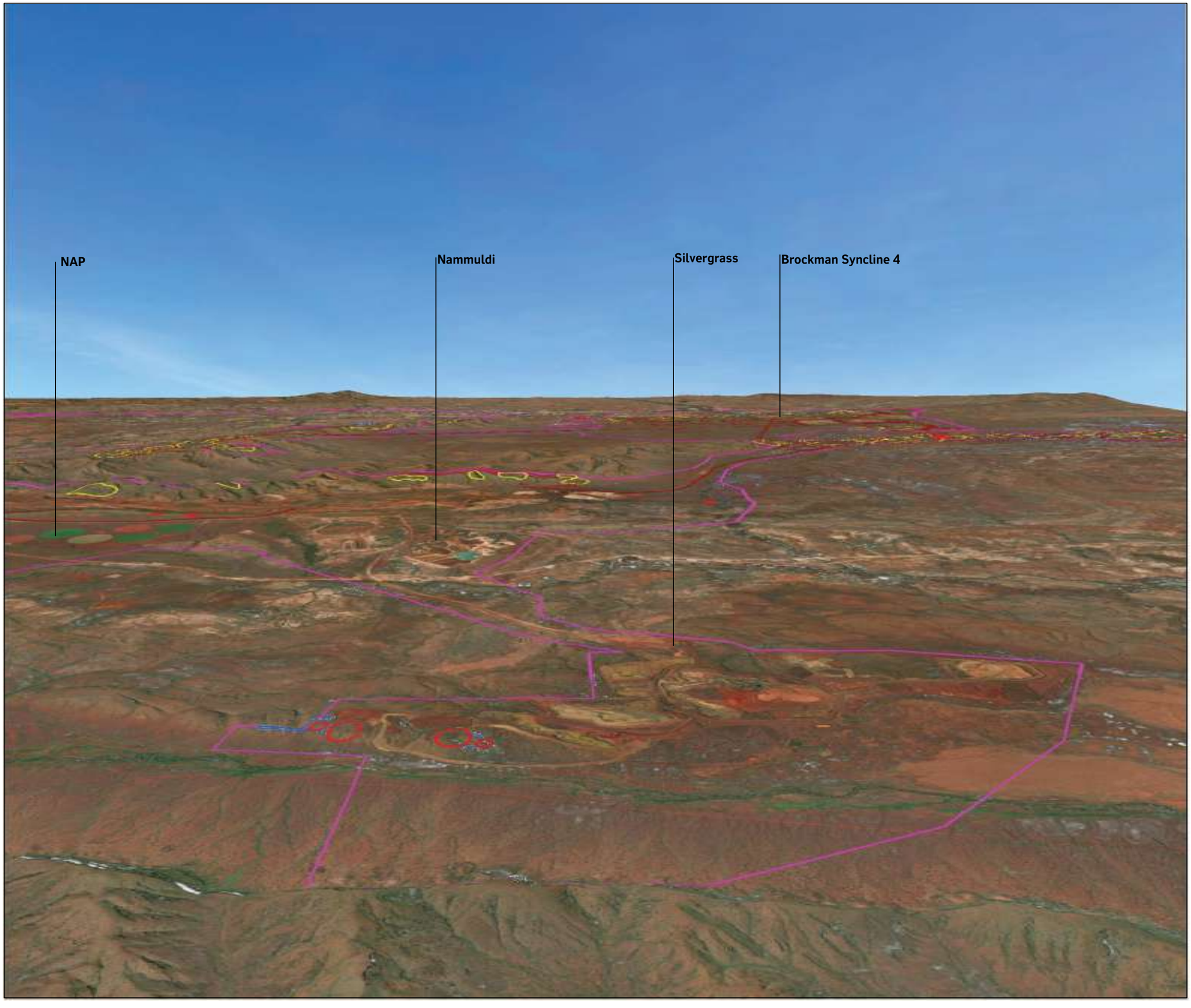

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Figure 8-31b
Mine Exclusion Zones
Roosts and Critical Habitat
Looking South

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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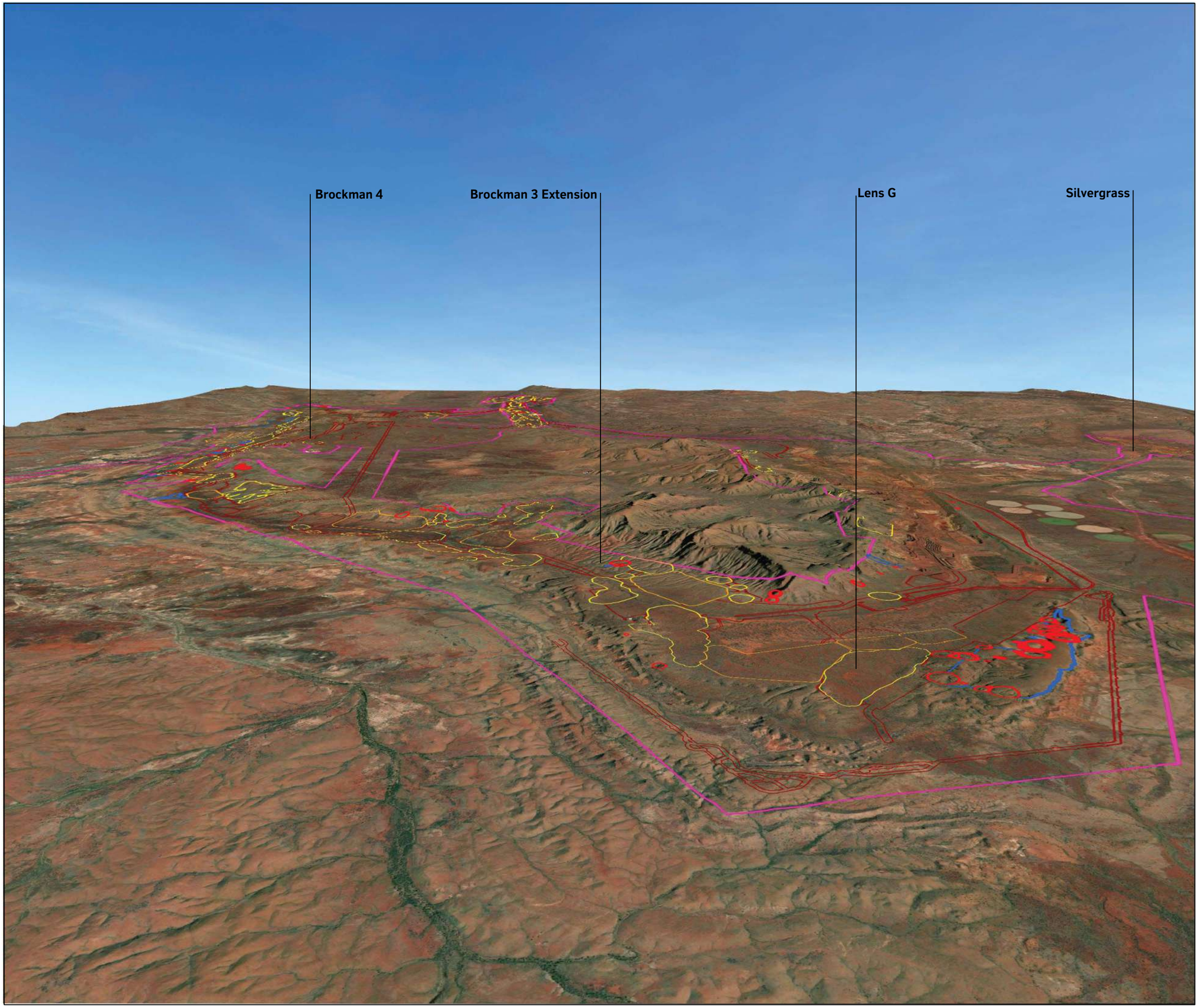

RioTinto

Figure 8-31c
Mine Exclusion Zones
Roosts and Critical Habitat
Looking West

Drawn: L.Fuentes
Plan: PDE0191287v1.2
Date: May 2023

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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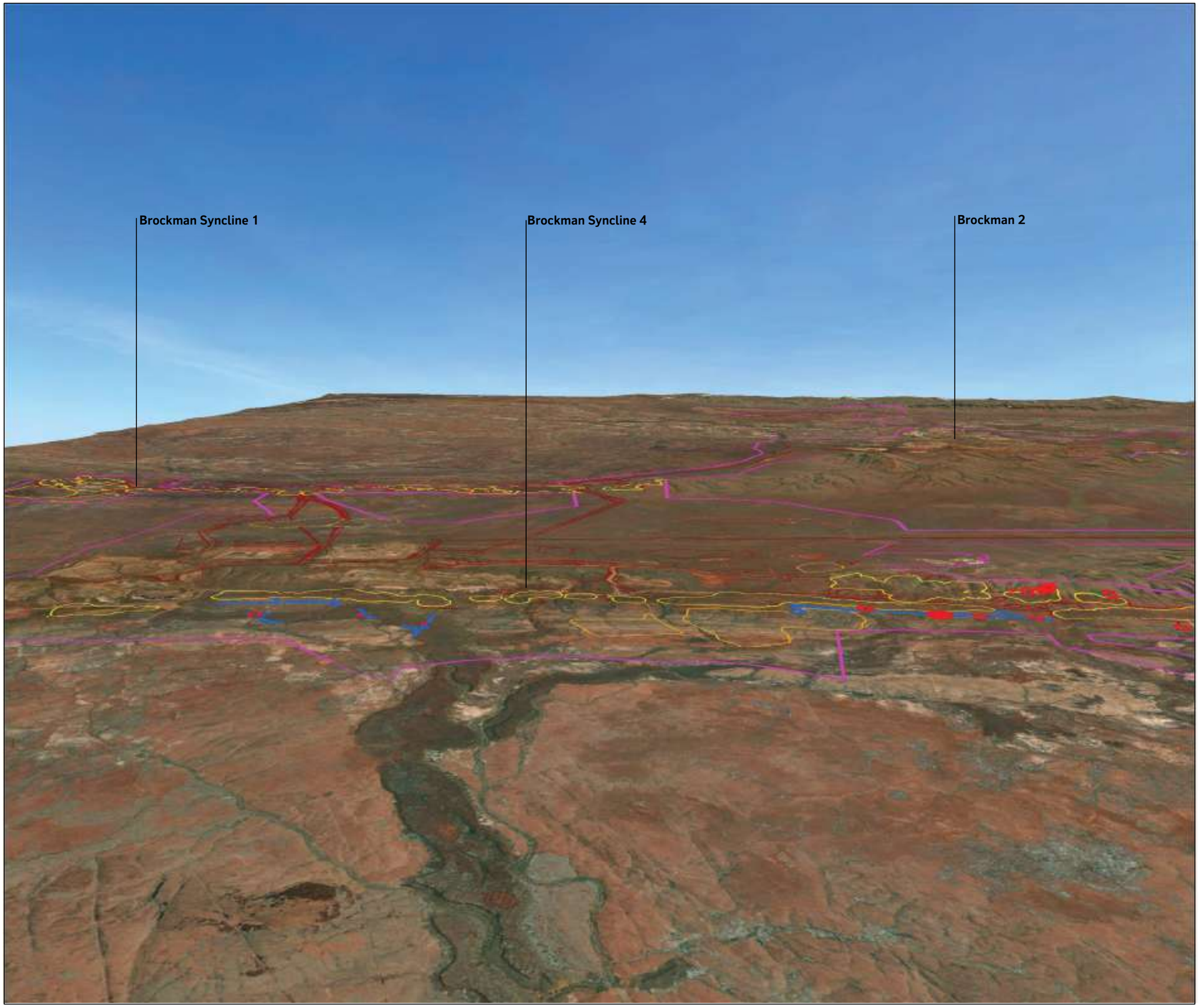

RioTinto

Figure 8-31d
Mine Exclusion Zones
Roosts and Critical Habitat
Looking North

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

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Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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8.5.4. Summary of the Application of the Mitigation Hierarchy

As described above, the Proposal has been designed to avoid and mitigate impacts. Table 8-23 summarises the mitigation hierarchy for this Proposal.

Table 8-23: Application of the Mitigation Hierarchy for Terrestrial Fauna

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Loss of fauna habitat	**Measures to Avoid**			
	• The Development Envelope and Conceptual Footprint have been modified during the design phase to avoid direct impacts to high significance vertebrate fauna habitat where practicable. This includes the avoidance of 106 bat roosts within the Development Envelope. • MEZs and MRZs have been established around 106 significant roosts within the Development Envelope, with limits on disturbance • MEZs and MRZs have been established around habitat linking roost clusters • MEZs and MRZs have been established around significant water features, where practicable • MRZs and MEZs will be included in the Proponents GIS system to ensure known locations are avoided. • The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system. • Pre-clearance surveys for Ghost Bat and/or Pilbara Leaf-nosed Bats, from known roosts which intersect with the clearing footprint including flushing of Roosts followed by sheeting of entrances to prevent return before ground disturbance occurring to be undertaken by trained ecologists.	Proposal Specific	Yes – approval is required under the BC Act for the disturbance of habitat for significant species	• There are no industry or best practice standards established in relation to habitat protection. Avoidance is the first and preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021b) • The approvals request system is well-established and ensures clearing does not occur in MEZs and that limits apply to MRZs. This system also tracks clearing where limits apply to habitat types, providing a high level of confidence that clearing will not be greater than assessed. • Avoidance of high significant habitat is a key recommendation for species conservation.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Minimise			
	• Development Envelope and Conceptual Footprint have been designed to minimise where practicable disturbance of high significance Gorge/Gully and Debris Slope/Rocky Outcrop habitats • Clearing of high significance habitat will be restricted through authorised extents • Known location of significant fauna habitat types will be included 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 ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system.	Proposal Specific	Yes – approval is required under the BC Act for the disturbance of habitat for significant species	• These measures are best practice and are consistent with conservation advice for the Pilbara Leaf-nosed and Ghost Bat (TSSC 2016a, b) and the National Recovery Plan for the Northern Quoll (Hill and Ward 2010). • The approvals request system is well-established and ensures clearing does not occur in MEZs and that limits apply to MRZs. This system also tracks clearing where limits apply to habitat types • Retention of high significance habitats is one of the key recommendations for species conservation.
	Measures to Rehabilitate			
	• Preparation and regular update of a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a) • The MCP includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms are stable and consider ecological and hydrological factors. • Habitat elements considered part of the rehabilitation design includes: • Vegetation is known to provide preferred food or shelter preference • Retaining and replacing woody debris	A Proposal specific MCP has been developed, based on RTIO standard approach to closure planning	No	• Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a, b]). The MCP must 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 vegetated and stable landform with habitat features. However, the uncertainty in relation to the re-creation of habitat values following mining is acknowledged. Therefore, clearing is treated as a long-term or permanent impact for this assessment.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore 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.			
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• MRZs (minor clearing allowed, no blasting or mining excavation) will be established around significant roosts (Appendix B.3) • MEZs (no direct impact) will be established around habitat linking roost clusters and significant water features • Limit to clearing (direct impact) of high significance habitat (Gorge/Gully and Debris Slope/Rocky Outcrop) • Limit to clearing of category 3 and 4 roosts.		• MRZs and MEZs are anticipated to be included as a Ministerial Condition • Clearing limits to be included as a Ministerial Condition	
Fragmentation of fauna habitat, due to land clearing	**Measures to Avoid**			
	• The Development Envelope and Conceptual Footprint have been modified during the design phase to avoid, where possible fragmentation of significance vertebrate fauna habitat. • Significant corridors in different landforms such as ridges, hillsides and creeklines will remain in place to allow movement around the mining area and through the landscape thus maintaining habitat connectivity, particularly between the three areas enclosed by the Development Envelope.	Standard business practise	No	• There are no industry or best practice standards established in relation to habitat protection. Avoidance is the first and preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021b) • Avoidance of high suitability habitat is a key recommendation for species conservation.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Minimise			
	• The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system. • Mining will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement. • Culverts, which are often used by fauna as corridors, will be installed along linear infrastructure allowing for continued dispersal. • On tracks that cross drainage lines, no windrows will be established within the drainage line in order to maintain natural free flow of water and minimise barriers to fauna which use drainage lines for dispersal. • Windrows on all roads and tracks will be kept as low as possible, where safety regulations allow, to allow fauna to cross the road as quickly as possible. • The Proponent will undertake feral animal management on site, in particular for cats which are known to occur within the area. • Progressive rehabilitation of disturbed areas will be prioritised in order to re-establish vegetation cover and connectivity. • Larger sized rocks will be stockpiles so as to recreate fauna habitat features during rehabilitation such as rocks and crevasse.	Standard business practise	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 thus reducing the likelihood for fragmentation. • There are no industry or best practice standards established in relation to protection of native fauna from habitat fragmentation. Where avoidance is not possible, minimisation of impacts is the next preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021b)
	Measures to Rehabilitate			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Preparation and regular update of a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a) The MCP includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms are stable and consider ecological and hydrological factors including habitats previously fragmented. Habitat elements considered part of the rehabilitation design includes: • Vegetation is known to provide preferred food or shelter preference, particularly for significant fauna. • Retaining and replacing woody debris • Managing feral predators and herbivores across both reference and rehabilitated areas • Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore 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.	A Proposal specific MCP has been developed based on RTIO standard approach to closure planning.	No	• Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a, b). The MCP must 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 vegetated and stable landform with habitat features. However, the uncertainty in relation to the re-creation of habitat values following mining is acknowledged. Therefore, clearing is treated as a long-term or permanent impact for this assessment.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through standard industry practices		N/A	
	Measures to Minimise			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Loss of fauna individuals	• Most light vehicle movements outside of operating mine areas will occur during daylight hours, which will minimise interaction with nocturnal species • The Proponent will undertake progressive clearing to allow fauna to migrate away from clearing activities or machinery movements. • Clearing will commence, where possible, from a disturbed vegetation edge to an undisturbed area (to encourage mobile fauna to relocate to adjacent areas naturally). • The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Vehicle traffic will be confined to defined roads and tracks • Roadkill will be removed from trafficable areas to reduce the risk of an increase in predators • Barbed wire fences will be avoided in most instances. If barbed wire fencing is required (due to legislative, safety or pastoral requirements), the top strand will be replaced with plain wire, and reflectors will be placed on the top wire to help prevent the entanglement of bats.	Standard business practise	No	• There are no industry or best practice standards established in relation to protection of native fauna. Where avoidance is not possible, minimisation of impacts is the next preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021b) • EPA 2016c guidance has consideration for minimising impacts to terrestrial fauna from potential impacts and activities (including direct and indirect). • Reflectors on fences are best practice and consistent with Conservation Advice for MNES bat species (TSSC 2016a, b). • These measures will minimise impacts to fauna species but will not avoid all injuries.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• 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 at turkeys' nests and sediment ponds will have egress points. • The top edges of artificial water source, trenches and borrow pits will be sloped to enable fauna egress.			
	Measures to Rehabilitate			
	• Preparation and regular update of a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a) • Borrow pits would be designed, constructed and rehabilitated to minimise surface water ponding.	A Proposal specific MCP has been developed based on RTIO standard approach to closure planning.	No	• Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a, b). The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b). • There is a moderate certainty that rehabilitation measures will provide a vegetated and stable landform. However, there is uncertainty in relation to the re-creation of habitat values following mining. Therefore, clearing is treated as a long-term or permanent impact for this assessment.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through standard industry practices		N/A	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Loss of SRE species and SRE habitat	**Measure to Avoid**			
	• The Development Envelope and Conceptual Footprint have been modified during the design phase to avoid direct impacts to high suitability SRE habitats, where practicable • The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system • Clearing limits applied to MNES habitat will also result in limits to high suitability SRE habitat.	Standard business practise	No	• There are no industry or best practice standards established in relation to habitat protection. Avoidance is the first and preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021b) • Avoidance of high suitability habitat is a key recommendation for species conservation.
	Measure to Rehabilitate			
	• Development Envelope and Conceptual Footprint have been designed to minimise where practicable disturbance of high suitability SRE habitat (Gorge/Gully and Debris Slope/Rocky Outcrop habitats) • Clearing of high suitability habitat will be restricted through authorised extents • Known location of significant SRE habitat types will be included 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 ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system.	A Proposal specific MCP has been developed based on RTIO standard approach to closure planning.	No	• The approvals request system is well-established and tracks clearing where limits apply to habitat types • Retention of high suitability habitats is one of the key recommendations for species conservation.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measure to Rehabilitate			
	Preparation and regular update of a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a) The MCP includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms are stable and consider ecological and hydrological factors. Habitat elements considered part of the rehabilitation design includes: • Vegetation is known to provide preferred food or shelter preference • Retaining and replacing woody debris • Managing feral predators and herbivores across both reference and rehabilitated areas • Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore 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.	A Proposal specific MCP has been developed based on RTIO standard approach to closure planning.	No	• Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a, b). The MCP must 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 vegetated and stable landform with habitat features. However, the uncertainty in relation to the re-creation of habitat values following mining is acknowledged. Therefore, clearing is treated as a long-term or permanent impact for this assessment.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Limit to clearing (direct impact) of high suitability SRE habitat (Gorge/Gully and Debris Slope/Rocky Outcrop)		Clearing limits to be included as a Ministerial Condition	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Indirect Impacts				
Habitat degradation associated with construction and operation activity, including dust and altered fire regimes	**Measures to Avoid**			
	Clearing activities will not be undertaken when fire danger ratings are severe or high	Standard business practise	No	This measure is standard industry practice and will prevent the ignition of fire as a result of clearing activities. Similar measures have been implemented in the Proponents other operations in the region and are shown to be effective and as such provides a high level of certainty.
	Measures to Minimise			
	The Proponent will implement management measures such as dust suppression to minimise disturbance to fauna habitats. These measures will include, but not be limited to, the use of water carts with water sourced from dewatering activities and sprayers on crushers: • 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 • The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Vehicles would be restricted from accessing rehabilitated surfaces except for management purposes	Standard business practise	No	• These measures are best practices and are consistent with Conservation Advice for MNES bat species (TSSC 2016a, b) and National Recovery Plan for MNES species Northern Quoll (Hill and Ward 2010). • 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 Development Envelope as a result of the Proposal. • The Proponent has well-established dust and waste management procedures across its Pilbara mine sites providing moderate certainty

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• The Proponent will implement measures such as maintaining fire breaks, hot works procedures and fire equipment available in buildings and vehicles • Fire response procedures and personnel training, including site induction on fire prevention and management will be provided.			
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through standard industry practices		N/A	
Disturbance from light, noise and/or vibration, resulting in the displacement of fauna	**Measures to Avoid**			
	Vibration limits will apply to apartment block and isolated category 2 and 3 roosts within the Development Envelope to manage impacts from vibration and to maintain significant roosts structural integrity as per Table 8-22.	Proposal specific	No	• There are no industry or best practice standards established in relation to habitat protection. Avoidance is the first and preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021b). • Avoidance of significant habitat is a key recommendation for species conservation.
	Measures to Minimise			
	• Permanent lighting will be installed only where 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, MRZs, significant caves, critical habitat)	Standard business practise	No	These measures have been developed to meet the current industry standards for managing light and noise pollution, including the National Light Pollution Guidelines (DotEE 2020).

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Temporary lighting (e.g., trailer mounted units) may be required to provide a safe working environment for short periods, where practicable, and while still providing a safe working environment; these will be positioned to minimise direct light spill into sensitive areas. • Equipment design would be specified to be within Australian standard noise limits			
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	
	Vibration limits for the apartment block and isolated category 2 and 3 roosts		EMP	
Increase in abundance and diversity of pest species	**Measures to Minimise**			
	• Landfills will be fenced, and putrescible wastes will be regularly covered. • Borrow pits would be designed and constructed to minimise surface water ponding after rehabilitation. • Feral animal control would be undertaken as required, in co-operation with regional control programs and the Traditional Owners	Standard business practise	No	These measures have been developed to meet the current industry standards.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through standard industry practices		N/A	

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8.6. Assessment and Significance of Residual Impacts

8.6.1. Assessment of Direct Residual Impacts

8.6.1.1. Loss of Fauna Habitat as a Result of Clearing

The Proposal will clear up to 7,896 ha of native vegetation representing fauna habitat within the Development Envelope. The Proposal includes flexibility to alter the location of the Proposal elements within the Development Envelope; however, maximum clearing limits are proposed for high significance habitat types (Gorge/Gully and Debris Slope/Rocky Outcrop). Maximum areas for clearing for each high significance habitat type are presented in Table 8-15 and approximate extents for each moderate to low value habitat type in Table 8-16.

Each habitat type is represented outside the Development Envelope, extending throughout the survey area. The extrapolation mapped approximately 332,569 ha of these habitat types within a 10 km buffer of the survey area, indicating that all habitat types are widespread beyond the Development Envelope (Table 8-23).

Northern Quoll

The proposed clearing of critical Gorge/Gully, Debris Slope/Rocky Outcrop (denning and breeding) habitat and supporting Major and Minor Creekline (foraging and dispersal) habitats when within the species home range is considered a significant residual impact and is proposed to be offset (See Section 13). 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 habitats for the species and are considered of low significance.

At least 1,128.6 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitat and approximately 4,120 ha (76%) of supporting Major and Minor Creekline (foraging and dispersal) habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated mapped area (outside the Development Envelope). Individuals can also disperse and forage more broadly in the surrounding low significance habitats.

The Proposal 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 can disperse through these disturbed areas.

While the Proposal will result in clearing of up to 331.0 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitat and a further 140 ha of supporting Major and Minor Creekline (foraging and dispersal) habitat for the species within its home range, significant areas of these habitat types will remain both within the Development Envelope and surroundings.

Pilbara Leaf-nosed Bat

The Proposal will result in clearing up to a maximum of 331.0 ha (14% in the survey area and 23% of the Development Envelope) of critical Gorge/Gully (Priority 1 and 2 foraging) and Debris Slope/Rocky Outcrop (Priority 3 foraging) habitats. These habitats are recognised as important foraging habitats for the species and are therefore considered critical breeding/roosting habitat.

Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain habitats within 10 km of the Upper Beasley River Roost and 10 km from Plunge Pool (a significant water feature) are considered supporting habitats within the species' home range because of the foraging and dispersal opportunities that these habitats provide.

Clearing of critical Gorge/Gully and Debris Slope/Rocky Outcrop (breeding and roosting) habitat and supporting Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plains habitats (foraging and dispersal habitat), when within the species' home range are considered a significant residual impact and are proposed to be offset (See Section 13). The offset method and calculations for fauna habitat are detailed in Section 13.4.

The remaining habitats do not represent critical or supporting habitat for the species and are considered of low significance.

At least 1,128.6 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (breeding and roosting) habitat and 22,890.0 ha (85.9%) of supporting Major and Minor Creekline, and Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated area. Individuals can also disperse and forage more broadly in the surrounding low significance habitats.

Habitat connectivity will be maintained along the three major creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These major creeklines 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 Pilbara Leaf-nosed Bat and enable dispersal and connection between individuals and populations.

Of the 131 Pilbara Leaf-nosed Bat roosts potentially used as nocturnal roosts (category 4 roosts) within the Development Envelope, 25 will be impacted by the Proposal (these roosts overlap with the removal of Ghost Bat roosts). All 25 roosts are either nocturnal refuge (category 4 roosts) or of no usage and are not considered critical roosting habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021a) (Figure 8-32). The only known permanent roost (Upper Beasley River Roost) is outside the Development Envelope and will not be impacted.

The Pilbara Leaf-nosed Bat relies on surface water availability for foraging and survival. The Proposed Action will not impact Plunge Pool, a groundwater-fed pool within the Development Envelope or Ridge Pool, a surface water pool located outside the Development Envelope and near the UBRR (Section 6.6). Fifteen known ephemeral pools and two artificial water features throughout the Development Envelope will not be impacted as they will be included in MEZs. Clearing critical Gorge/Gully and Debris Slope/Rocky Outcrop and supporting habitat comprising Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plains is considered a significant residual impact and is proposed to be offset (See Section 13).

While implementation of the Proposal will result in the clearing of up to 331 ha of critical (roosting and breeding) habitat for the species and a further 2,946 ha of supporting (foraging and dispersal) habitat within the species home range, the Development Envelope avoids the only confirmed permanent diurnal roost in the vicinity (Upper Beasley River Roost). The Proposal has also been designed to avoid impacts to Plunge Pool located within a 10 km distance of this roost. Additionally, the large majority of roosts

within the Development Envelope (all category 4) will remain intact and habitat immediately surrounding these will be maintained via implementation of MEZs and MRZs.

Ghost Bat

The Proposal will result in clearing up to a maximum of 331 ha (14% in the survey area and 23% of the Development Envelope) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitats.

Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain habitats within 5 km from a category 2 cave or category 3 cave associated with an apartment block are considered supporting (foraging and dispersal) habitats within the species' home range.

The clearing of high significance critical Gorge/Gully, Debris Slope/Rocky Outcrop and moderate significance critical Major Creekline, Minor Creekline and Alluvial, Colluvial and Hardpan Plains habitats, when within the species home range, is considered a significant residual impact and is proposed to be offset (Section 13).

The remaining habitats do not represent critical habitat for the species and are considered of low significance.

At least 1,128.6 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop habitat, 22,890 ha (85.9%) of supporting Major Creekline, Minor Creekline and Alluvial, Colluvial and Hardpan Plain habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope and 4,270 Major Creekline habitats have been mapped within the extrapolated area. Individuals can also disperse and forage more broadly in the surrounding low significance habitats.

Habitat connectivity will be maintained along the three major creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These major creeklines 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 BS1 ridge by protecting a cluster of seven roosts that have been removed from the mine plan and placed within MEZs.

Of the 131 Ghost Bat roosts within the Development Envelope, 25 will be impacted by the Proposal. Fourteen represent category 3 roosts, and 11 represent category 4 roosts. Category 3 and 4 roosts are not considered critical habitat for the Ghost Bat (Bat Call WA 2021c) (Figure 8-32). All significant roosts (including category 2 roosts and apartment block roosts) will be retained within MEZs and MRZs (Section 8.5.2).

While Proposal implementation will result in clearing of up to 331 ha (14% in the survey area and 23% of the Development Envelope) of critical (roosting and breeding) habitat for the species and a further 2,946 ha of supporting (foraging and dispersal) habitat, when within the species home range, the proposal has been designed to avoid all category 2 and apartment block roosts within the Development Envelope. Habitat connectivity along the three major creek lines will also be maintained. Implementation of measures outlined in Table 8-23, including implementation of MEZs and MRZs will ensure development does not impinge on these values or the foraging habitat immediately adjacent.

RioTinto

Figure 8-32
Category 3 and 4 Non-critical Roosts to be Impacted by the Proposal

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint
- Impacted Cave Location

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

Cave Name	Cave Category	
	Ghost Bat	Pilbara Leaf-nosed Bat
B2BAT06	Category 3	Category 4
BS4MM-Aug16-13	Category 3	No Usage
BS4MMJul16-11	Category 3	No Usage
C1	Category 4	Category 4
C2	Category 4	Category 4
CBRK-053	Category 3	Category 4
CBRK-084	Category 3	Category 4
CBRK-086	Category 3	Category 4
CBRK-094	Category 4	Category 4
CBRK-096	Category 4	Category 4
CBRK-098	Category 4	Category 4
CBRK-102	Category 4	Category 4
CBRK-103	Category 3	Category 4
CBRK-104	Category 3	Category 4
CBRK-107	Category 4	Category 4
CBRK-108	Category 3	Category 4
CBRK-124	Category 4	Category 4
CBRK-138	Category 4	Category 4
CBRK-144	Category 3	Category 4
CBRK-145	Category 4	Category 4
CBRK-151	Category 3	Category 4
GBS_CA_04	Category 4	Category 4
GBS_CA_06	Category 3	No usage
GBS_CA_21	Category 3	No usage
MAMCAM11-01	Category 3	Category 4

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Pilbara Olive Python

The Proposal will result in the clearing of up to 331 ha (14% in the survey area and 23% of the Development Envelope) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (shelter and breeding) habitats.

Major and Minor Creekline habitats within 1 km of known Pilbara Olive Python records is considered supporting (foraging and dispersal) habitat within the species' home range.

The clearing of critical Gorge/Gully and Debris Slope/Rocky Outcrop and supporting Major Creekline and Minor Creekline habitats within the species home range is considered a significant residual impact and is proposed to be offset (Section 13).

The remaining habitats do not represent critical habitat for the species and are considered of low significance.

At least 1,128.6 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop habitat and 4,120 ha (76%) of supporting Major Creekline and Minor Creekline (foraging and dispersal) habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated area. Furthermore, 18 of the 22 water features within the Development Envelope will be retained with MEZs and MRZs and remain available for use by the Pilbara Olive Python (Section 8.5.2.5).

Proposal implementation will result in clearing of up to 331 ha of critical (shelter and breeding) habitat for the species and a further 140 ha of supporting (foraging and dispersal) habitat, when within the species home range. However, the Proposal has been designed to avoid impacts to Plunge Pool, where the Pilbara Olive Python has most frequently been recorded. Implementation of measures outlined in Table 8-23, such as implementation of MEZs and MRZs around the majority of water features (including Plunge Pool) will ensure development does not impinge on these values or the foraging habitat immediately adjacent.

Grey Falcon

The Proposal will result in a loss of approximately 69 ha (9% of the survey area and 12% of the Development Envelope) of Major Creekline habitat that could be considered critical breeding/nesting habitat for the Grey Falcon within the Development Envelope. As this habitat type will not be directly impacted beyond the construction of essential infrastructure, mostly narrow crossings, and clearing is limited, it is considered that the Proposal will not result in a significant residual impact to this species.

Fork-tailed Swift

The Fork-tailed Swift is not dependent upon any one habitat type within the Development Envelope. As a result, the Proposal is unlikely to cause substantial loss or modification of important habitats for this species. The Proposal is also unlikely to cause disruption to an ecologically significant proportion of the population (1% or 1,000 individuals) (DoE 2015a). Based on the above it is considered that the Proposal will not result in a significant residual impact to this species.

Priority Fauna

Table 8-24 presents the assessment and significance of residual impacts to DBCA-listed fauna from the Proposal.

Table 8-24: Assessment and Significance of Residual Impacts to DBCA Listed Fauna

Species	Assessment and Significance of Residual Impact
Species Known to Occur within the Development Envelope	
Peregrine Falcon	The Peregrine Falcon inhabits a wide range of habitats, including forests, woodlands, wetlands and open country. Individuals have a home range of up to 30 km^2. They nest in recesses of cliff faces, tree hollows and along rivers (Biota 2019e). The Peregrine Falcon is unlikely to rely on the habitats within the Development Envelope for breeding or foraging. The most suitable habitat for the species within the Development Envelope is Gorge/Gully, Debris Slope/Rocky Outcrop and the Major Creekline habitat. Up to 331 ha (14% in the survey area and 23% of the Development Envelope) of Gorge/Gully and Debris Slope/Rocky Outcrop will be cleared. Approximately 69 ha of Major Creekline (9% in the survey area and 12% of the Development Envelope) will be cleared for the Proposal. At least 1,128.6 ha (77%) of Gorge/Gully and Debris Slope/Rocky Outcrop and approximately 503 ha (87%) of Major Creekline habitat will remain available within the Development Envelope. And an additional 11,491 ha of Gorge/Gully and Debris Slope/Rocky Outcrop and 4,270 ha of Major Creekline has been mapped beyond the Development Envelope within the extrapolated area. The Proposal is not expected to adversely affect the regional population or the conservation status of the species.
Western Pebble-mound Mouse	The Western Pebble-mound Mouse is common and recorded throughout the Hamersley and Chichester subregions in the Pilbara. Clearing will directly impact approximately 6,685 ha (13% of the survey area and 20% of the Development Envelope) of suitable denning, shelter and foraging habitat (Colluvial Plain, Gently Sloping Rise, Midslope/Upper Slope and Footslope habitat) within the Development Envelope. These habitat types are widespread throughout the Development Envelope (with approximately 26,962 ha (80%) remaining), and an additional 80,958 ha has been mapped beyond the Development Envelope within the extrapolated area. The Proposal is not expected to adversely affect the regional population or the conservation status of the species.
Lined-soil Crevice Skink	The Lined Soil-crevice Skink was recorded from the Alluvial Plain habitat in the BS1 assessment area during surveys with numerous records from outside the Development Envelope in Alluvial Plain and Minor Creekline habitat types (from along Caves Creek and near the Silvergrass area). Clearing will directly impact approximately 166 ha (5% of the survey area and 8% in the Development Envelope) of Alluvial Plain in the Development Envelope. This habitat type is widespread throughout the Development Envelope (with approximately 1,969 ha (92%) remaining), and an additional 739 ha has been mapped beyond the Development Envelope within the extrapolated area. The Proposal is not expected to adversely affect the regional population or the conservation status of the species.
Species Likely to Occur Within the Development Envelope	
Long-tailed Dunnart	The Long-tailed Dunnart was considered rare; however, research has shown it is relatively widespread but restricted to specific habitats (rocky habitat with boulders) (Biota 2019d). Suitable habitat for this species occurs within the Development Envelope. Clearing will impact up to 331 ha (14% of the survey area and 23% of the Development Envelope) of suitable habitat (Gorge/Gully and Debris Slope/Rocky Outcrop) within the Development Envelope. A total of 1,128.6 ha (77%) of suitable Gorge/Gully and Debris Slope/Rocky Outcrop will

Species	Assessment and Significance of Residual Impact
	remain within the Development Envelope. An additional 11,491 ha has been mapped beyond the Development Envelope within the extrapolated area. The Proposal is not expected to adversely affect the regional population or the conservation status of the species.
Short-tailed Mouse	The Short-tailed Mouse has not been recorded within the Development Envelope. However, previous surveys have recorded this species in the Alluvial Plain habitat type near the Silvergrass area, and suitable denning, shelter and foraging habitats occur within the Development Envelope. Clearing will directly impact approximately 166 ha (5% of the survey area and 6.4% of the Development Envelope) of Alluvial Plain within the Development Envelope. This fauna habitat type is widespread throughout the Development Envelope (with approximately 2,45 ha (93.6%) remaining) and an additional 739 ha has been mapped beyond the Development Envelope within the extrapolated area. The Proposal is not expected to adversely affect the regional population or the conservation status of the species.
Gane's Blind Snake	The Gane's Blind Snake is distributed throughout the Pilbara region but is poorly collected. The records to date suggest that this species may be associated with moist gorges and gullies, however, the species has also been recorded from mulga woodland and rocky scree slopes (Biota 2019e, f). Clearing from this Proposal will directly impact 331 ha (14% of the extent within the survey area and 23% within the Development Envelope) of suitable Gorge/Gully and Debris Slope/Rocky Outcrop habitat for this species. A total of 1,128.3 ha (77%) of suitable Gorge/Gully and Debris Slope/Rocky Outcrop will remain within the Development Envelope. An additional 11,491 ha has been mapped beyond the Development Envelope within the extrapolated area. The Proposal is not expected to adversely affect the regional population or the conservation status of the species.

8.6.1.2. Fragmentation of Fauna Habitats due to Land Clearing

Development of the Proposal would result in the clearing of approximately 7,896 ha of fauna habitat, representing approximately 12% of the area surveyed as presented in Table 8-15 and Table 8-16, whilst Figure 8-23 shows the indicative site layout over the habitat types.

Clearing of habitat in the Development Envelope would have some impact to biological diversity and ecological integrity on a very local scale, but little impact on a regional scale, with areas of similar habitat in excellent condition remaining intact beyond the Development Envelope.

Land clearance does not result in the creation of small and/or disconnected islands or fragments within or across habitat types and as such connectivity throughout the mapped habitat types would largely remain during and after the project.

Additionally, the three areas identified as being potentially isolated, and which could be at risk of fragmentation by the Proposal (a small area north of BS4 (1,480 ha), Mount Brockman south of BS2 (17,485 ha) and the surrounding area near Ridge Pool (1,873 ha)) have a combined size of 20,838 ha. These patch sizes are vast and would be able to support larger and more stable fauna habitats and populations of species.

Northern Quoll

Habitat degradation and population isolation are identified in the National Recovery Plan for the Northern Quoll as key threats to the species (Hill and Ward, 2010).

While Northern Quolls are present throughout the Hamersley Ranges, the Proposal area is regionally within low density areas of Northern Quoll populations, as modelled by Moore et al (2021) (Figure 8-33). In a regional context, higher density populations of Northern Quolls exist in places like the northern and western edges of the Hamersley Range, on Dolphin Island off Dampier, and in the large areas of granite outcropping south of Port Hedland.

Long-term work on the ecology of Northern Quolls in the Pilbara has shown that:

- Northern Quolls are highly mobile and are not currently constrained by major infrastructure in the Pilbara. Northern Quolls from all areas of the Pilbara are indistinguishable from each other by region, that is, there is enough movement across the region to maintain genetic mixing (Chan et al., 2020; Shaw et al., 2023).
- Northern Quolls will use artificial denning habitat if it has sufficient resources and protection from predators (Cowan et al., 2020).
- Northern Quolls use creeks and rivers as dispersal pathways (Shaw et al., 2023), meaning that retention of vegetation around creeks and rivers will be more important than across spinifex plains.
- Northern Quolls will use culverts under rail and roads as a protected pathway through these barriers (Creese, 2012).

The area containing Mt Brockman, which is likely to support Northern Quolls as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) so should provide sufficient habitat to maintain Northern Quolls living within it, taking into consideration that there will be sufficient opportunity for them to access the greater Pilbara population as shown in Figure 8-34.

To ensure environmental impacts minimised, the Proponent has suggested a maximum clearing extent for habitat types of high significance, as per Table 8-15. The Proponent proposes that these limits be conditioned within the MS. These limits will ensure that fragmentation of these habitats is minimised too as low as reasonably possible.

Habitat fragmentation is not expected to significantly affect Northern Quoll habitat connectivity or movement (Figure 8-34). Additionally, implementation of measures outlined in Table 8-26 will reduce the risk of direct impacts to individuals and/or critical habitat and ensure indirect impacts are minimised.

RioTinto

Figure 8-33
Potential Distribution of the Northern Quoll as Modelled by Moore et al. (2021)

Drawn: L.Fuentes
Plan: RTIO-1012684v1
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:2,100,000 @A3
GIS.Team@riotinto.com

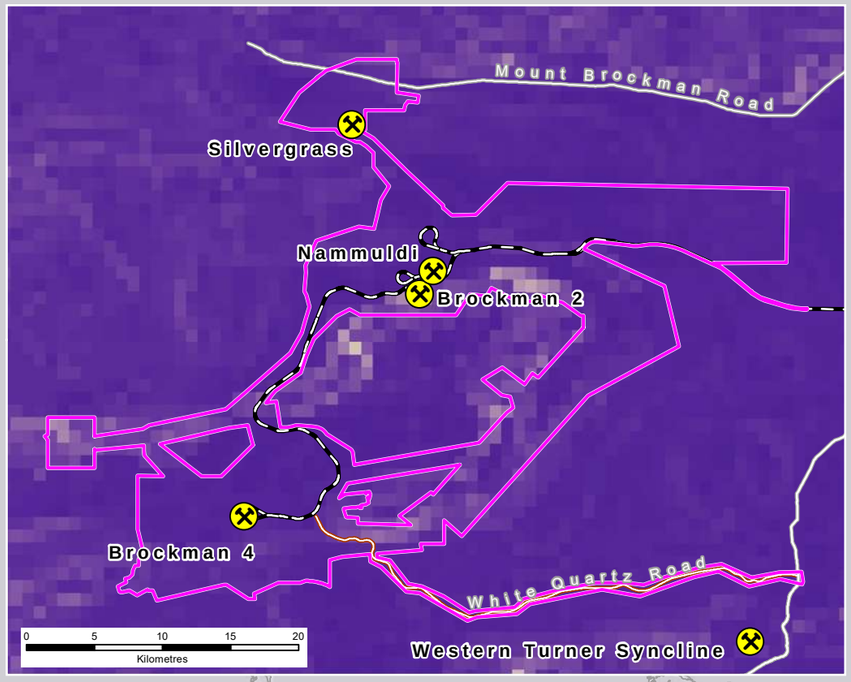
Legend

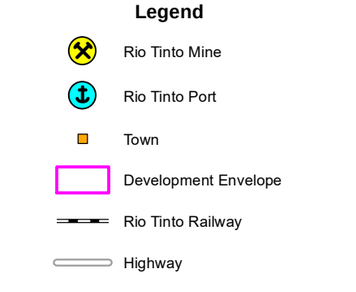
- Rio Tinto Mine
- Rio Tinto Port
- Town
- Development Envelope
- Rio Tinto Railway
- Highway
- Minor Road
- Site Access Road

Dasyurus hallucatus Distribution

High : 0.950361

Low : 0.000189836





N

0 15 30 45 60
Kilometres

Map units in metres

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Figure 8-34
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- High Significance
- Moderate Significance
- Low Significance

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 8-34
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Map A

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

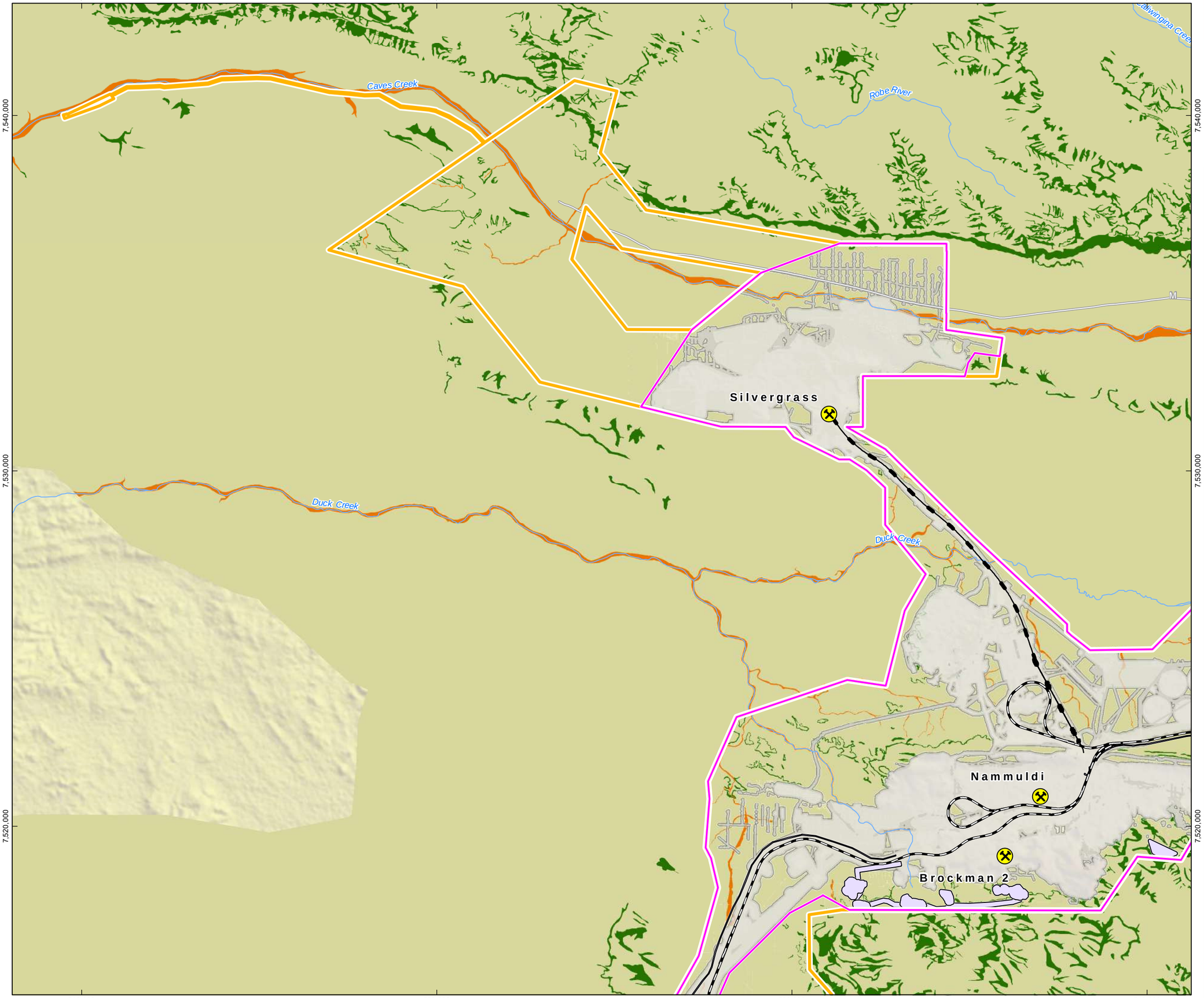
Legend

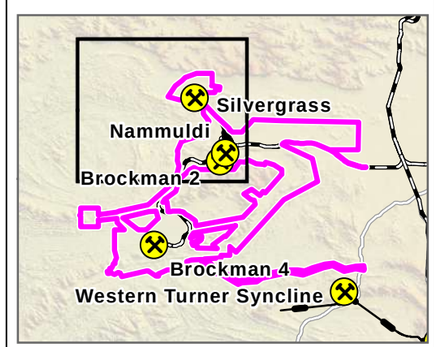
- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- High Significance
- Moderate Significance
- Low Significance

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek





N

0 1 2 3 4 5
Kilometres

Map units in metres

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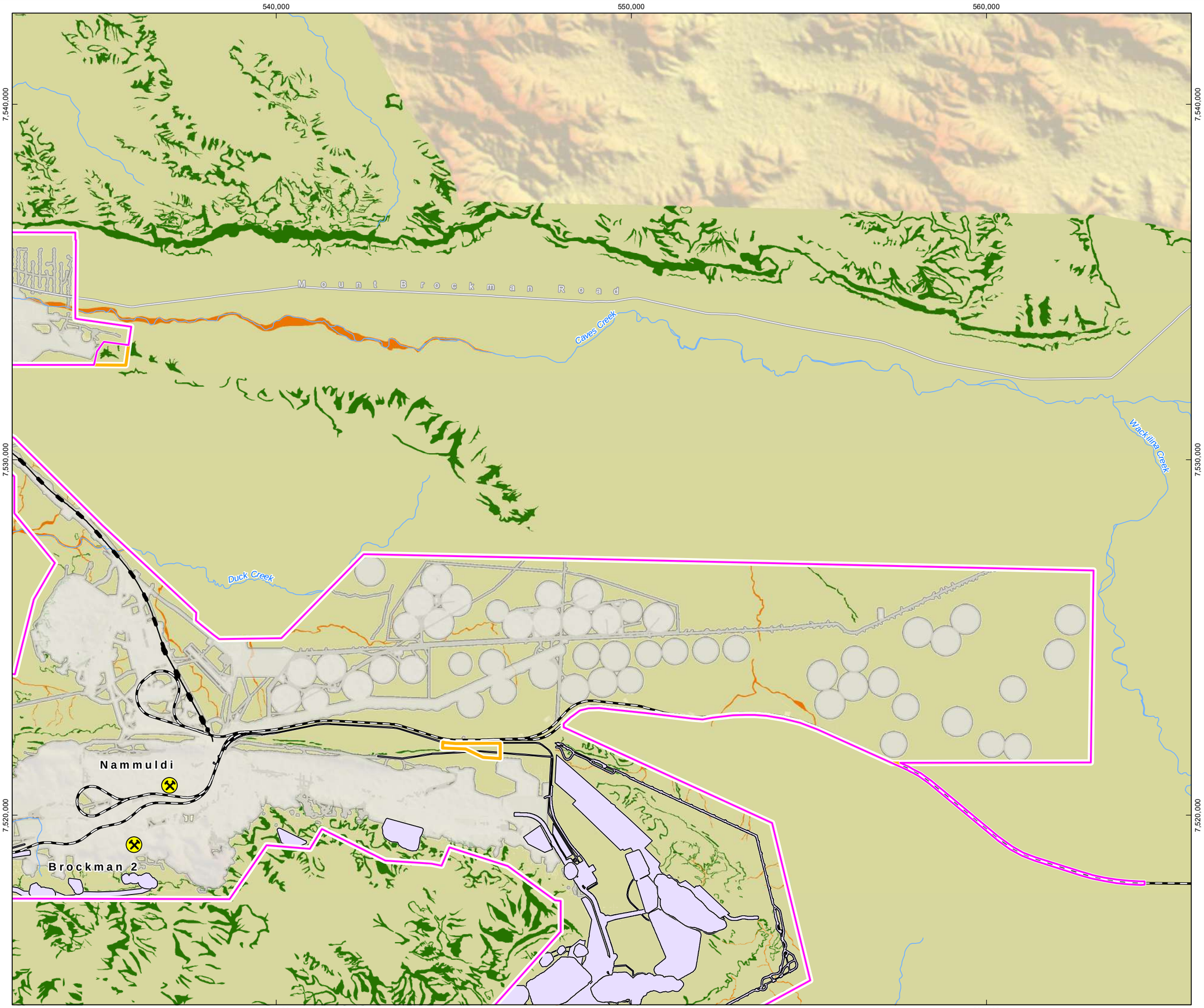
RioTinto

Figure 8-34
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Map B

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



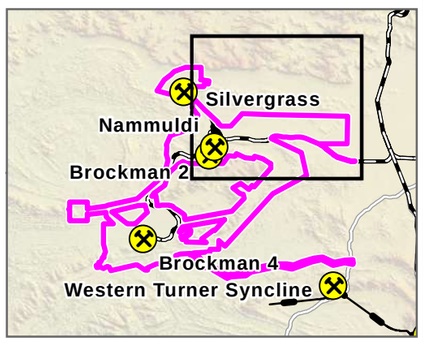
Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- High Significance
- Moderate Significance
- Low Significance

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



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0 1 2 3 4 5
Kilometres

Map units in metres

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RioTinto

Figure 8-34
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

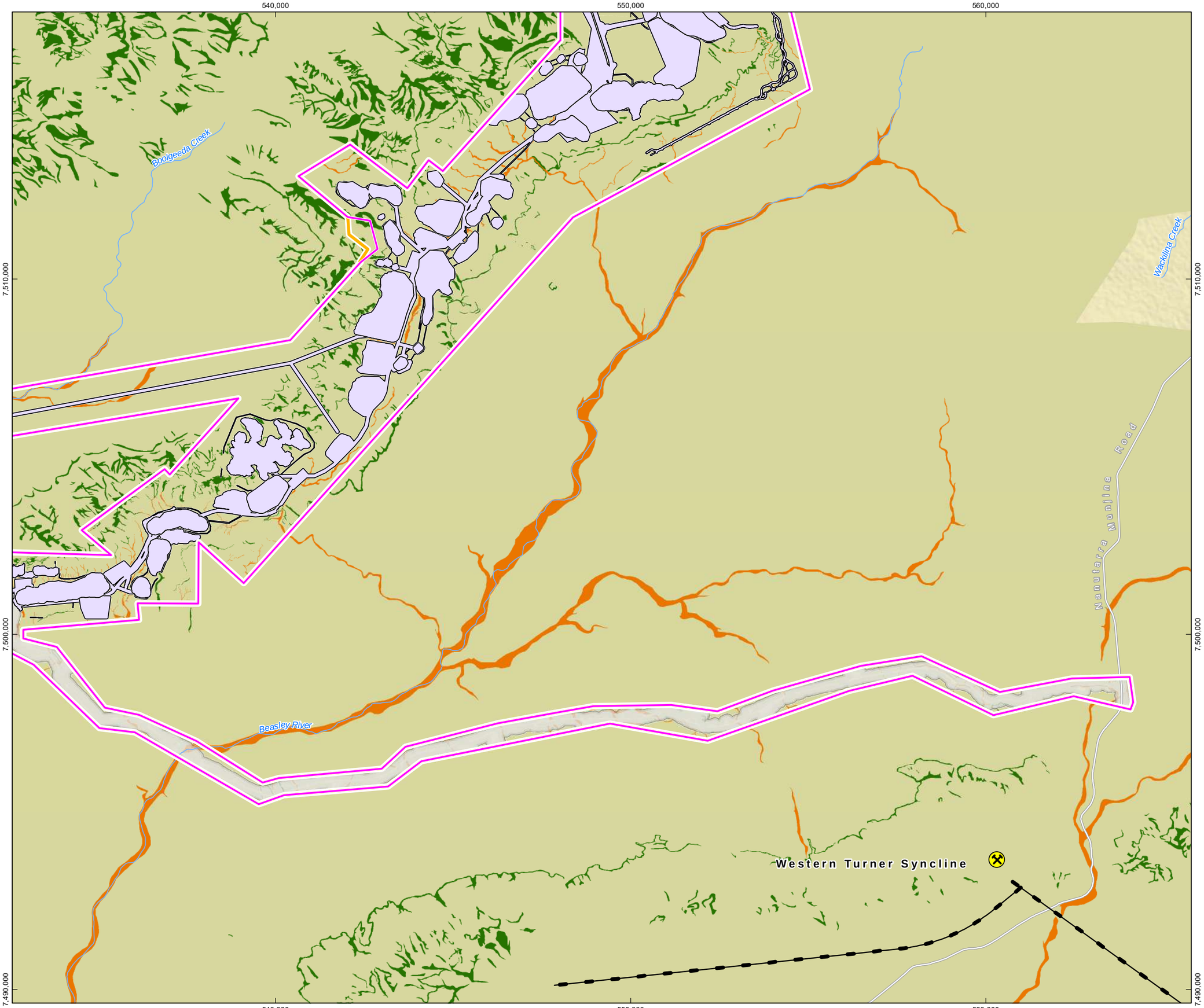
Legend

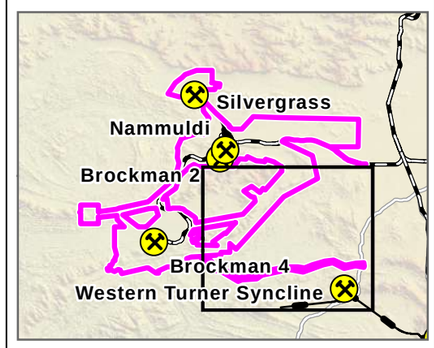
- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- High Significance
- Moderate Significance
- Low Significance

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek





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Kilometres

Map units in metres

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RioTinto

Figure 8-34
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Map D

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

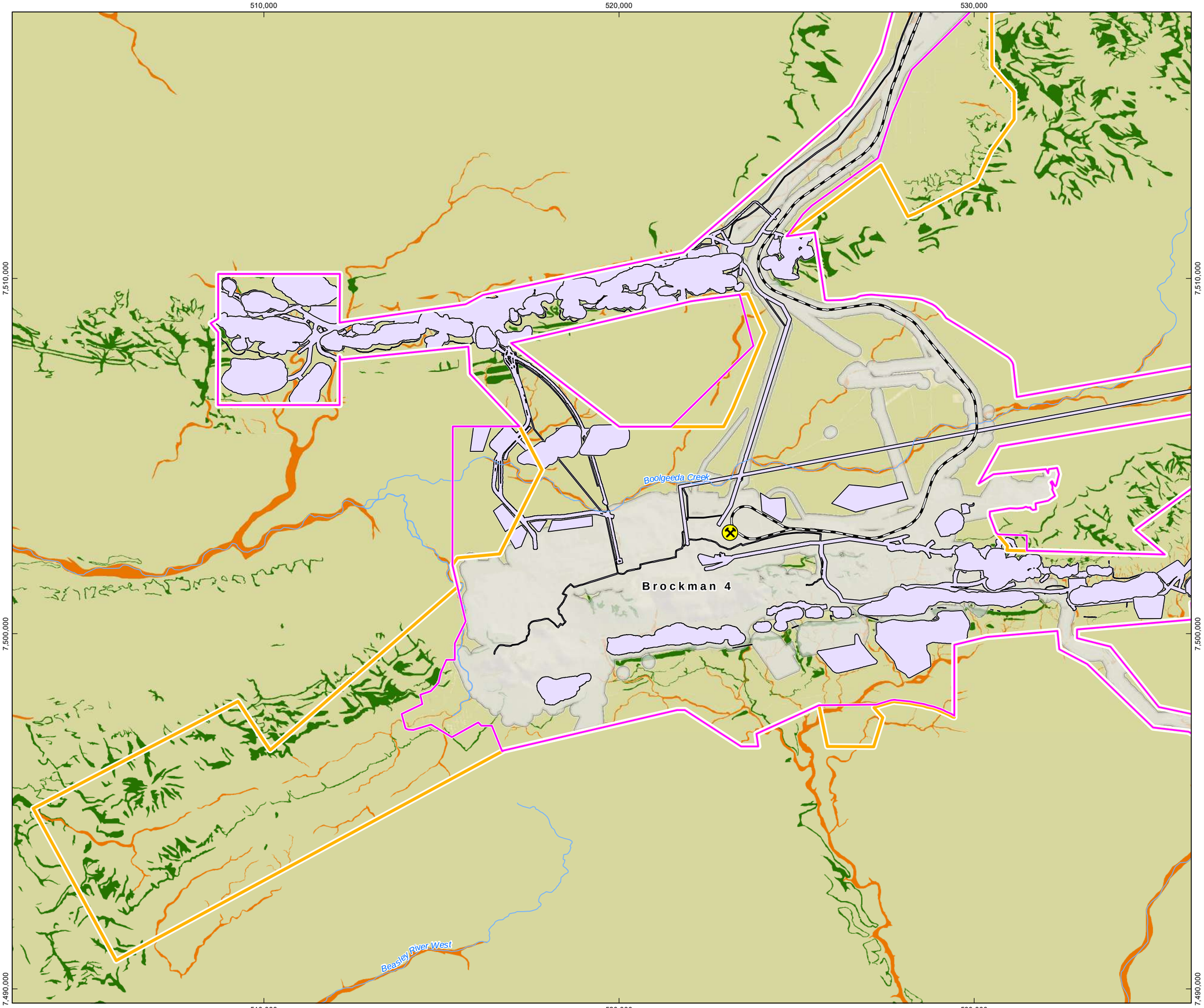
Legend

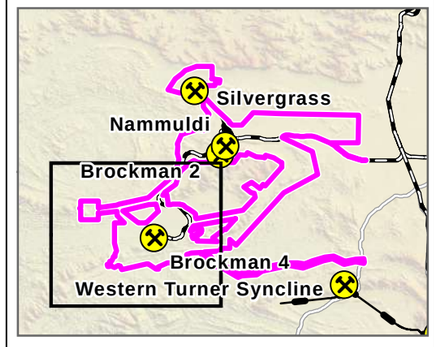
- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- High Significance
- Moderate Significance
- Low Significance

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek





N

0 1 2 3 4 5

Kilometres

Map units in metres

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Pilbara Leaf-nosed Bat

Fragmentation is not expected to significantly impact Pilbara Leaf-nosed Bats, as a result of the Proposal, due to:

- The UBRR being located within an excised area, outside of the Development Envelope
- The yet to be identified Lower Caves Creek Roost does not fall within the Development Envelope
- VHF tracking of PLNB conducted by Biologic (2021e and 2022c) recorded the Pilbara Leaf-nosed Bats spending a significant time period outside of the VHF array, and likely outside of the Development Envelope
- VHF tracking of Pilbara Leaf-nosed Bats for the Greater Paraburdoo Iron Ore Hub (MS 1195) project, recorded a bat traveling approximately 40 km between two isolated ranges on two consecutive nights, demonstrating the long-range dispersal and foraging abilities of the species (Biologic 2020e). Hence this species has demonstrated ability to travel beyond the Development Envelope to forage
- Critical habitat, in the form of pools near roost caves are either outside of the Development Envelope or protected within MEZ's

Of the 131 Pilbara Leaf-nosed Bat roosts with the potential to be used as a nocturnal roost within the Development Envelope, 25 will be impacted by the Proposed Action (these roosts overlap with the removal of Ghost Bat roosts). All 25 roosts are either nocturnal refuge (category 4 roosts) or of no usage and are not considered critical habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021a) (Table 8-17 and Figure 8-32). MEZs within MRZs will be established around the 106 remaining known category 4 roosts. The only known permanent roost (UBRR) is outside the Development Envelope and will not be impacted.

The Pilbara Leaf-nosed Bat relies on surface water availability for foraging and survival. The Proposal will not impact Plunge Pool, a groundwater-fed pool within the Development Envelope nor Ridge Pool, a surface water pool located outside the Development Envelope and near the UBRR (Section 6). These are the only two known critical water features in the survey area. Fifteen known ephemeral pools and two artificial water features throughout the Development Envelope will not be impacted as they will be protected within MEZs.

The area containing Mt Brockman, which is likely to provide the greatest area of critical and supporting habitat for the Pilbara Leaf-nosed Bat, as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) with fragmentation of these habitats unlikely to occur as a result of the Proposal.

In addition to the above habitat connectivity will be maintained along the three Major Creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These Major Creeklines 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 Pilbara Leaf-nosed Bat and enable dispersal and connection between individuals and populations.

Ghost Bat

Fragmentation is not expected to significantly impact Ghost Bats, as a result of the Proposal due to the following:

- All Apartment Blocks and Isolated Category 2 caves are being retained, which will allow Ghost Bats to continue to move throughout the landscape during and post implementation of the Proposal.
- All Apartment Blocks and Isolated Category 2 caves have been included in appropriately sized MRZ and MEZs.

- Category 2 and 3 caves are not permanently occupied; therefore Ghost Bats can easily relocate away if disturbed by the pre-mining or pit development operations.
- High quality breakaways and ridgelines have been covered under MEZ's, which will aid with dispersal.
- Ghost Bats have been recorded foraging 40 km in a night (return flight distance) by Bullen et al. (2023). Hence this species has demonstrated capability to travel beyond the Development Envelope to forage.
- Bullen (2023) commented that current field work involving numerous personal observation sessions at Ghost Bat roost entrances has shown that the species does not begin to forage from the ground immediately upon exiting the roost but departs the local area and begins to forage from the ground some distance away. This is supplemented by satellite tracking GPS tagged Ghost Bats (Bullen et al. 2023) and VHF and GPS data from Augusteyn et al. (2018)

Of the 131 Ghost Bat roosts within the Development Envelope, 25 will be impacted by the Proposal. Of these, 14 represent category 3 roosts and 11 represent category 4 roosts. Category 3 and 4 roosts are not considered critical habitat for the Ghost Bat (Bat Call WA 2021c) (Figure 14-23). All significant roosts (including category 2 roosts and apartment block roosts) will be retained within MEZs and MRZs (Table 14-20 and Figure 14-25).

The area containing Mt Brockman, which is likely to provide the greatest area of critical and supporting habitat for the Ghost Bat, as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) with fragmentation of these habitats unlikely to occur as a result of the Proposal.

In addition to the above habitat connectivity will be maintained along the three Major Creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These Major Creeklines 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 range within the BS1 assessment area by protecting a cluster of seven roosts removed from the mine plan and placed within MEZs and MRZs.

Pilbara Olive Python

The Pilbara Olive Python occurs in rocky habitats near surface water, which it relies upon for hunting. Prey is often captured by striking from a submerged position in the water. A reduction in surface water availability could potentially reduce the hunting opportunities for Pilbara Olive Python. Eighteen of the 22 water features (15 ephemeral, two artificial and Plunge Pool) within the Development Envelope will be retained within MEZs and MRZs and remain available for use by the Pilbara Olive Python.

The area containing Mt Brockman, which is likely to provide the greatest area of critical and supporting habitat for the Pilbara Olive Python, as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) with fragmentation of these habitats unlikely to occur as a result of the Proposal.

Intact Pilbara Olive Python habitat will remain within and surrounding the Development Envelope. Significant corridors in Gorge/Gully, Debris Scope/Rocky Outcrop and Major Creekline habitats will allow movement around the mining area and through the landscape. As such, habitat fragmentation caused by the Proposal is not expected to have significantly detrimental overall effects on Pilbara Olive Python habitat or movement.

8.6.1.3. Loss of Fauna Individuals

All fauna (especially ground-dwelling species) present within the Development Envelope may be vulnerable to injury or mortality from vehicle and machinery movements, specifically during clearing activities.

While vehicle movements will increase temporarily during construction, overall vehicle movements during the operational phase will reduce. Vehicle movements at night are much less than during the day and are generally limited to in-pit operations, reducing the likelihood of interactions with nocturnal fauna.

The Proponent will implement management measures to mitigate the loss of fauna individuals (Table 8-23), such as:

- Progressive clearing to allow fauna to migrate away from clearing activities or machinery movements
- Clearing will commence, where possible, from a disturbed vegetation edge to an undisturbed area (to encourage mobile fauna to relocate to adjacent areas naturally).
- 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.

Vehicle and machinery movements are not expected to significantly impact the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat or Pilbara Olive Python population.

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. Barbed wire will be avoided where practicable. Where the use of barbed wire fencing is required by pastoralists, legislated, or required for safety reasons, the top strand will be replaced with plain wire, and reflectors will be installed to deter bat interaction. As a result, the potential impacts from fencing are expected to be low.

8.6.1.4. Loss of SRE Individuals and SRE Habitat

Of the 15 potential SRE invertebrate species that have been recorded within the Conceptual Footprint, seven (*Aname* `sp. 1`, *Aname* `sp. N19`, *Beierolpium* `sp. 7/3 small`. *Lychas* `hairy tail complex`, Isopoda Gen. nov `sp. 1`, *Rhagada* `Pilbara banded complex` and *Urodacus* sp. A) occur both inside and outside of the Development Envelope, and thus potential clearing of their habitat is unlikely to pose a significant impact to these species. As such, they are not considered further in this assessment.

EPA Technical Guidance for Sampling of SREs (EPA 2016d) states that a risk-based approach may be adopted for situations where surveys have been completed, but potential SREs are only recorded from within the Development Envelope. In this situation, a risk-based approach would be considered in cases where (EPA 2016d):

- A potential SRE taxon is represented by one or few specimens from only within proposed development areas
- Contextual data on the wider distribution and status of the taxon is unavailable from WAM or DBCA
- Additional targeted surveys appear unlikely to yield results in a reasonable timeframe.

For potentially restricted taxa that meet the above criteria, habitat use as a surrogate for inferring distributional boundaries can be considered. While there are limitations to using such surrogates, this provides the only practicable method of undertaking an informed assessment of the likelihood of small-scale SRE distributional restrictions. Consideration can also be given to the known distribution patterns and ecology of other species belonging to the same genus to inform the assessment of potential restrictions.

Due to the historic sampling of SRE specimens and different taxonomic methods used (morphological and molecular), a review and consolidation of SRE taxonomies is unable to be achieved. As such, a risk-based approach is used to assess the vulnerability of SRE species to the Proposal.

A vulnerability rating is included in Table 8-25 for the eight potential SRE species to inform the assessment of the likelihood of SRE species being lost due to clearing from the Proposal. This vulnerability rating is based on the number of locations where specimens were collected and the prevalence near to, but outside the Development Envelope of the habitat types at these locations. The following describes the three classes of vulnerability assignment:

- **Low Vulnerability**: Species recorded at multiple locations from a common and continuous habitat type within the survey area. The habitat typically provides limited microhabitats and refugia conducive to short range endemism
- **Medium Vulnerability**: Species/Genus represented by a singular record from either a common and continuous habitat type within the survey area or multiple records of a species across both restricted and common habitat types
- **High Vulnerability**: Singular or a low number of records of a species that were recorded in an isolated or restricted habitat type that provides high quality refugia (gorges, scree slopes, springs, vine thickets)

None of the potential SRE species were recorded from isolated/restricted habitats within the Development Envelope as depicted in Figure 8-35; instead, they occurred within widespread and common habitats (Colluvial Plain, Footslope and Minor Creekline) that occur broadly across the Development Envelope and its surrounds. These widespread habitats are less likely to be barriers to species dispersal and typically do not support significant refugia/microhabitats required by SRE species. As such, these species are less likely to be restricted solely to impact areas.

No potential SRE species recorded as part of the proposed project assessment are considered to have a high vulnerability rating, whilst eight have a medium vulnerability rating (Table 8-25).

Table 8-25: Relative Vulnerability of the Proposal on Potential Short-Range Endemics

Species	No of Collection Locations	SRE Habitat	Species Surrogate	Vulnerability Assessment
Aname sp.	1	Colluvial Plain		Medium
Anamidae sp. indet	3	Colluvial Plain		Medium
Barychelidae sp. indet	1	Footslope		Medium
Indolpium sp. indet	1	Minor Creekline		Medium
Isopoda Gen. nov `sp. 3`	1	Minor Creekline	Isopoda Gen. nov `sp. 1`	Medium
Kwonkan sp. indet	2	Colluvial Plain		Medium
Pseudoscorpiones sp. Indet	1	Minor Creekline		Medium
Urodacus sp.B	1	Minor Creekline	*Urodacus* sp A	Medium

***Aname* sp., *Anamidae* sp. indet and *Kwonkan* sp. indet**

Aname sp., Anamidae sp. indet and *Kwonkan* sp. indet were all identified from the Colluvial Plain habitat type. As shown in Table 8-16, 25,299 ha of Colluvial Plain habitat has been mapped, with 21,516 ha occurring within the Development Envelope. Approximately 3,266 ha (13% within mapped area) of this habitat type is expected to be impacted by the Proposal (Figure 8-29).

Based upon the fact that the Colluvial Plain habitat is widespread across the survey area, this species is unlikely to be restricted to the Development Envelope, and at least 85% of this habitat type is expected to remain. As such, it is considered unlikely that the Proposal would have a significant impact upon these potential SREs.

Barychelidae sp. indet

Barychelidae sp. indet was identified from the Footslope habitat type. As shown in Table 8-16, 4,761 ha of Footslope habitat has been mapped, with 3,562 ha occurring within the Development Envelope. Approximately 1,043 ha (22% within the mapped area) of this habitat type is expected to be impacted by the Proposal. Footslope habitat within the Development Envelope often borders the Colluvial Plain habitat type, and *Barychelidae sp* likely utilise both habitat types (Figure 8-29).

Based upon the fact that the Footslopes habitat is widespread across the survey area, this species is unlikely to be restricted to the Development Envelope, and at least 75% of both the Footslope and Colluvial Plain habitat types are expected to remain (Figure 8-29) following implementation of the Proposal, it is considered unlikely that the Proposal would have a significant impact upon this potential SRE.

Indolpium sp. indet, *Pseudoscorpiones* sp. Indet, *Isopoda* Gen. nov `sp. 3` and *Urodacus* sp.B

Indolpium sp. indet, *Pseudoscorpiones* sp. indet, Isopoda Gen. nov `sp. 3` and *Urodacus* sp B were identified from the Minor Creekline habitat type. As shown in Table 8-16, 904.2 ha of Minor Creekline habitat has been mapped, with 766.7 ha occurring within the Development Envelope. Approximately 186 ha (21% within the mapped area) of this habitat type is expected to be impacted by the Proposal. As with the Footslope habitat, Minor Creekline habitat also often borders the Colluvial Plain habitat types, and it is thus likely that these species utilise both habitat types (Figure 8-29).

In addition, species surrogates for Isopoda Gen. nov `sp. 3` and *Urodacus* sp B have been identified and are discussed below.

One specimen of Isopoda Gen. nov `sp. 3` was collected from within the BS2 assessment area within the Minor Creekline habitat, bordering the Colluvial Plain habitat type. When the genus was assessed against all available SRE taxonomic records, one further specimen of Isopoda Gen. nov was recorded inside and outside impact areas. Isopoda Gen. nov `sp. 1` has a linear distribution of approximately 15 km and has been collected at 9 locations (including the collection location of Isopoda Gen. nov `sp. 3`), both inside and outside the Development Envelope (Figure 8-29). Isopoda Gen. nov `sp. 1` was found in Minor Creekline and Colluvial Plain habitat types.

Similarly, one specimen of *Urodacus* sp B was collected from within the BS1 assessment area within the Minor Creekline habitat, bordering the Colluvial Plain habitat type. When the genus was assessed against all available SRE taxonomic records, one further specimen of *Urodacus* was recorded inside and outside impact areas. *Urodacus* sp A has a linear distribution of approximately 9 km and has been collected at two locations (including the collection location of *Urodacus* sp B), both inside and outside the Development Envelope (Figure 8-29). *Urodacus* sp A was collected from the Minor Creekline and Colluvial Plain Habitat types.

Based upon the fact that the Minor Creekline and Colluvial Plain habitat types are widespread across the survey area, at least 75% and 85% of these habitat types are expected to remain, as well as species surrogates for Isopoda Gen. nov `sp. 3` and *Urodacus* sp B it is considered unlikely that the Proposal would have a significant impact upon these potential SREs.

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Figure 8-35
Potential Short-range Endemic Species of Medium Vulnerability over Habitat Types
Overview

Drawn: L.Fuentes
Plan: PDE0191423v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:210,990 @A3
GIS.Team@riotinto.com

500,000 520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Mount Brockman Road

Silvergrass

Nammuldi

Brockman 2

Brockman 4

Western Turner Syncline

Nanutarra - Munjina Road

Legend

Development Envelope
Survey Area
Conceptual Footprint

Short Range Endemics (SRE)

- *Aname* sp.
- *Anamidae* sp. indet.
- *Barychelidae* sp. indet.
- *Indolpium* sp. indet.
- *Indolpium* sp. indet.
- *Kwonkan* sp. indet.
- *Pseudoscorpiones* sp. indet.
- *Urodacus* sp.B

Short Range Endemic (SRE) Habitat

High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance

- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

Rio Tinto Mine
Rio Tinto Railway
Conveyor
Major Road
Minor Road
Site Access Road
Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 8-35
Potential Short-range Endemic Species of Medium Vulnerability over Habitat Types
Map A

Drawn: L.Fuentes
Plan: PDE0191423v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint

Short Range Endemics (SRE)

- *Barychelidae* sp. indet.
- *Kwonkan* sp. indet.

Short Range Endemic (SRE) Habitat

High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance

- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek

N

0 2 4 6
Kilometres

Map units in metres

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Figure 8-35
Potential Short-range Endemic Species of Medium Vulnerability over Habitat Types
Map A

Drawn: L.Fuentes
Plan: PDE0191423v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

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7,540,000 7,530,000 7,520,000

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint

Short Range Endemics (SRE)

- *Barychelidae* sp. indet.
- *Kwonkan* sp. indet.

Short Range Endemic (SRE) Habitat

High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance

- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek

N

0 2 4 6
Kilometres

Map units in metres

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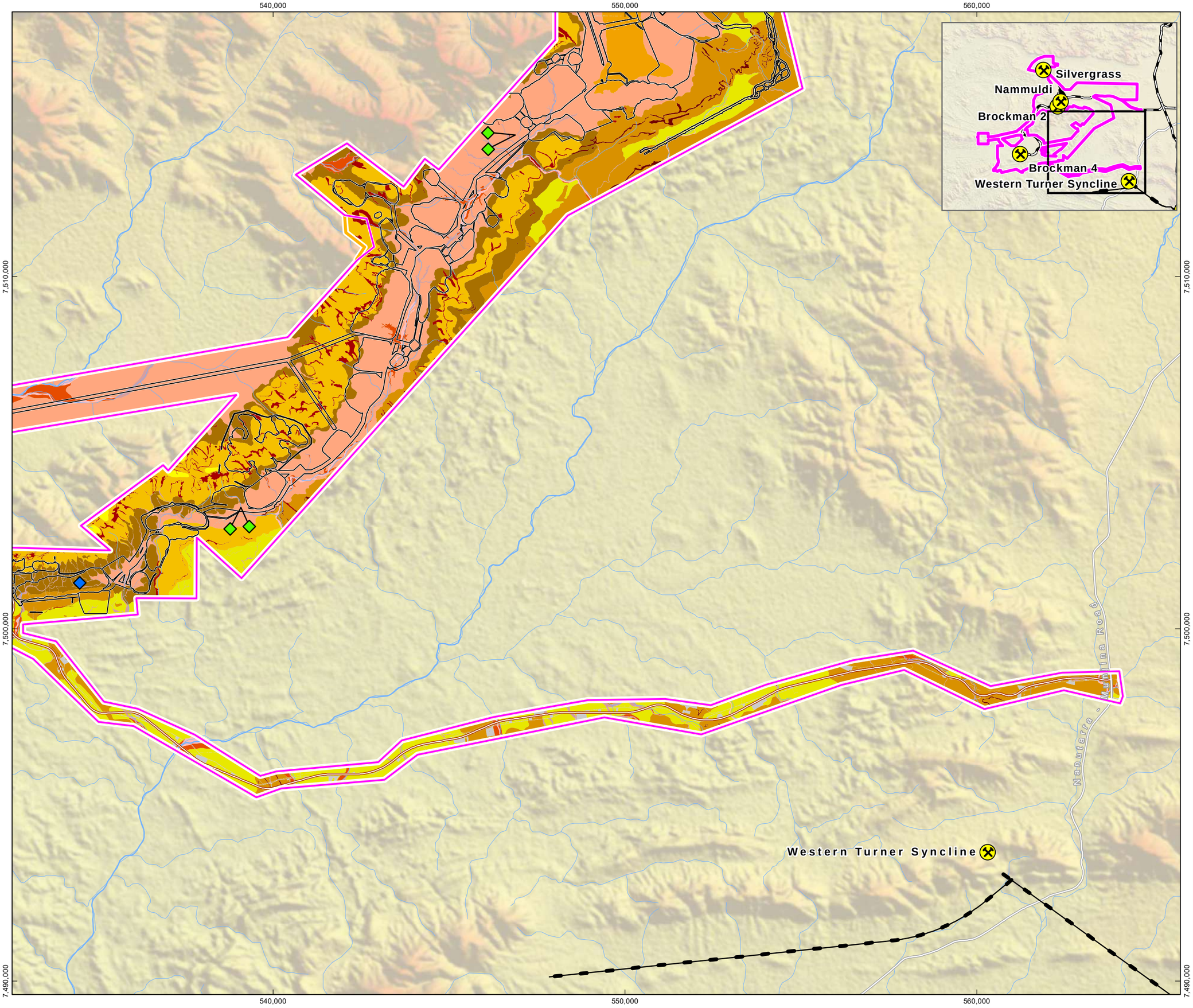
Figure 8-35
Potential Short-range Endemic Species of Medium Vulnerability over Habitat Types
Map C

Drawn: L.Fuentes
Plan: PDE0191423v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope
- Survey Area
- Conceptual Footprint

Short Range Endemics (SRE)

- *Anamidae* sp. indet.
- *Barychelidae* sp. indet.

Short Range Endemic (SRE) Habitat

High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance

- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6

Kilometres

Map units in metres

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Figure 8-35
Potential Short-range Endemic Species of Medium Vulnerability over Habitat Types
Map D

Drawn: L.Fuentes
Plan: PDE0191423v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000
520,000
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7,500,000
7,490,000

Brockman 4

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint

Short Range Endemics (SRE)

- *Aname* sp.
- *Barychelidae* sp. indet.
- *Indolpium* sp. indet.
- *Urodacus* sp.B

Short Range Endemic (SRE) Habitat

High Significance

- Debris slope/rocky outcrop
- Gorge/gully and free face

Moderate Significance

- Alluvial plain
- Colluvial plain
- Major creekline
- Minor creekline

Low Significance

- Footslope
- Gently sloping rise
- Hardpan plain
- Midslope/upper slope
- Pediment slope
- Plateau
- Disturbed

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6
Kilometres

Map units in metres

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8.6.2. Assessment of Indirect Residual Impacts

Indirect impacts to potential SRE species are considered a low risk from alteration/degradation of fauna habitat due to hydrological changes, increased weeds, dust, feral animals and altered fire regimes, and light, noise and vibration and therefore are not discussed further.

8.6.2.1. Degradation or Alteration of Habitat as a Result of Altered Hydrological Regimes

There will be no significant change to the existing hydrological regime at Boolgeeda Creek and Duck Creeks, as a result of surface discharge (as currently approved under MS 925 and MS 1000). The riparian communities along these creeks are adapted to periodic inundation from surface water flows and any habitat changes are expected to be temporary, with a gradual adaptation of habitat to lower water availability upon cessation of dewatering. As a result, the effects of surplus water discharge are expected to be minor and temporary, and related impacts to foraging and dispersal habitat are not expected to be significant.

On this basis, the alteration of hydrological regimes as a result of the Proposal is not expected to degrade or alter fauna habitat to the extent that it significantly impacts the local fauna population.

8.6.2.2. Degradation or Alteration of Habitat Features (Caves) as a Result of Dewatering

Groundwater levels across the Brockman Syncline are generally deep and beyond the typical depth of vegetation root systems (>20 m bgl). Pre-mining groundwater levels within the Development Envelope range from 593 to 495 mRL. The range in depth is a reflection of both the variation in surface elevations combined with the local groundwater gradient.

Figure 6-4 presents pre-mining depth to water contours (metres below ground level – m bgl) for the Brockman Syncline aquifer. Depth to groundwater is variable due to significant topographic variation.

As such, habitat features such as Caves (which generally sit high up within the landscape) are unlikely to be connected to groundwater within the syncline and groundwater drawdown of the synclinal aquifers will not result in a change to the temperature and/or humidity of the caves.

8.6.2.3. Habitat Degradation Associated with Construction and Operation Activity

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 bats and other fauna may experience a negative impact, and there are also no established criteria to represent the impacts of dust on pools (ETA 2021). In the absence of criteria specific to animal health, the human health criteria are useful for considering potential effects on fauna (ETA 2021).

The study found dust parameters will be elevated within the Development Envelope in earlier Proposal stages during construction and then decline (Section 10) The assessment shows Plunge Pool will be consistently subject to levels above the human health criteria for the life of mine (ETA 2021). There is no evidence that dust negatively impacts surface water features and therefore is considered not significant for fauna and the water features they use for drinking. The effect of dust emissions and deposition in relation to Plunge Pool as a significant cultural heritage place is discussed further in Sections 12 and 15.

ETA (2021) found high variability in the predicted ground level concentrations at various bat cave receptors depending on their proximity to mining operations. However, this does not represent the concentrations within the caves (which may be significantly lower) (EPA 2021). All significant bat caves (category 2 and category 3 associated with an apartment block) will be placed in MEZs within MRZs

and, therefore, will have a set distance from any mining activities, reducing the risk of high dust concentrations at the cave entrance.

The impacts of dust are typically non-lethal 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 are 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.

Fire

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 potential bushfires' extent and size. 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 Section 8.5), no significant increase in the risk of fire occurring is anticipated.

8.6.2.4. Disturbance from Light, Noise and Vibrations

Management measures to limit the impact of noise and light on fauna would be considered during the Proposal's detailed design, construction and operational phases and engineering controls implemented where possible.

Lighting will be designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020):

- Permanent lighting will only be installed where required, mainly in-pit and operational areas
- 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 Debris Slope/Rocky Outcrop)
- 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.

The disturbance will be localised and managed by implementing management measures (see Section 8.5). As such, any disturbance from light and noise associated with the Proposal are not considered significant to the survival of any significant fauna species.

Vibration limits have been applied to roosts of significance to the Pilbara Leaf-nosed Bat and Ghost Bat (Table 8-22). These measures, along with the buffers provided by MEZs within MRZs, are expected to ensure the integrity of these roosts are maintained, and seasonal variations in vibration limits will reduce the risk of disturbance to the breeding activities of these species.

8.6.2.5. Increase in Abundance and Diversity of Pest Species

Fencing of attractant areas (waste disposal/landfill) would limit the increase of pest species within the Development Envelope by decreasing access and attraction. Borrow pits will also be designed and constructed to minimise surface water ponding after rehabilitation, limiting pest species' attraction. Additional management measures such as the regular covering of wastes and trapping of pest species would further reduce the impact to native fauna.

Whilst there is the possibility that the Proposal could result in an increased number of pest species, it is more likely that the implementation of management measures (see Section 8.5) in an area that currently has limited feral animal control programs in place would result in a decrease in feral animal populations in the local area.

8.6.3. 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 (Table 8 14). However, these species occur widely in the Hamersley sub-region and can move through the local landscape. The retention of critical breeding habitat will help maintain the significant fauna species in the area. The loss of critical habitat for MNES is considered a significant 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.

Clearing for the Proposal has the potential to result in habitat fragmentation. The impact of fragmentation has the potential to be most apparent within the BS1 assessment area as a cumulative effect given the proximity to the adjacent Eliwana project, creating a potential barrier to fauna dispersal to the north. However, the connected habitat extends throughout the Development Envelope and into the areas surrounding the Proposal and adjacent project. The presence of connected habitat outside the Development Envelope is expected to reduce the significance of the fragmentation to fauna in the area.

The estimated cumulative impacts from this Proposal and reasonably foreseeable projects on the land systems within the Hamersley subregion are anticipated to total 122,797 ha (3%; Table 8-21). This Proposal’s contribution is 7,896 ha (0.2%). The cumulative impacts on land systems are small (the highest loss is 6% within the Rocklea Land System with 41,044 ha). Therefore, the full range of habitat types associated with these land systems will remain in the Hamersley subregion.

The cumulative loss of vegetation and fauna habitat due to mining in the Hamersley sub-region is recognised as potentially significant as per the EPAs *Cumulative Environmental Impacts of Development in the Pilbara Region* (EPA 2014) and therefore is addressed through the PEOF.

Given the large majority of these land systems will remain intact after Proposal implementation, this clearing is not considered significant at both a local and regional scale.

8.6.4. Significance of Residual Impacts

8.6.4.1. Non-Significant Residual Impacts

- The proposed avoidance and management measures associated with the Proposal that demonstrate non-significant residual impact to Terrestrial Fauna include:
- The significant category 2 (Upper Beasley River Roost) and category 3 Pilbara Leaf-nosed Bat roosts are located outside of the Development Envelope and will not be directly impacted by the Proposal, indirect impacts are considered unlikely.
- Of the 131 non-significant (category 4) Pilbara Leaf-nosed Bat roosts within the Development Envelope, post implementation of the Proposal it is predicted that 106 will remain due to overlap with Ghost Bat roosts and placed in MRZs/MEZs and managed via an EMP. A total of 25 category 4 roost which are not considered critical habitat will be impacted by the Proposal
- All significant Ghost Bat roosts (isolated category 2 roosts and apartment block roosts) will be retained within the Development Envelope and placed in MRZs/MEZs (Figure 8 27) and managed via the EMP.
- Of the 66 non-significant (category 3) and 42 non-significant (category 4) Ghost Bat roosts within the Development Envelope, post implementation of the Proposal it is predicted that 14 and 11 will be impacted by the Proposal. These roosts are not considered critical habitat for the species.
- Of the 25 water features known within the Development Envelope, 13 have been placed in MRZs/MEZs, including the permanent groundwater sustained Plunge Pool and managed via the EMP. Four ephemeral water features will be impacted by the Proposal. These water features are not considered critical habitat for the species.
- No potential SRE species are considered to have a high risk from the Proposal or were recorded from isolated/restricted habitat types within the Development Envelope.

8.6.4.2. Significant Residual Impacts

After application of mitigation measures, the following significant residual impacts are predicted to Terrestrial Fauna:

- Clearing of up to 264 ha and 67 ha (28% and 13%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and denning) habitats for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python within the Development Envelope. This clearing is proposed to be managed via upper limits of clearing as per Table 8-15 and will be offset as per Section 13
- Clearing of approximately 25 ha and 114 ha (4% and 15%) supporting Major and Minor (foraging and dispersal) habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, when within the species home range. This clearing is proposed to be offset as per Section 13
- Clearing of approximately 65 ha, 2,638 ha and 104 ha (3%, 12% and 9%) supporting Alluvial, Colluvial and Hardpan Plain habitat for the Pilbara Leaf-nosed and Ghost Bat, when within the species home range. This clearing is proposed to be offset as per Section 13.

8.6.5. Summary of Assessment and Proposed Regulatory Mechanisms

Table 8-26 details the residual impact, assessment findings, and recommended conditions.

Table 8-26: Assessment Findings and Proposed Regulatory Mechanisms for Terrestrial Fauna

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
Direct Impacts		
Clearing of critical habitat (including high suitability SRE habitat)	The clearing associated with the Proposal will impact up to 331.0 ha (22.6%) of critical fauna habitat (Gorge/Gully and Debris Slope/Rocky Outcrop) within the Development Envelope. Clearing within these habitats will be restricted to upper clearing limits of: • 264 ha of Gorge/Gully habitat • 67 ha of Debris Slope/Rocky Outcrop habitat. as outlined in Section 8.5 and offset.	Proposed to be regulated through the implementation of: • Ministerial conditions limiting the extent of clearing of high significance fauna habitat to 264 ha of Gorge/Gully and 67 ha of Debris Slope/Rocky Outcrop habitat within the Development Envelope • Offsets (Section 13) • DJSTI – State Agreement Act *Iron Ore (Hamersley Range) Agreement Act 1963)*
Clearing of supporting foraging and dispersal habitat	The clearing associated with the Proposal will impact approximately 2,946 ha of supporting foraging and dispersal habitat within the home range of MNES species as described in Section 8.4.1.1, composed of: • 25 ha of Major Creekline habitat • 114 ha of Minor Creekline habitat • 65 ha of Alluvial Plain habitat • 2,638 ha of Colluvial Plain habitat • 104 ha of Hardpan Plain habitat.	Regulated through offsets
Impacts on habitat features (Caves and Water Features)	The Development Envelope contains 208 potential bat roosts and 22 known water features. The Proponent will impact 25 known caves that are all category 4 (non-critical) or non-usage Pilbara Leaf-nosed Bat roosts and category 3 or 4 (non-critical) Ghost Bat roosts. The Proponent will avoid all known significant category 2 and apartment block (category 3) roosts by implementing MEZs within MRZs around all known locations. The Proponent will impact four pools, comprising four ephemeral pools. The Proponent will avoid 18 water features by implementing MEZs around them, including the significant water feature Plunge Pool.	Regulated by: • Ministerial conditions limiting the extent of clearing of known bat roosts within the Development Envelope to fourteen category 3 and 11 category 4 Ghost Bat roosts and 25 category 4 Pilbara Leaf-nosed bat roosts • Ministerial conditions on the implementation of MEZs and MRZs • Prepare and implement an EMP for the management of significant bat roosts
Impacts on significant fauna species	Seven significant fauna species have been recorded within the Development Envelope. The Proponent has proposed mitigation measures, including:	Regulated by: • Prepare and implement an EMP for the management of significant fauna species

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
	• Undertake progressive clearing to allow fauna to move away • Vehicle traffic will be confined to defined roads and tracks • Barbed wire fences will be avoided in most instances. If barbed wire fencing is required (due to legislative, safety or pastoral requirements), the top strand will be replaced with plain wire, and reflectors will be placed on the top wire to help prevent the entanglement of bats.	
Impacts on potential SRE species	Fifteen (15) out of 42 potential SRE species recorded in the Development Envelope were recorded in the Conceptual Footprint. Seven of the 15 species are known from records within and outside the Development Envelope and therefore are not of concern Eight species are known from records within the Development Envelope only. Four of the eight species are known from multiple habitat types or locations and therefore are not considered restricted to the Conceptual Footprint The remaining four species are known from Minor Creekline habitat and are expected not to be restricted to the Conceptual Footprint	Regulated by: • Ministerial conditions limiting the extent of clearing of high significance fauna habitat to 264 ha of Gorge/Gully and 67 ha of Debris Slope/Rocky Outcrop habitat within the Development Envelope
Indirect Impacts		
Risk of dust deposition	The Proponent has proposed mitigation measures, including: • Dust suppression techniques such as sprayers on crushers and water tanks utilising surplus water from groundwater abstraction • Ensuring the amount of disturbed land is as small as reasonable, reducing the amount of dust generating surfaces • The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. These mitigation measures are expected to be consistent with the EPA's objectives.	Standard management. No specific regulation required
Risk of increase of introduced pests	The Proponent has proposed mitigation measures, including:	Standard management. No specific regulation required

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
	• Landfills will be fenced, and putrescible wastes will be regularly covered • Feral animal control would be undertaken as required, in co-operation with regional control programs and the Traditional Owners	
Risk of the potential increase in bushfire incidence	The Proponent has proposed mitigation measures, including: • Ensuring no clearing activities are undertaken when fire danger rating is above high • Ensuring fire management measures are implemented, including management and monitoring of hot works, vehicle movement and disposal of potential fire starting waste • Ensuring firefighting equipment is present around the site and within vehicles and implementing fire response training to all personnel. These mitigation measures are expected to be consistent with the EPA's objectives.	Regulated by: • DJTSI - State Agreement Act (*Iron Ore (Hamersley Range) Agreement Act 1963*)
Risk of increased disturbance from Light, Noise and Vibration	The Proponent has proposed mitigation measures, including: • Vibration limits will apply to significant bat roosts within the Development Envelope to manage impacts from vibration and to maintain the significant roost s structural integrity • Lighting in mining areas will be directed towards mining activities to minimise light overspill • Equipment design would be specified to be within Australian standard noise limits	Regulated by: • Prepare and implement an EMP for the management of vibration levels at significant bat roosts

8.7. 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.

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Terrestrial Fauna are set out below:

- The Proponent shall not clear more than:
  - 264 ha of Gorge/Gully habitat within the Development Envelope
  - 67 ha of Debris Slope/Rocky Outcrop habitat with the Development Envelope

- No direct or indirect impacts from the Proposal to Ghost Bat or Pilbara Leaf-nosed Bat roosts retained within MRZs and MEZs shown in Figure 8-30
- Minimise direct and indirect impacts from the Proposal to the Northern Quoll and Pilbara Olive Python habitat in accordance with the EMP.

The Proponent will implement the EMP as per Appendix B.3 to achieve these outcomes.

The significant residual impact, after implementation of the mitigation hierarchy, is clearing of up to 331 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and denning) habitat within the Development Envelope and approximately 3,792 ha of supporting Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, when within the species home range. Environmental offsets are proposed for this clearing and are discussed in Section 13. Subject to conditions recommended in Table 8-26 and implementation of offsets (Section 13), the Proponent considers that the Proposal can be managed to meet the EPA's objective to protect Terrestrial Fauna so that biological diversity and ecological integrity are maintained.

9. SUBTERRANEAN FAUNA

9.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021b) 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 groups:

- Stygofauna – aquatic and living in groundwater
- Troglofauna – air breathing and living in caves and voids.

Subterranean fauna often displays 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 2016a). 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 that are not hypersaline for stygofauna. This assessment recognises these inherent links.

9.2. Relevant Policy and Guidance

Table 9-1 presents relevant policy and guidance for Subterranean Fauna and demonstrates how this has been considered for the Proposal.

Table 9-1: Relevant Policy and Guidance for Subterranean Fauna

Policy or Guidance	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021b)	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.
Environmental Factor Guideline: Subterranean Fauna (EPA 2016f)	Considered in the design (methods and approach) of Subterranean Fauna surveys (previous guidelines

Policy or Guidance	Explain How the Policy and Guidance has been Considered
EPA Technical Guidance: Subterranean Fauna Surveys for Environmental Impact Assessment (EPA 2021j)	were used where surveys were undertaken before current guidelines)
Instructions on how to prepare an Environmental Review Document (EPA 2021d)	This document forms the basis of the headings and content provided in this ERD
Other State or Commonwealth	
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 flora and vegetation (Appendix B.4).
Statutory Guidelines for Mine Closure Plans (MCP) (DMIRS 2020b)	

9.3. Receiving Environment

9.3.1. Studies and Survey Effort

Table 9-2 summarises the Proposal-specific and other relevant regional surveys and studies undertaken for Subterranean Fauna. Key studies and survey reports are provided in Appendix F.1 and F.2. The spatial extent and location of stygofauna and troglofauna sampling are shown in Figure 9-1 and Figure 9-2.

Table 9-2: Summary of Technical Studies undertaken for Subterranean Fauna

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Greater Brockman Subterranean Fauna Survey Report (Biologic 2022d; Appendix F.1)	**Study/Survey area:** Brockman Syncline, Particularly BS1, 2, 3 and 4 **Type:** • Desktop review of previous subterranean fauna records/surveys in the vicinity of the Proposal (Biota 2005, Biota 2007, Biota 2010, Biota 2011, Biota 2016c and Biota 2016d) • Two-phase level 2 stygofauna and troglofauna survey throughout the study area and wider local area, including morphological and molecular identifications. • Two phase targeted survey throughout the study area (primarily in relation to stygofauna) including morphological and molecular identifications. • DNA Analysis Report as an appendix. **Timing:** • Level 2 Survey Phase 1: 3 – 14 October 2018, 29 November 2018 – 7 December 2018, 10 – 18 April 2019 and 5 – 11 June 2019 (4 trips) • Level 2 Survey Phase 2: 9 - 18 April 2019, 6 – 14 June 2019, 18 – 27 June 2019 and 12 – 22 August 2019 (4 trips) • Targeted Survey Phase 1: 15 – 21 October 2020 (2 teams). • Targeted Survey Phase 2: 20 – 25 February 2021 (2 teams).	Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following: • Environmental Factor Guideline: Subterranean Fauna (EPA 2016f) • Technical Guidance – Subterranean Fauna Surveys for Environmental Impact Assessment (EPA 2021j)
Habitat Assessment and Modeling Report (Biologic 2022b; Appendix F.2)	**Survey area**: Greater Brockman Operation. Consolidated area comprised 75,087 ha**.** **Type:** Desktop assessment and integration of:	There is no specific guidance for subterranean fauna habitat categorisation or modelling. The assessment includes a quantitative assessment of the physicochemical and geological parameters within the Brockman Syncline in order to

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Prepared for Rio Tinto.	• 2D surface geology for suitable habitat • 3D habitat modelling from drill hole information AWT and BWT • Groundwater geochemical profiling of stygofauna habitats BWT. **Timing:** 2018 -2022	determine suitable geological habitat for subterranean fauna in and surrounding the Proposal. The following limitations and constraints associated with this study have been identified: • The habitat assessment was constrained to areas of high confidence, thereby excluding a limited number of lithologies lacking physical data. • It is not possible to precisely represent the occurrence, extent, and connectivity of fine scale voids that may provide habitat. • Abiotic and biotic factors such as humidity, infiltration rates, ecology, behaviour, and nutrient sources, are likely key factors affecting the distribution/occurrence of subterranean fauna species but are currently understudied and not included in the model. • Categorisation of stand and tag provided a consistent, reliable basis for identification of subterranean voids and porous zones that have resulted from weathering processes. Information on the weathering processes (weathering and oxidation states) may improve this process but was not consistently available. • 3D pit shell data for thee Eliwana Iron Ore Mine adjacent to the BS1 assessment was not publicly available for inclusion in the model extent. • Cumulative BWT impact scenarios from Eliwana and the Proposal were subject to the data, assumptions, and constraints/limitations of the third-party drawdown modelling (FMG 2018). The Cumulative long-term scenario represents an indicative worst-case scenario assuming the maximum groundwater abstraction as approved under the current water license at the Eliwana operations. Actual groundwater abstraction at Eliwana may differ. • The depth of basement across the modelling areas was based on the integration of all available geological and hydrogeological data / airborne electromagnetics, drilling and bore logging data, hydrogeological interpretations, and groundwater physicochemical profiling. Varying depths of vertical habitat (100 and 150 mbgl) were applied across the modelled areas with biological data providing support for this assessment. Further testing may be useful to confirm the findings. The above limitations are not considered significant, and the method used provides for the finest resolution of subterranean fauna habitat modelling currently known in the industry and as such is consistent with the EPAs objective for this factor.

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
		In addition, the modelling has also used the same basic methodology to subterranean fauna habitat characterisation as that utilised for the Greater Paraburdoo Iron Ore Hub Proposal (Assessment Number: 2189) which was peer reviewed by both a biological and hydrogeological expert and presented to the EPA. The 3D habitat model created for this Proposal has been further developed and refined considering the feedback from the previous peer review as well as advances in modelling technology/software capacity. The model has also been customised taking into consideration site specific geological, hydrogeological and water related conditions as would be expected and required for differing sites to ensure the model is site specific and accurately reflects the environment of the Proposal. As such this work is consistent with the EPAs objective for this factor.
Brockman Syncline Regional Groundwater Model – Cumulative Impact Assessment (RPS 2021a; Appendix C.4) Prepared for Rio Tinto	**Study/Survey area:** Brockman Syncline deposits region (including current B2N and BS4 operations). **Type:** Groundwater modelling study to assess cumulative impacts arising from proposed Brockman Syncline mining. **Timing:** Assessment undertaken November 2021.	Prepared in accordance with the information requirements in the EPA Inland Water factor guideline.
Brockman Syncline: Hydrogeological Assessment (Rio Tinto 2022c)	**Study/Survey area:** Brockman Syncline deposits region (including BS2, BS4 and Nammuldi operations). **Type:** Hydrogeological Assessment of the Brockman Syncline region with conceptual hydrogeological modelling, groundwater flow modelling and assessment of impacts. **Timing:** Data and results presented as of 2022.	Prepared in accordance with information requirements in the EPA Inland Water factor guideline and the DWER Operational policy no. 5.12 – Hydrogeological reporting associated with a groundwater well licence.

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Figure 9-1
Spatial Extent and Location of Stygofauna Sampling for the Proposal

Drawn: L.Fuentes
Plan: PDE01900285v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Approved Part IV Indicative Footprint
- Groundwater Contour (mAHD)
- Stygofauna Sampling Sites

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Mount Brockman Road
Duck Creek
Calwingina Creek
Boolgeeda Creek
Beasley River
Beasley River West
White Quartz Road
Nanutarra - Munjina Road

RioTinto

Figure 9-2
Spatial Extent and Location of Troglofauna Sampling for the Proposal

Drawn: L.Fuentes
Plan: PDE01900286v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Approved Part IV Indicative Footprint
- Troglofauna Sampling Sites

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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For the purposes of Subterranean Fauna, the Development Envelope has been conceptually split into four sections based upon geographical location, hydrology, hydrogeology, system basements, topography, water tables and lateral boundaries (Figure 2-7) as follows:

- BS1: Proposed AWT and BWT pits at BS1 East and West
- BS2: Proposed AWT and BWT pits including Pits 1-3 and Pit 14 and Lens G
- BS3: Proposed AWT and BWT pits including Marra Mamba pit M and J, Diesel, Sandalford, Monkey, Lauriston, Creekside, Orbe and Brokenwood
- BS4: Extension of the existing Marra Mamba pits R and Q to support BWT mining plus proposed AWT and BWT pits at Endeavour, and Marra Mamba pits N and O.

9.3.2. Subterranean Fauna Habitat

9.3.2.1. Overview

The geological and hydrogeological setting of the Development Envelope is dominated by the mountainous Brockman Range and the synclinal valley (the Brockman Syncline) surrounding it. The main geological and hydrogeological formations which provide habitat for Subterranean Fauna comprise:

- Bedded ironstone ranges occurring as ridges around the outer rim of the Syncline formed in the Brockman Iron Formation and Marra Mamba Iron Formation (MMIF). Highly suitable subterranean fauna habitats (AWT and BWT) are prevalent in:
    - Weathered and fractured Dales Gorge and Joffre Members of the Brockman Iron Formation
    - Mt Newman Member of the MMIF, and pisolitic duricrust/ hardcap on the flanks of the ranges
    - Other members of the Brockman Iron Formation and MMIF also provide similar habitat values where suitably weathered/ fractured
- The synclinal valley features suitable habitats (AWT/BWT) within:
    - Unconsolidated and porous alluvial/ colluvial detritals
    - Secondarily weathered deposits of calcrete and pisolitic channel iron deposits (CID) occurring in patches throughout the valley detritals
    - Weathered/fractured Wittenoom Dolomite Formation occurring throughout the valley (typically below the detritals and BWT).

A generalised stratigraphy of the major geological units is described in Table 9-3 and shown on Figure 6-2, with notes relating to subterranean fauna habitat suitability, based on local sampling results and regional knowledge. The sections of the Development Envelope occur in different areas of the Syncline, each having a unique combination of geological, hydrological, and topographical factors that have contributed to the size, extent, and complexity of habitat available for subterranean fauna above and below the water table (refer Biologic 2022d for full details).

Table 9-3:Generalised Stratigraphy of Major Geological Units Occurring Within the Development Envelope

Age	Unit	Description	Typical suitability for subterranean fauna
Cainozoic	Detrital layers (alluvium/ colluvium)	Superficial deposits occupying lower flanks, valleys, drainage lines. Secondary calcrete, silcrete, and CID common.	Medium to high – particularly in secondary deposits, well sampled throughout the Pilbara

Age	Unit		Description	Typical suitability for subterranean fauna
	Channel Iron Deposits (CID)		Secondarily weathered deposits of Robe Pisolite, mainly along drainage lines or in valley detritals.	High – well sampled throughout the Pilbara
Paleozoic	Wyloo Group		Sandstone, mudstone, conglomerate, banded iron formation (BIF) and chert.	Medium to low – poorly sampled
	Turee Creek Group (Kungarra Formation)		Fine-grained sandstone, siltstone, and mudstone.	Unknown/ uncertain.
Various	Dolerite Dykes		Dolerite dykes intrude the bedrock (following fault planes) throughout the Syncline. Most strike NW to SE.	Low – mainly impervious, potential barriers
Hamersley Group				
Proterozoic	Boolgeeda Formation		BIF, jaspilite, siltstone and shale.	Low – poorly sampled, typically low permeability.
	Woongarra Formation		Rhyolite lavas, pyroclastic rocks, and BIF	
	Weeli Wolli Formation		Jaspilitic BIF, shale and siltstone.	
	Brockman Iron Formation (HB)	Yandicoogina Shale	Interbedded chert, shale and BIF	Medium to low – poorly sampled
		Joffre Member	BIF with shale bands	Medium to high – particularly mineralised/ hydrated, well sampled Low within impervious shale bands (e.g., J3 unit)
		Whaleback Shale	Interbedded chert and shale bands, minor BIF.	Medium to low – moderately sampled
		Dales Gorge	Interbedded BIF and shale bands	Medium to high – particularly with secondary alteration features, well sampled
	Mount McRae Shale Formation		Shale and interbedded BIF	Low – mainly impervious, potential barrier, well sampled
	Mount Silvia Formation		BIF, chert, and shale	Mostly low – poorly sampled, typically low permeability.
	Wittenoom Formation (HD)	Bee Gorge Member	Calcareous dolomite, chert, volcaniclastics and BIF.	Medium to high – particularly fractured/ weathered, moderately sampled
		Paraburdoo Member	Dolomite with minor chert.	Medium to high – particularly fractured/ weathered/ karstic, well sampled
		West Angela Member	Manganese rich shale, BIF, dolomite and chert.	Mostly low – poorly sampled, typically low permeability.
	Marra Mamba Iron	Mount Newman Member	BIF with thin shale bands	Medium to high – particularly with secondary alteration features, well sampled

Age	Unit		Description	Typical suitability for subterranean fauna
	Formation (HM)	McLeod Member	BIF, chert, and carbonate, with interbedded shale.	Medium to high – particularly with secondary alteration features, moderately sampled
		Nammuldi Member	Cherty BIF interbedded with thin shales.	Medium to low – poorly sampled, typically lower permeability.
Fortescue Group				
Lower Proterozoic	Jeerinah Formation		Basaltic flows interbedded with shale, chert, BIF, mudstone, quartzite, and dolomite.	Mostly low – poorly sampled, typically low permeability.
	Bunjinah, Pyradie, and Boongal Formations		Metabasaltic flows and breccia.	Unknown/ uncertain.
	Hardey Formation		Sedimentary pelite, metasandstone and conglomerate.	

Habitat complexity is increased in many sections of the Syncline by numerous geological structures such as faults and transverse dykes, which partly compartmentalise the bedrock habitats. Detrital habitats are variably porous/ weathered at local scales and predominantly overlie the dykes and hence are not subject to the same faulting/ disconformities as the underlying bedrock.

Groundwater levels vary in depth from surface, size/ extent, and degree of connectivity between various compartments occurring throughout the synclinal valley. Some, but not all of the aforementioned dykes appear to constrain hydrogeological connectivity, with significant differences in the depth of the water table, between various sections of the Syncline as shown on Figure 6-3 and Figure 6-5.

9.3.2.2. Subterranean Fauna Habitat Modelling

Due to the subterranean nature of the habitat, 3D modelling was undertaken of prospective above and below water table subterranean habitats to inform the impact assessment. The determination of prospective habitats was predominantly based on lithological information derived from downhole drill logging data and bore logs, together with diamond drill cores, hydrogeological information, geophysical survey information, and structural information, targeted at detecting the most likely geological and hydrogeological strata where suitable cavities, fractures and porous zones occur, providing habitat and habitat connectivity for subterranean fauna.

These data sources are independently validated, integrated, and cross checked against actual subterranean fauna records from sampling throughout the Development Envelope and the immediate local context. Further details of the habitat modelling methodology are available in Biologic (2022b), based upon Rio Tinto and Biologic's independent peer reviewed 3D habitat modelling framework described in Biologic (2022b). Subterranean fauna habitats relevant for both troglofauna and stygofauna were modelled in two distinct zones:

- Zone A – Detailed 3D modelling zone, which represents the upper part of the geological strata nearer to surface which has been extensively drilled
- Zone B – Broader stratigraphic modelling zone, which represents lower geological strata below or surrounding Zone A where modelling was reliant upon a lower density of information.

Aquifer/Groundwater System Basement

Defining a conceptual 'hydrogeological basement' of the synclinal aquifer system relevant for subterranean fauna habitat modelling (namely for stygofauna) was an important step to limit the ultimate

depth of potentially suitable habitat in Zone B BWT. Hydrogeological characteristics and groundwater profiling were the two main aspects built into the 3D model to define a system basement.

Hydrogeological characteristics

The primary information used to define the basement was the porosity and hydrogeological characteristics of the lower strata, modelled in 3D using baseline stratigraphic models. Bore logs and diamond cores were investigated, as well as groundwater yields, pump testing, and results of hydrogeological and geophysical investigations.

Groundwater Geochemical Profiling

Groundwater sampling for laboratory chemical analysis has been undertaken since the 1990's across the Brockman Syncline, with a majority of the data collected for the BS2, BS4 and Nammuldi areas (Rio Tinto 2020c).

Groundwater quality is typically fresh, with electrical conductivities varying between 400 and 1,500 µS/cm and pH values ranging from between 5.5 and 8.5 with a mean of 7.4. Groundwater quality is generally within ANZECC & ARMCANZ (2000) guidelines for aquatic ecosystems, with the exception of copper and zinc, which were recorded at elevated levels at some sites (Rio Tinto 2020c).

Studies of 55 water bores and drill holes throughout the BS1, BS3, and parts of BS2 assessment areas were undertaken with the aim of characterising the vertical physiochemical profile of the aquifer, to inform 3D habitat modelling. Groundwater quality is known to strongly affect the habitat suitability for stygofauna, and therefore it was important to determine how physicochemical conditions change with depth. This was particularly relevant for validating the suitability of deeper potential habitats (below 100 m bgl).

Physicochemical parameters were measured at rapid intervals (10 measurements per second) as probes were steadily lowered below the water table to a maximum depth of 200 m from surface (or end of hole). A suite of parameters including specific conductivity, total dissolved solids, dissolved oxygen, acidity (pH), oxidation-reduction potential, turbidity, temperature, pressure, and depth (from surface and from water level) were recorded. Dissolved oxygen and specific conductivity values were applied to the habitat model as evaluations, creating isosurfaces and demonstrating 3D spatial variability of these parameters throughout the model.

Finally, subterranean fauna sampling information was cross-checked where available, with the results of groundwater profiling surveys. In most sections of the syncline, the available information correlated with stygofauna records showed that potential viable stygofauna habitat could occur deeper than 100 - 120 m below surface up to a 150 m ultimate system basement. However, in the BS1W compartment, groundwater occurs lower/deeper in the stratigraphic profile, and hence the available data suggested that 100 m from surface was more suitable for defining the conceptual system basement of the aquifer relevant for stygofauna (Biologic 2022d).

Groundwater Water Levels

The Brockman Syncline comprises a series of hydrogeological compartments (separated by dykes and hydrogeological barriers) with different groundwater levels relative to the topographic surface. Current groundwater levels for each compartment, prior to any groundwater drawdown occurring, were used to form a site-wide synclinal water table layer and generate the pre-impact water table. The resulting water table layers formed the modelling boundary surfaces between AWT and BWT habitats.

Topography

Topographic information (LiDAR and elevation mapping) was used to form the upper surface boundary of the habitat modelling. The proposed and current/ approved pit shells were extracted from the topography to enable a post-mining habitat calculation to be estimated.

Lateral Boundaries

The 3D modelling of habitat suitability 'layers' within Zone A was conservatively limited to a 300 m radial extent around each bore/ drill hole collar, representing the area of maximum confidence in the drill logging information and interpretation of habitat suitability. To provide a conservative estimation, extrapolation beyond the 300 m high confidence boundary was excluded from the modelling within Zone A. This constraint can sometimes result in an artificial "islands" effect presented in the 3D model outputs in this document (Figure 9-3 to Figure 9-15).

However, stratigraphic modelling within Zone B was designed to model broader stratigraphic features beyond the 'detailed modelling zone' to the limits of the conceptual aquifer basement and hydrogeological system boundaries, using available 2D and 2D geological and hydrogeological data. Aquifer system boundaries were used as lateral boundaries for modelling in Zone B, including the regional dolerite sill within the Joffre J3 unit of the Brockman Iron Formation, the Fortescue Group geologies occurring at the lower boundary of the Nammuldi Member of the MMIF, and the conceptual 'hydrogeological basement' as described above.

9.3.2.3. Stygofauna Habitat

Suitable habitats for stygofauna occur mainly within the synclinal valley in Tertiary detrital aquifers and fractured/weathered rock aquifers at varying depths from surface. The detrital aquifers are composed of colluvial and alluvial sediments of variable porosity, and areas of secondary weathered calcrete and CID, which also provide highly suitable stygofauna habitats due to their predisposition to being porous or hosting cavities. Deeper fractured/ weathered rock aquifers occur in the Brockman Iron Formation, MMIF, and Wittenoom Dolomite (particularly, but not exclusively within the Dales Gorge Member, Mt Newman Member, and Bee Gorge/ Paraburdoo Members where saturated).

Numerous dykes, sills and structures within the bedrock constrain groundwater in various sections of the syncline and create multiple 'hydrogeological compartments'. However, the dykes are not considered to restrict groundwater flows and habitat connectivity within the overlying detrital aquifers unless corresponding to a significant change in water levels between compartments. Dykes that do not correspond to a significant change in water levels may allow connectivity due to faults and fracturing or periodic overtopping through the overlying detrital aquifers.

Local variability in the thickness, extent, and continuity of BWT habitats is attributed to the local hydrostratigraphic context, the occurrence of transverse dykes and geological structures, and the bathymetric form of the aquifer basement within each section or area of the synclinal valley.

Habitat modelling in Zone A BWT shows highly detailed modelling throughout the upper saturated profile of the Brockman synclinal valley. The majority of drill holes and bores did not reach the system basement at 100-150 mbgl, therefore Zone A BWT underrepresents the full extent of prospective stygofauna habitats within the synclinal valley.

Deeper prospective stygofauna habitats were modelled within Zone B BWT via evaluation and interpretation of stratigraphic trends between the lower boundary of Zone A and the system basement. The suitability of the hydrostratigraphic units in Zone B BWT was informed by hydrogeological and geophysical information, groundwater profiling and stygofauna sampling in selected deeper bores.

The final 3D model of BWT stygofauna habitats is based on a large amount of drill-hole information. In total, 17,512 drill holes were used to model the BWT habitats throughout the Proposal. More than 860 thousand metres of BWT hole intervals were categorised into stygofauna habitat suitability categories (Zone A BWT and Zone B BWT). Modelling the BWT habitats with such a large amount of data resulted in a high degree of confidence in the stygofauna habitat assessment and assessment of impacts to habitats. An overview of the 3D subterranean fauna habitats BWT for the Proposal is shown in Figure 9-3

Based on the extensive drilling data, an estimate of habitat volume for each section of the Development Envelope, within each Zone of habitat is provided in Table 9-4. These estimates take into consideration that the Proposal is located in close proximity to three brownfields sites which have been and are currently mining AWT and BWT. Habitat volumes are based on current hydrogeological information.

The important stygofauna habitat values within each of the four assessment areas are briefly described below.

Table 9-4: Summary of Volumetric Habitat Available to Stygofauna BWT Across the Proposal Areas

Habitat Zones	Modelled Volume (m^3) ('000)				
	BS1	BS2	BS3	BS4	Total
Zone A BWT	334,488	348,543	274,426	433,539	1,390,996
Zone B BWT	3,479,682	9,096,700	2,758,784	13,442,200	28,777,366
Total BWT	3,814,170	9,445,243	3,033,210	13,875,739	30,168,362

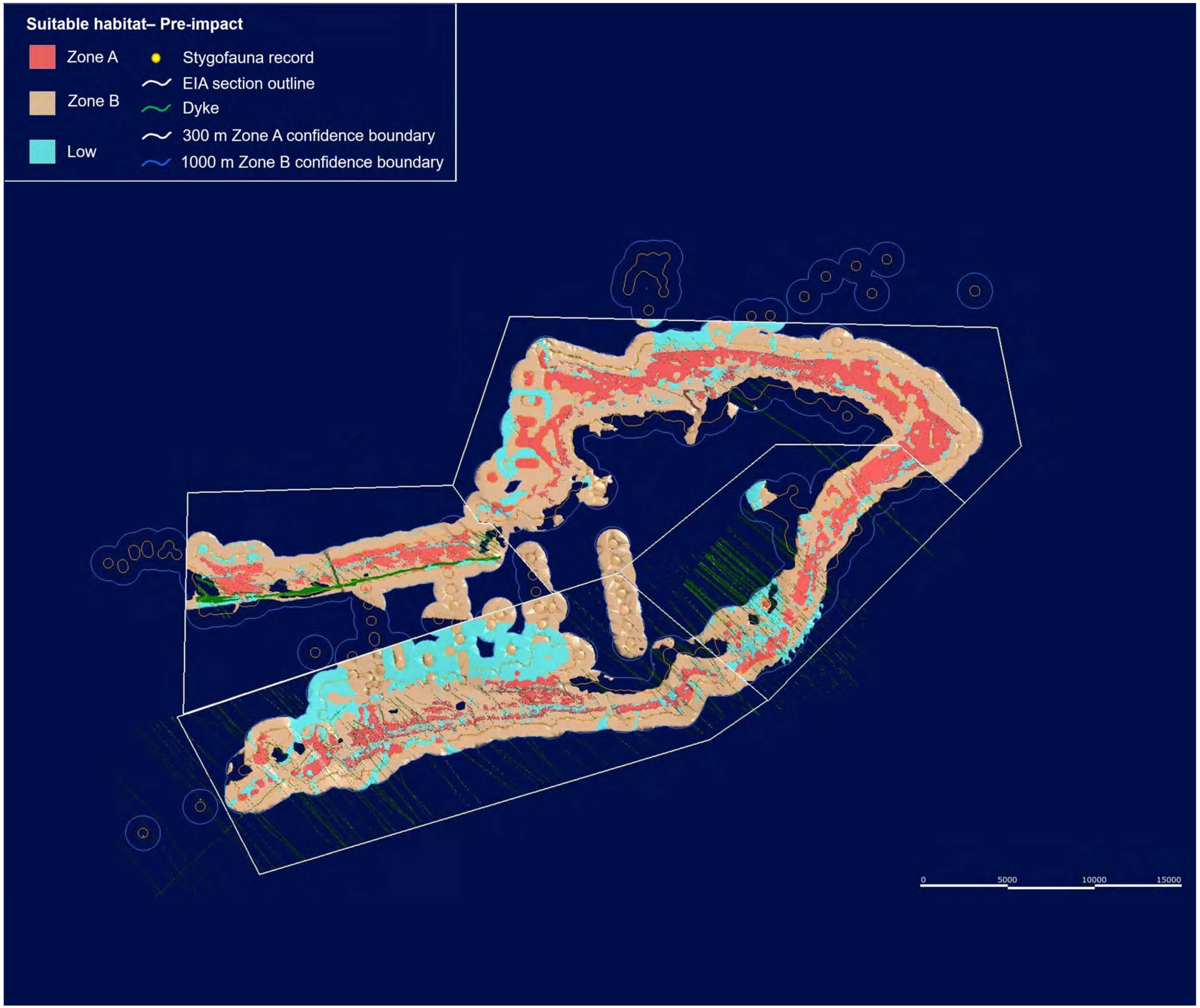

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Figure 9-3
3D BWT Habitat Modelling Results Overview

Drawn: L.Fuentes
Plan: PDE0190288v1
Date: June 2022

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Brockman Syncline 1 Assessment Area

At BS1, 3D modelling shows large areas of suitable stygofauna habitat oriented along the strike of the syncline and synclinal valley. The synclinal valley hosts thin to moderately thick BWT habitats, hosted by detrital aquifers and underlying fractured/weathered rock aquifers. These habitats in the valley are connected to the Brockman Iron Formation on the ranges which extends partially below water table in this area and provides further prospective stygofauna habitats. The northern side of the synclinal valley is composed of MMIF which occurs mostly beyond the modelling boundary, but also provides additional suitable stygofauna habitats where it extends below the water table.

Numerous minor transverse dykes and faults occur at BS1, as well as a major, central/perpendicular dyke that corresponds to a groundwater level change of approximately 40 m from BS1W to BS1E (EMM 2021). Any compartmentalisation of habitat between the minor transverse dykes does not appear to be reflected in groundwater levels and is considered only relevant to deeper bedrock habitats, rather than the detrital habitats described above.

Groundwater profiling and detailed habitat modelling at BS1E showed a range of moderately to highly suitable habitat characteristics, with depth increasing to 100 mbgl and beyond. The hydrogeological compartment at BS1W, however, occurs lower in the stratigraphic profile and both hydrogeological habitat suitability (porosity/fracturing) and dissolved oxygen levels decrease more substantially approaching depths up to 100 mbgl. For this reason, 100 mbgl was considered an appropriate hydrogeological system basement at BS1W with respect to modelling suitable stygofauna habitat, whereas at BS1E 150 mbgl was modelled as the system basement for suitable habitat, as for all other sections of the syncline.

Figure 9-4 provides a 2D view of these habitats at BS1, whilst cross and long sections of the 3D subterranean habitats BWT are presented in Figure 9-5 and Figure 9-6.

Brockman Syncline 2 Assessment Area

At BS2, extensive, continuous, and thick suitable stygofauna habitats are hosted by the deep detrital aquifer in the synclinal valley. The Brockman Iron Formation and MMIF bands are relatively far apart in this section, making the synclinal valley more extensive compared to other sections of the Development Envelope. The Brockman Iron Formation ranges to the south of the synclinal valley do not provide prospective BWT habitats for stygofauna, as the ranges are tall and mostly above water table in this section.

In the south-western corner of BS2 the limited access to drillhole information beyond the Proponent's tenure has resulted in artificial gaps in the model, and consequently the extent and connectivity of prospective suitable habitat in this area is underrepresented in the 3D model. Based on surface geological and structural mapping it is understood that these habitats extend throughout the synclinal valley at BS2, including the area in the south-western corner of BS2.

Numerous dykes, faults, and folds occur through the syncline at BS2. However, these geological structures are not considered to restrict groundwater connectivity within the overlying Tertiary detrital aquifer which makes up the majority of prospective stygofauna habitat at BS2.

Figure 9-7 provides a 2D view of these habitats at BS2, whilst cross and long sections of the 3D subterranean habitats BWT are presented in Figure 9-8 and Figure 9-9.

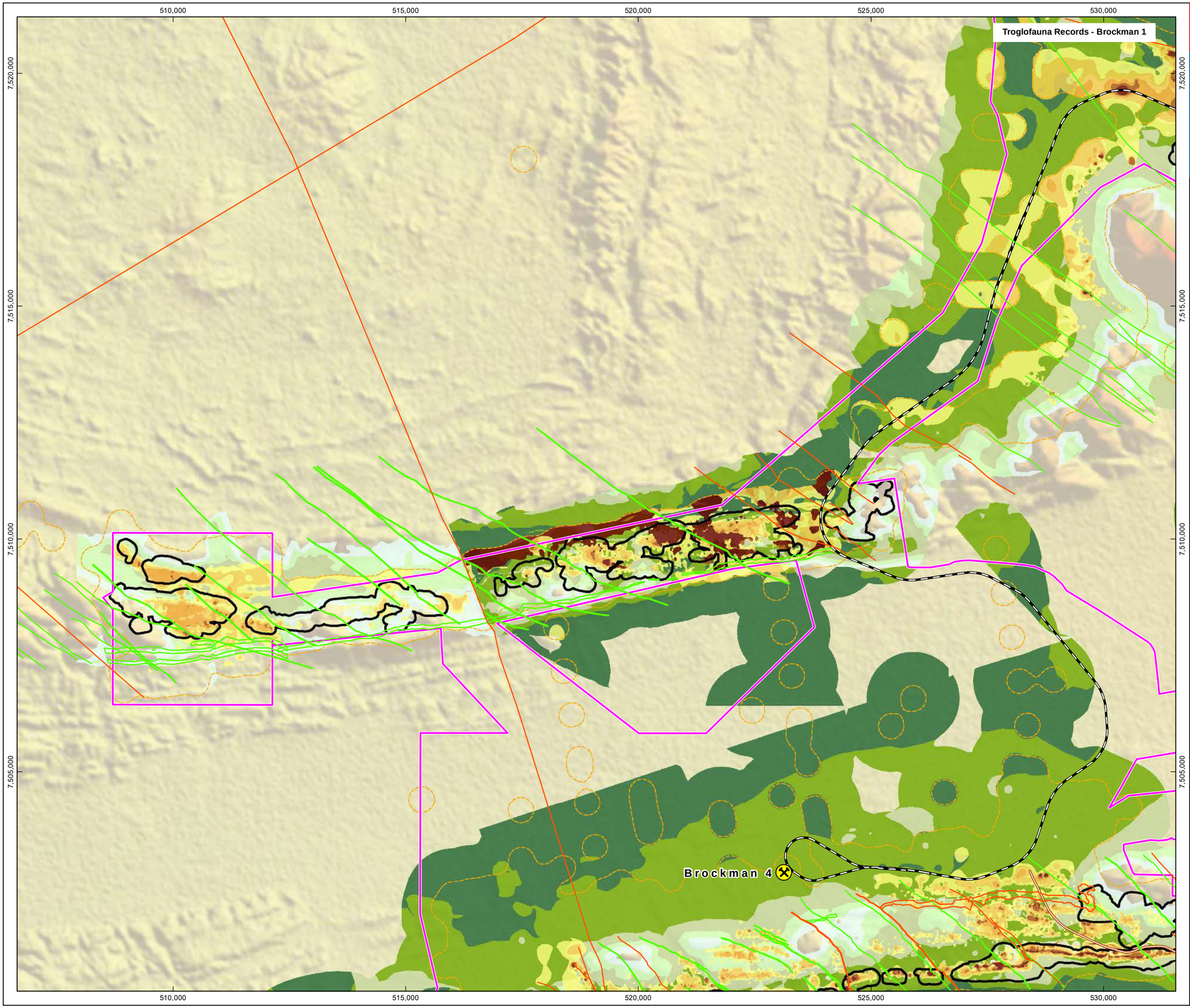

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Figure 9-4
2D Subterranean BWT Habitats within the BS1 Assessment Area

Drawn: L.Fuentes
Plan: PDE01900290v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barriers (Potential)
- 3D Modelling Boundary

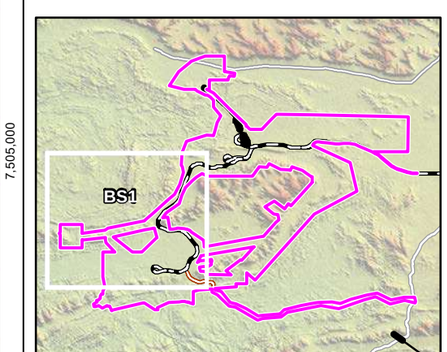
Habitat Thickness Zone

- 0 - 20m
- 20 - 50m
- 50 - 75m
- 75 - 100m
- 100 - 200m

Habitat Thickness Zone B

- 0 - 30m
- 30 - 60m
- 60 - 90m
- 90 - 120m
- 120 - 167m

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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0 0.5 1 1.5 2 2.5 3
Kilometers
Map units in metres

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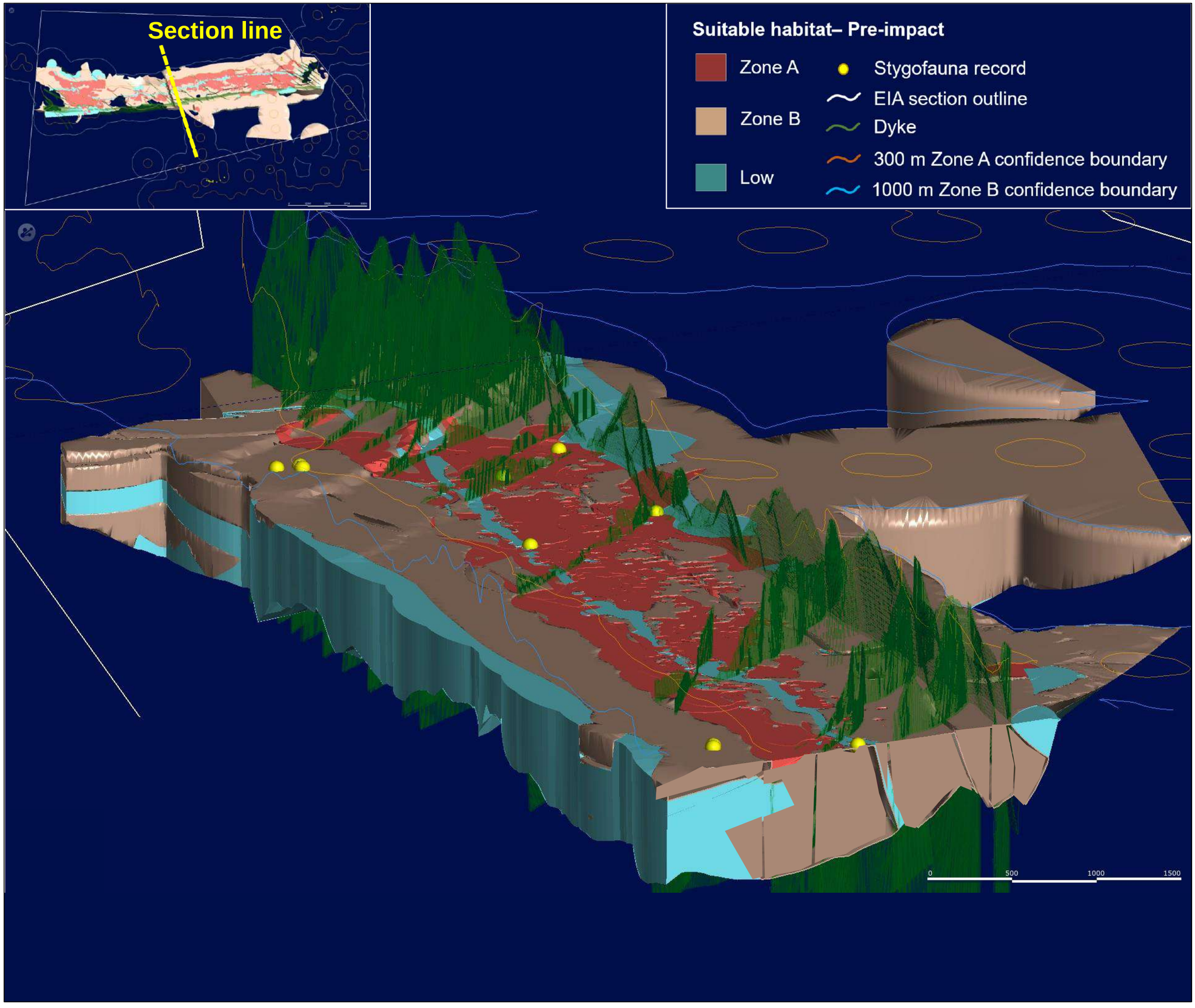

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Figure 9-5
Cross Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS1 Assessment Area

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Plan: PD ED190289M
Date: July 2022 *GIS.Team@riotinto.com*

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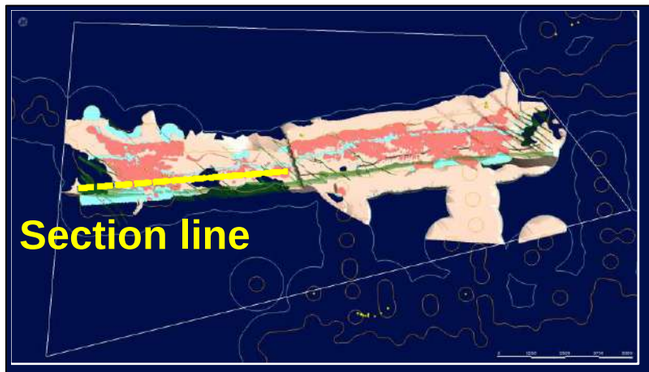

Suitable habitat– Pre-impact

- Zone A
- Zone B
- Low
- Stygofauna record
- EIA section outline
- Dyke
- 300 m Zone A confidence boundary
- 1000 m Zone B confidence boundary

0 500 1000 1500 2000

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Figure 9-6
Long Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS1 Assessment Area

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Plan: PD ED190289vl
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Figure 9-7
2D Subterranean BWT Habitats within the BS2 Assessment Area

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Plan: PDE0190292v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
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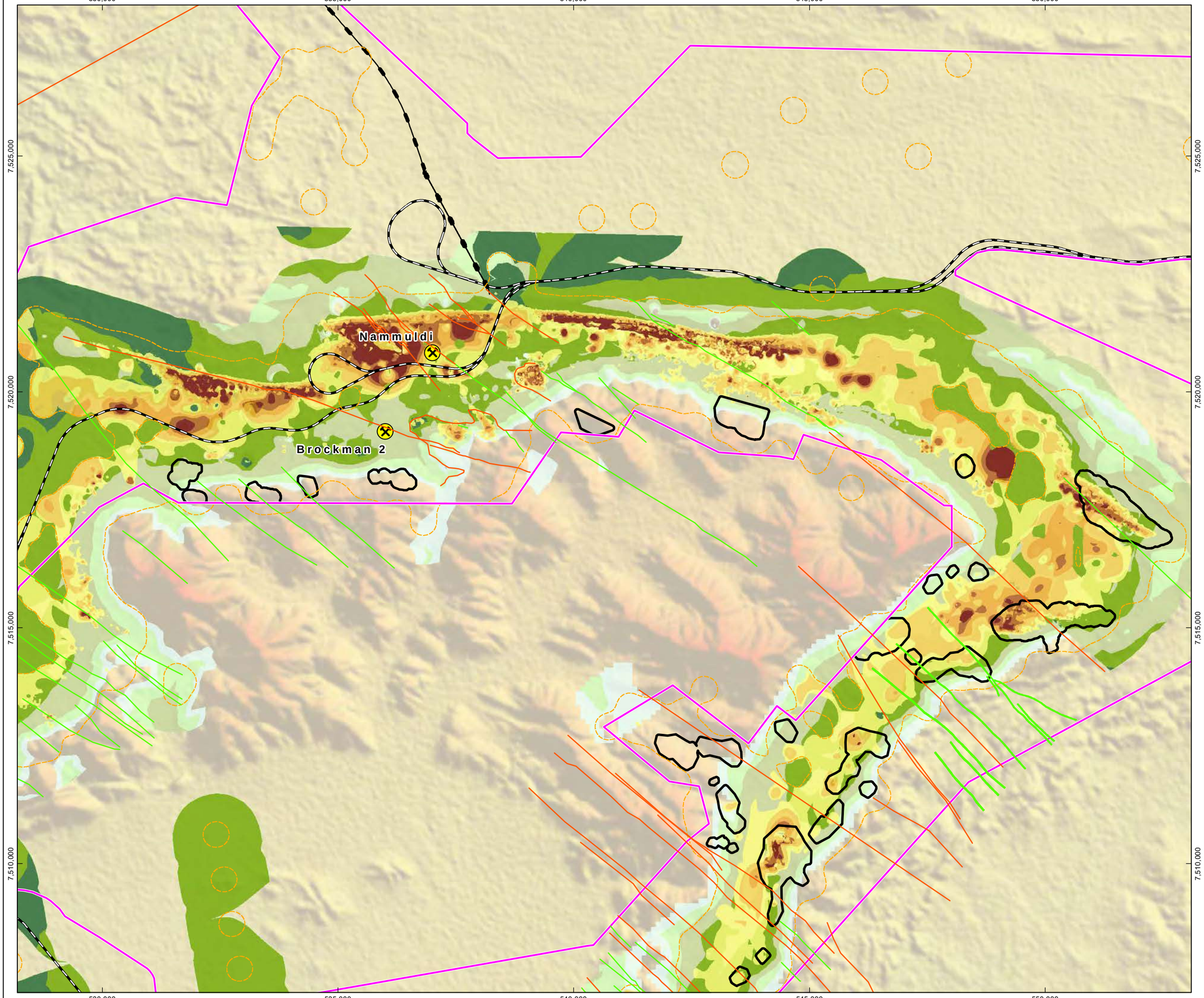


Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- 3D Modelling Boundary

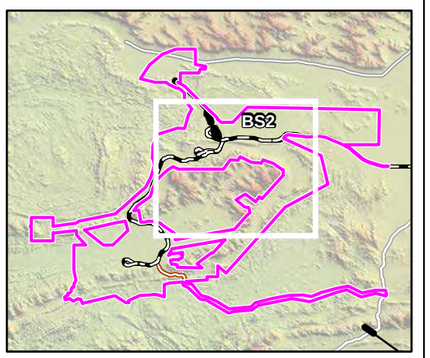
Habitat Thickness Zone A

- 0 - 20m
- 20 - 50m
- 50 - 75m
- 75 - 100m
- 100 - 200m

Habitat Thickness Zone B

- 0 - 30m
- 30 - 60m
- 60 - 90m
- 90 - 120m
- 120 - 167m

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor



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Kilometers

Map units in metres

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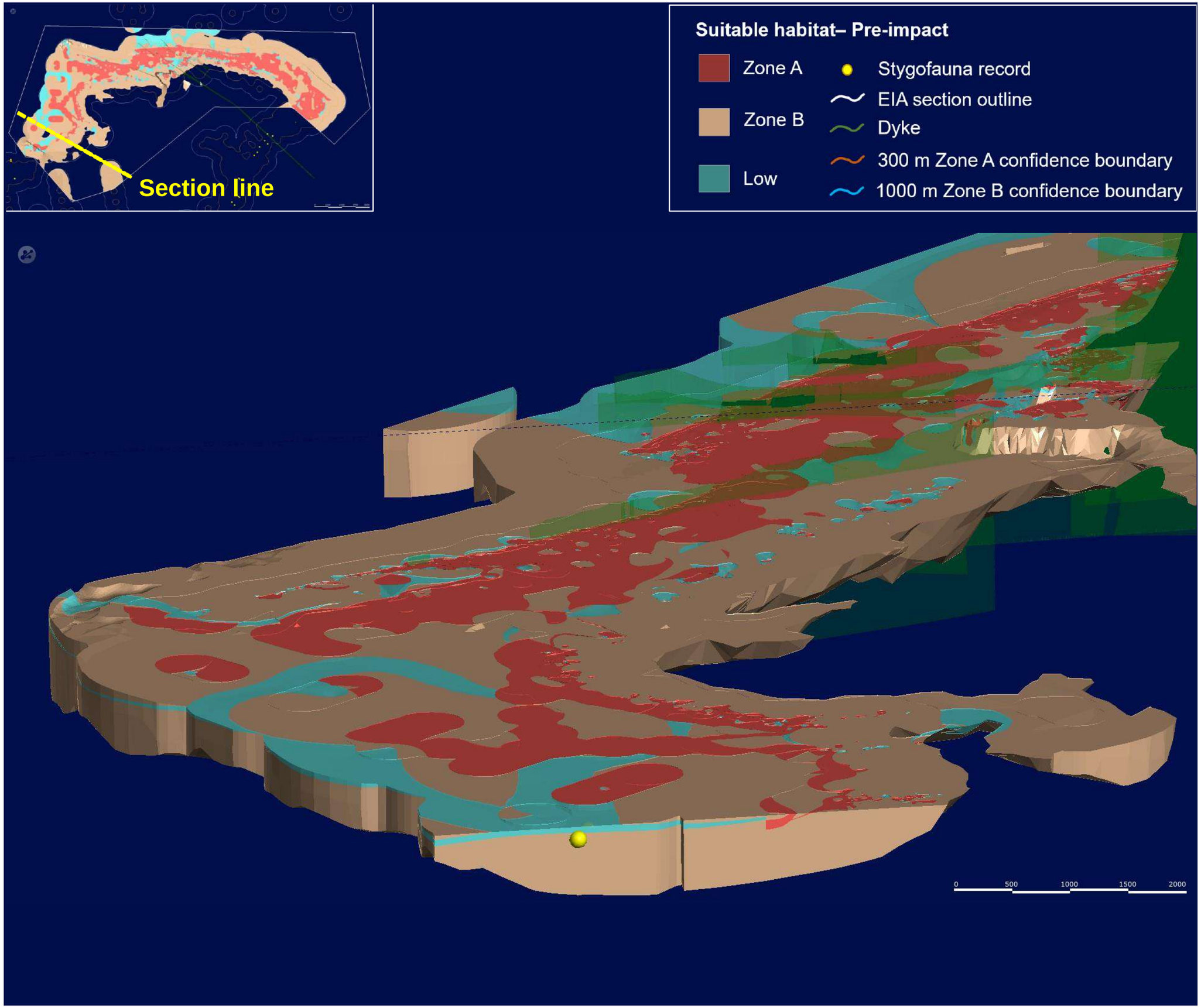

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Figure 9-8
Cross Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS2 Assessment Area

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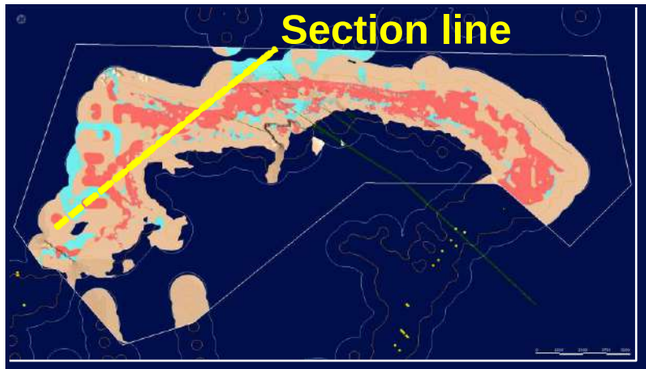

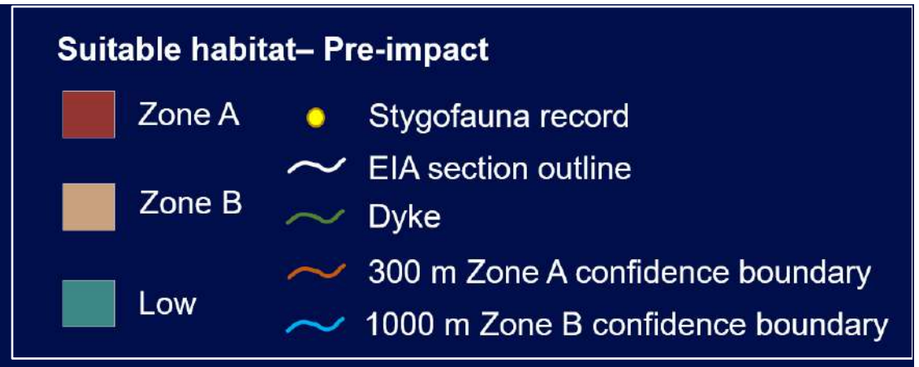

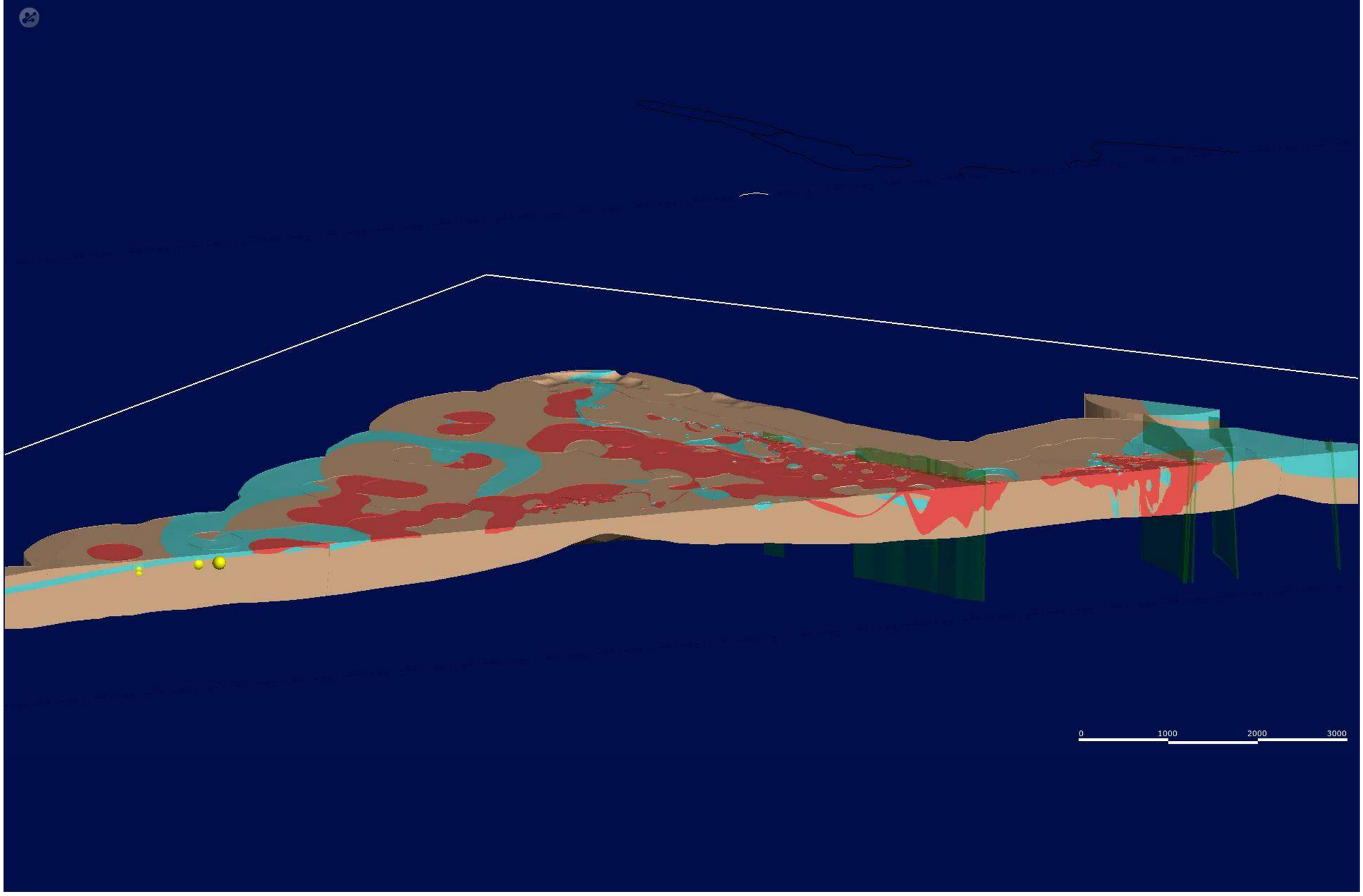

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Figure 9-9
Long Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS2 Assessment Area

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Brockman Syncline 3 Assessment Area

At BS3, 3D modelling shows extensive, continuous, and relatively thick stygofauna habitats primarily within the synclinal valley. Within Habitat Zone A, extensive areas of thick BWT habitat occur throughout the synclinal valley, associated with deep detrital aquifers and fractured rock aquifers lying below. These zones are supported by deeper prospective stygofauna habitats within Habitat Zone B BWT, which occurs mostly below Zone A and extends more widely and with more continuity along the synclinal valley.

As observed in other assessment areas, dykes, faults, and folds are common at BS3 and intersect the syncline in a near perpendicular fashion. These geological structures are understood to compartmentalise the bedrock aquifers and reduce overall habitat connectivity along strike. Nevertheless, some habitat connectivity is expected to be maintained. Where a hydrological head difference is observed across a dyke there are no hydrogeological barriers preventing the movement of stygofauna where overtopping occurs from one compartment to the next; where there is no hydrological head difference, stygofauna movement can occur between compartments within the overlying saturated detrital formations. A groundwater divide occurs in the very northern section of BS3 (between BS3 and BS2). South of the groundwater divide (affecting BS3), groundwater flows along strike in a southern direction, occasionally over-topping dykes and flowing from one compartment to the next.

Figure 9-10 provides a 2D view of these habitats at BS3, whilst cross and long sections of the 3D subterranean habitats BWT are presented in Figure 9-11 and Figure 9-12.

Brockman Syncline 4 Assessment Area

At BS4, relatively extensive and thick suitable stygofauna habitats are found along the strike of the syncline within fractured/weathered rock aquifers below the MMIF and Brockman Iron Formation bands, as well as within overlying detrital aquifers and deeper fractured rock aquifers in the synclinal valley in between the two bands. The MMIF and Brockman Iron Formation formations are relatively close together in this section, brought together by intense folding, faulting, and deformation in this area of the syncline. Consequently, BWT habitats in this area are more complex compared to other assessment areas within the Development Envelope, however modelling did not reveal any major breaks in the overall continuity of habitat at the landscape scale.

Geological structures such as dykes, faults, and folds are common at BS4 and oriented in a north-west to south-east striking direction. These structures are expected to reduce overall habitat connectivity along strike by compartmentalising bedrock aquifers below the MMIF and Brockman Iron Formation bands and within the synclinal valley. Nevertheless, many dykes in this area are not considered impermeable due to faults and fracturing (and based on hydrogeological data and water levels), and periodic overtopping through detritals is expected to provide some habitat connectivity along strike.

Figure 9-13 provides a 2D view of these habitats at BS4, whilst cross and long sections of the 3D subterranean habitats BWT are presented in Figure 9-14 and Figure 9-15.

No stygofauna are known to occur or have been recorded within the BS4 assessment area.

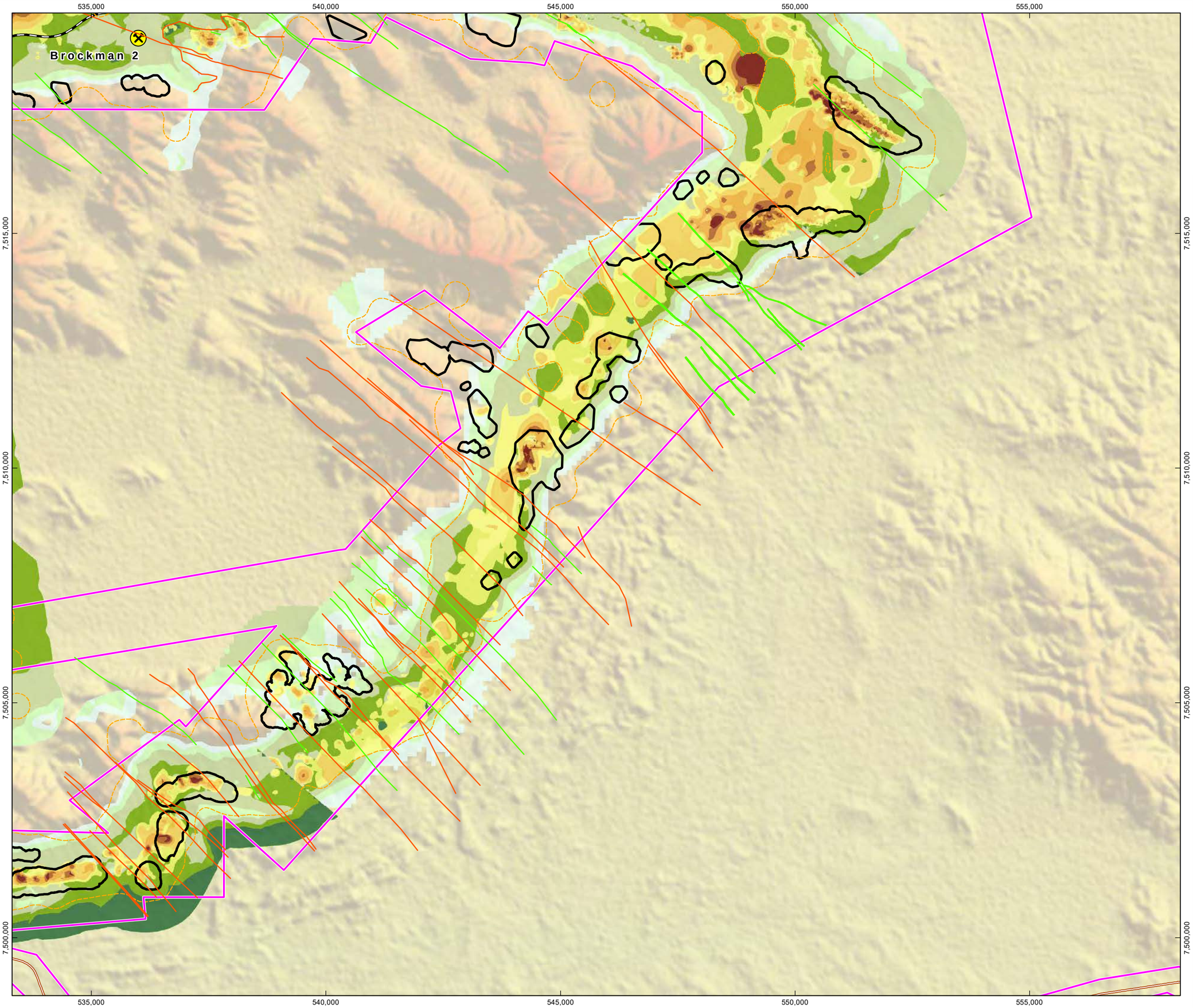

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Figure 9-10
2D Subterranean BWT Habitats within the BS3 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190294v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- 3D Modelling Boundary

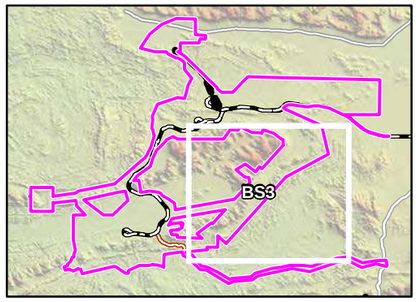
Habitat Thickness Zone A

- 0 - 20m
- 20 - 50m
- 50 - 75m
- 75 - 100m
- 100 - 200m

Habitat Thickness Zone B

- 0 - 30m
- 30 - 60m
- 60 - 90m
- 90 - 120m
- 120 - 167m

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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0 0.5 1 1.5 2 2.5 3
Kilometers

Map units in metres

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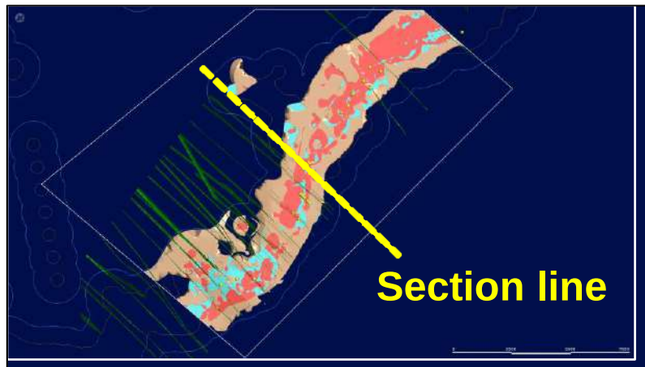

Suitable habitat– Pre-impact

- Zone A
- Zone B
- Low
- Stygofauna record
- EIA section outline
- Dyke
- 300 m Zone A confidence boundary
- 1000 m Zone B confidence boundary

0 500 1000 1500 2000

RioTinto

Figure 9-11
Cross Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS3 Assessment Area

Drawn: L.Fuentes
Plan: PD ED190293M
Date: July 2022

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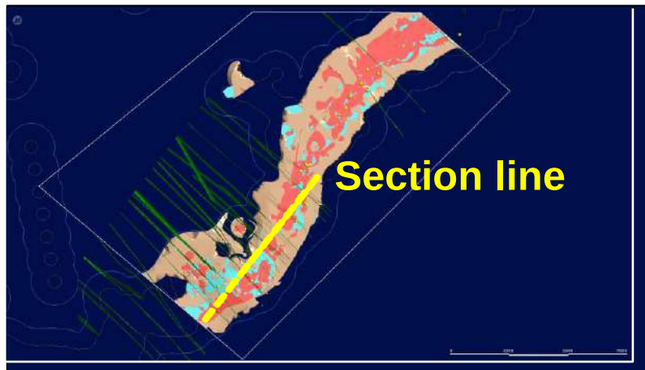

Suitable habitat– Pre-impact

- Zone A
- Zone B
- Low
- Stygofauna record
- EIA section outline
- Dyke
- 300 m Zone A confidence boundary
- 1000 m Zone B confidence boundary

0 500 1000 1500 2000

RioTinto

Figure 9-12
Long Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS3 Assessment Area

Drawn: L.Fuentes
Plan: PD ED190293M
Date: July 2022

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Figure 9-13
2D Subterranean BWT Habitats within the BS4 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190296v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

515,000 520,000 525,000 530,000 535,000

7,510,000 7,505,000 7,500,000 7,495,000

Brockman 4

Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- 3D Modelling Boundary

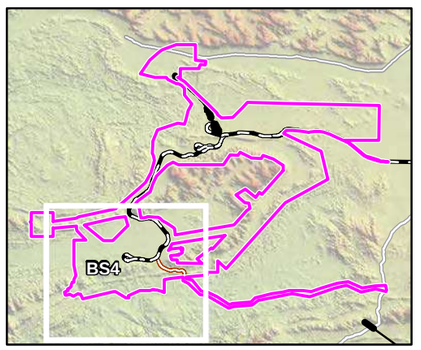
Habitat Thickness Zone A

- 0 - 20m
- 20 - 50m
- 50 - 75m
- 75 - 100m
- 100 - 200m

Habitat Thickness Zone B

- 0 - 30m
- 30 - 60m
- 60 - 90m
- 90 - 120m
- 120 - 167m

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



N

0 0.5 1 1.5 2 2.5 3
Kilometers

Map units in metres

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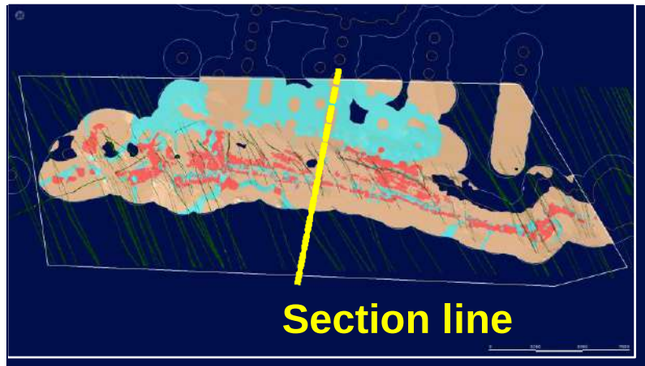

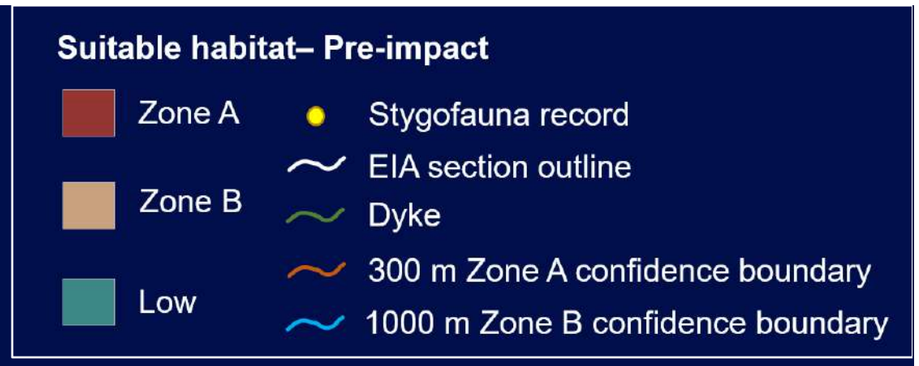

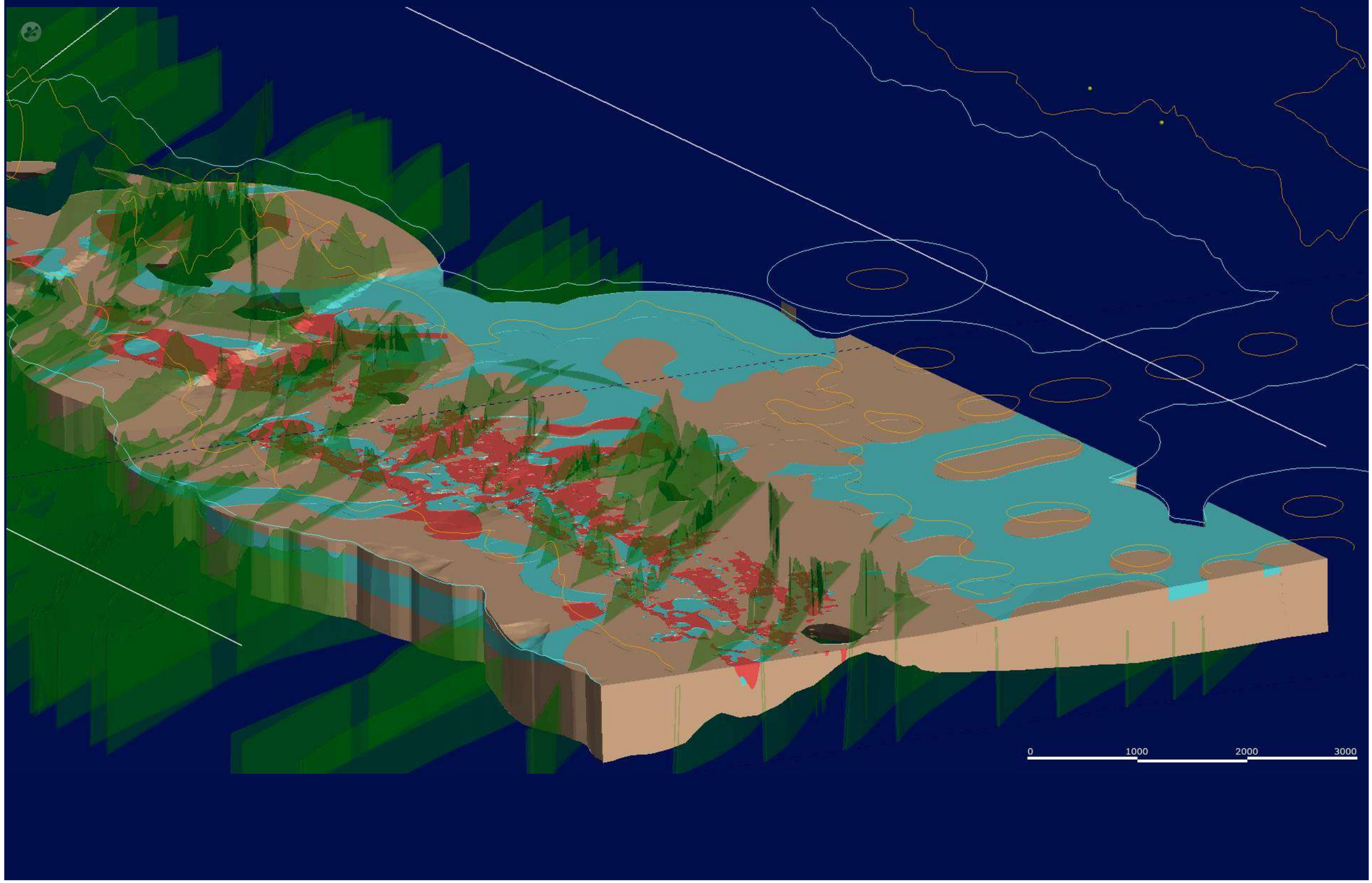

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Figure 9-14
Cross Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS4 Assessment Area

Drawn: L.Fuentes
Plan: PD ED190295M
Date: July 2022 *GIS.Team@riotinto.com*

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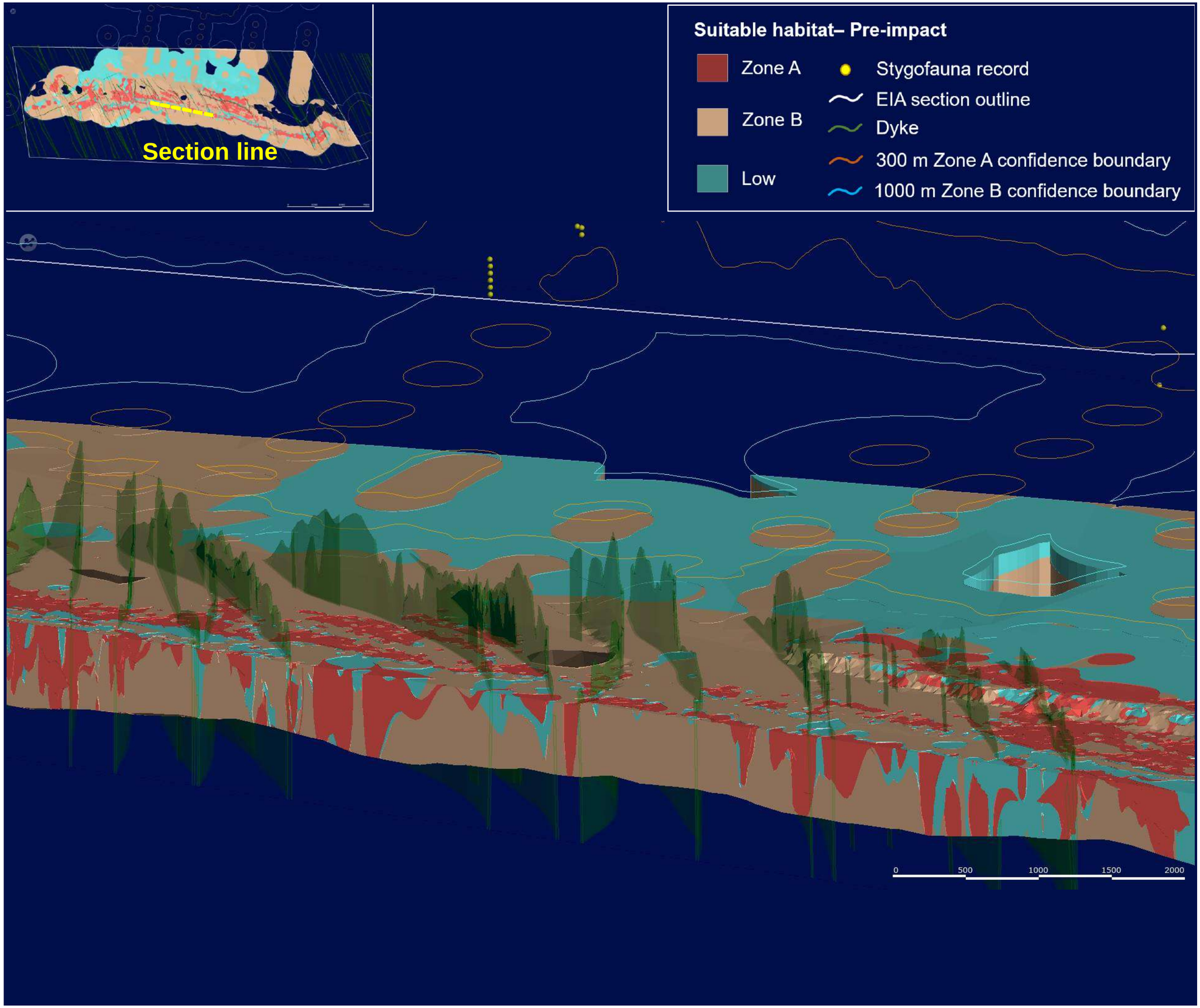

RioTinto

Figure 9-15
Long Section of the 3D Subterranean Habitat Model Showing BWT Habitats within the BS4 Assessment Area

Drawn: L.Fuentes
Plan: PD ED190295M
Date: July 2022

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9.3.2.4. Troglofauna Habitat

3D habitat modelling (Figure 9-16) showed that suitable AWT habitats for troglofauna occur widely throughout all four assessment areas of the Development Envelope, hosted within a variety of geological settings (Figure 9-17, Figure 9-18, Figure 9-19, Figure 9-20 to Figure 9-27). The Brockman Iron Formation and MMIF ranges encircling the Brockman Syncline host the majority of suitable troglofauna habitat as they commonly feature highly fractured and weathered rock habitats created by secondary (supergene) weathering processes. Suitable troglofauna habitats also extend along the flanks of the Brockman Iron Formation and MMIF ranges, hosted by an iron-rich hardcap (pisolitic duricrust). The valleys between the Brockman Iron Formation and MMIF ranges provide further troglofauna habitats within Robe Pisolite CID, karstic calcrete deposits, and weathered Wittenoom Dolomite Formation. Unconsolidated alluvial and colluvial detrital layers in the valleys provide further suitable AWT habitats for troglofauna where sufficient void spaces occur.

Geological structures such as dykes, sills, faults and shear zones are very common throughout the Development Envelope and mainly strike in a north-west to south-east direction (Figure 9-17, Figure 9-18, Figure 9-19, Figure 9-20 to Figure 9-27). These structures may influence local habitat connectivity either by increasing fracturing within the base rock or by potentially creating fresh rock barriers. Nevertheless, AWT habitat connectivity along the syncline is likely maintained via a layer of Tertiary detrital material within the synclinal valley which overlies the numerous structural elements in most areas.

The AWT habits obtained from the 3D model represent a conservative estimate of suitable AWT habitats occurring at Greater Brockman, as the 3D habitat model was constrained within 300 m of drilling data, and any modelled AWT habitats outside of that high confidence boundary (300 m) (shown as Zone B in light blue in (Figure 9-16) were excluded. As such, the Brockman Iron Formation ranges mapped within the central axis of the syncline are mostly outside of the habitat modelling boundary but are expected to provide a large amount of further prospective AWT habitat at Greater Brockman. Similarly, MMIF ranges at Eliwana to the west of BS1 are outside of the modelling boundary but are expected to provide further suitable AWT habitats for troglofauna west of the BS1 assessment area.

The final 3D model of AWT troglofauna habitats is based on a large amount of drill-hole information. In total, 31,135 drill holes were used to model the AWT habitats throughout the Proposal. More than 1.4 million metres of AWT downhole length were categorised into troglofauna habitat suitability categories (Zone A AWT and Zone B BWT). Modelling the AWT habitats with such a large amount of data resulted in a high degree of confidence in the troglofauna habitat assessment and the assessment of impacts to habitats.

Based on the above an estimate of habitat volume for each section of the Development Envelope, within each Zone of habitat is provided in Table 9-5. These estimates take into consideration that the Proposal is located in close proximity to three brownfields sites which have been and are currently mining AWT and BWT. Habitat volumes are based on current geological and hydrological (water table) information.

Table 9-5: Summary of Volumetric Habitat Available to Troglofauna AWT Across the Proposal Areas

Habitat Zones	Modelled Volume (m^3) ('000)				
	BS1	BS2	BS3	BS4	Total
Zone A AWT	1,071,370	2,880,540	1,556,440	1,818,320	7,326,670
Zone B AWT	965,240	3,473,469	1,343,470	2,319,077	8,101,256
Total AWT	2,036,610	6,354,009	2,899,910	4,137,397	15,427,926

The important troglofauna habitat values within each of the four EIA sections are briefly described below.

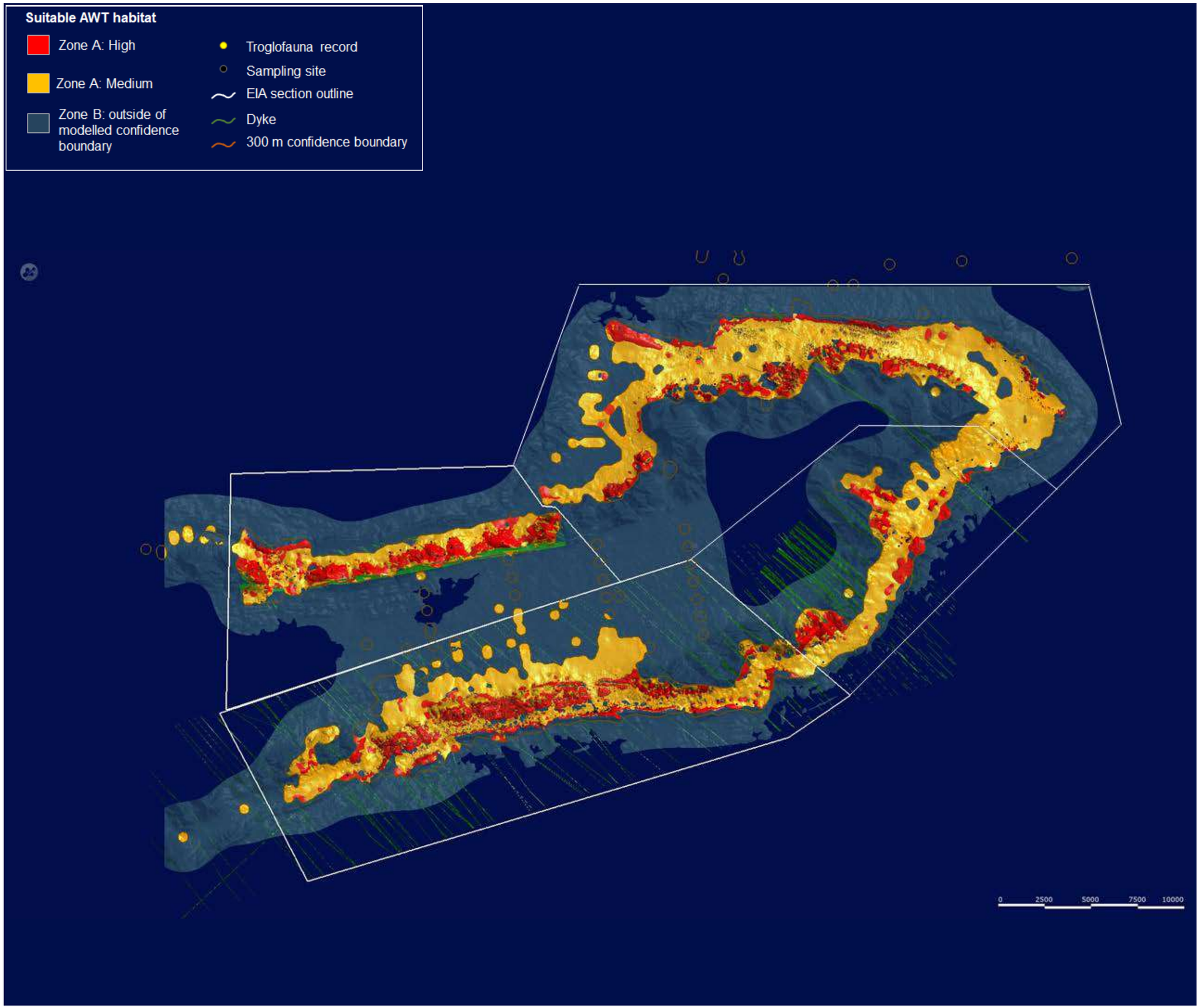

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Figure 9-16
3D AWT Habitat Modelling Results Overview

Drawn: L.Fuentes
Plan: PD ED190297M
Date: July 2022

GIS.Team@riotinto.com

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Brockman Syncline 1 Assessment Area

At BS1 the 3D modelling shows extensive, continuous, and variably thick troglofauna habitat along the strike of the ridgeline and throughout the synclinal valley (Figure 9-16). Large extents of AWT habitat occur in well-connected areas associated with the hills and ridges of the Brockman Range. Geologically, these hills comprise the Dales Gorge, Whaleback Shale, and Joffre Members of Brockman Iron Formation (Brockman Iron Formation). Where exposed to weathering and intense fracturing from faults and deformation, such units are well-known to provide suitable habitats for troglofauna (Biologic 2022b). The synclinal valley to the immediate north of the Brockman Range at BS1 hosts variable thickness AWT habitats comprised of colluvial detritals and calcrete. The AWT detrital habitats are continuous along strike of the valley and are locally contiguous with the bedded ironstone habitats formed in Brockman Iron Formation within the hills and mountains.

Numerous dykes, faults, and folds occur within the bedrock formations at sub-perpendicular angles to the strike orientation of BS1. Most dykes extend north-westerly from the syncline (approximately 300 degrees azimuth), while a major regional dyke occurs between BS1E and BS1W in a more perpendicular direction (approximately 340 degrees azimuth). The dykes are limited to bedrock; therefore, AWT habitat connectivity likely exists via suitable habitats within the detritals occurring in the valley which overlie these geological structures.

Figure 9-17 provides a 2D view of these habitats at BS1, whilst cross and long sections of the 3D subterranean habitats AWT are presented in Figure 9-18 and Figure 9-19.

Brockman Syncline 2 Assessment Area

At BS2 suitable troglofauna habitats (AWT) are extensive, continuous, and moderately thick throughout the broad synclinal valley, and increasingly thick suitable habitat occurs along the flanks and upland areas of the Brockman Range (along the southern margin of the Development Envelope at BS2). Bedded ironstone geologies (respectively in Brockman Iron Formation and MMIF) outcrop at the southern and northern margins of the wide synclinal valley at BS2, which itself hosts suitable troglofauna habitat in AWT overlying detrital formations between the two ridges.

Localised lenses of the AWT habitat occurs along the southern flank of the valley where Mt McRae Shales outcrop on the flanks of the Brockman Range, as well as along the main strike of the valley. Fewer dykes occur in the BS2 section than other sections of the syncline, with only a single major dyke occurring across the full width of modelled habitat (striking from ESE to WNW) immediately south of Brockman 2 pit.

Nevertheless, the dykes are not considered likely to form complete barriers for troglofauna movement owing to the well-connected AWT overlying detrital habitats across the valley. Beyond the southern boundary of 3D modelling, towards the centre of the syncline, available regional geological information suggests a continuation of thick, contiguous habitat in Brockman Iron Formation throughout the mountainous area of the Brockman Range.

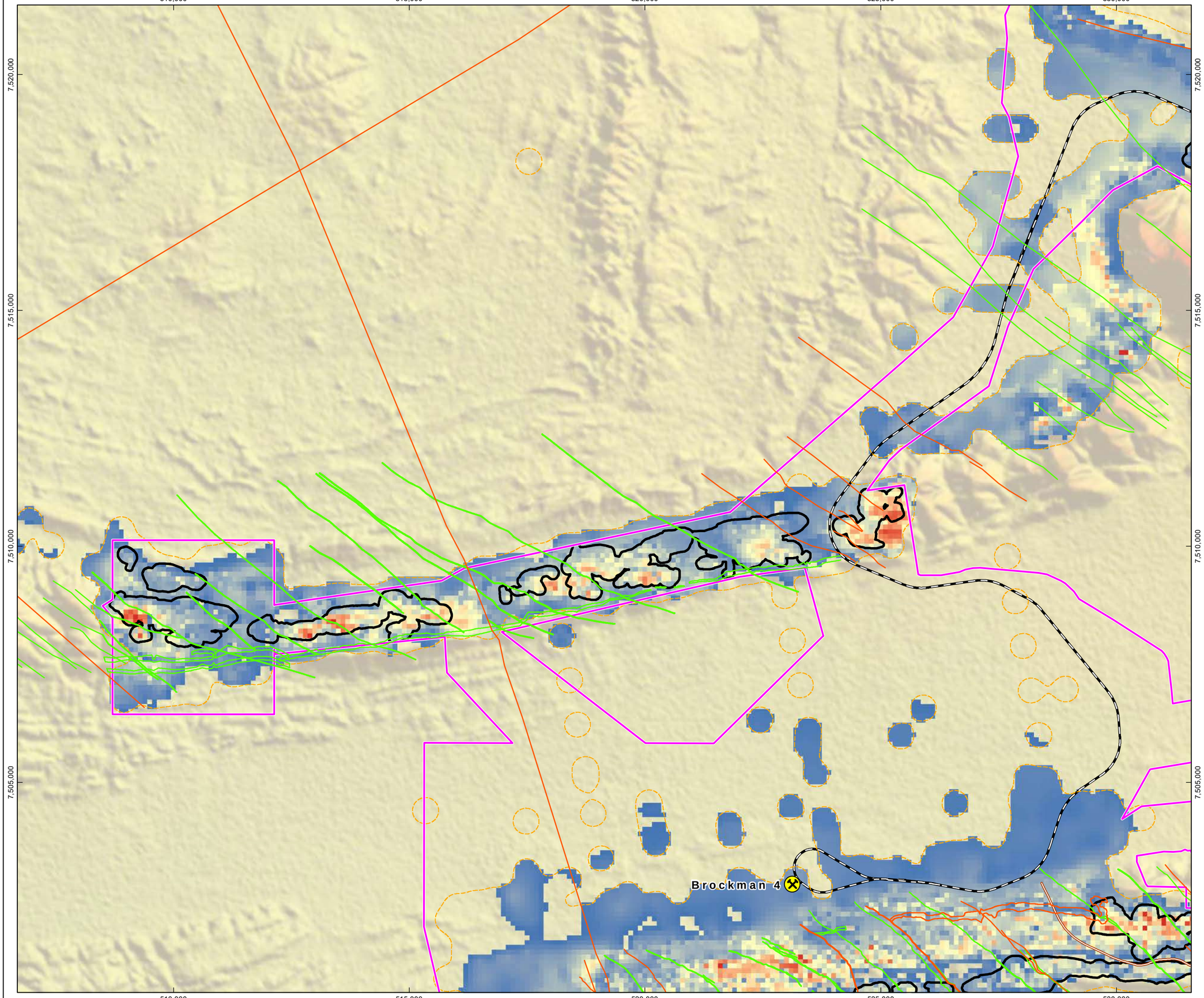
Figure 9-20 provides a 2D view of these habitats at BS2, whilst cross and long sections of the 3D subterranean habitats AWT are presented in Figure 9-21and Figure 9-22.

RioTinto

Figure 9-17
2D Subterranean AWT Habitats within the BS1 Assessment Area

Drawn: L.Fuentes
Plan: PDE01900299v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com



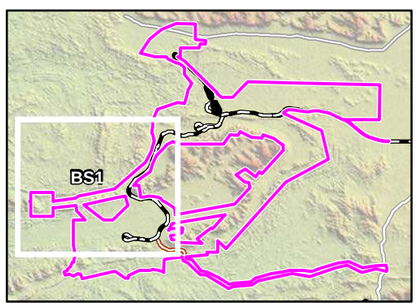
Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- 3D Modelling Boundary

Habitat Thickness Pre-impact

- High : 283 mAWT
- Low : 0.1 mAWT

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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Kilometers

Map units in metres

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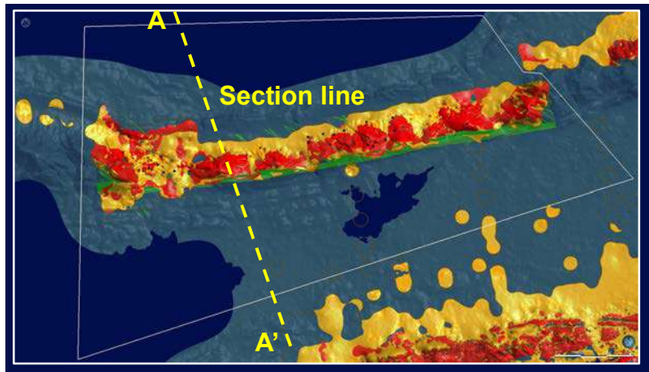
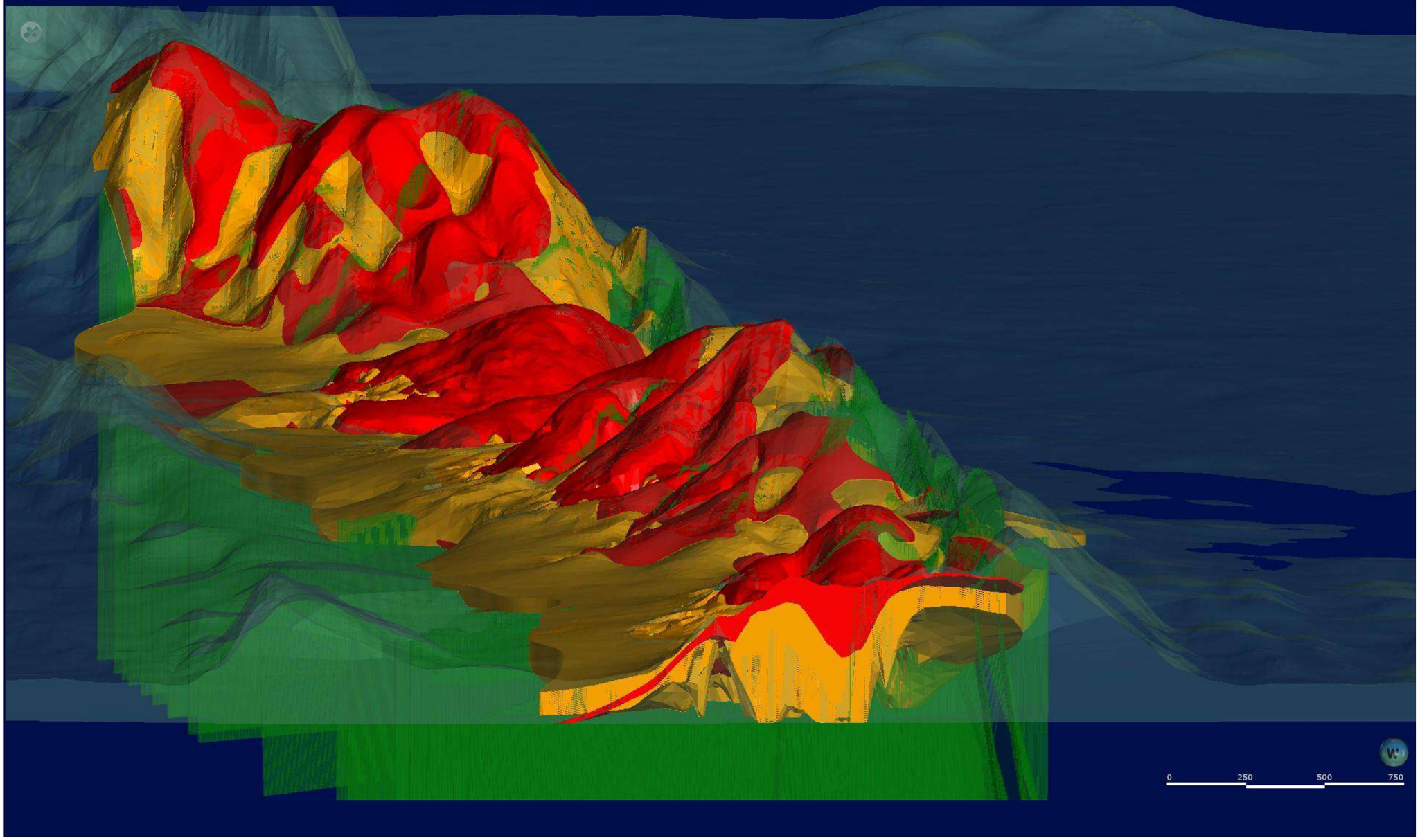


Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

A

A'



RioTinto

Figure 9-18
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS1 Assessment Area

Drawn: L.Fuentes
Plan: PD ED190298M
Date: July 2022

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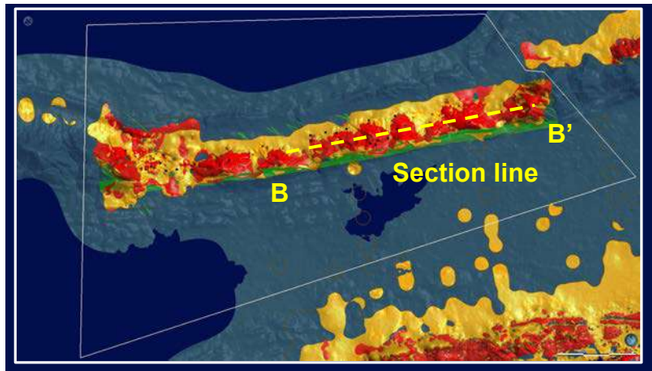

Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

B

B'

0 500 1000 1500 2000

RioTinto

Figure 9-19
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS1 Assessment Area

Drawn: L Fuentes
Plan: PD ED190298M
Date: July 2022

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RioTinto

Figure 9-20
2D Subterranean AWT Habitats within the BS2 Assessment Area

Drawn: L.Fuentes
Plan: PDE01900301v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

530,000
535,000
540,000
545,000
550,000

7,525,000
7,520,000
7,515,000
7,510,000

Nammuldi

Brockman 2

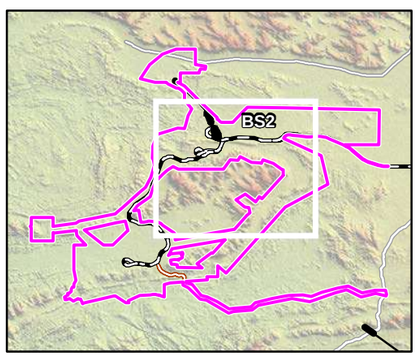
Legend

- Development
- Proposed Pit
- Hydraulic Barrier
- Hydraulic Barrier
- 3D Modelling

Habitat Thickness Pre-impact

- High : 283
- Low : 0.1 mAWT

- Rio Tinto
- Rio Tinto
- Conveyor



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0 0.5 1 1.5 2 2.5 3

Kilometers

Map units in metres

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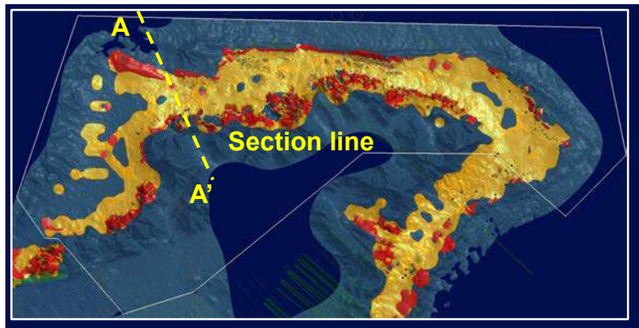
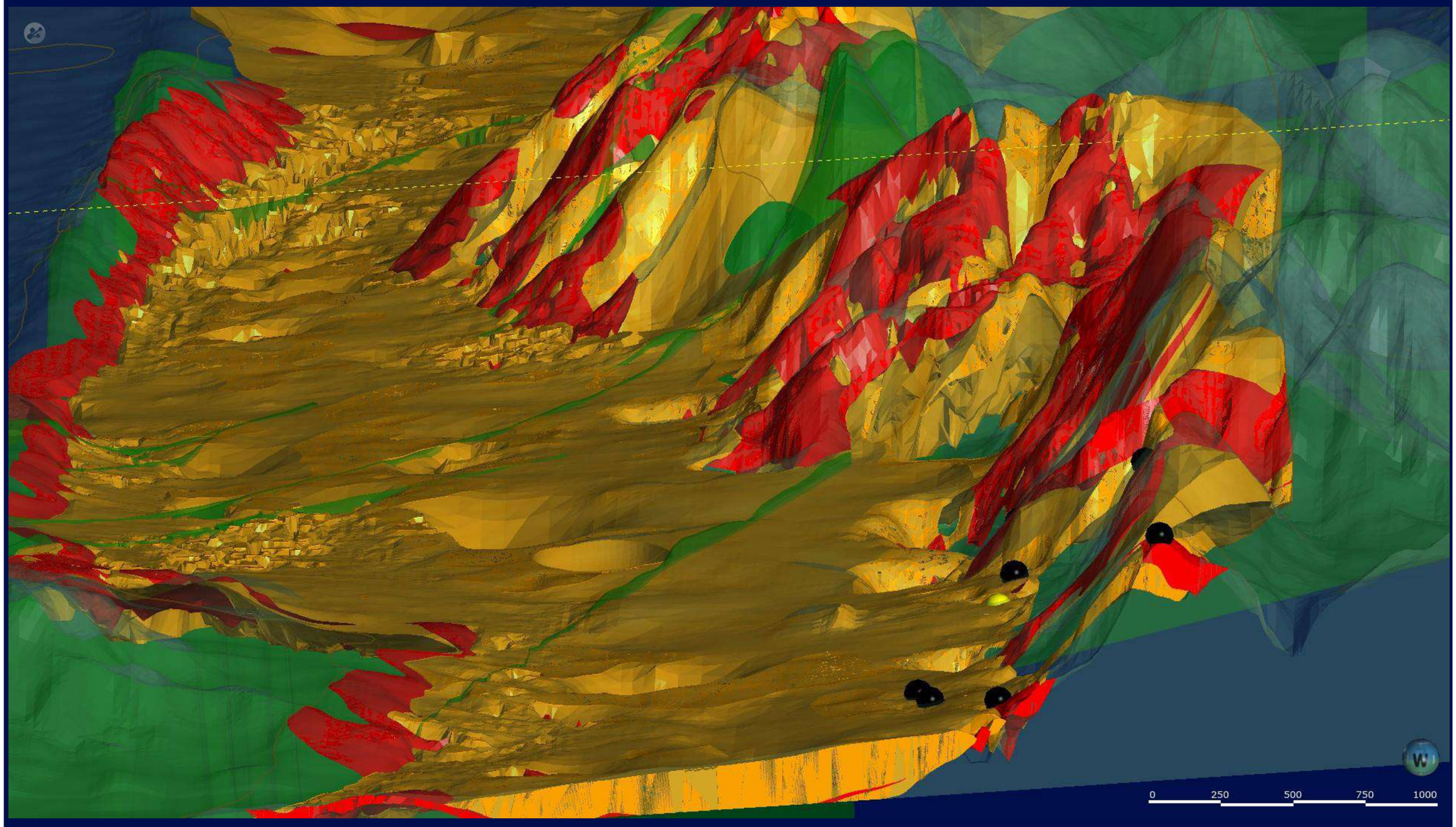


Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

A

A'



RioTinto

Figure 9-21
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS2 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190300v1
Date: June 2022
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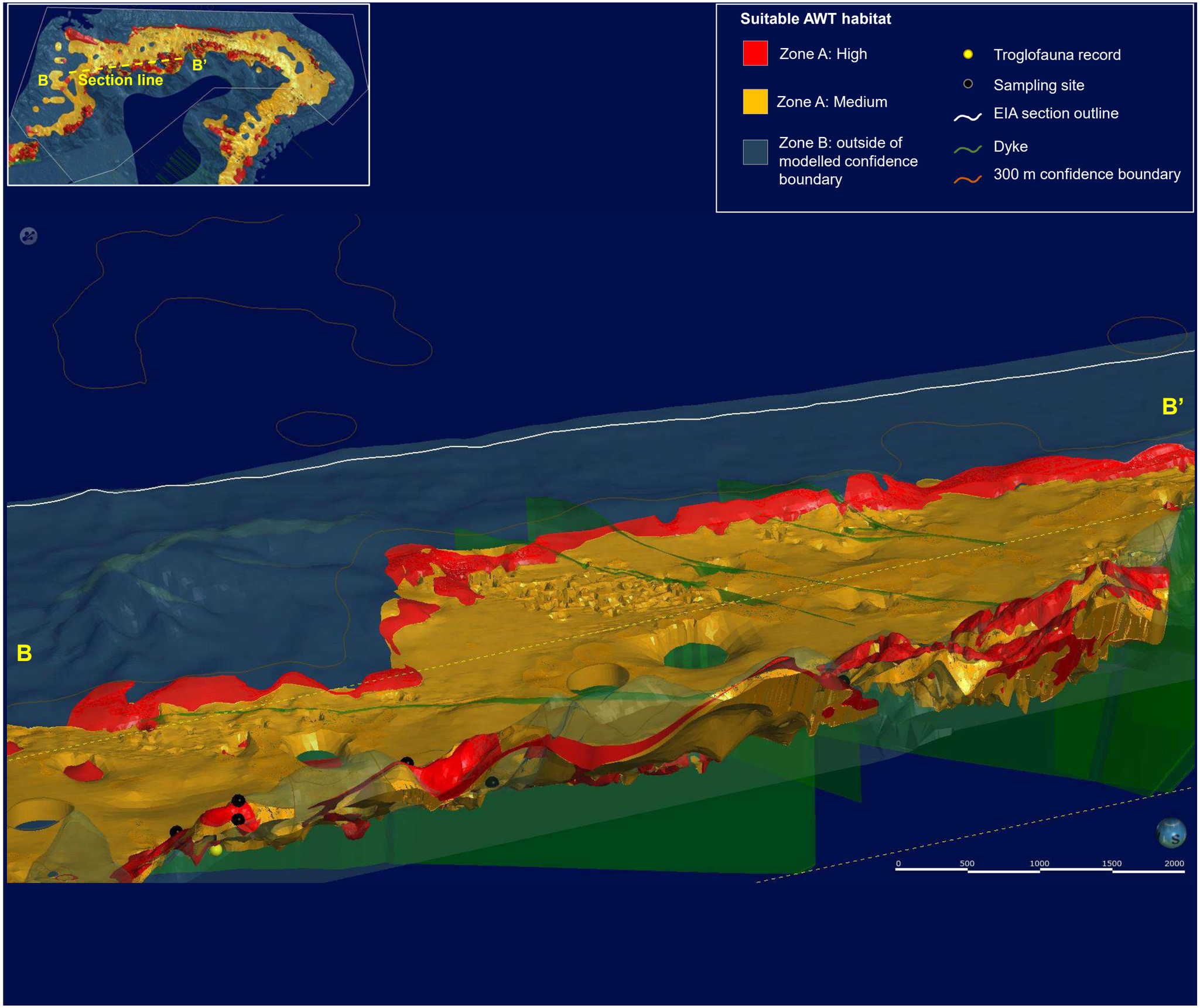

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Figure 9-22
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS2 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190300v1
Date: June 2022
GIS.Team@riotinto.com

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Brockman Syncline 3 Assessment Area

At BS3, 3D modelling shows extensive, continuous and variably thick troglofauna habitats AWT along the strike of the synclinal valley. The 3D habitat modelling extends up into the Brockman Range at only a few locations in this section, but where it does so (in the centre of the section around BSMM pits, and in the south around BS3 pit), the modelling confirms that the Brockman Range provides very thick suitable AWT habitats (>250m AWT). By comparison, the valley hosts thin to moderately thick AWT habitats. The eastern side of synclinal valley (MMIF band) is beyond the modelling boundary but its extension (as indicated by surface geological mapping) provides further highly suitable troglofauna habitats.

Dykes, faults, and folds within bedrock geologies are common at BS3 and intersect the syncline in a perpendicular fashion. Nevertheless, habitat connectivity across dykes is retained through thin to moderately thick overlying AWT detrital habitats.

Numerous dykes occur within the bedrock throughout the BS3 section at angles roughly perpendicular to the strike of the valley. The number and extent of the dykes throughout the modelled habitat in this section is interpreted as a potential factor influencing the ability of troglofauna species to disperse. However, the overlying AWT detrital habitats within the valley are known to be well-connected above the dykes in the bedrock, therefore some troglofauna species may be able to disperse around or beyond these compartmentalised bedrock habitats.

Figure 9-23 provides a 2D view of these habitats at BS3, whilst cross and long sections of the 3D subterranean habitats AWT are presented in Figure 9-24 and Figure 9-25.

Brockman Syncline 4 Assessment Area

At BS4, extensive, moderately to highly thick suitable troglofauna habitats are found oriented along the strike of the syncline. The synclinal valley in this section is compressed, therefore the majority of habitat is located within the Brockman Iron Formation and MMIF bedrock, which occur in adjacent, contiguous bands striking roughly east-west. These two bands have been brought together by intense folding, faulting, and deformation in this section of the syncline, which has resulted in numerous transverse dykes (mainly at SE to NW angles as in BS1), as well as increasing the fracturing of the rock.

Consequently, complex fractured and weathered rock habitats occur throughout this section AWT, and there is a thinner sequence of detrital habitat overlying the bedrock and dykes. This does not appear to have resulted in higher numbers of restricted troglofauna species however, or species with predominantly shorter linear ranges than the other sections, as discussed further in section 3.3.2. The intense faulting, shearing and deformation occurring throughout this section may provide fractures in dykes or opportunities for species to make their way around potential barriers. There may also be areas of connected habitat to the north or to the south beyond the current modelling boundaries.

Figure 9-26 provides a 2D view of these habitats at BS4, whilst cross and long sections of the 3D subterranean habitats AWT are presented in Figure 9-27 and Figure 9-28.

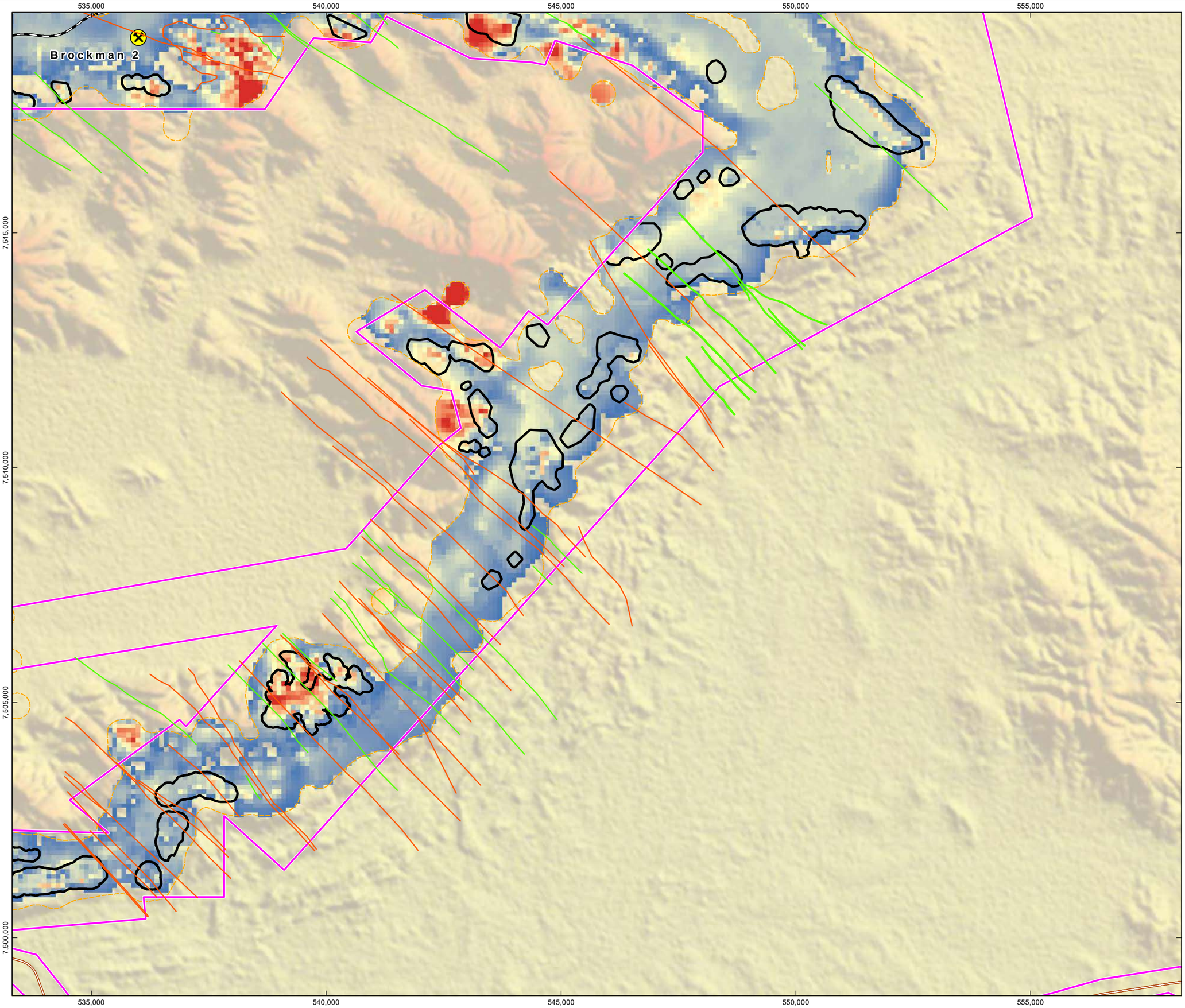

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Figure 9-23
2D Subterranean AWT Habitats within the BS3 Assessment Area

Drawn: L.Fuentes
Plan: PDE01900303v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

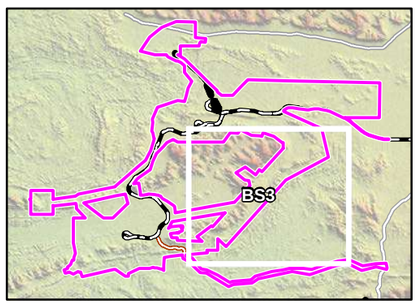
Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- 3D Modelling Boundary

Habitat Thickness Pre-impact

- High : 283 mAWT
- Low : 0.1 mAWT

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road



N

0 0.5 1 1.5 2 2.5 3
Kilometers

Map units in metres

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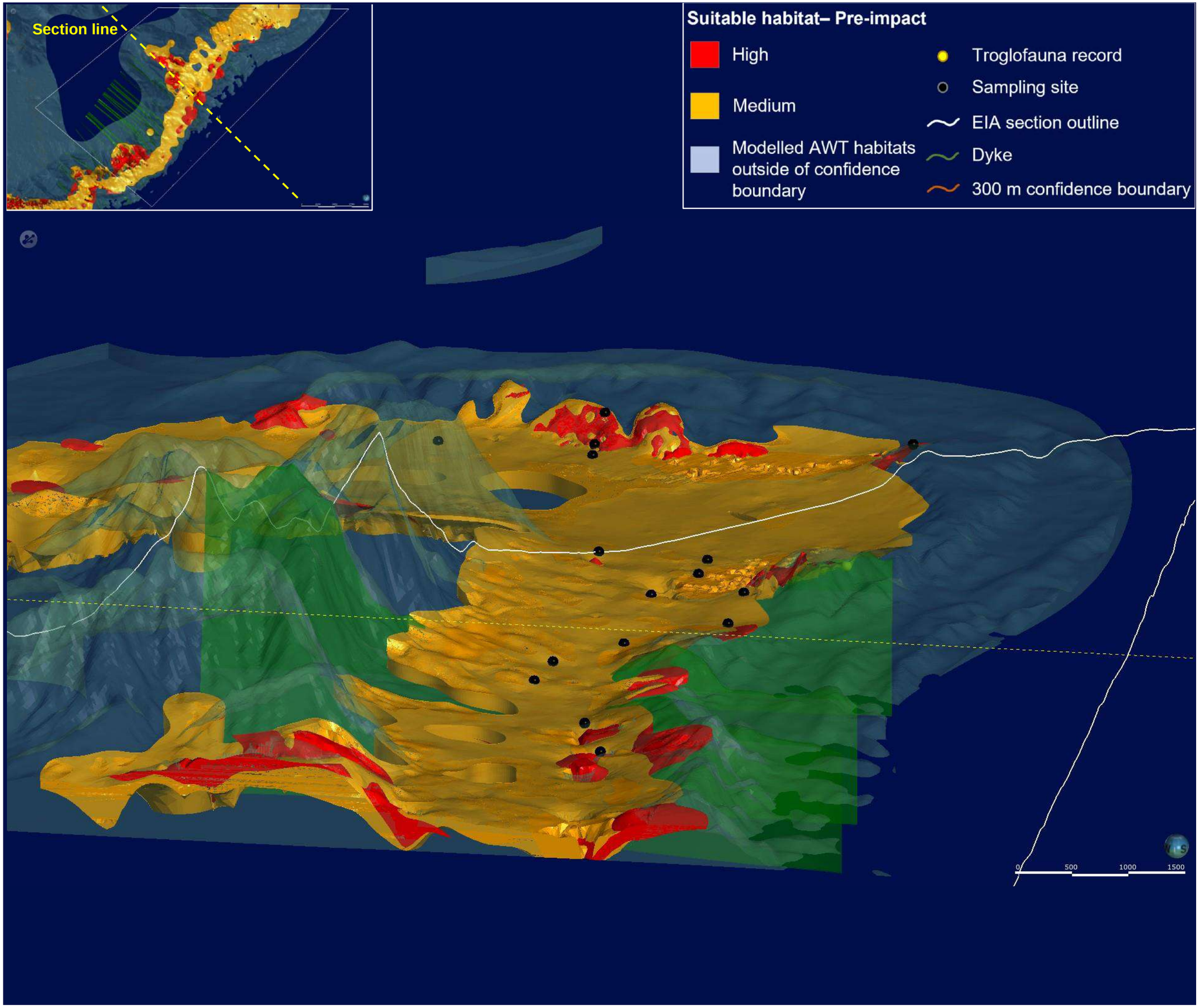

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Figure 9-24
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS3 Assessment Area

Drawn: L.Wilkerson
Plan: PDE0190302v1
Date: June 2022
GIS.Team@riotinto.com

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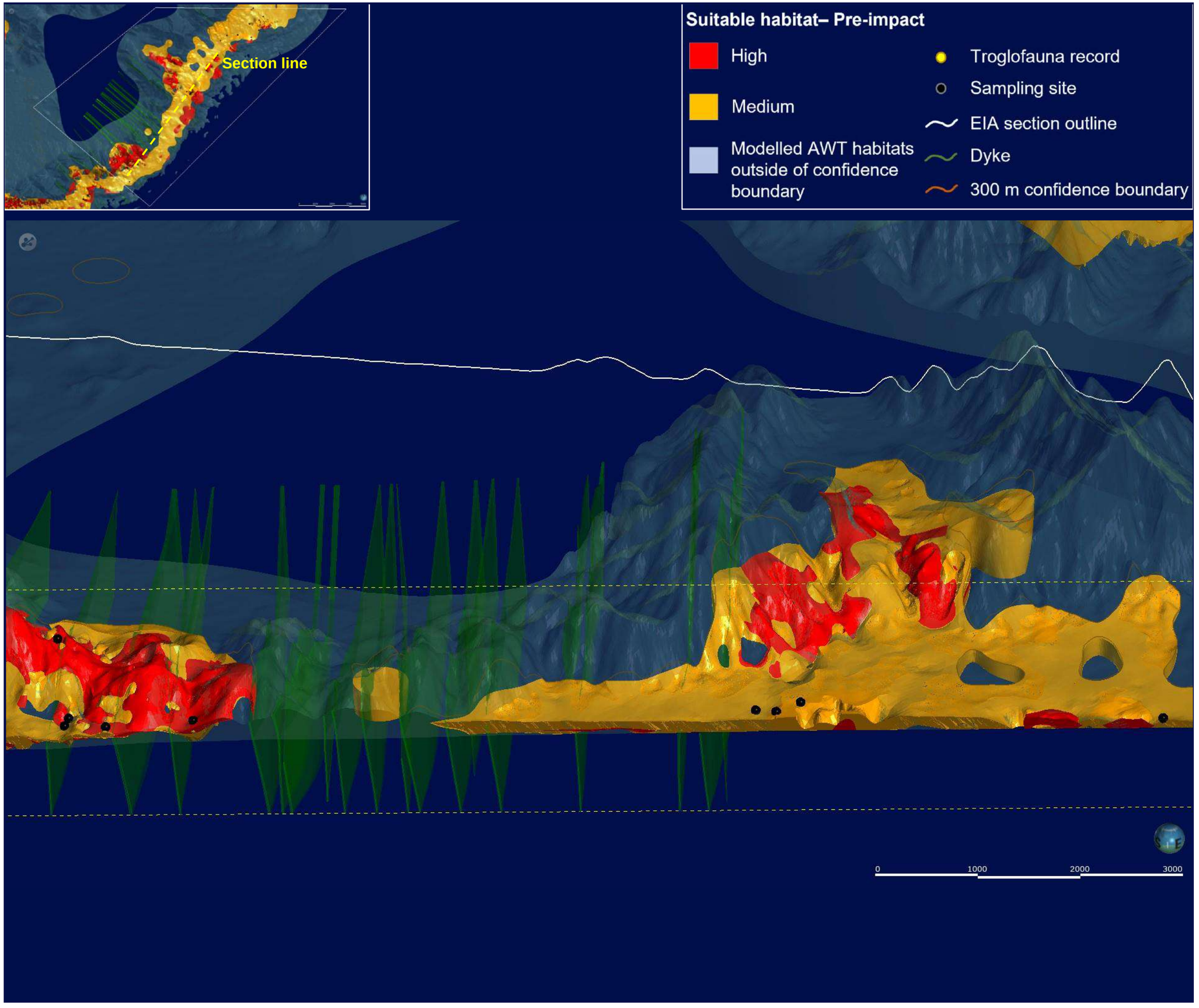

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Figure 9-25
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS3 Assessment Area

Drawn: L.Wilkerson
Plan: PDE0190302v1
Date: June 2022 *GIS.Team@riotinto.com*

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Figure 9-26
2D Subterranean AWT Habitats within the BS4 Assessment Area

Drawn: L.Fuentes
Plan: PDE01900305v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
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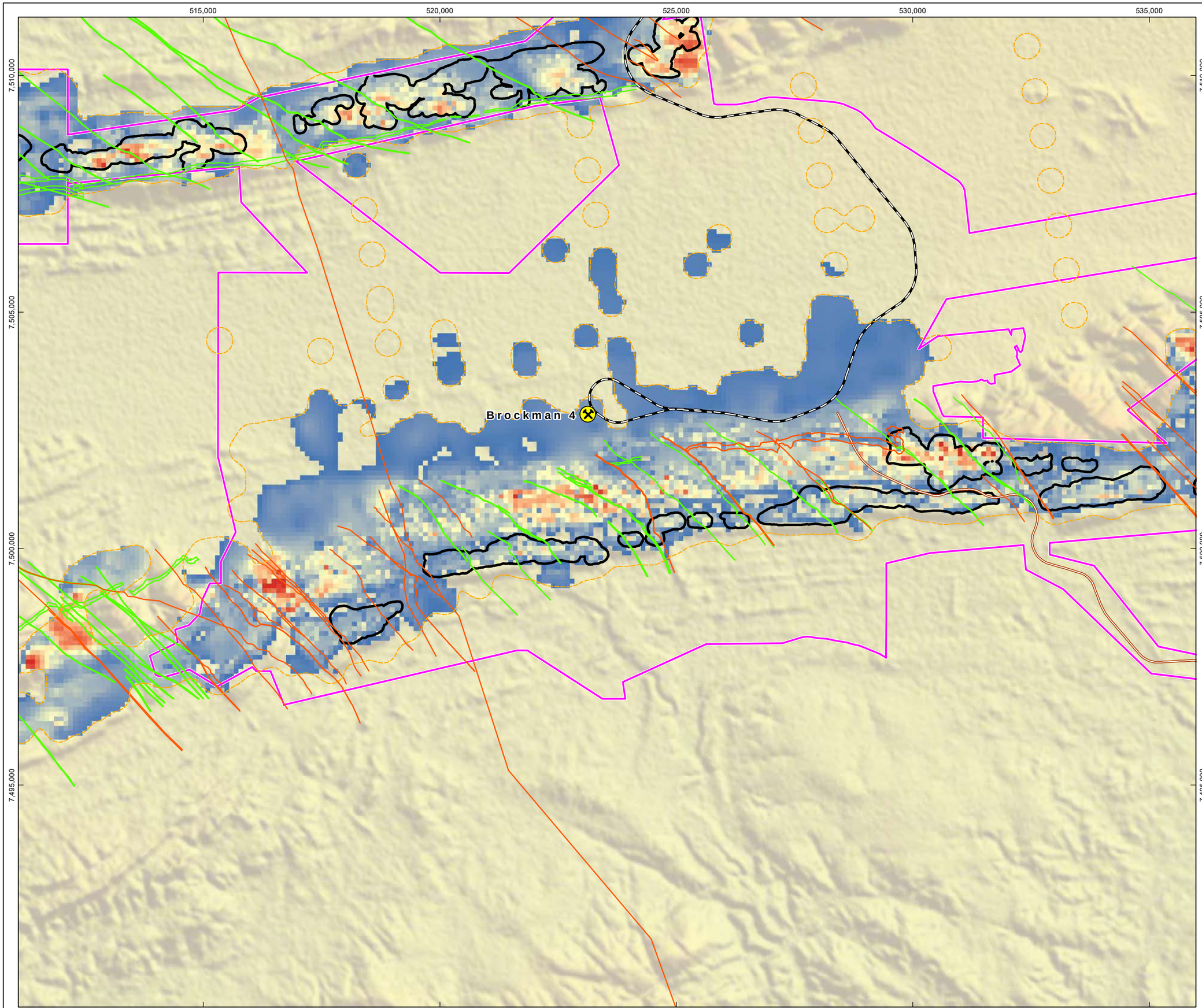


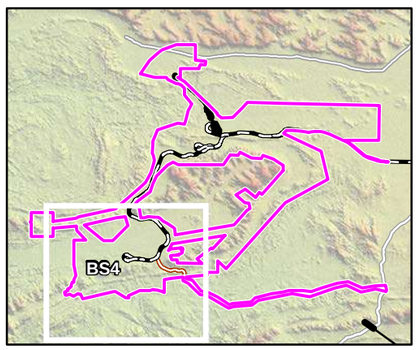
Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- 3D Modelling Boundary

Habitat Thickness Pre-impact

- High : 283 mAWT
- Low : 0.1 mAWT

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road



N

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Kilometers

Map units in metres

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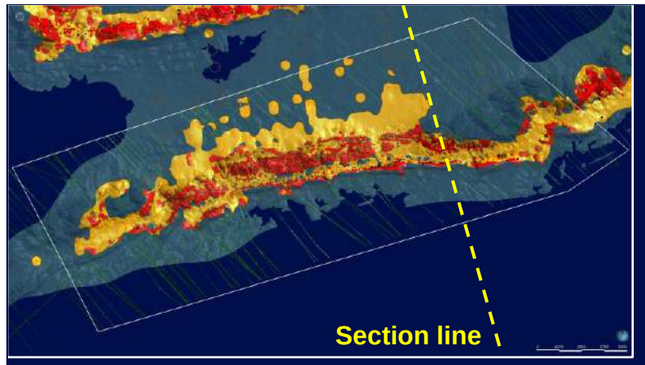

Suitable habitat– Pre-impact

- High
- Medium
- Modelled AWT habitats outside of confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

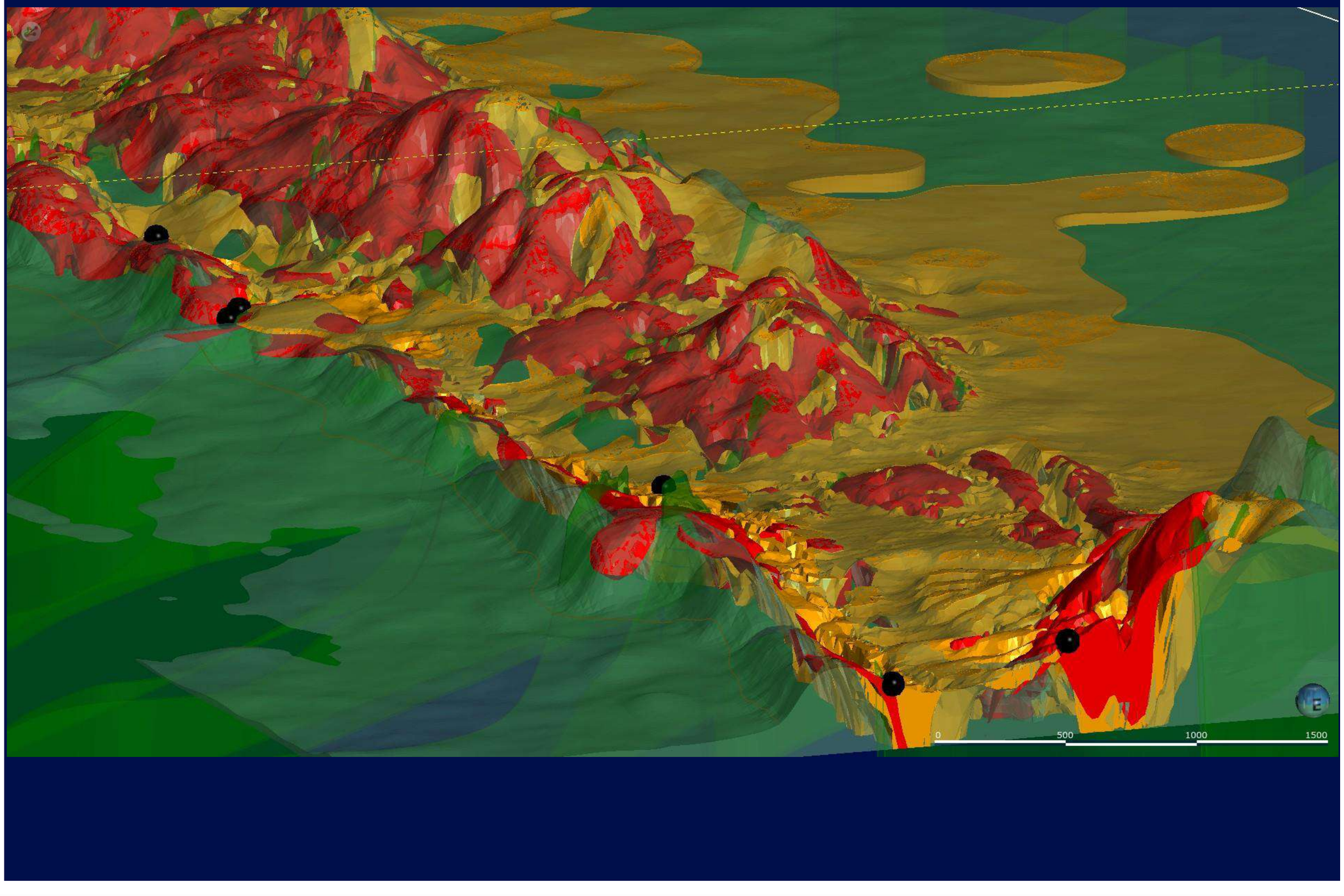

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Figure 9-27
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS4 Assessment Area

Drawn: L.Fuentes
Plan: PD ED190304\1
Date: July 2022
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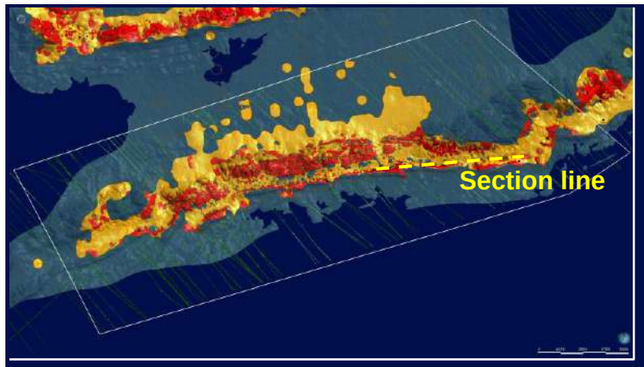

Suitable habitat– Pre-impact

- High
- Medium
- Modelled AWT habitats outside of confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

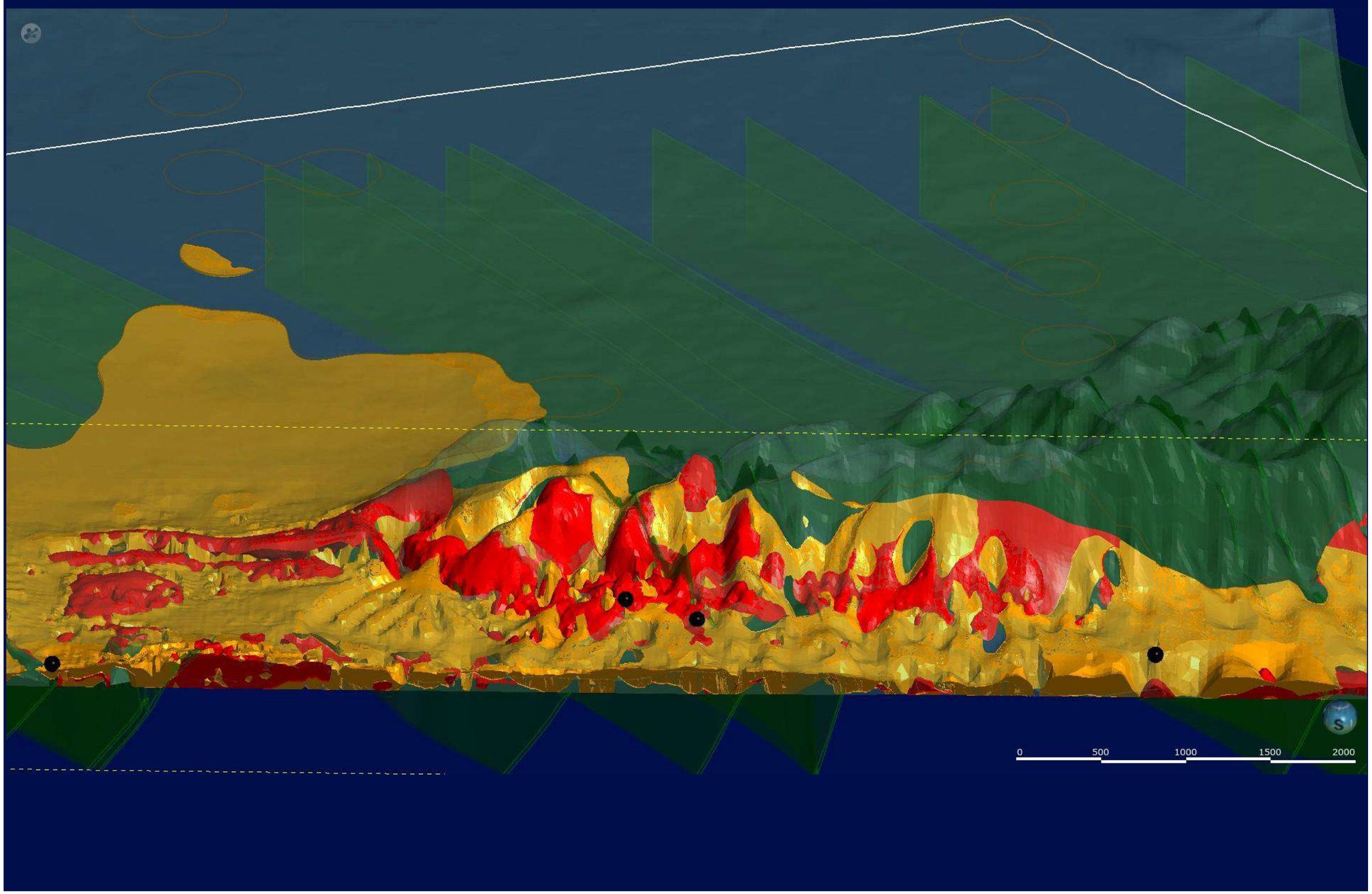

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Figure 9-28
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats within the BS4 Assessment Area

Drawn: L.FUentes
Plan: PD ED190304vl
Date: July 2022
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9.3.3. Subterranean Fauna Assemblage

A total of 1,015 specimens (including higher order identifications) of subterranean fauna have been recorded throughout the Study Area, comprising 350 troglofauna specimens and 760 stygofauna specimens. The high species diversity is attributable to the large size of the Development Envelope, the occurrence of suitable habitats throughout the Development Envelope, the complexity of habitats (i.e., via dykes), as well as the high rate of sampling and taxonomic effort undertaken. The subterranean faunal assemblage is discussed in the following sections and detail is provided in Appendix F.1.

9.3.3.1. Stygofauna

Using morphological and genetic (DNA barcoding) methods, a total of 75 stygofauna species/ operational taxonomic units (OTUs) were identified from the 665 stygofauna specimens collected representing eight higher order groups comprising Oligochaeta, Acari, Ostracoda, Calanoida, Cyclopoida, Bathynellacea, Amphipoda and Isopoda (Table 9-6). The number of stygofauna taxa recorded throughout the Study Area is comparatively high, i.e. subterranean fauna surveys at the nearest mining project at Eliwana recorded 15 stygofauna taxa (Biologic 2018).

The distribution of stygofauna within and surrounding the Proposal is shown in Figure 9-29 to Figure 9-32.

Table 9-6: Stygofauna Recorded from and Surrounding the Proposal

Taxon	BS1	BS2	BS3	BS4	Outside assessment / Impact Area/s	Total No of specimens	Distribution	Subterranean Status	Species Considered for Assessment
Amphipoda									
Amphipoda `sp. Biologic-AMPH009`				X ^		56	Locally restricted Linear Range 0.9 km	Potential Stygobite, Potential SRE	
Bogidiella `sp. B05`		X				1	Locally restricted	Potential Stygobite, Potential SRE	X
Bogidiellidae `sp. Biologic-AMPH011`	X					3	Likely locally widespread Linear Range 11.8 km	Potential Stygobite, Potential SRE	X
Nedsia `sp. Biologic-AMPH003`				X ^		125	Single site	Potential Stygobite, Potential SRE	
Nedsia `sp. Biologic-AMPH052`	X					1	Regionally widespread Linear Range 100+ km	Uncertain Stygobite Not SRE	
Nedsia `sp. WAM-AMPE003`	X					5	Regionally widespread Linear Range 100+ km	Uncertain Stygobite Not SRE	
Nedsia `sp. B04`	X					7	Regionally widespread Linear Range 81 km	Uncertain Stygobite Unlikely SRE	
Melitidae `sp. B05 (sp. 1 group)`	X					1	Regionally widespread Linear Range 74 km	Uncertain Stygobite Unlikely SRE	
Paramelitidae `sp. Biologic-AMPH012`			X			1	Single site	Potential Stygobite Potential SRE	
Paramelitidae `sp. Biologic-AMPH015`			X			44	Locally restricted Linear Range 11 km	Potential Stygobite Potential SRE	X
Paramelitidae `sp. Helix-AMP037`	X			X		9	Regionally widespread Linear Range 100+ km	Uncertain Stygobite Not SRE	
Paramelitidae `sp. Biologic-AMPH047`			X			1	Single site	Potential Stygobite Potential SRE	X
Paramelitidae `sp. Biologic-AMPH048`			X			1	Single site	Potential Stygobite Potential SRE	X
Paramelitidae `sp. B22`					X	15	Occurs beyond Development Envelope	Potential Stygobite Potential SRE	
Paramelitidae `sp. B36`	X					5	Regionally widespread Linear Range 80 km	Uncertain Stygobite Uncertain SRE	
Paramelitidae `sp. B58`					X	5	Occurs beyond Development Envelope	Potential Stygobite Uncertain SRE	
Pilbarus millsi		X				1	Regionally widespread	Uncertain Stygobite Not SRE	
Syncarida									

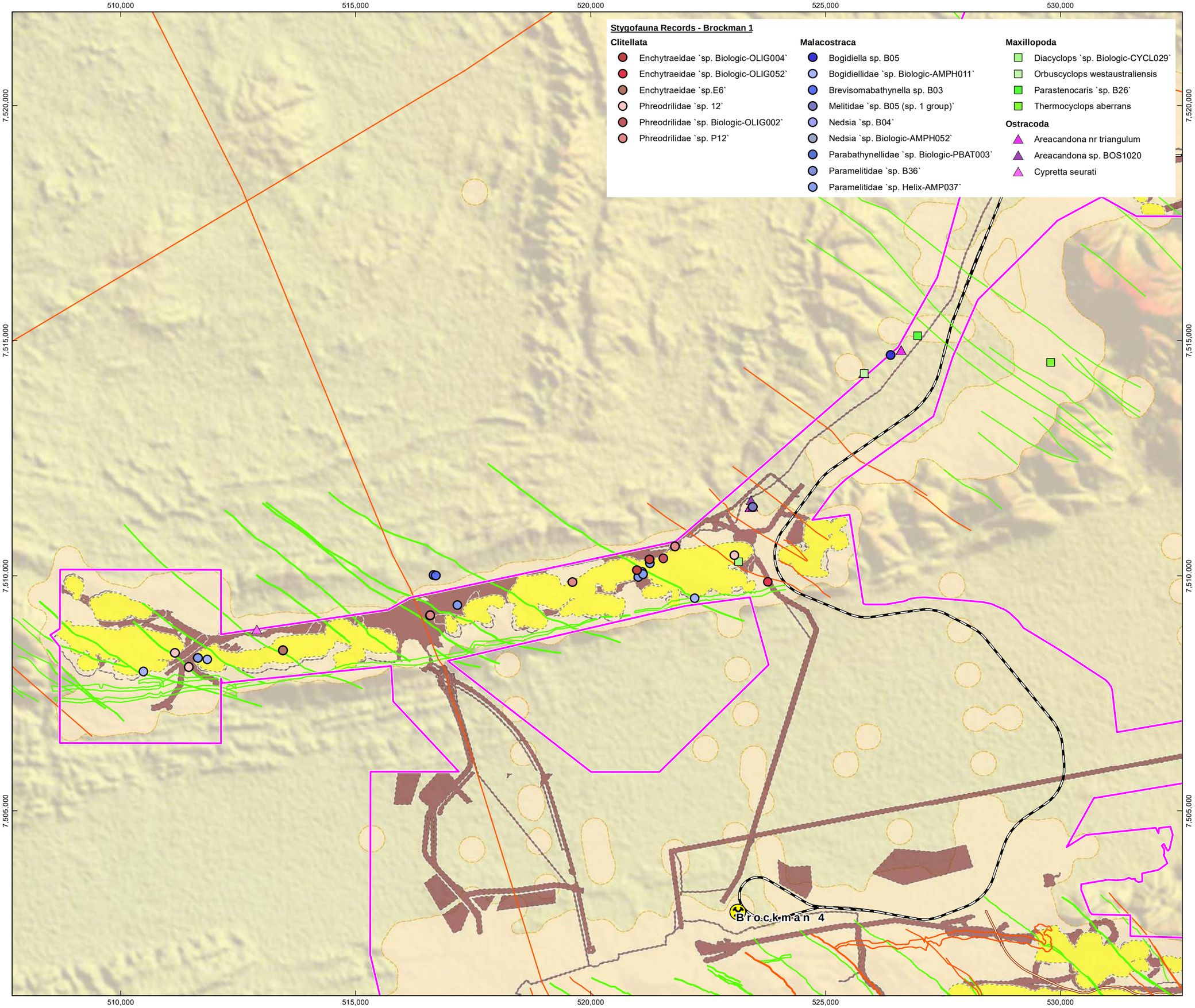
Taxon	BS1	BS2	BS3	BS4	Outside assessment / Impact Area/s	Total No of specimens	Distribution	Subterranean Status	Species Considered for Assessment
Atopobathynella `sp. BGCK`				X ^		1	Single site	Stygobite Potential SRE	
Atopobathynella `sp. Biologic-PBAT013`				X ^		15	Locally restricted Linear Range 0.13 km	Stygobite Potential SRE	
Atopobathynella `sp. Biologic-PBAT014`				X ^		1	Single site	Stygobite Potential SRE	
Bathynellidae `sp. Biologic-BATH001`				X ^		1	Single site	Stygobite Potential SRE	
Bathynellidae `sp. Biologic-BATH002`				X ^		2	Locally restricted LR4 km	Stygobite Potential SRE	
Bathynellidae `sp. Biologic-BATH003`				X ^		8	Locally restricted Linear Range 0.4 km	Stygobite Potential SRE	
Billibathynella sp. indet.		X				1	Uncertain	Stygobite Potential SRE	
Brevisomabathynella `sp. A`					X	3	Occurs beyond Development Envelope. Linear Range 10 km	Stygobite Potential SRE	
Brevisomabathynella `sp. B`					X	1	Occurs beyond Development Envelope	Stygobite Potential SRE	
Brevisomabathynella `sp. B03`	X					3	Single site	Stygobite Potential SRE	X
Brevisomabathynella `sp. C`					X	1	Occurs beyond Development Envelope	Stygobite Potential SRE	
Parabathynellidae `sp. Biologic-PBAT003`	X					6	Single site	Stygobite Potential SRE	X
Parabathynellidae `sp. Biologic-PBAT004`			X			22	Locally restricted Linear Range 2 km	Stygobite Potential SRE	X
Parabathynellidae `sp. Biologic-PBAT005`			X			7	Locally restricted Linear Range 0.8 km	Stygobite Potential SRE	X
Parabathynellidae `sp. Biologic-PBAT012`			X			10	Locally restricted Linear Range 1 km	Stygobite Potential SRE	X
Parabathynellidae `sp. Biologic-PBAT022`				X ^		3	Single site	Stygobite Potential SRE	
Calanoida									
Calanoida ‘sp. Biologic-CALA002’			X			1	Single site	Uncertain Stygobite Uncertain SRE	X

Taxon	BS1	BS2	BS3	BS4	Outside assessment / Impact Area/s	Total No of specimens	Distribution	Subterranean Status	Species Considered for Assessment
Cyclopoida									
Anzcyclops? `sp. BS3`			X			2	Locally restricted Linear Range 4.5 km	Potential Stygobite Uncertain SRE	X
Diacyclops humphreysi (humphreysi)				X		40	Regionally widespread Linear Range 700 km	Stygobite Not SRE	
Diacyclops 'sp. Biologic-CYCL029'	X					1	Single site	Uncertain Stygobite Uncertain SRE	X
Mesocyclops brooksi		X				1	Regionally widespread Linear Range 600 km	Stygobite Not SRE	
Mesocyclops notius					X	1	Occurs beyond Development Envelope	Not Stygobite Not SRE	
Microcyclops varicans				X		3	Regionally widespread Linear Range 1000+ km	Not Stygobite Not SRE	
Orbuscyclops westaustraliensis		X				3	Regionally widespread	Not Stygobite Not SRE	
Thermocyclops aberrans		X				2	Regionally widespread Linear Range 200+ km	Not Stygobite Not SRE	
Thermocyclops cf aberrans				X		9	Single site	Uncertain Stygobite Uncertain SRE	
Harpacticoida									
Parastenocaris `sp. B26`		X				6	Regionally widespread	Uncertain Stygobite Uncertain SRE	
Isopoda									
Microcerberidae `sp. Biologic-ISOP026			X			1	Single site	Potential Stygobite Potential SRE	X
Isopoda `sp. Biologic-ISOP011`				X		35	Occurs beyond Development Envelope	Potential Stygobite Potential SRE	
Podocopida									
Areacandona nammuldi		X				28	Single site	Stygobite Confirmed SRE	
Areacandona nr triangulum	X	X				7	Locally restricted Linear Range 4.6 km	Stygobite Confirmed SRE	X
Areacandona sp. BOS1020	X					2	Locally restricted Linear Range 0.15 km	Stygobite Potential SRE	X
Candonopsis tenuis				X		20	Regionally widespread	Not Stygobite	

Taxon	BS1	BS2	BS3	BS4	Outside assessment / Impact Area/s	Total No of specimens	Distribution	Subterranean Status	Species Considered for Assessment
							Linear Range 360+ km	Not SRE	
Cypretta seurati	X					2	Regionally widespread, Linear Range 600+ km	Not Stygobite Not SRE	
Limnocythere `sp. BOS1314`				X		12	Locally widespread Linear Range 41.8 km	Uncertain Stygobite Uncertain SRE	
Trombidiformes									
Pezidae `sp. BGCK`				X ^		3	Single site	Uncertain Stygobite Uncertain SRE	
Pezidae `sp. BS3X`			X			1	Single site	Uncertain Stygobite Uncertain SRE	X
Tubificida									
Enchytraeidae `sp. E6`	X	X		X		3	Regionally widespread Linear Range 300+ km.	Not Stygobite Not SRE	
Enchytraeidae `sp. E11`			X	X		2	Regionally widespread Linear Range 300+ km.	Not Stygobite Not SRE	
Enchytraeidae `sp. Biologic-OLIG004`	X		X			9	Regionally widespread Linear Range 200+ km.	Not Stygobite Not SRE	
Enchytraeidae `sp. Biologic-OLIG006`	X		X			6	Regionally widespread Linear Range 160+km	Not Stygobite Not SRE	
Enchytraeidae `sp. Biologic-OLIG016`			X	X		15	Locally widespread Linear Range46 km	Not Stygobite Uncertain SRE	
Enchytraeidae `sp. Biologic-OLIG017`			X	X		2	Regionally widespread Linear Range 160+ km	Not Stygobite Not SRE	
Enchytraeidae `sp. Biologic-OLIG018`			X			5	Locally widespread Linear Range 48.6 km	Not Stygobite Uncertain SRE	
Enchytraeidae `sp. Biologic-OLIG022`			X			11	Regionally widespread Linear Range 300+ km	Not Stygobite Not SRE	
Enchytraeidae `sp. Biologic-OLIG052`	X					1	Single site	Not Stygobite Unlikely SRE	X
Enchytraeidae `sp. Biologic-OLIG053`				X ^		1	Single site	Not Stygobite Unlikely SRE	
Enchytraeidae `sp. Biologic-OLIG055`				X ^		1	Single site	Not Stygobite Unlikely SRE	
Antarctodrilus `sp. Biologic-OLIG054`				X ^		1	Single site	Not Stygobite Unlikely SRE	

Taxon	BS1	BS2	BS3	BS4	Outside assessment / Impact Area/s	Total No of specimens	Distribution	Subterranean Status	Species Considered for Assessment
Phreodrilidae `sp. 12`	X		X			25	Regionally widespread Linear Range 300+ km	Not Stygobite Not SRE	
Phreodrilidae `sp. Biologic-OLIG001`				X ^		1	Single site	Not Stygobite Unlikely SRE	
Phreodrilidae `sp. Biologic-OLIG002`	X					1	Single site	Not Stygobite Unlikely SRE	X
Phreodrilidae `sp. Biologic-OLIG011`				X ^		13	Locally restricted Linear Range 0.9 km	Not Stygobite Unlikely SRE	
Phreodrilidae `sp. P12`	X		X			8	Regionally widespread Linear Range 100+ km	Not Stygobite Not SRE	
Phreodrilus peniculus		X				1	Regionally widespread	Not Stygobite Not SRE	
Pristina aequiseta				X		6	Regionally widespread Linear Range 1000+ km	Not Stygobite Not SRE	
Pristina leidyi				X		2	Regionally widespread Linear Range 1000+ km	Not Stygobite Not SRE	
Nais communis				X		1	Regionally widespread Linear Range 1000+ km	Not Stygobite Not SRE	

^ – only located within Boolgeeda Creek hyporheic



RioTinto

Figure 9-29
Stygofauna Recorded from the BS1 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190307v1
Date: September 2022

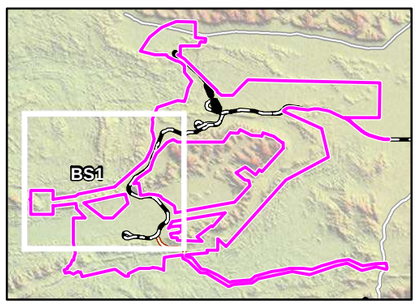
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- 3D Modelled Area

Conceptual Footprint

- Pit
- Infrastructure
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road



N

0 1 2 3
Kilometers
Map units in metres

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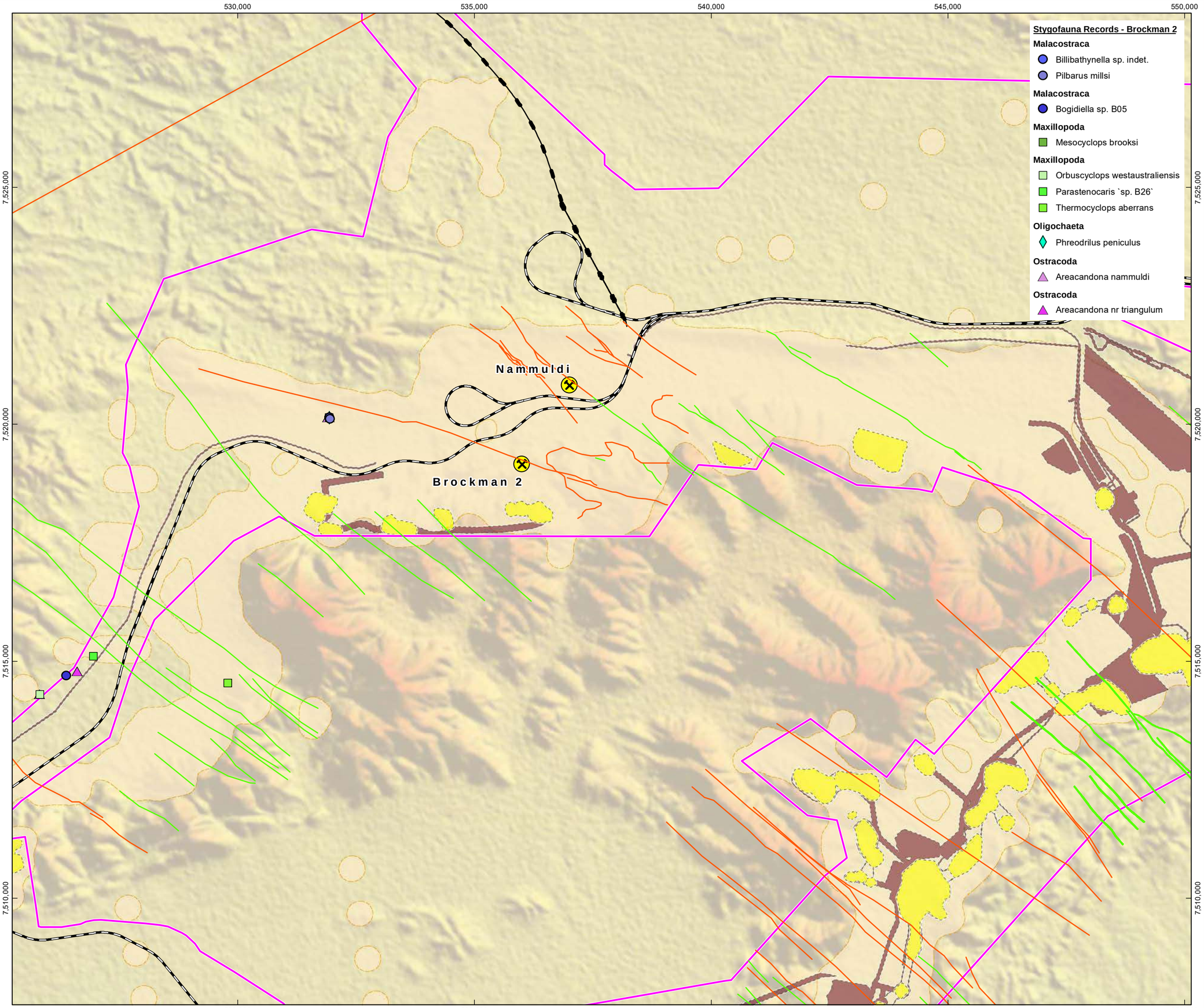


RioTinto

Figure 9-30
Stygofauna Recorded from the BS2 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190308v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

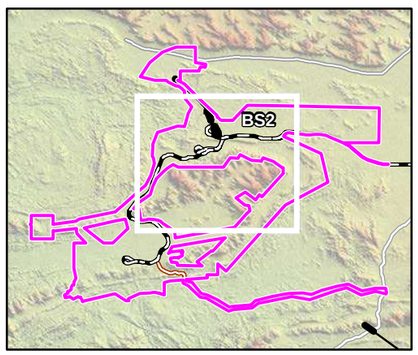
Legend

- Development Envelope
- 3D Modelled Area
- Hydraulic Barrier (Confirmed)
- Hydraulic Barriers (Potential)

Conceptual Footprint

- Pit
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor



N

0 1 2 3
Kilometers
Map units in metres

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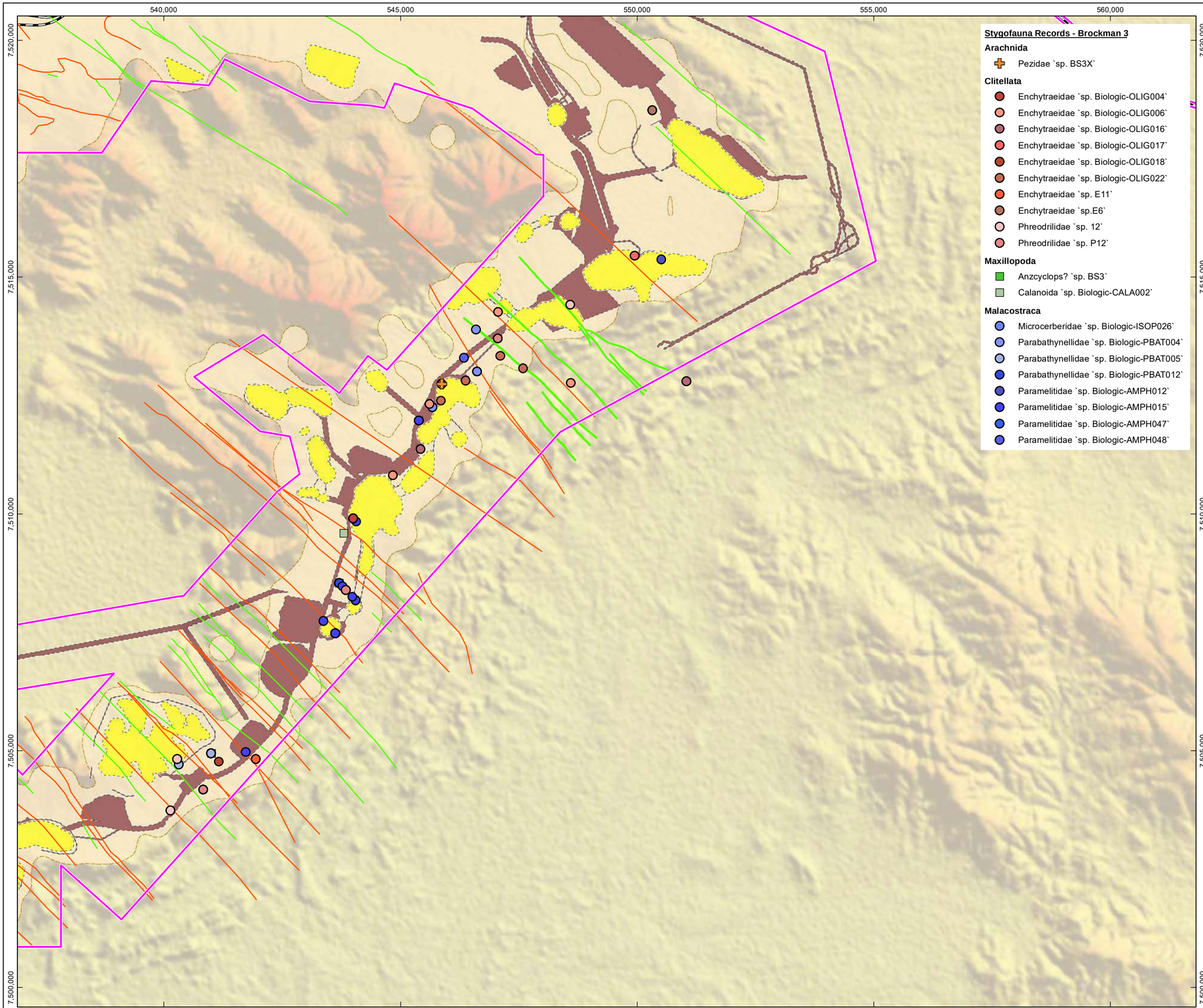


RioTinto

Figure 9-31
Stygofauna Recorded from the BS3 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190309v1
Date: September 2022

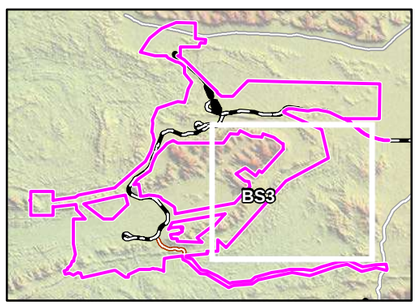
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- 3D Modelled Area
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)

Conceptual Footprint

- Pit
- Infrastructure
- Rio Tinto Railway



N

0 1 2 3
Kilometers

Map units in metres

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Figure 9-32
Stygofauna Recorded from the BS4 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190310v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
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Stygofauna Records - Brockman

Arachnida
- Pezidae `sp. BGCK`

Maxillopoda
- Diacyclops humphreysi (humphreysi)
- Microcyclops varicans
- Thermocyclops cf aberrans

Ostracoda
- Candonopsis tenuis
- Limnocythere `sp. BOS1314`

Clitellata
- Antarctodrilus `sp. Biologic-OLIG054`
- Enchytraeidae `sp. Biologic-OLIG016`
- Enchytraeidae `sp. Biologic-OLIG017`
- Enchytraeidae `sp. Biologic-OLIG053`
- Enchytraeidae `sp. Biologic-OLIG055`
- Enchytraeidae `sp. E11`
- Enchytraeidae `sp.E6`
- Nais communis
- Phreodrilidae `sp. Biologic-OLIG001`
- Phreodrilidae `sp. Biologic-OLIG011`
- Pristina aequiseta
- Pristina leidyi

Malacostraca
- Amphipoda `sp. Biologic-AMPH009`
- Atopobathynella `sp. BGCK`
- Atopobathynella `sp. Biologic-PBAT013`
- Atopobathynella `sp. Biologic-PBAT014`
- Bathynellidae `sp. Biologic-BATH001`
- Bathynellidae `sp. Biologic-BATH002`
- Bathynellidae `sp. Biologic-BATH003`
- Isopoda `sp. Biologic-ISOP011`
- Nedsia `sp. Biologic-AMPH003`
- Parabathynellidae `sp. Biologic-PBAT022`
- Paramelitidae `sp. Helix-AMP037`

Brockman 4

510,000 515,000 520,000 525,000 530,000

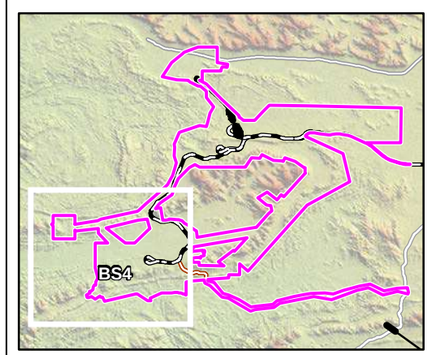
7,510,000 7,505,000 7,500,000 7,495,000

Legend

- Development Envelope
- 3D Modelled Area
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)

Conceptual Footprint
- Pit
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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Kilometers

Map units in metres

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9.3.3.2. Troglofauna

A total of 350 troglofauna specimens representing 164 troglofauna taxa (species or operational taxonomic units) were recorded within the Development Envelope comprising Araneae, Palpigradi, Pseudoscorpiones, Schizomida, Scorpiones, Isopoda, Chilopoda, Pauropoda, Polydesmida, Polyxenida, Symphyla, Diplura, Blattodea, Coleoptera, Hemiptera and Zygentoma (Table 9-7).

The distribution of troglofauna within and surrounding the Proposal is shown in Figure 9-33 to Figure 9-36

Table 9-7: Troglofauna Collected from and Surrounding the Proposal

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Aranea									
Anapistula sp. 'EW'	X					2	Occurs beyond Development Envelope	Troglobite Potential SRE	
Araneae `sp. Biologic-ARAN004`				X		1	Single site only	Potential Troglobite Potential SRE	
Araneae `sp. Biologic-ARAN005`	X					2	Multiple sites, LR 1.7 km	Potential Troglobite Potential SRE	X
Gnaphosidae `sp. Biologic-ARAN006`		X	X			2	Locally widespread Linear Range 15 km	Potential Troglobite Potential SRE	
Gnaphosidae `sp. Biologic-ARAN007`				X		1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Prethopalpus `sp. Biologic-ARAN001`			X			1	Single site only	Troglobite Potential SRE	X
Prethopalpus `sp. Biologic-ARAN002`		X				1	Single site only	Troglobite Potential SRE	
Prethopalpus `sp. Biologic-ARAN016`				X		1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Prethopalpus `sp. Biologic-ARAN023`			X			1	Single site	Troglobite Potential SRE	X
Prethopalpus sp. 'MW21'					X	1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Theridiidae `sp. WAM-ARAN001`	X			X		5	Regionally widespread Paraburdoo	Not troglobite Not SRE	
Palpigradi									
Palpigradi `sp. Biologic-PALP002`		X				1	Single site	Potential Troglobite Potential SRE	
Palpigradi `sp. Biologic-PALP003`			X			2	Multiple sites Linear Range 0.2 km	Potential Troglobite Potential SRE	X
Palpigradi `sp. Biologic-PALP004`			X			2	Multiple sites Linear Range 3.3 km	Potential Troglobite Potential SRE	X
Palpigradi `sp. Biologic-PALP006`			X			1	Single site	Potential Troglobite Potential SRE	
Palpigradi `sp. Biologic-PALP007`		X				1	Single site	Potential Troglobite Potential SRE	X

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Palpigradi `sp. Biologic-PALP008`				X		1	Single site	Potential Troglobite Potential SRE	
Palpigradi `sp. Biologic-PALP009`				X		1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Palpigradi `sp. Biologic-PALP010`	X					1	Single site	Potential Troglobite Potential SRE	X
Palpigradi `sp. Biologic-PALP012`			X			1	Single site	Potential Troglobite Potential SRE	
Palpigradi `sp. Biologic-PALP013`				X		6	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Palpigradi `sp. Biologic-PALP031`			X			1	Single site	Potential Troglobite Potential SRE	X
Palpigradi `sp. Biologic-PALP032`			X			1	Single site	Potential Troglobite Potential SRE	
Palpigradi `sp. Biologic-PALP033`			X			1	Single site	Potential Troglobite Potential SRE	
Pseudoscorpiones									
Chthoniidae `sp. Biologic-PSEU004`	X					4	Multiple sites Linear Range 0.5 km	Troglobite Potential SRE	X
Chthoniidae `sp. Biologic-PSEU005`				X		1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Chthoniidae `sp. Biologic-PSEU006`	X					3	Multiple sites Linear Range 1.0 km	Troglobite Potential SRE	X
Chthoniidae `sp. Biologic-PSEU007`			X			1	Single site	Troglobite Potential SRE	X
Chthoniidae `sp. Biologic-PSEU008`				X		1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Chthoniidae `sp. Biologic-PSEU009`				X		2	Occurs beyond Development Envelope	Troglobite Potential SRE	
Indolpium `sp. Biologic-PSEU003`	X					1	Single site	Troglobite Potential SRE	
Atemnidae `sp. WAM-PSE087`					X	1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Chernetidae `sp. Helix marra mamba`			X			1	Single site	Troglobite Potential SRE	X

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Chthoniidae `sp. Helix marra mamba`				X		1	Single site	Troglobite Potential SRE	
Chthoniidae `sp. WAM-PSE088`					X	2	Occurs beyond Development Envelope	Troglobite Potential SRE	
Troglochernes sp. indet.			X			1	Single site	Troglobite Potential SRE	X
Schizomida									
Draculoides `sp. Biologic-SCHI010`				X		1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Draculoides `sp. Biologic-SCHI011`				X		2	Occurs beyond Development Envelope	Troglobite Potential SRE	
Draculoides `sp. Biologic-SCHI017`	X					4	Multiple sites Linear Range 2.0 km	Troglobite Potential SRE	X
Draculoides `sp. Biologic-SCHI019`	X					11	Multiple sites Linear Range 15.7 km	Troglobite Potential SRE	X
Paradraculoides `Helix lineage S1`				X		4	Defunct OTU, synonym P. `sp. Helix Marra Mamba`	Troglobite Potential SRE	
Paradraculoides `Helix lineage S2`				X		1	Defunct OTU, synonym P. `sp. Helix Marra Mamba`	Troglobite Potential SRE	
Paradraculoides `Helix lineage S3`			X			2	Defunct OTU, synonym P. `sp. Helix Marra Mamba`	Troglobite Potential SRE	
Paradraculoides `sp. B12`	X					2	Multiple sites Linear Range 15 km	Troglobite Potential SRE	
Paradraculoides `sp. Helix marra mamba`			X	X		11	Multiple sites Linear Range 15.7 km	Troglobite Potential SRE	X
Paradraculoides sp. B12A					X	1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Paradraculoides sp. new 2					X	1	Occurs beyond Development Envelope	Troglobite Potential SRE	
Scorpiones									
Scorpiones `sp. Biologic-SCOR002`			X			1	Single site	Troglobite Potential SRE	
Isopoda									
Armadillidae `sp. Biologic-ISOP002`	X					2	Single site	Potential Troglobite Potential SRE	X

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Armadillidae `sp. Biologic-ISOP004`				X		1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Armadillidae `sp. Biologic-ISOP008`				X		1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Buddelundia? `sp. Biologic-ISOP005`			X			1	Single site	Uncertain Troglobite Potential SRE	X
Buddelundia? `sp. Biologic-ISOP006`			X			1	Single site	Uncertain Troglobite Potential SRE	
Isopoda `sp. Biologic-ISOP007`			X			1	Single site	Potential Troglobite Potential SRE	X
Philosciidae `sp. Biologic-ISOP001`		X				1	Multiple sites Linear Range 41 km	Not Troglobite Unlikely SRE	
Armadillidae `sp. Helix-I1`			X			3	Single site	Potential Troglobite Potential SRE	X
Armadillidae `sp. Helix-I2`			X			1	Single site	Potential Troglobite Potential SRE	X
Philosciidae `sp. Helix-I7`				X		1	Synonym: Philosciidae `sp. Biologic- ISOP001`. Defunct OTU	Not Troglobite Unlikely SRE	
Troglarmadillo `sp. Helix-I1`			X			2	Multiple sites Linear Range 5.3 km	Potential Troglobite Potential SRE	
Troglarmadillo sp. B46	X					1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Geophilomorpha									
Geophilomorpha `sp. Biologic-CHIL002`	X					1	Single site	Potential Troglobite Potential SRE	
Geophilomorpha `sp. Biologic-CHIL007`	X					4	Single site	Potential Troglobite Potential SRE	
Scolopendromorpha									
Cormocephalus `sp. A`		X				1	Occurs beyond Development Envelope Linear Range 100+ km	Not Troglobite Not SRE	
Scolopendromorpha `sp. Biologic-CHIL005`				X		1	Single site	Uncertain Troglobite Potential SRE	
Scolopendromorpha `sp. Biologic-CHIL006`				X		3	Collected from hyporheic samples only, LR 0.8 km	Not troglofauna; Potential soil fauna, uncertain SRE	

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Scolopendromorpha `sp. BS1`	X					1	Single site	Not Troglobite Potential SRE	
Cryptops sp. indet.					X	2	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Symphyla									
Hanseniella `sp. Biologic-SYMP001`		X				1	Single site	Potential Troglobite Potential SRE	X
Hanseniella `sp. Biologic-SYMP003`		X	X			5	Multiple sites Linear Range16.4 km	Potential Troglobite Potential SRE	X
Hanseniella `sp. Biologic-SYMP006`				X		2	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Hanseniella `sp. Biologic-SYMP031`			X			1	Single site	Potential Troglobite Potential SRE	
Hanseniella `sp. Biologic-SYMP032`			X			1	Single site	Potential Troglobite Potential SRE	
Scolopendrellidae `sp. Biologic-SYMP008`				X		1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Scolopendrellidae `sp. Biologic-SYMP014`				X		1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Scutigerellidae `sp. Biologic-SYMP004`		X	X			2	Multiple sites Linear Range 2.9 km	Potential Troglobite Potential SRE	
Scutigerellidae `sp. Biologic-SYMP005`				X		1	Single site	Potential Troglobite Potential SRE	
Scutigerellidae `sp. Biologic-SYMP007`	X			X		4	Multiple sites Linear range 12.0 km	Potential Troglobite Potential SRE	
Symphyla `sp. Biologic-SYMP013`				X		4	Single site	Potential Troglobite Potential SRE	
Symphylella `sp. Biologic-SYMP030`			X			1	Single site	Potential Troglobite Potential SRE	
Symphylella `sp. BS4`				X		2	Single site	Potential Troglobite Potential SRE	
Symphylella `sp. BS1`	X					1	Single site	Potential Troglobite Potential SRE	
Symphyella sp. 'EW'					X	1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Scolopendrellopsis `sp. BS1`	x					1	Single site	Potential Troglobite Potential SRE	
Pauropoda									
Pauropoda `sp. Biologic-PAUR004`				X		1	Occurs beyond Development Envelope	Not Troglobite Uncertain SRE	
Pauropoda `sp. Biologic-PAUR005`		X				1	Single site	Uncertain Troglobite Potential SRE	
Pauropoda `sp. Biologic-PAUR006`		X				1	Single site	Uncertain Troglobite Potential SRE	
Pauropoda `sp. Biologic-PAUR007`		X				2	Multiple sites Linear 1.2 km	Uncertain Troglobite Potential SRE	X
Pauropoda `sp. Biologic-PAUR008`			X	X		2	Multiple sites Linear Range 52.6 km	Not Troglobite Uncertain SRE	
Pauropoda `sp. Biologic-PAUR009`	X					1	Occurs beyond Development Envelope	Not Troglobite Uncertain SRE	
Pauropoda `sp. Biologic-PAUR010`		X				1	Single site	Uncertain Troglobite Potential SRE	
Pauropoda `sp. Biologic-PAUR011`				X		1	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Pauropoda `sp. Biologic-PAUR013`			X			1	Single site	Uncertain Troglobite Potential SRE	X
Pauropoda `sp. Biologic-PAUR036`			X			1	Single site	Uncertain Troglobite Potential SRE	
Pauropoda `sp. Biologic-PAUR037`			X			1	Single site	Uncertain Troglobite Potential SRE	
Pauropoda `sp. Biologic-PAUR038`			X			1	Single site	Uncertain Troglobite Potential SRE	X
Pauropoda `sp. Biologic-PAUR039`			X			1	Single site	Uncertain Troglobite Potential SRE	X
Pauropoda `sp. Biologic-PAUR040`			X			1	Single site	Uncertain Troglobite Potential SRE	
Pauropodidae sp. B29					X	1	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Pauropodidae sp. B41					X	1	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Pauropodidae sp. B42					X	2	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Pauropodidae sp. B43					X	1	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Polydesmida									
Polydesmida ‘sp. Biologic-POLD002’			X			1	Single site	Troglobite Potential SRE	
Polyxenida									
Polyxenida `sp. Biologic-POLX002`			X			2	Multipe sites Linear Range 100+ km	Not Troglobite Not SRE	
Polyxenida `sp. Biologic-POLX003`	X	X	X			4	Multipe site Linear Range 100+ km	Not Troglobite Not SRE	
Polyxenida `sp. Biologic-POLX005`		X				1	Multipe sites Linear Range 100+ km	Not Troglobite Not SRE, not SRE	
Lophoproctidea `sp. Biologic-POLX006`			X			1	Multipe sites Linear Range 100+ km	Not Troglobite Not SRE	
Diplura									
Japygidae `sp. Biologic-DIPL008`	X					1	Single site	Potential Troglobite Potential SRE	X
Japygidae `sp. Biologic-DIPL009`				X		1	Single site	Potential Troglobite Potential SRE	
Japygidae `sp. Biologic-DIPL014`	X					1	Single site	Potential Troglobite Potential SRE	X
Japygidae `sp. Biologic-DIPL015`	X					1	Multiple sites Linear Range 20 km	Uncertain Troglobite Potential SRE	
Japygidae `sp. Biologic-DIPL027`			X			1	Single site	Potential Troglobite Potential SRE	
Japygidae `sp. Biologic-DIPL028`			X	X		2	Multiple Sites Linear Range 27.1 km.	Uncertain Troglobite Potential SRE	X
Parajapygidae `sp. Biologic-DIPL007`			X			1	Single site	Potential Troglobite Potential SRE	X
Parajapygidae `sp. Biologic-DIPL018`	X					1	Single site	Potential Troglobite Potential SRE	
Parajapygidae `sp. Biologic-DIPL029`			X			1	Single site	Potential Troglobite Potential SRE	

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Projapygidae `sp. Biologic-DIPL003`	X					1	Single site	Potential Troglobite Potential SRE	X
Projapygidae `sp. Biologic-DIPL004`			X			1	Single site	Potential Troglobite Potential SRE	
Projapygidae `sp. Biologic-DIPL005`				X		1	Single site	Potential Troglobite Potential SRE	
Projapygidae `sp. Biologic-DIPL013`	X					1	Single site	Potential Troglobite Potential SRE	X
Projapygidae `sp. Biologic-DIPL030`			X			2	Multiple sites Linear Range 2.4 km	Potential Troglobite Potential SRE	
Projapygidae `sp. Biologic-DIPL031`			X			2	Multiple sites Linear Range 0.6 km	Potential Troglobite Potential SRE	
Projapygidae `sp. Biologic-DIPL032`			X			1	Single site	Potential Troglobite Potential SRE	X
Campodeidae sp. 'EW'					X	1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Japygidae `sp. Helix marra mamba`				X		1	Single site	Potential Troglobite Potential SRE	X
Projapygidae sp. B14					X	1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Projapygidae sp. B17	X					1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Blattodea									
Nocticola `sp. Biologic-BLAT005`	X					4	Multiple sites Linear Range 1.6 km	Uncertain Troglobite Potential SRE	X
Nocticola `sp. Biologic-BLAT006`	X					5	Multiple sites Linear Range 2.0 km	Uncertain Troglobite Potential SRE	X
Nocticola `sp. Biologic-BLAT007`	X	X	X	X		12	Multiple sites Linear Range44.0 km	Not Troglobite Unlikely SRE	
Nocticola `sp. Biologic-BLAT008`		X	X			10	Multiple sites Linear Range 18.6 km	Uncertain Troglobite Potential SRE	X
Nocticola `sp. Biologic-BLAT010`	X					9	Multiple sites Linear Range33.2 km	Not Troglobite Unlikely SRE	
Nocticola `sp. Biologic-BLAT012`				X		1	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Nocticolidae `sp. Helix-BNA`					X	25	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Nocticolidae `sp. Helix-BNR`					X	1	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Coleoptera									
Carabidae `sp. Biologic-COLE001`			X	X		2	Multiple sites Linear Range 40.7 km	Not Troglobite Unlikely SRE	
Coleoptera `sp. Biologic-COLE002`			X			3	Single site	Uncertain Troglobite Potential SRE	
Coleoptera `sp. Biologic-COLE003`	X					1	Single site	Uncertain Troglobite Potential SRE	X
Cryptorhynchinae `sp. Biologic-COLE004`				X		2	Multiple sites Linear Range 3.4 km	Uncertain Troglobite Potential SRE	
Ptinella? `sp. BS1`	X					4	Single site	Uncertain Troglobite Potential SRE	X
Staphylinidae? `sp. BS1`	X					3	Single site	Uncertain Troglobite Potential SRE	X
Carabidae `sp. Helix-C1`				X		3	Synonym: Carabidae `sp. Biologic- COLE001`. Defunct OTU	Uncertain Troglobite Potential SRE	
Carabidae `sp. Helix-C2`				X		1	Single site	Uncertain Troglobite Potential SRE	
Carabidae `sp. Helix-C3`			X			1	Single site	Uncertain Troglobite Potential SRE	
Carabidae `sp. Helix-C4`				X		1	Single site	Uncertain Troglobite Potential SRE	
Macranillus sp. 'EW'					X	1	Occurs beyond Development Envelope	Uncertain Troglobite Potential SRE	
Staphylinidae `sp. Helix-C5`				X		1	Single site	Uncertain Troglobite Potential SRE	
Staphylinidae `sp. Helix-C6`				X		1	Single site	Uncertain Troglobite Potential SRE	X
Hemiptera									
Meenoplidae `sp. Biologic-HEMI001`	X	X	X	X		12	Multiple sites Linear range 48.2 km	Not Troglobite Unlikely SRE	

Taxon	BS1	BS2	BS3	BS4	Outside Assessment / Impact Areas	Total specimens	Distribution	Subterranean Status	Species Considered for Assessment
Meenoplidae `sp. Biologic-HEMI004`				X		2	Collected from hyporheic samples only, LR 0.1 km	Not Troglobite Unlikely SRE	
Phaconeura `sp. WAM-PHAC001`		X				1	Regionally widespread Linear Range 100+km	Not Troglobite Not SRE	
Phaconeura `sp. WAM-PHAC002`	X	X	X	X		9	Regionally widespread Linear Range 100+ km	Not Troglobite Not SRE	
Zygentoma									
Atelurinae `sp. Biologic-ZYGE008`	X		X	X		6	Multiple sites Linear Range 35.7 km	Not Troglobite Unlikely SRE	
Nicoletiidae `sp. Biologic-ZYGE002`					X	1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Nicoletiidae `sp. Biologic-ZYGE004`	X					1	Single site	Potential Troglobite Potential SRE	
Nicoletiinae `sp. Biologic-ZYGE005`		X				3	Multiple sites Linear range 2.4 km	Potential Troglobite Potential SRE	X
Nicoletiinae `sp. Biologic-ZYGE006`			X			2	Multiple sites Linear Range 2.3 km	Potential Troglobite Potential SRE	X
Nicoletiinae `sp. Biologic-ZYGE007`			X			1	DNA match: Nicoletiinae `sp. Helix Marra Mamba`. 2 pits LR 4.5 km	Potential Troglobite Potential SRE	X
Nicoletiinae `sp. Biologic-ZYGE015`	X					2	Multiple sites Linear Range 17.5 km	Uncertain troglobite Unlikely SRE	
Lepidospera sp. B10					X	1	Occurs beyond Development Envelope	Potential Troglobite Potential SRE	
Nicoletiidae `sp. Helix marra mamba`				X		1	Synonym: Nicoletiinae `sp. Biologic- ZYGE007`. Defunct OTU.	Potential Troglobite Potential SRE	
Subnicoletiinae `sp. Biologic-ZYGE024`			X			1	Single site	Potential Troglobite Potential SRE	
Subnicoletiinae `sp. Biologic-ZYGE025`			X			1	Single site	Potential Troglobite Potential SRE	
Subnicoletiinae `sp. Biologic-ZYGE026`				X		1	Single site	Potential Troglobite Potential SRE	
Subnicoletiinae `sp. Biologic-ZYGE027`			X			1	Single site	Potential Troglobite Potential SRE	

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Troglofauna Records - Brockman 1

Arachnida
- Anapistula sp. 'EW'
- Araneae `sp. Biologic-ARAN005`
- Chthoniidae `sp. Biologic-PSEU004`
- Chthoniidae `sp. Biologic-PSEU006`
- Draculoides `sp. Biologic-SCHI017`
- Draculoides `sp. Biologic-SCHI019`
- Indolpium `sp. Biologic-PSEU003`
- Palpigradi `sp. Biologic-PALP010`
- Paradraculoides `sp. B12`
- Theridiidae `sp. WAM-ARAN001`

Chilopoda
- Geophilomorpha `sp. Biologic-CHIL002`
- Geophilomorpha `sp. Biologic-CHIL007`
- Scolopendromorpha `sp. BS1`

Diplopoda
- Polyxenida `sp. Biologic-POLX003`

Insecta
- Atelurinae `sp. Biologic-ZYGE008`
- Coleoptera `sp. Biologic-COLE003`
- Meenoplidae `sp. Biologic-HEMI001`
- Nicoletiidae `sp. Biologic-ZYGE004`
- Nicoletiinae `sp. Biologic-ZYGE015`
- Nocticola `sp. Biologic-BLAT005`
- Nocticola `sp. Biologic-BLAT006`
- Nocticola `sp. Biologic-BLAT007`
- Nocticola `sp. Biologic-BLAT010`
- Phaconeura `sp. WAM-PHAC002`
- Ptinella? `sp. BS1`
- Staphylinidae? `sp. BS1`

Malacostraca
- Armadillidae `sp. Biologic-ISOP002`
- Troglarmadillo sp. B46

Pauropoda
- Pauropoda `sp. Biologic-PAUR009`

Symphyla
- Scolopendrellopsis `sp. BS1`
- Scutigerellidae `sp. Biologic-SYMP007`
- Symphylella `sp. BS1`

Brockman 4

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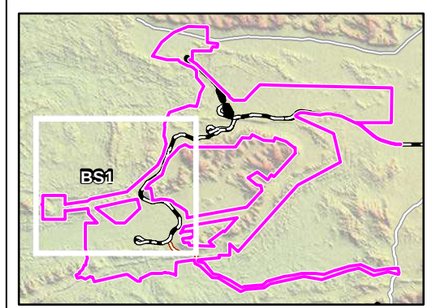
Figure 9-33
Troglofauna Recorded from the BS1 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190312v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend
- Development Envelope
- 3D Modelled Area
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)

Conceptual Footprint
- Pit
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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Kilometers
Map units in metres

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Nammuldi

Brockman 2

Troglofauna Records - Brockman 2

Arachnida
- Gnaphosidae `sp. Biologic-ARAN006`
- Palpigradi `sp. Biologic-PALP007`
- Prethopalpus `sp. Biologic-ARAN002`

Chilopoda
- Cormocephalus `sp.

Diplopoda
- Polyxenida `sp. Biologic-POLX003`

Insecta
- Meenoplidae `sp. Biologic-HEMI001`
- Nicoletiinae `sp. Biologic-ZYGE005`
- Nocticola `sp. Biologic-BLAT007`
- Phaconeura `sp. WAM-PHAC001`
- Phaconeura `sp. WAM-PHAC002`

Malacostraca
- Philosciidae `sp. Biologic-ISOP001`

Pauropoda
- Pauropoda `sp. Biologic-PAUR006`
- Pauropoda `sp. Biologic-PAUR007`

Symphyla
- Hanseniella `sp. Biologic-SYMP001`
- Hanseniella `sp. Biologic-SYMP003`

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Figure 9-34
Troglofauna Recorded from the BS2 Assessment Area

Drawn: L.Fuentes
Plan: PDE01900313v1
Date: September 2022

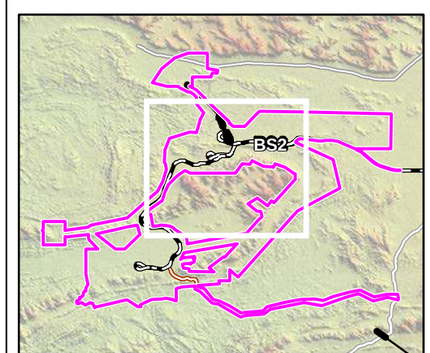
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- 3D Modelled Area
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)

Conceptual Footprint
- Pit
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor



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Map units in metres

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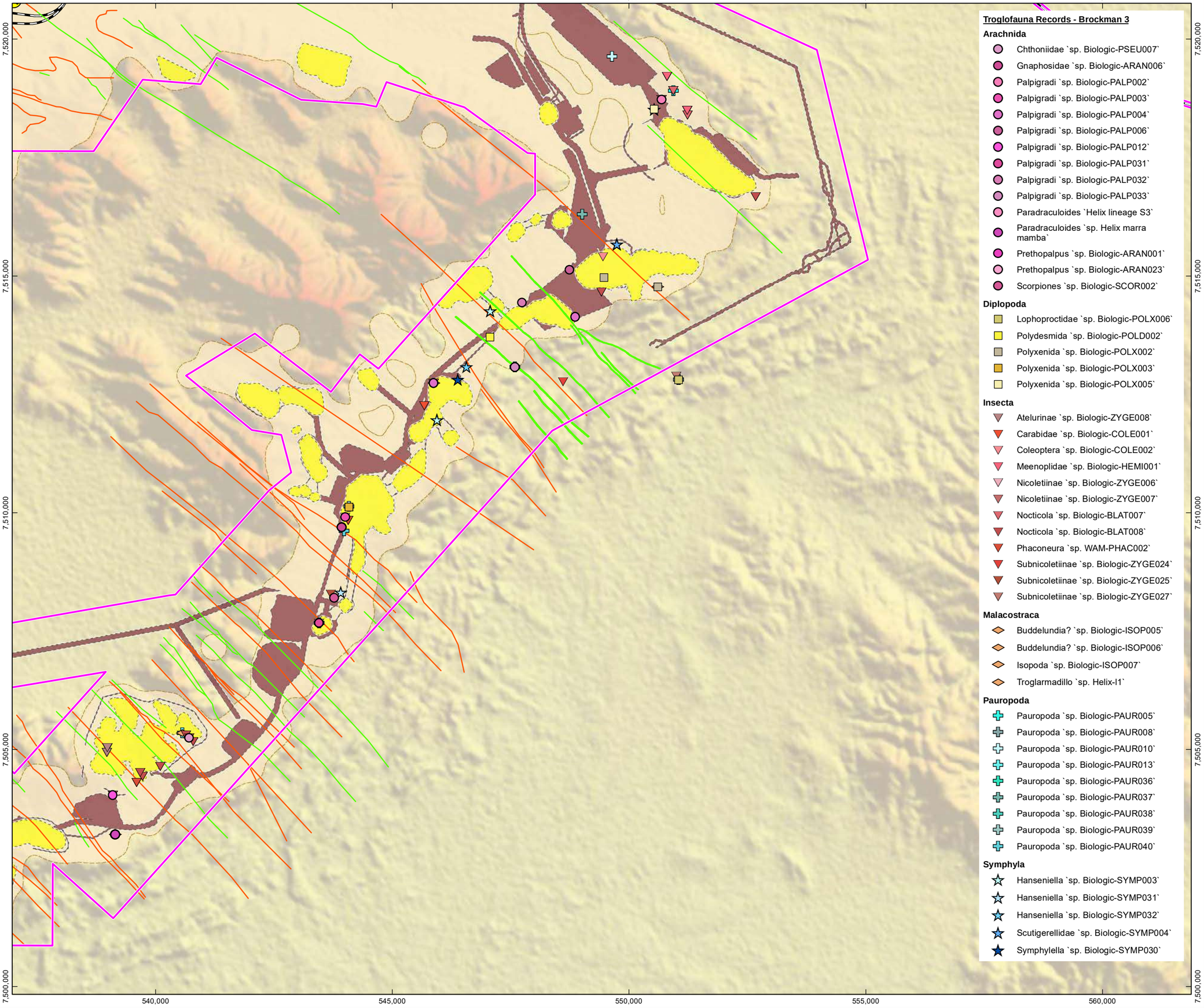

Troglofauna Records - Brockman 3

Arachnida
- Chthoniidae `sp. Biologic-PSEU007`
- Gnaphosidae `sp. Biologic-ARAN006`
- Palpigradi `sp. Biologic-PALP002`
- Palpigradi `sp. Biologic-PALP003`
- Palpigradi `sp. Biologic-PALP004`
- Palpigradi `sp. Biologic-PALP006`
- Palpigradi `sp. Biologic-PALP012`
- Palpigradi `sp. Biologic-PALP031`
- Palpigradi `sp. Biologic-PALP032`
- Palpigradi `sp. Biologic-PALP033`
- Paradraculoides `Helix lineage S3`
- Paradraculoides `sp. Helix marra mamba`
- Prethopalpus `sp. Biologic-ARAN001`
- Prethopalpus `sp. Biologic-ARAN023`
- Scorpiones `sp. Biologic-SCOR002`

Diplopoda
- Lophoproctidae `sp. Biologic-POLX006`
- Polydesmida `sp. Biologic-POLD002`
- Polyxenida `sp. Biologic-POLX002`
- Polyxenida `sp. Biologic-POLX003`
- Polyxenida `sp. Biologic-POLX005`

Insecta
- Atelurinae `sp. Biologic-ZYGE008`
- Carabidae `sp. Biologic-COLE001`
- Coleoptera `sp. Biologic-COLE002`
- Meenoplidae `sp. Biologic-HEMI001`
- Nicoletiinae `sp. Biologic-ZYGE006`
- Nicoletiinae `sp. Biologic-ZYGE007`
- Nocticola `sp. Biologic-BLAT007`
- Nocticola `sp. Biologic-BLAT008`
- Phaconeura `sp. WAM-PHAC002`
- Subnicoletiinae `sp. Biologic-ZYGE024`
- Subnicoletiinae `sp. Biologic-ZYGE025`
- Subnicoletiinae `sp. Biologic-ZYGE027`

Malacostraca
- Buddelundia? `sp. Biologic-ISOP005`
- Buddelundia? `sp. Biologic-ISOP006`
- Isopoda `sp. Biologic-ISOP007`
- Troglarmadillo `sp. Helix-I1`

Pauropoda
- Pauropoda `sp. Biologic-PAUR005`
- Pauropoda `sp. Biologic-PAUR008`
- Pauropoda `sp. Biologic-PAUR010`
- Pauropoda `sp. Biologic-PAUR013`
- Pauropoda `sp. Biologic-PAUR036`
- Pauropoda `sp. Biologic-PAUR037`
- Pauropoda `sp. Biologic-PAUR038`
- Pauropoda `sp. Biologic-PAUR039`
- Pauropoda `sp. Biologic-PAUR040`

Symphyla
- Hanseniella `sp. Biologic-SYMP003`
- Hanseniella `sp. Biologic-SYMP031`
- Hanseniella `sp. Biologic-SYMP032`
- Scutigerellidae `sp. Biologic-SYMP004`
- Symphylella `sp. Biologic-SYMP030`

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Figure 9-35
Troglofauna Recorded from the BS3 Assessment Area

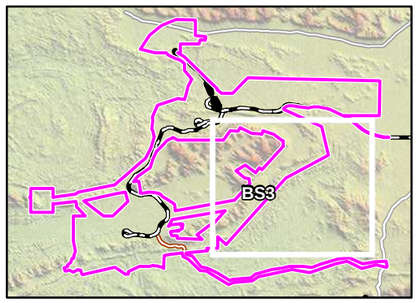
Drawn: L.Fuentes
Plan: PDE0190314v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend
- Development Envelope
- 3D Modelled Area
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)

Conceptual Footprint
- Pit
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway



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Kilometers

Map units in metres

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Troglofauna Records - Brockman 4

Arachnida
- Araneae `sp. Biologic-ARAN004`
- Chernetidae `sp. Helix marra mamba`
- Chthoniidae `sp. Biologic-PSEU005`
- Chthoniidae `sp. Biologic-PSEU008`
- Chthoniidae `sp. Biologic-PSEU009`
- Chthoniidae `sp. Helix marra mamba`
- Draculoides `sp. Biologic-SCHI010`
- Draculoides `sp. Biologic-SCHI011`
- Gnaphosidae `sp. Biologic-ARAN007`
- Palpigradi `sp. Biologic-PALP008`
- Palpigradi `sp. Biologic-PALP009`
- Palpigradi `sp. Biologic-PALP013`
- Paradraculoides `Helix lineage S1`
- Paradraculoides `Helix lineage S2`
- Paradraculoides `Helix lineage S3`
- Paradraculoides `sp. Helix marra mamba`
- Prethopalpus `sp. Biologic-ARAN016`
- Theridiidae `sp. WAM-ARAN001`
- Troglochernes sp. indet.

Insecta
- Atelurinae `sp. Biologic-ZYGE008`
- Carabidae `sp. Biologic-COLE001`
- Carabidae `sp. Helix-C1`
- Carabidae `sp. Helix-C2`
- Carabidae `sp. Helix-C3`
- Carabidae `sp. Helix-C4`
- Cryptorhynchinae `sp. Biologic-COLE004`
- Meenoplidae `sp. Biologic-HEMI001`
- Meenoplidae `sp. Biologic-HEMI004`
- Nicoletiidae `sp. Helix marra mamba`
- Nicoletiinae `sp. Biologic-ZYGE015`
- Nocticola `sp. Biologic-BLAT007`
- Nocticola `sp. Biologic-BLAT012`
- Phaconeura `sp. WAM-PHAC002`
- Staphylinidae `sp. Helix-C5`
- Staphylinidae `sp. Helix-C6`
- Subnicoletiinae `sp. Biologic-ZYGE026`

Chilopoda
- Scolopendromorpha `sp. Biologic-CHIL005`
- Scolopendromorpha `sp. Biologic-CHIL006`

Malacostraca
- Armadillidae `sp. Biologic-ISOP004`
- Armadillidae `sp. Biologic-ISOP008`
- Armadillidae `sp. Helix-I2`
- Philosciidae `sp. Helix-I7`
- Troglarmadillo `sp. Helix-I1`

Entognatha
- Japygidae `sp. Biologic-DIPL009`
- Japygidae `sp. Helix marra mamba`
- Projapygidae `sp. Biologic-DIPL005`

Pauropoda
- Pauropoda `sp. Biologic-PAUR004`
- Pauropoda `sp. Biologic-PAUR008`
- Pauropoda `sp. Biologic-PAUR011`

Symphyla
- Hanseniella `sp. Biologic-SYMP006`
- Scolopendrellidae `sp. Biologic-SYMP008`
- Scolopendrellidae `sp. Biologic-SYMP014`
- Scutigerellidae `sp. Biologic-SYMP005`
- Scutigerellidae `sp. Biologic-SYMP007`
- Symphyla `sp. Biologic-SYMP013`
- Symphylella `sp. BS4`

Brockman 4

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Figure 9-36
Troglofauna Recorded from the BS4 Assessment Area

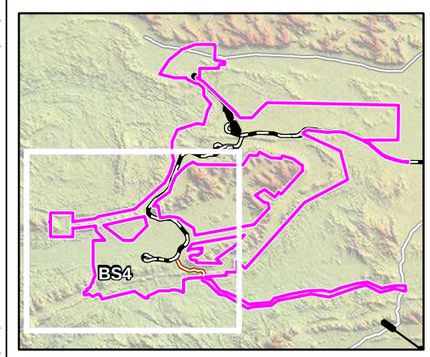
Drawn: L.Fuentes
Plan: PDE01900328v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend
- Development Envelope
- 3D Modelled Area
- Hydraulic Barrier (Confirmed)
- Hydraulic Barriers (Potential)

Conceptual Footprint
- Pit
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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Kilometers

Map units in metres

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9.3.4. Summary of Key Subterranean Fauna Values

The key environmental values associated with subterranean fauna include:

- Extensive, highly suitable, complex BWT habitats
- A diverse stygofauna assemblage, particularly within the BS1 and BS3 assessment areas
- Extensive, thick, well-connected AWT habitats throughout the Development Envelope
- A diverse troglofauna assemblage occurring in each section of the syncline.

9.4. Potential Environmental Impacts

9.4.1. Direct Impacts

Potential direct impacts from the Proposal to subterranean fauna have been identified as:

- Loss of individuals or reduction in stygofauna habitat through mining and/or groundwater drawdown
- Loss of individuals or reduction in troglofauna habitat as a result of mining.

9.4.1.1. Loss of Individuals or Reduction in Stygofauna Habitat through Mining and/or Groundwater Drawdown

A numerical groundwater model was developed to quantify the groundwater drawdown within the Brockman Syncline based on the combined dewatering required for approved and proposed mining as described in Section 6.3. Details of the Brockman groundwater model is provided in RPS (2021a) included in Appendix C.4.

Modelled drawdown due to groundwater abstraction from all approved and proposed Brockman Syncline Operations at the end of mining is shown in 6.4.1.1 in the Inland Water section.

Using the groundwater contours and the volume of stygofauna habitat reduction, through mining and groundwater drawdown, the habitat remaining for stygofauna was calculated at the end of mining (2050) within each assessment area and is presented in Table 9-8. Direct impacts of the Proposal on stygofauna habitats from the Proposal are predicted to result in impacts to approximately 33% of the pre-impact BWT habitat (at the end of mining 2050/groundwater drawdown).

Further detailed for each assessment area are provided in the sections below.

Table 9-8: Potential Impacts to Stygofauna Habitat BWT from the Proposal

Habitat Type	BS1	BS2	BS3	BS4	Total
Modelled suitable Habitat (m^3) ('000)					
Zone A BWT	334,488	348,543	274,426	433,539	1,390,996
Zone B BWT	3,479,682	9,096,700	2,758,784	13,442,200	28,777,366
Total BWT	**3,814,170**	**9,445,243**	**3,033,210**	**13,875,739**	**30,168,362**
Modelled Habitat Reduction from the Proposal (m^3) ('000)					
Zone A BWT	295,740	237,234	187,778	186,161	906,913
Zone B BWT	1,349,772	3,166,300	917,973	3,700,000	9,134,045
Total BWT	**1,645,512**	**3,403,534**	**1,105,751**	**3,886,161**	**10,040,958**
Modelled Total Habitat Remaining (%)					
Zone A BWT	11.6	31.9	31.6	57.1	34.8
Zone B BWT	61.2	65.2	66.7	72.5	68.3
Total BWT	**56.9**	**64.0**	**63.5**	**72.0**	**66.7**

Brockman Syncline 1 Assessment Area

Direct impacts of the Proposal on stygofauna habitats within the BS1 assessment area, as detailed in Table 9-8 are predicted to result in a:

- Impact to approximately 43% of the pre-impact BWT habitat (at the end of mining 2050/ groundwater drawdown)
- Reduction in the thickness and connectivity of BWT habitat across the BS1 section, due to the increased influence of transverse dykes within the bedrock as the water table is lowered.

Direct impacts of the Proposal on stygofauna focus only on species considered to be potentially restricted to within the impact assessment area. The species, the locations they were collected from, and the number of individuals collected are shown in Table 9-9. Figure 9-37 shows these species in the context of habitat remaining post mining (2050).

Table 9-9: Potentially Restricted Stygofauna Species within the BS1 Assessment Area

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Amphipoda			
Bogidiellidae `sp. Biologic-AMPH011`	11 km (occurs across central dyke at BS1)	3	4
Syncarida			
Brevisomabathynella `sp. B03`	46 m (2 adjacent sites)	3	2
Parabathynellidae `sp. Biologic-PBAT003`	3 m (2 adjacent sites)	6	2
Oligochaeta			
Enchytraeidae `sp. Biologic-OLIG052`	Singleton	1	1
Phreodrilidae `sp. Biologic-OLIG002`	Singleton	1	1
Cyclopoida			
Diacyclops `sp. Biologic-CYCL029`	Singleton	1	1

Ostracoda			
Areacandona nr triangulum	4.5 km (occurs at BS2)	7	4
Areacandona `sp. BOS1020`	150 m	2	2

Brockman Syncline 2 Assessment Area

Direct impacts of the Proposal on stygofauna habitats within the BS2 assessment area, as detailed in Table 9-8, is expected to result in:

- Impact to approximately 36% of the pre-impact BWT habitat (at the end of mining 2050/ groundwater drawdown)
- Habitat extent, thickness, and connectivity remain largely unaffected in the area where stygofauna unique to the Development Envelope were recorded (south-western corner of BS2).

Direct impacts of the Proposal on stygofauna focus only on species considered to be potentially restricted to within the impact assessment area. The species, locations they were collected from, and the number of individuals collected are shown in Table 9-10. Figure 9-38 shows these species in the context of habitat post mining (2050).

Table 9-10: Potentially Restricted Stygofauna Species within the BS2 Assessment Area

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Amphipoda			
Bogidiella `sp. B05'	Singleton	1	1
Paramelitidae `sp. Biologic-AMPH012'	Singleton	1	1
Ostracoda			
Areacandona nr triangulum	4.6 km (occurs at BS1)	7	5

Brockman Syncline 3 Assessment Area

Direct impacts of the Proposal on stygofauna habitats within the BS3 assessment area, as detailed in Table 9-8, are predicted to result in:

- Impact to approximately 37% of the pre-impact BWT habitat (at the end of mining 2050/ groundwater drawdown)
- A reduction in the thickness and connectivity of BWT habitat throughout the BS3 section, due to the increased influence of numerous dykes within the bedrock as the water table declines.

Direct impacts of the Proposal on stygofauna focused only on those species considered to be potentially restricted to within the impact assessment area. These species, the locations they were collected from, and the number of individuals collected are shown in Table 9-11. Figure 9-39 shows these species in the context of habitat post mining (2050).

Table 9-11: Potentially Restricted Stygofauna Species within the BS3 Assessment Area

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Amphipoda			
Paramelitidae `sp. Biologic-AMPH015` *	11 km	44	6
Paramelitidae `sp. Biologic-AMPH047` *	Singleton	1	1
Paramelitidae `sp. Biologic-AMPH048` *	Singleton	1	1
Isopoda			

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Microcerberidae `sp. Biologic-ISOP026` *	Singleton	1	1
Syncarida			
Parabathynellidae `sp. Biologic-PBAT004`*	2 km	22	5
Parabathynellidae `sp. Biologic-PBAT012` *	1 km	10	4
Parabathynellidae `sp. Biologic-PBAT005` *	0.8 km	7	2
Acari			
Pezidae `sp. BS3X` *	Singleton	1	1
Copepoda			
Anzcyclops? `sp. BS3` *	4.5 km	2	1
Calanoida `sp. Biologic-CALA002` *	Singleton	1	1

* only located within Boolgeeda Creek hyporheic

Brockman Syncline 4 Assessment Area

Direct impacts of the Proposal on stygofauna habitats within the BS4 assessment area, as detailed in Table 9-8, are predicted to result in:

- Impact to approximately 28% of the pre-impact BWT habitat (at the end of mining 2050/ groundwater drawdown)
- The pre-mining extent and thickness of the BWT habitat at BS4 appears naturally variable and fragmented.
- No stygofauna species are known to occur within the direct impact area of the BWT habitats at BS4.

Fifteen stygofauna taxa were recorded further north within the BS4 section, from hyporheic sampling at Boolgeeda Creek. The hyporheic habitats of Boolgeeda Creek are not expected to be directly impacted, therefore these stygofauna species are addressed under the indirect impacts section below.

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Figure 9-37
Direct Impacts of the Proposal on Stygofauna Assessed within the BS1 Assessment Area Post Mining (2050)

Drawn: L.Fuentes
Plan: PDE0190329v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

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Stygofauna Records - Brockman 1

Clitellata
- Enchytraeidae `sp. Biologic-OLIG052`
- Phreodrilidae `sp. Biologic-OLIG002`

Malacostraca
- Bogidiellidae `sp. Biologic-AMPH011`
- Brevisomabathynella sp. B03
- Parabathynellidae `sp. Biologic-PBAT003`

Maxillopoda
- Diacyclops `sp. Biologic-CYCL029`

Ostracoda
- Areacandona nr triangulum
- Areacandona sp. BOS1020

Brockman 4

Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- Zone A Modelling
- Zone B Modelling Boundary

Habitat Thickness (m)

Zone A
- 0 - 20
- 21 - 50
- 51 - 75
- 76 - 100
- 101 - 225

Habitat Thickness (m)

Zone B
- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 225

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access

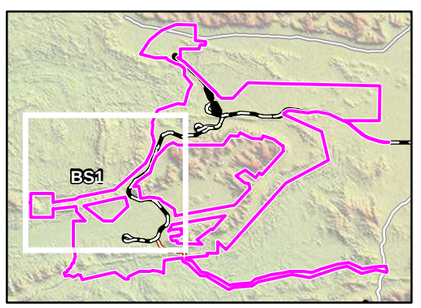

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Figure 9-38
Direct Impacts of the Proposal on Stygofauna Assessed within the BS2 Assessment Area Post Mining (2050)

Drawn: L.Fuentes
Plan: PDE0190331v1
Date: September 2022
Proj: GDA 1994 MGA Zone 50
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Stygofauna Records - Brockman 2

Malacostraca
- Bogidiella sp. B05
- Paramelitidae `sp. Biologic-AMPH012`

Ostracoda
- Areacandona nr triangulum

Nammuldi

Brockman 2

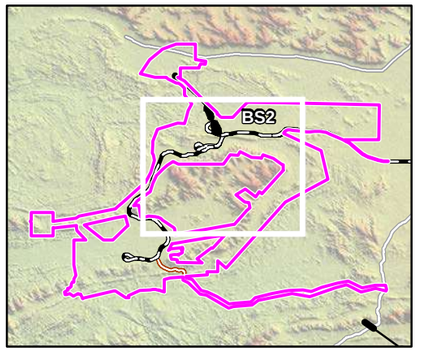
Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barriers (Potential)
- Zone A Modelling
- Zone B Modelling Boundary

Habitat Thickness (m)
Zone A
- 0 - 20
- 21 - 50
- 51 - 75
- 76 - 100
- 101 - 225

Habitat Thickness (m)
Zone B
- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 225

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor



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Map units in metres

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Figure 9-39
Direct Impacts of the Proposal on Stygofauna Assessed within the BS3 Assessment Area Post Mining (2050)

Drawn: L.Fuentes
Plan: PDE0190333v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
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Brockman 2

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Stygofauna Records - Brockman 3

Arachnida
- Pezidae `sp. BS3X`

Malacostraca
- Paramelitidae `sp. Biologic-AMPH015`
- Paramelitidae `sp. Biologic-AMPH047`
- Paramelitidae `sp. Biologic-AMPH048`
- Microcerberidae `sp. Biologic-ISOP026`
- Parabathynellidae `sp. Biologic-PBAT004`
- Parabathynellidae `sp. Biologic-PBAT005`
- Parabathynellidae `sp. Biologic-PBAT012`

Maxillopoda
- Anzcyclops? `sp. BS3`
- Calanoida `sp. Biologic-CALA002`

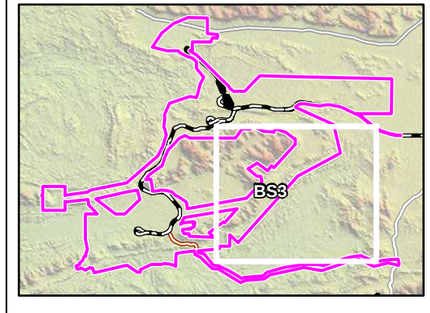
Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- Zone A Modelling
- Zone B Modelling Boundary

Habitat Thickness (m)
Zone A
- 0 - 20
- 21 - 50
- 51 - 75
- 76 - 100
- 101 - 225

Habitat Thickness (m)
Zone B
- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 225

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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Map units in metres

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9.4.1.2. Loss of Individuals or Reduction in Troglofauna Habitat through Mining

Suitable habitat for troglofauna (AWT) is directly impacted and reduced by mining/ excavation, therefore the proposed pits comprise the direct impact areas for troglofauna assessment. The habitat remaining at the end of mining within each assessment area is presented in Table 9-12.

Direct impacts of the Proposal on troglofauna habitats from the Proposal is predicted to result in impact to approximately 5% of the pre-impact AWT habitat.

Further detailed for each assessment area are provided in the sections below.

Table 9-12: Volumetric Impacts to Troglofauna Habitat at End of Mining (2050)

Habitat Zone	BS1	BS2	BS3	BS4	Total
Modelled Suitable Habitat (m^3) ('000)					
Zone A AWT	1,071,370	2,880,540	1,556,440	1,818,320	7,326,670
Zone B AWT	965,240	3,477,724	1,343,470	2,319,023	8,105,457
Total AWT	**2,036,610**	**6,358,264**	**2,899,910**	**4,137,343**	**16,397,367**
Habitat Reduction from the Proposal (m^3) ('000)					
Zone A AWT	226,380	73,800	158,640	166,300	625,120
Zone B AWT	30,100	10,100	28,703	39,301	108,204
Total AWT	**256,480**	**83,900**	**187,343**	**205,601**	**733,324**
Total Habitat Remaining %					
Zone A AWT	78.9	97.4	89.8	90.9	91.5
Zone B AWT	96.9	99.6	97.9	98.3	98.6
Total AWT	**87.4**	**98.6**	**93.5**	**95.0**	**89.6**

Brockman Syncline 1 Assessment Area

Direct impacts of the Proposal on troglofauna habitats at BS1, as detailed in Table 9-12, are predicted to result in:

- Impact to approximately 13% of the pre-impact AWT habitat at the end of mining (2050)
- 3D modelling shows a limited reduction in habitat thickness in certain areas.

Direct impacts of the Proposal on troglofauna species focused only on those species considered to be potentially restricted to within the impact assessment area. These species, the locations they were collected from, and the number of individuals collected are shown in Table 9-13, whilst Figure 9-40 shows these species in the context of habitat post mining (2050).

Table 9-13: Potentially Restricted Troglofauna Species within the BS1 Assessment Area

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Araneae			
Araneae `sp. Biologic-ARAN005`	1.7 km	2	2
Palpigradi			
Palpigradi `sp. Biologic-PALP010`	Singleton	1	1
Pseudoscorpiones			
Chthoniidae `sp. Biologic-PSEU004`	580 m	4	4

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Chthoniidae `sp. Biologic-PSEU006`	1.0 km	3	3
Schizomida			
Draculoides `sp. Biologic-SCHI017`	2.0 km	4	4
Draculoides `sp. Biologic-SCHI019`	15.7 km	11	9
Geophilomorpha			
Geophilomorpha `sp. Biologic-CHIL007	4 collected from one location	4	1
Diplura			
Japygidae `sp. Biologic-DIPL008`	Singleton	1	1
Japygidae `sp. Biologic-DIPL014`	Singleton	1	1
Projapygidae `sp. Biologic-DIPL003`	Singleton	1	1
Projapygidae `sp. Biologic-DIPL013`	Singleton	1	1
Blattodea			
Nocticola `sp. Biologic-BLAT005`	1.6 km	4	4
Nocticola `sp. Biologic-BLAT006`	2.0 km	5	3
Coleoptera			
Coleoptera `sp. Biologic-COLE003`	Singleton	1	1
Ptinella? `sp. BS1`	4 collected from one location	4	1
Staphylinidae? `sp. BS1`	3 collected from one location	3	1
Isopoda			
Armadillidae `sp. Biologic-ISOP002`	2 collected from one location	2	1

Brockman Syncline 2 Assessment Area

Direct impacts of the Proposal on troglofauna habitats at BS2, as detailed in Table 9-12, is predicted to result in:

- Impact to approximately 2% of the pre-impact AWT habitat at the end of mining (2050)
- 3D Modelling shows negligible change in habitat thickness, extent, or connectivity throughout BS2 assessment area.

Direct impacts of the Proposal on troglofauna species focused only on those species considered to be potentially restricted to within the impact assessment area. These species, the locations they were collected from, and the number of individuals collected are shown in Table 9-14, whilst Figure 9-41 shows these species in the context of habitat post mining (2050).

Table 9-14: Potentially Restricted Troglofauna Species within the BS2 Assessment Area

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Palpigradi			
Palpigradi `sp. Biologic-PALP007`	Singleton	1	1
Pauropoda			
Pauropoda `sp. Biologic-PAUR007`	1.2 km	2	2
Symphyla			

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Hanseniella `sp. Biologic-SYMP001`	Singleton	1	1
Hanseniella `sp. Biologic-SYMP003`	16.4 km	5	5
Blattodea			
Nocticola `sp. Biologic-BLAT008`	18 km	9	10
Zygentoma			
Nicoletiinae `sp. Biologic-ZYGE005	2.4 km	3	3

Brockman Syncline 3 Assessment Area

Direct impacts of the Proposal on troglofauna habitats at BS3, as detailed in Table 9-12, is predicted to result in:

- Impact to approximately 7% of the pre-impact AWT habitat at the end of mining (2050)
- 3D modelling shows a small reduction in habitat thickness in the location of the proposed pits, but the overall extent of suitable AWT habitats remains unaffected. Patches of thick AWT habitats remain in-situ throughout BS3.

Direct impacts of the Proposal on troglofauna species focused only on those species considered to be potentially restricted to within the impact assessment area. These species, the locations they were collected from, and the number of individuals collected are shown in Table 9-15, whilst Figure 9-42 shows these species in the context of habitat post mining (2050).

Table 9-15: Potentially Restricted Troglofauna Species within the BS3 Assessment Area

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Araneae			
Prethopalpus `sp. Biologic-ARAN001`	Singleton	1	1
Prethopalpus `sp. Biologic-ARAN023`	Singleton	1	1
Palpigradi			
Palpigradi `sp. Biologic-PALP003`	0.2 km	2	2
Palpigradi `sp. Biologic-PALP004`	3.3 km	2	2
Palpigradi `sp. Biologic-PALP031`	Singleton	1	1
Pseudoscorpiones			
Chthoniidae `sp. Biologic-PSEU007`	Singleton	1	1
Pauropoda			
Pauropoda `sp. Biologic-PAUR013`	Singleton	1	1
Pauropoda `sp. Biologic-PAUR038`	Singleton	1	1
Pauropoda `sp. Biologic-PAUR039`	Singleton	1	1
Symphyla			
Hanseniella `sp. Biologic-SYMP003`	16.7 km	5	2
Diplura			
Japygidae `sp. Biologic-DIPL028`	27.1 km	2	2
P*arajapygidae* `sp. Biologic-DIPL007	Singleton	1	1
Projapygidae `sp. Biologic-DIPL032	Singleton	1	1
Isopoda			
Buddelundia? `sp. Biologic-ISOP005`	Singleton	1	1

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
I*sopoda* `sp. Biologic-ISOP007`	Singleton	1	1
Blattodea			
Nocticola `sp. Biologic-BLAT008	18.6 km	10	2
Coleoptera			
Calanoida `sp. Biologic-COLE002`	Singleton	1	1
Zygentoma			
Nicoletiinae `sp. Biologic-ZYGE006`	2.3 km	2	2
Nicoletiinae `sp. Biologic-ZYGE007`	Singleton	1	1

Brockman Syncline 4 Assessment Area

Direct impacts of the Proposal on troglofauna habitats at BS4, as detailed in Table 9-12, is predicted to result in:

- Impact to approximately 5% of the pre-impact AWT habitat at the end of mining (2050)
- 3D modelling shows a small reduction in habitat thickness in the location of the proposed pits, but the overall extent of suitable AWT habitats remains unaffected.

Direct impacts of the Proposal on troglofauna species focused only on those species considered to be potentially restricted to within the impact assessment area. These species, the locations they were collected from, and the number of individuals collected are Table 9-16 whilst Figure 9-43 shows these species in the context of habitat post mining (2050).

Table 9-16: Potentially Restricted Troglofauna Species within the BS4 Assessment Area

Taxon	Linear Range	Number of Individuals Collected	Number of Collection Locations
Pseudoscorpiones			
Chernetidae `sp. Helix marra mamba`	Singleton	1	1
Chthoniidae `sp. Helix marra mamba`	Singleton	1	1
Troglochernes sp. indet.	Singleton	1	1
Schizomida			
Paradraculoides `sp. Helix marra mamba`	15.7 km	13	8
Diplura			
Japygidae `sp. Biologic-DIPL028`	27.7 km	3	3
Japygidae `sp. Helix marra mamba`	Singleton	1	1
Isopoda			
Armadillidae `sp. Helix-I1`	3 from one location	3	1
Armadillidae `sp. Helix-I2`	Singleton	1	1
Coleoptera			
Staphylinidae `sp. Helix-C6`	Singleton	1	1

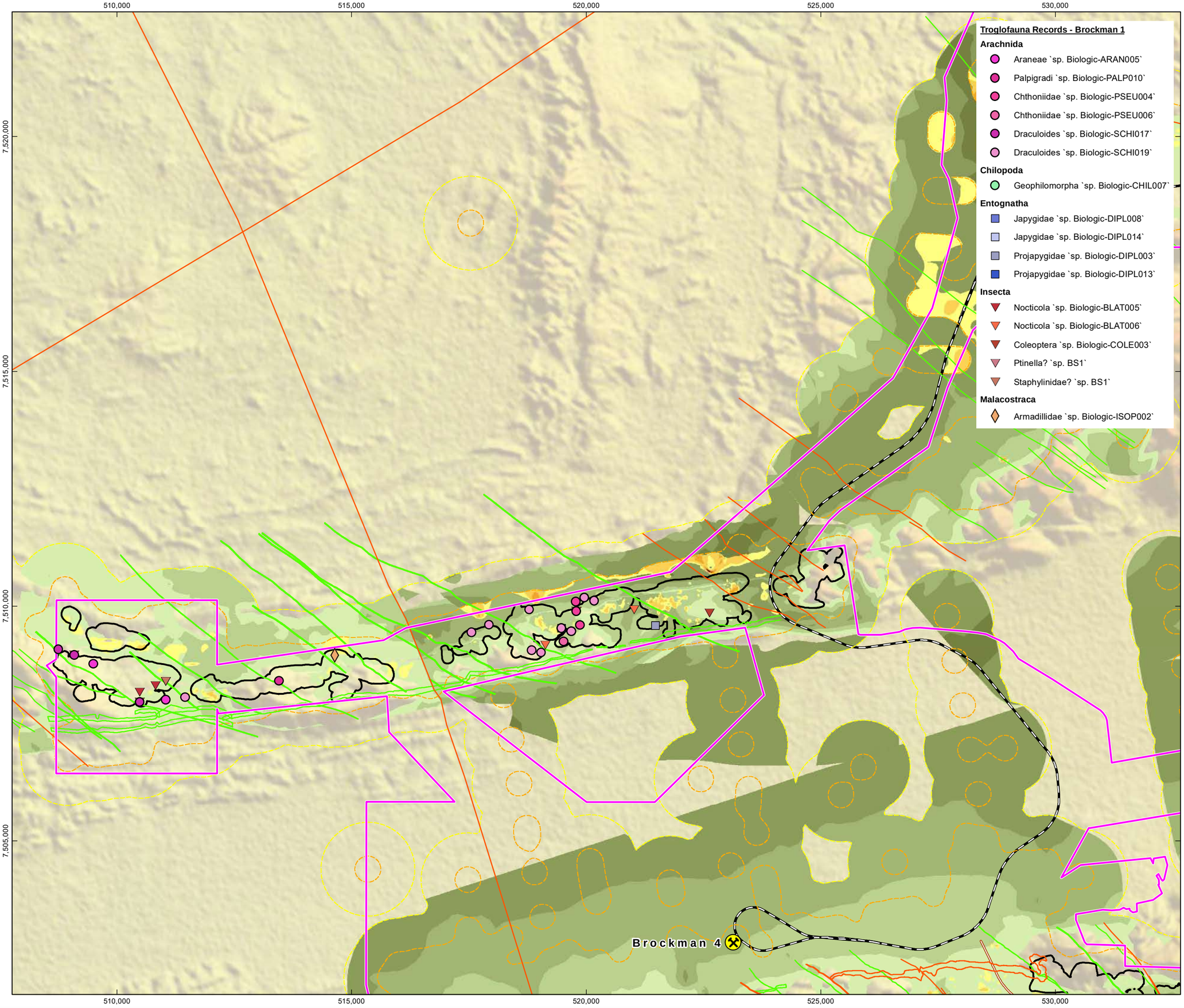

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Figure 9-40
Direct Impacts of the Proposal on Troglofauna Assessed within the BS1 Assessment Area Post Mining (2050)

Drawn: L.Fuentes
Plan: PDE0190335v1
Date: September 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- Zone A Modelling
- Zone B Modelling Boundary

Habitat Thickness (m)

Zone A

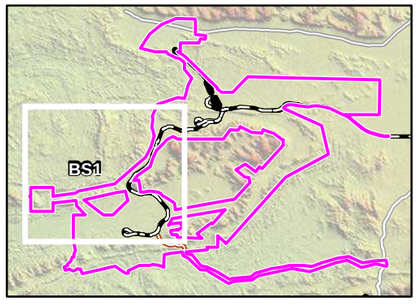
- 0 - 20
- 21 - 50
- 51 - 75
- 76 - 100
- 101 - 225

Habitat Thickness (m)

Zone B

- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 225

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



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Map units in metres

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Figure 9-41
Direct Impacts of the Proposal on Troglofauna Assessed within the BS2 Assessment Area Post Mining (2050)

Drawn: L.Fuentes
Plan: PDE0190336v1
Date: September 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
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Nammuldi

Brockman 2

Troglofauna Records - Brockman 2

Arachnida
- Palpigradi `sp. Biologic-PALP007`

Insecta
- Nicoletiinae `sp. Biologic-ZYGE005`
- Nocticola `sp. Biologic-BLAT008`

Pauropoda
- Pauropoda `sp. Biologic-PAUR007`

Symphyla
- Hanseniella `sp. Biologic-SYMP001`
- Hanseniella `sp. Biologic-SYMP003`

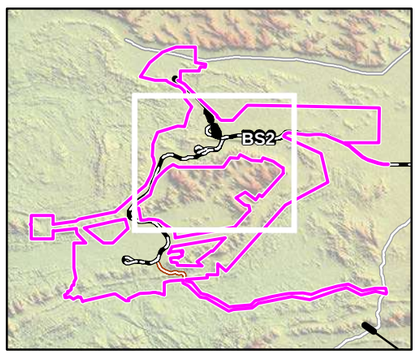
Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- Zone A Modelling
- Zone B Modelling Boundary

Habitat Thickness (m)
Zone A
- 0 - 20
- 21 - 50
- 51 - 75
- 76 - 100
- 101 - 225

Habitat Thickness (m)
Zone B
- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 225

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor



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Kilometers

Map units in metres

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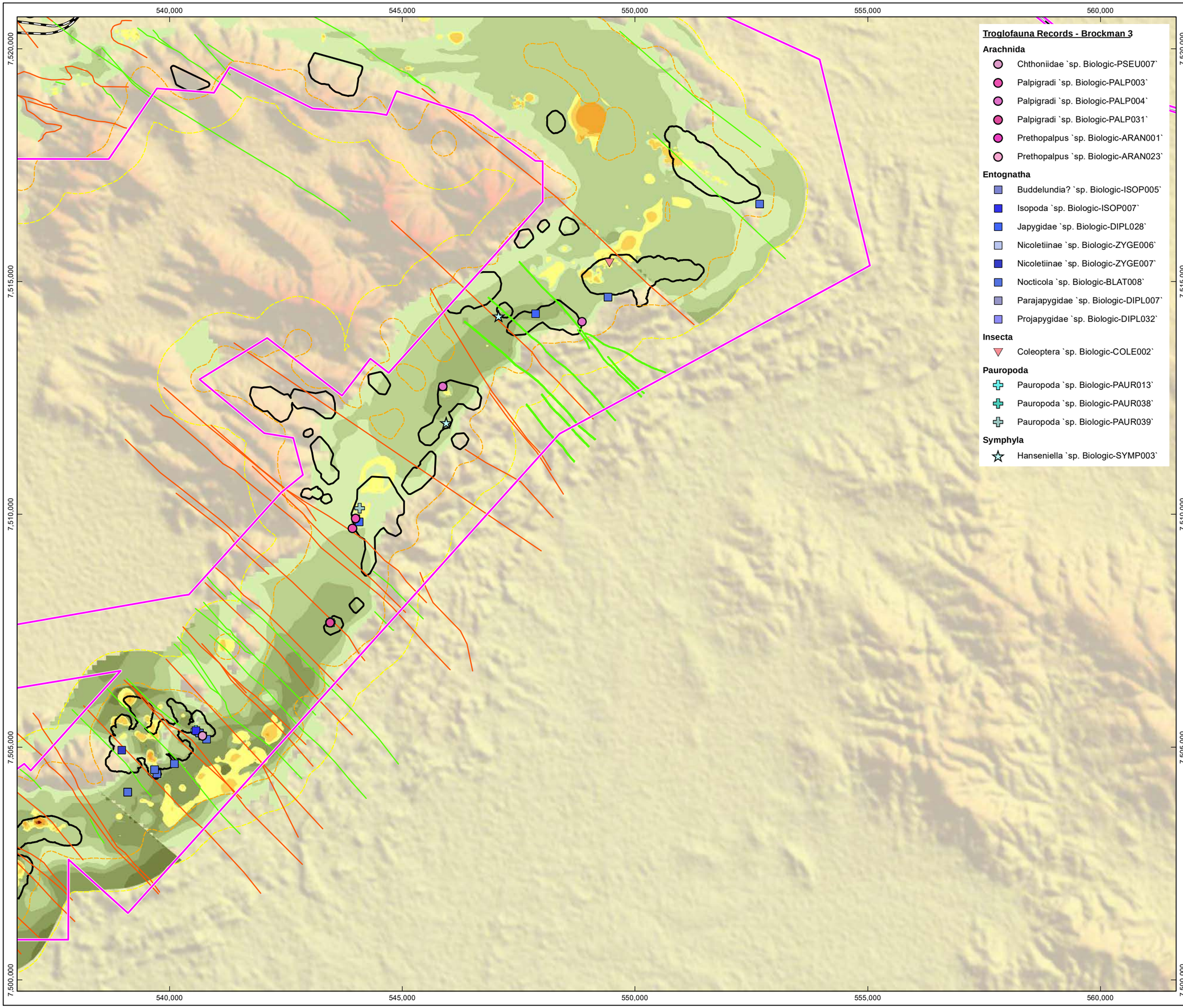

Troglofauna Records - Brockman 3

Arachnida
- Chthoniidae `sp. Biologic-PSEU007`
- Palpigradi `sp. Biologic-PALP003`
- Palpigradi `sp. Biologic-PALP004`
- Palpigradi `sp. Biologic-PALP031`
- Prethopalpus `sp. Biologic-ARAN001`
- Prethopalpus `sp. Biologic-ARAN023`

Entognatha
- Buddelundia? `sp. Biologic-ISOP005`
- Isopoda `sp. Biologic-ISOP007`
- Japygidae `sp. Biologic-DIPL028`
- Nicoletiinae `sp. Biologic-ZYGE006`
- Nicoletiinae `sp. Biologic-ZYGE007`
- Nocticola `sp. Biologic-BLAT008`
- Parajapygidae `sp. Biologic-DIPL007`
- Projapygidae `sp. Biologic-DIPL032`

Insecta
- Coleoptera `sp. Biologic-COLE002`

Pauropoda
- Pauropoda `sp. Biologic-PAUR013`
- Pauropoda `sp. Biologic-PAUR038`
- Pauropoda `sp. Biologic-PAUR039`

Symphyla
- Hanseniella `sp. Biologic-SYMP003`

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Figure 9-42
Direct Impacts of the Proposal on Troglofauna Assessed within the BS3 Assessment Area Post Mining (2050)

Drawn: L.Fuentes
Plan: PDE0190337v1
Date: September 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

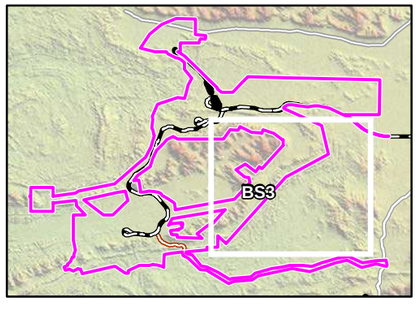
Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barrier (Potential)
- Zone A Modelling
- Zone B Modelling Boundary

Habitat Thickness (m)
Zone A
- 0 - 20
- 21 - 50
- 51 - 75
- 76 - 100
- 101 - 225

Habitat Thickness (m)
Zone B
- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 225

- Rio Tinto Mine
- Rio Tinto Railway



N

0 1 2 3
Kilometers

Map units in metres

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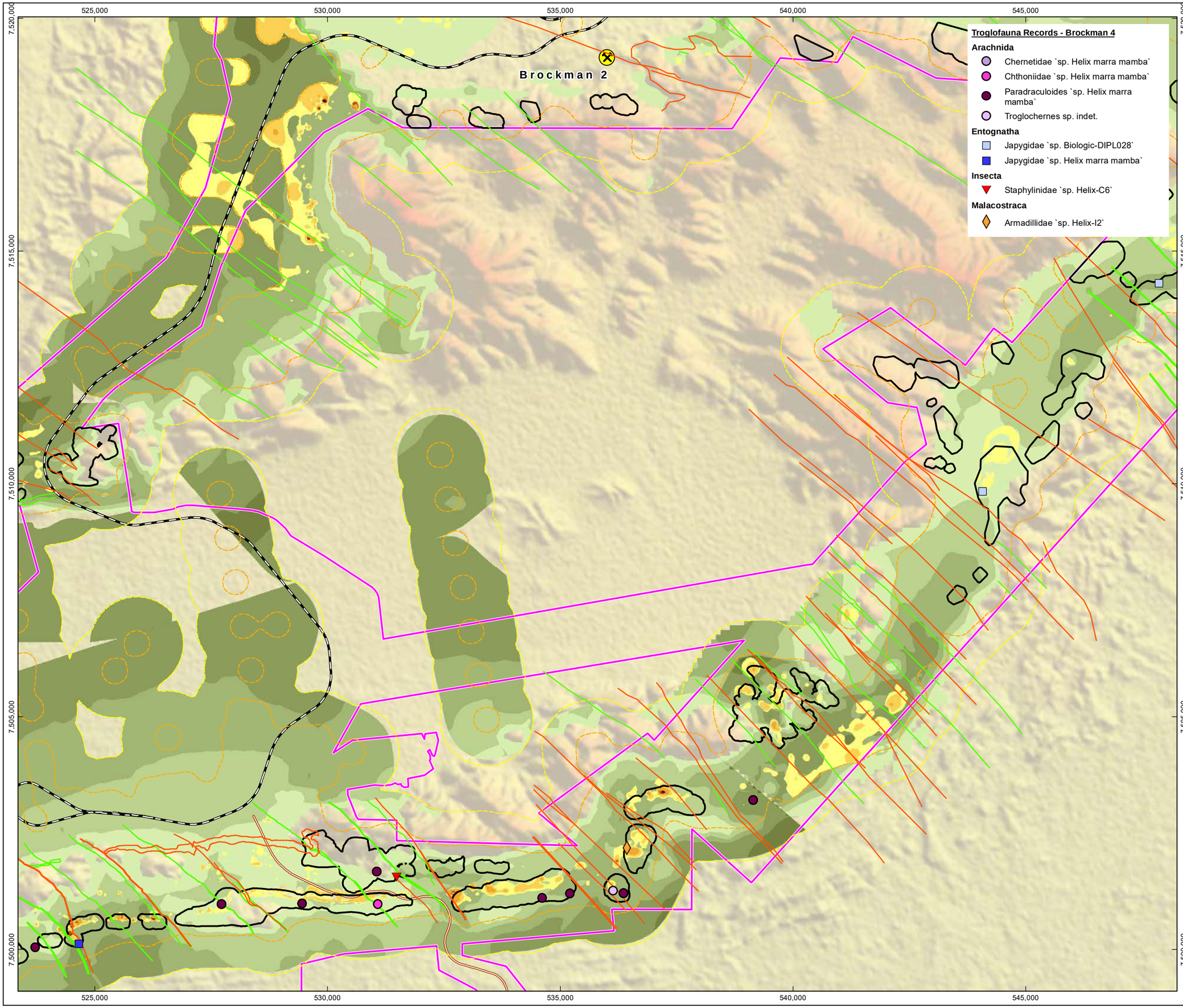

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Figure 9-43
Direct Impacts of the Proposal on Troglofauna Assessed within the BS4 Assessment Area Post Mining (2050)

Drawn: L.Fuentes
Plan: PDE01900338v1
Date: September 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:75,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Proposed Pit
- Hydraulic Barrier (Confirmed)
- Hydraulic Barriers (Potential)
- Zone A Modelling Boundary
- Zone B Modelling Boundary

Habitat Thickness (m)

Zone A

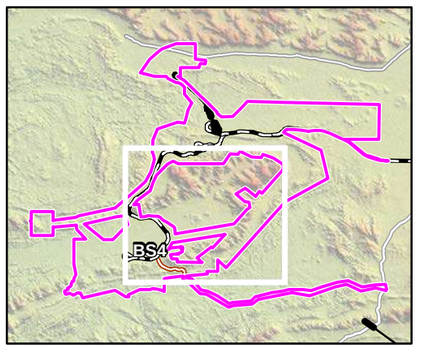
- 0 - 20
- 21 - 50
- 51 - 75
- 76 - 100
- 101 - 225

Habitat Thickness (m)

Zone B

- 0 - 30
- 31 - 60
- 61 - 90
- 91 - 120
- 121 - 150
- 151 - 225

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access



N

0 1 2 3
Kilometers

Map units in metres

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9.4.2. Indirect Impacts

Potential indirect impacts from the Proposal to subterranean fauna have been identified as:

- Changes to surface inputs of flow/volume of water, nutrients and oxygen from:
  - Construction of waste landforms, stockpiles and WFSFs
  - Vegetation clearing
  - Changed hydrological regime.
- Changes to the structure and presence of underground voids from:
  - Sedimentation and fill (beneath waste landforms, stockpiles and WFSFs)
  - Compaction, blasting/shock and vibration.
- Desiccation of subterranean habitat from:
  - Groundwater drawdown
  - Changes to surface infiltration
- Fragmentation of previously connected/contiguous habitat by excavation
- Contamination from spills, leaching and environmental incidents.
- Mounding of groundwater as a result from water storage in pit voids

This assessment considers the areas of proposed waste landforms, stockpiles, and WFSFs as the major indirect impact areas, mainly for troglofauna habitats (AWT), but also in some cases stygofauna habitats (BWT), due to the potential for reduced infiltration from the surface, and the risk of cavity fill from clays and fine sediments. The risks of similar impacts in the wider footprint beyond WRLs and WFSFs (i.e., areas of vegetation clearing, construction, land surface changes and seepage) are likely to be more localised and therefore not significant.

The risk of inundation to troglofauna habitat (AWT) from changed hydrological flows is expected to be effectively managed by surface water management practices. Local surface water management plans are developed for each deposit area prior to commencement of mining. Groundwater drawdown may have an indirect impact on hydrogeological flows within remnant stygofauna habitat (BWT), but this is unlikely to be significant beyond the direct reduction of habitat from groundwater drawdown.

The risk of compaction, vibration, and shock to subterranean habitats in the dominant geological setting of the Development Envelope (banded iron formations) is unlikely to propagate more than a few metres beyond proposed pits or excavation areas (EPA 2012), and infrastructure or roads at the surface. Based on the comparatively vast extent of suitable habitat throughout the Development Envelope, these risks are minimal.

The risk of desiccation to AWT habitat from groundwater drawdown and surface cover changes is difficult to assess or model on available information. Troglofauna require a near-saturated humid atmosphere within their subterranean cavities, and it is likely that both surface infiltration and groundwater may have an influence on the humidity of the suitable habitat. The assessment considered the pre-mining water table depth and the area of habitat covered by proposed waste landforms, stockpiles, and WFSFs in relation to potential desiccation risks.

The risks of habitat fragmentation to subterranean species and assemblages are assessed on a case-by-case basis for each impact scenario as described in section 9.3. Some subterranean species are naturally more dispersal-limited than others, and most of the subterranean habitats within the Brockman Syncline are subject to partial habitat barriers formed by dykes and sills. Therefore, the assessment considered habitat factors alongside ecological characteristics and known species ranges to determine the likelihood of indirect impacts of fragmentation.

The risk of contamination to subterranean habitat from spills, leachates, and environmental incidents is expected to be effectively managed by spill and incident management practices, and appropriate engineering controls around tailings facilities and chemical storage and use areas.

Should localised mounding occur it is not expected to significantly impact troglofauna habitats nor result in a change in status of a troglofauna species or group.

9.4.3. Cumulative Impacts

The Brockman Syncline aquifer system is primarily a closed system with little connection with the surrounding lithologies (Section 6.3.3.1), therefore only Proposals situated either close to the Proposal (troglofauna) or Proposals within the confines of the aquifer system (stygofauna) will result in cumulative impacts.

9.4.3.1. Stygofauna

The 'cumulative' scenario of BWT modelled habitat remaining was calculated from the combined direct impacts of historical and reasonably foreseeable mining operations, representing a maximum, worst-case scenario. The cumulative impact scenario considered the combined impacts of:

- Pits and groundwater drawdown impacts from 'current approved (including historical)' and 'proposed' scenarios
- Potential evaporative losses from open BWT pits following closure, at year 2350
- Third-party groundwater drawdown impacts at BS1 from the neighboring Fortescue Metals Group (FMG) Eliwana operations.

The data used for modelling third-party groundwater drawdown impacts comprised digitised drawdown contours published as part of FMG approval documents for the Eliwana project. The data, assumptions, and constraints/ limitations of the third-party drawdown modelling are limited to the published approval documents for the Eliwana project (FMG 2018a).

Cumulative impacts of the Proposals (including current predicted impacts) on stygofauna values are expected to result in an impact to approximately:

- 65% of BWT habitat within the BS1 assessment area
- 64% of BWT habitat within the BS2 assessment area
- 48% of BWT habitat within the BS3 assessment area
- 42% of BWT habitat within the BS4 assessment area.

The impact rankings of stygofauna taxa remain the same under both the proposed and cumulative scenarios, except for three species (Paramelitidae `sp. Biologic-AMPH012` within the BS2 assessment area and Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003`within the BS1 assessment area), which have increased from medium under the proposed LoM scenario to high under the cumulative impact scenario. These species are discussed further in Section 9.6.3.1.

9.4.3.2. Troglofauna

Cumulative impacts on AWT troglofauna habitat have been assessed based on modelling of a combination of direct impacts from current/ approved Rio Tinto mining operations within the syncline and proposed mining operations associated with the Proposal at end of life of mine (2050).

Due to the lack of available information (3d pit-shell data) in the public domain it was not possible to quantify the cumulative impact of FMG's Eliwana operations using the habitat modelling methodology applied in the rest of this assessment. It was however noted from the Proponents ERD that the mine pits did not represent isolated troglofauna habitats within the Development Envelope and that there was

suitable connectivity between habitations within and outside of the mine pits and therefore the Proposal was unlikely to pose a significant impact to troglofauna.

Cumulative impacts of the Proposal on troglofauna values are expected to result in an impact to approximately:

- 14% of AWT habitat within the BS2 assessment area
- 28% of AWT habitat within the BS4 assessment area.

The impact rankings of troglofauna taxa remain the same under both the proposed and cumulative scenarios.

9.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids and minimises, where practicable, impacts on subterranean fauna and habitat present in the Development Envelope.

Table 9-17 summarises how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during proposal design to develop appropriate mitigation and management strategies to address the key potential impacts on Subterranean Fauna, whilst the sections below provide detailed information on each in relation to Subterranean Fauna.

Table 9-17: Mitigation Measures for Subterranean Fauna

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Loss of individuals or reduction in stygofauna habitat Loss of individuals or reduction in troglofauna habitat	**Measures to Minimise**			
	• Pit dewatering will be minimised to that required to safely access below water table resources • The water management strategy includes the preferential discharge of surplus water to mine pits when they are available. This strategy will result in recharge at those locations and minimise the total export of water and groundwater drawdown within the Brockman syncline aquifers • Groundwater will be abstracted compliant with an approved Groundwater Licence and Operating Strategy, which will include the development of trigger and threshold levels for groundwater quality and levels • Updating/recalibration of groundwater models at least annually for the first five years reducing to tri-annually should no difference be observed between predicted and actual modelling.	Proposal Specific	Yes – Groundwater Licence limiting the total abstraction volume per annum and associated Groundwater Licence Operating Strategy	There are no industry or best practice standards established in relation to the protection of subterranean fauna and/or habitat protection. Minimisation of impacts to species and/or habitats is considered the most effective control.
	Measures to Rehabilitate			
	• Backfill of pits to reduce the potential drawdown extent post closure • Preparation and regular update of a Mine Closure Plan consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a).	Proposal Specific	No	Backfilling of pits to reduce potential drawdown extent post closure is considered an effective control in preventing long term drawdown
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Annual limit on groundwater abstraction		Ministerial condition with annual limit on groundwater abstraction	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Indirect Impacts				
	Measures to Minimise			
	• Clearing and/or disturbance to remain within the approved Development Envelope • Appropriate design of waste landforms specifically encapsulation of PAF waste rock and minimisation of oxidation to prevent changes to groundwater quality • Appropriate design of hazardous material storages in accordance with relevant guidelines and Australian Standards • Construction and maintenance of surface water drainage systems to control and contain runoff from mining areas and divert clean stormwater away from pits and other mining disturbance areas • Construction of TSF as per approved designs to minimise seepage • Monitoring of groundwater quality during operations • Provision of spill kits and implementation of spill management procedures.	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			
	• Backfill of pits with moderate or high risk of forming acidic pit lakes • Preparation and regular update of a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a)	Standard business practice	No	• Backfilling of pits with moderate or high risk of forming acidic pit lakes is considered an effective control in preventing contamination of local aquifers. • The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes, including backfill of pits (DMIRS 2020b).

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	• No limits proposed – managed through standard industry practices		N/A	

9.6. Assessment and Significance of Residual Impacts

Subterranean fauna habitat values were assessed based on the 3D habitat modelling. The 3D modelling facilitates EIA of potential impacts to subterranean fauna habitat values by providing:

- Quantification of the impacts to habitat resulting from various scenarios – volume of habitat reduced in m^3, and volume of habitat remaining in-situ as a proportion of the pre-impact volume (% remaining)
- Predicted changes to habitat thickness, connectivity, and extent under each scenario
- Predicted impacts on habitat quality in relation to groundwater physicochemical profiles measured on site.

Changes to habitat extent, thickness, and connectivity were assessed via 3D visual comparisons of the modelled habitat before and after the proposed mining/ groundwater drawdown, particularly in relation to potentially restricted subterranean fauna records. Additionally, for stygofauna, the potential suitability of the remaining BWT habitat in relation to groundwater quality was assessed, based on measurements using down-hole groundwater quality probes. The current groundwater profile (in relation to specific conductivity and dissolved oxygen) was modelled against the suitable 3D habitat in each assessment area, enabling a comparison of the likely groundwater profile before and after the proposed groundwater drawdown.

Direct and cumulative direct impacts were quantitatively assessed via 3D modelling, whereas indirect impacts were calculated by a 2D area assessment of proposed waste dumps/ stockpiles against the habitat remaining after the maximum impact scenario for each section of the syncline (i.e., combined long-term scenario, or cumulative scenario).

In consideration of the above, impacts to habitat values within each assessment area were allocated an overall impact ranking of High, Medium or Low as defined below:

- High impact – Modelled residual impacts would likely affect the long-term viability or persistence of the habitat values.
- Medium impact – Proposed management/ mitigation strategies would likely sufficiently reduce the residual impacts to ensure the long-term viability or persistence of the habitat values
- Low impact – The long-term viability or persistence of the values is not at risk.

The subterranean fauna species values assessment focused on unique taxa recorded only from the Development Envelope, as such widespread or putatively widespread taxa and known trogloxenes/troglophiles or stygoxenes/stygophiles were excluded. The known distribution of each taxon was then assessed in relation to the proposed mining or groundwater drawdown impacts, with consideration given to ecological factors and habitat factors influencing its potential wider distribution.

For troglofauna, the pits represented the direct impacts. For stygofauna, pits and areas of groundwater drawdown represented the direct impacts.

The overall assessment of direct impacts to habitat values (i.e., high, medium, or low impacts to each relevant area of habitat) within the known and potential range of each species, formed a key factor in the assessment of risks to troglofauna and stygofauna species. Each troglofauna or stygofauna species/ taxon was allocated an overall impact ranking of High, Medium, or Low as follows:

- High impact – Proposed residual impacts are likely to affect the long-term viability or persistence of the species values
- Medium impact – Proposed management/ mitigation strategies are likely to sufficiently reduce the residual impacts to ensure the long-term viability or persistence of the values
- Low impact – The long-term viability or persistence of the values is not at risk.

9.6.1. Assessment of Direct Residual Impacts

9.6.1.1. Loss of Individuals or Reduction in Stygofauna Habitat

Brockman Syncline 1 Assessment Area

3D habitat modelling (Table 9-8) has shown that a considerable thickness and extent (57%) of BWT habitat will remain throughout the BS1 assessment area (Figure 9-44 and Figure 9-45). This remaining habitat is expected to continue to support stygofauna assemblages based on:

- The occurrence of suitably porous, fractured, and weathered hydrostratigraphic formations above the aquifer basement within the remaining parts of the habitat
- Groundwater quality profiling showing that the dissolved oxygen and salinity conditions within the remaining parts of habitat (at depths between 70 m bgl and 135 m bgl) are within suitable ranges for stygofauna of between 1 – 3 mg/L (Biologic 2022d).

The recorded occurrence of several stygofauna species at considerable depths BWT (i.e., between 66 m and 93 m in BIF and between 118 m and 142 m in Wittenoom Dolomite (Biologic 2022d) in the BS1 section.

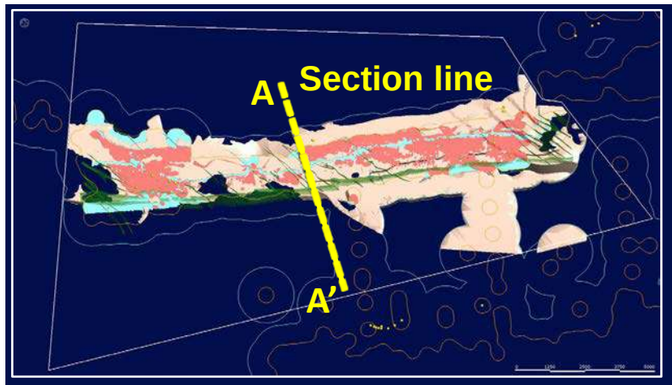
Direct impacts of the Proposal on stygofauna species, as summarised in Table 9-18, are considered medium for four taxa and low for four taxa. Additional Information for species considered to have medium impact ranking is provided in Table 9-19.

Table 9-18: Summary of Direct Impact Rank and Rationale for Stygofauna within the BS1 Assessment Area

Taxon	Likelihood of Occurring Beyond Direct impacts	Magnitude of Direct impacts	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Amphipoda				
Bogidiellidae `sp. Biologic-AMPH011`	Medium (occurs across central dyke)	Medium	High (BS1E), Medium (BS1W)	Medium
Syncarida				
Brevisomabathynella `sp. B03`	Low (stygobitic SRE, 2 adjacent sites)	Medium	High (BS1 central)	Medium
Parabathynellidae `sp. Biologic-PBAT003`	Low (stygobitic SRE singleton)	Medium	High (BS1 central)	Medium
Oligochaeta				
Enchytraeidae `sp. Biologic-OLIG052`	High (amphibious)	Medium	High (BS1E)	Low
Phreodrilidae `sp. Biologic-OLIG002`	Medium (typically widespread)	Medium	High (BS1E), Medium (BS1W)	Medium
Cyclopoida				
Diacyclops `sp. Biologic-CYCL029`	High (typically widespread)	Medium	High (BS1E)	Low
Ostracoda				
Areacandona nr triangulum	Confirmed (occurs at BS2)	Low	High (BS1E), likely high (BS2)	Low
Areacandona `sp. BOS1020`	Uncertain	Low	High (BS1E)	Low

Table 9-19: Additional Information for Stygofauna Species Considered to have Medium Impact Ranking within the BS1 Assessment Area

Taxon	Additional Information
B*revisomabathynella* `sp. B03`	*Brevisomabathynella* `sp. B03` and *Parabathynellidae* `sp. Biologic-PBAT003`were recorded from sites approximately 800 m apart in the central hydrogeological compartment immediately east of the major dyke in BS1 (Table 9-9). These two taxa were collected during different survey periods and were unable to be directly compared; therefore, potential synonymy cannot be excluded. Syncarid taxa are entirely stygobitic and almost always known from very localised ranges in the Pilbara region (Guzik et al. 2008; Matthews et al. 2020; Perina et al. 2018, 2019a; Perina et al. 2019b). Given the habitat compartmentalisation, and the detection of very few records despite repeated sampling throughout BS1, these taxa are conservatively treated as putatively restricted to the central compartment of BS1, east of the major dyke. Habitat modelling showed a medium level of impact to BWT habitats throughout BS1. The majority of remaining habitat is modelled within Zone B BWT (up to 80 m thick within the Mt Newman and Dales Gorge Members, and Wittenoom Dolomite) at depths from 70 m bgl - 150 m bgl (Figure 9-44). Physicochemical profiling data within the central compartment indicated broadly suitable conditions for stygofauna within this depth range (e.g. dissolved oxygen from 4.8 mg/L at 75mbgl to >8 mg/L at 90 mbgl (Biologic 2022d). The available data and 3D modelling suggest that deeper habitats suitable for these species is likely to persist in the central compartment east of the dyke at BS1.
Parabathynellidae `sp. Biologic-PBAT003`	
Bogidiellidae `sp. Biologic-AMPH011	Bogidiellidae `sp. Biologic-AMPH011 and Phreodrilidae `sp. Biologic-OLIG002`were recorded from linear ranges of approximately 11-12 km throughout BS1E and BS1W (Table 9-9). Given that the major dyke at BS1 forms a hydrogeological barrier (with a water table difference of 40 m from east to west) (EMM 2021), these taxa are unlikely to be able to cross this barrier. There is a possibility that the dyke could be periodically overtopped in flood conditions, and/ or a possibility that both taxa could range more widely beyond the synclinal aquifer at BS1, in areas to the north or south. Wider occurrence beyond BS1 has been established for similar, co-occurring stygofauna species (e.g., Phreodrillidae sp. 12, and amphipods such as Paramelitidae `sp. Helix-AMP037` and *Nedsia* `sp. WAM-AMPE003`) (Biologic 2021a). Surface drainage patterns have been shown to enter the BS1 valley from the Fortescue Group geologies to the north, draining southwards to Boolgeeda Creek in the middle of the syncline. Sampling in Boolgeeda Creek to date has only detected one shared species with BS1 (Paramelitidae `sp. Helix-AMP037`), but this does not exclude the possibility of wider occurrence beyond the synclinal aquifer for these species.
Phreodrilidae `sp. Biologic-OLIG002`	Habitat modelling showed a medium level of impact to BWT habitats throughout BS1. At BS1 east, remaining habitats in Zone A and B are thick (between 50-70 mbgl, and system basement at 150 m bgl) (Figure 9-44) and similar in extent to pre-impact habitats. Groundwater profiling throughout the section showed a range of suitable conditions for stygofauna at these depths (e.g., dissolved oxygen between 1.2 mg/L to 2.7 mg/L from 50 to 135 mbgl in Wittenoom Dolomite and Mt Newman Member at BS1E). At BS1 west, remaining habitats are thinner and less extensive than pre-impact with the water table in the proposed scenario at approximately 40 mbgl, and system basement at 100 mbgl. Groundwater conditions at depth in BS1W were variable, with western bores showing sharper declines in dissolved oxygen as depth increased, relative to eastern bores in BS1W (Biologic 2022d). The direct impacts to Phreodrilidae `sp. Biologic-OLIG002` and Bogidiellidae `sp. Biologic-AMPH011`, are considered medium, with high confidence in the persistence of suitable habitats throughout most of the known linear range of these species, particularly in the eastern section of BS1.



Suitable BWT habitat

- Zone A
- Zone B
- Low
- Stygofauna record
- EIA section outline
- Dyke
- 300 m Zone A confidence boundary
- 1000 m Zone B confidence boundary

A

A'

0 500 1000 1500

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Figure 9-44
Cross Section of the 3D Subterranean Habitat Model Showing BWT Habitats Post Mining (2050) within the BS1 Assessment Area

Drawn: L.Fuentes
Plan: PD ED190339vl
Date: July 2022

GIS.Team@riotinto.com

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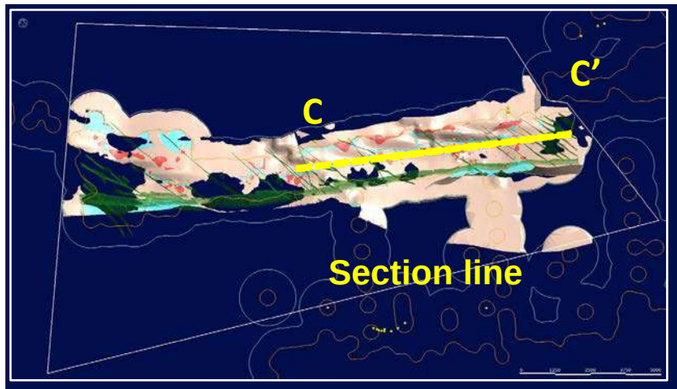

Suitable BWT habitat

- Zone A
- Zone B
- Low
- Stygofauna record
- EIA section outline
- Dyke
- 300 m Zone A confidence boundary
- 1000 m Zone B confidence boundary

C

C'

0 500 1000 1500

RioTinto

Figure 9-45
Long-section of the 3D Subterranean Fauna Model Showing BWT Habitats Post Mining (2050) within the BS1 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190340v1
Date: July 2022
GIS.Team@riotinto.com

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Brockman Syncline 2 Assessment Area

Habitat extent, thickness, and connectivity remain largely unaffected in the area where stygofauna unique to the Development Envelope where recorded (south-western corner of the BS2 assessment area) (Figure 9-46 and Figure 9-47).

Neighbouring third-party tenements in the south-west corner of BS2 assessment area limited access to drill hole information for the habitat model in the area where restricted stygofauna were found. It is expected that more extensive and continuous habitats continue to exist within the south-west corner of the BS2 assessment area following implementation of the Proposal.

The extent of prospective suitable BWT habitat within the BS2 assessment area is currently underrepresented in the 3D model due to the low density and shallowness of drill holes which limited the modelling of Habitat Zone A throughout much of the BS2 assessment area.

Three unique stygofauna taxa were included in the assessment for the BS2 assessment area. To date, none of these taxa are known to occur beyond the Greater Brockman Development Envelope.

Direct impacts of the Proposal on stygofauna species, as summarised in Table 9-20, are considered medium for one taxon and low for two taxa. Additional Information for species considered to have medium impact ranking is provided in Table 9-21.

Table 9-20: Summary of Direct Impact Rank and Rationale for Stygofauna within the BS2 Assessment Area

Taxon	Likelihood of Occurring Beyond Direct impacts	Magnitude of Direct impacts	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Amphipoda				
Bogidiellidae `sp. B05 `	Medium (singleton at BS2 west only)	Low	Medium (beyond modelling boundary	Low
Paramelitidae `sp. Biologic-AMPH012`	Medium (singleton at BS2 east only)	Medium	Medium (Zone B only)	Medium
Ostrocoda				
Areacandona nr triangulum	Confirmed (occurs at BS1)	Low	Medium	Low

Table 9-21: Additional Information for Stygofauna Species Considered to have Medium Impact Ranking within the BS2 Assessment Area

Taxon	Additional Information
Paramelitidae `sp. Biologic-AMPH012`	Paramelitidae `sp. Biologic-AMPH012` was recorded in the far south-eastern portion of the BS2 assessment area (Figure 9-38). Due to the numerous dykes providing hydrogeological barriers to the south in BS3, Paramelitidae `sp. Biologic-AMPH012` is considered reasonably unlikely to occur further south, it is more likely that this species could range further north or west in the eastern part of BS2 assessment area. It is possible that this species may occur more widely than currently recorded in areas less impacted, or elsewhere beyond the Brockman Syncline. The south-eastern portion of the BS2 assessment area appears less constrained by dykes perpendicular to the strike of the valley, and the higher oxygen saturation of the groundwater at depth suggests that the overlying strata (detritals, Mt Newman, and Wittenoom Dolomite) are sufficiently porous/fractured/weathered to facilitate more rapid transfer of infiltration from the surface. Suitable habitats are expected to occur at considerable depths based upon groundwater quality profiling (5-6 mgl/L dissolved oxygen levels in deep bores between 90 – 150 m bgl) (Figure 9-46) and stratigraphic modelling in Zone B (Mt Newman, and Wittenoom Dolomite) with approximately 25 – 30 m thickness of habitat remaining within this area. The overall reduction of prospective habitats within the BS2 assessment area is 36% (and cumulatively estimated at 64%). However, 3D modelling indicates that habitat extent, thickness, and connectivity remain largely unaffected in the area and more widely throughout the surrounding area. It should also be noted that the extent of prospective suitable BWT habitat within the BS2 assessment area is currently underrepresented.

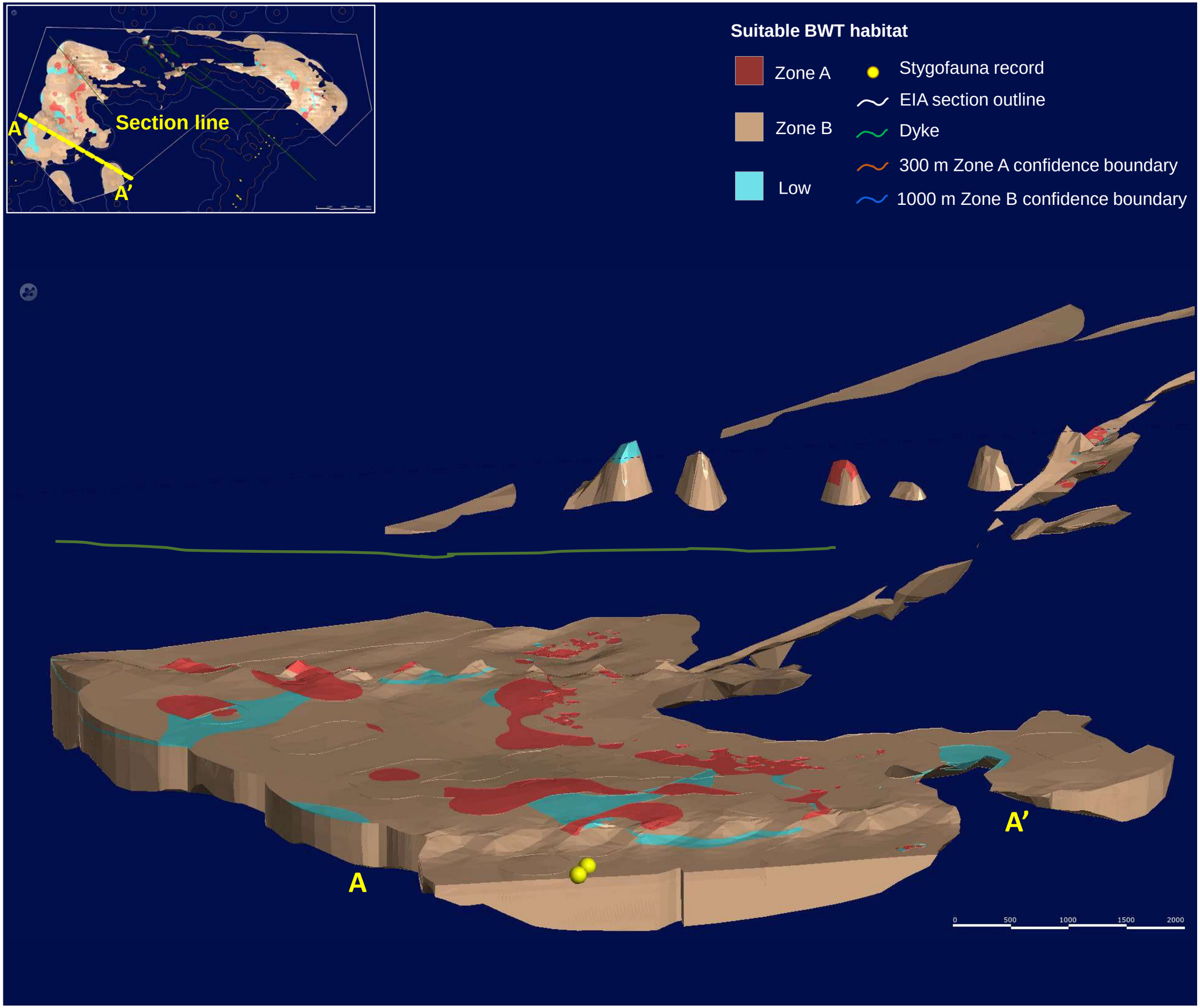

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Figure 9-46
Cross Section of the 3D Subterranean Habitat Model Showing BWT Habitats Post Mining (2050) within the BS2 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190341v1
Date: July 2022
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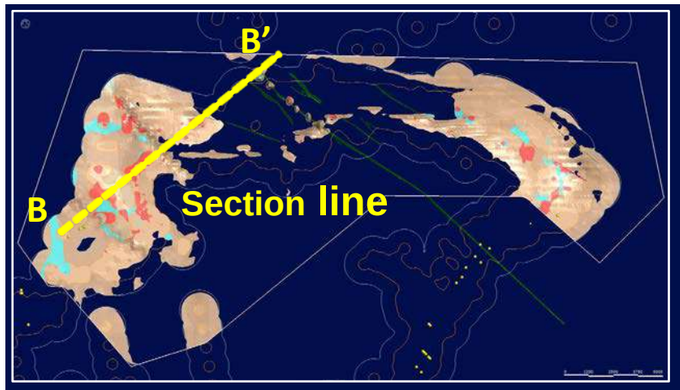

Suitable BWT habitat

- Zone A
- Zone B
- Low
- Stygofauna record
- EIA section outline
- Dyke
- 300 m Zone A confidence boundary
- 1000 m Zone B confidence boundary

B

B'

0 1000 2000 3000

RioTinto

Figure 9-47
Long-section of the 3D Subterranean Fauna Model Showing BWT Habitats Post Mining(2050) within the BS2 Assessment Area

Drawn: L.Fuentes

Plan: PDE0190342v1
Date: July 2022

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Brockman Syncline 3 Assessment Area

3D modelling has shown that a reasonable thickness and extent of BWT habitat will remain intact, within the BS3 assessment area (Figure 9-48 and Figure 9-49). Habitat remaining is expected to continue to support stygofauna assemblages, based on:

- The occurrence of suitably porous, fractured, and weathered hydrostratigraphic units (mainly within the Wittenoom Dolomite, and Mt Newman Member) above the system basement within Zone B BWT
- Groundwater quality profiling showing that dissolved oxygen and salinity conditions at depths (e.g., between 90 m bgl and 150 m bgl) are within suitable ranges for stygofauna (Biologic 2022d)
- The recorded occurrence of several stygofauna species at considerable depths BWT (i.e., between 68 m and 88 m in Mt Newman Member) within the BS3 assessment area (Biologic 2022d).

Direct impacts of the Proposal on stygofauna species, as summarised in Table 9-22, are considered medium for five taxa and low for five taxa. Additional Information for species considered to have medium impact ranking is provided in Table 9-23.

Table 9-22: Summary of Direct Impact Rank and Rationale for Stygofauna taxa within the BS3 Assessment Area

Taxon	Likelihood of Occurring Beyond Direct Impacts	Magnitude of Direct Impact	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Amphipoda				
Paramelitidae `sp. Biologic-AMPH015`	High - recorded in all areas of BS3	Medium (northern areas), Low (southern areas)	Medium (northern areas), High (southern areas)	Low
Paramelitidae `sp. Biologic-AMPH047`	High - singleton, southern compartment	Low	High (Zone A & B)	Low
Paramelitidae `sp. Biologic-AMPH048`	Medium - singleton, northern compartment	Medium	Medium (Zone B only)	Medium
Isopoda				
Microcerberidae `sp. Biologic-ISOP026`	Uncertain - singleton, central compartment, poorly known taxon	Medium	Medium (Zone B only)	Medium
Syncarida				
Parabathynellidae `sp. Biologic-PBAT004`	Low - short-ranging stygobite, northern compartment only	Medium	Medium (Zone B only)	Medium
Parabathynellidae `sp. Biologic-PBAT012`	Low - short-ranging stygobite, central compartment only	Medium	Medium (Zone B only)	Medium
Parabathynellidae `sp. Biologic-PBAT005`	High - short-ranging stygobite, southern compartment only	Low	High (Zone A & B)	Low

Taxon	Likelihood of Occurring Beyond Direct Impacts	Magnitude of Direct Impact	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Acari				
Pezidae `sp. BS3X`	Unlikely - group is typically stygoxenic	Medium	Medium (Zone B only)	Low
Copepoda				
Anzcyclops? `sp. BS3`	High – central and southern compartment	Low	High (Zone A & B)	Low
Calanoida `sp. Biologic-CALA002`	Uncertain - singleton, poorly known group	Medium	Medium (Zone B only)	Medium

Table 9-23: Additional Information for Stygofauna Species Considered to have Medium Impact Ranking within the BS3 Assessment Area

Taxon	Additional Information
Parabathynellidae `sp. Biologic-PBAT012`	Two taxa are known only from the central BS3 compartment, a syncarid recorded from four sites, Parabathynellidae `sp. Biologic-PBAT012`, and an isopod recorded from a single site Microcerberidae `sp. Biologic-ISOP026` (Figure 9-39). Owing to the occurrence of numerous dykes that may act as hydrogeological barriers, it is possible that these taxa do not occur more widely, although two other species are shared between the central and southern compartments. The habitats in the central compartment of BS3 within Zone B BWT are expected to remain suitable for stygofauna. The remaining habitat is modelled up to 60 m thick above basement within the weathered Mt Newman Member of the MMIF and Wittenoom Dolomite (Figure 9-48). Groundwater profiling at bores in the central compartment indicated broadly suitable conditions for stygofauna within this depth range (e.g. dissolved oxygen from 4.8 mg/L at 53 mbgl to 1.3 mg/L at 100 mbgl) (Biologic 2022d). Stygofauna taxa were recorded from bores slotted at depths between 56m and 88m in the central compartment and other compartments at BS3. Direct impacts are therefore ranked medium for both taxa. The 3D modelling has shown that a considerable thickness and extent of BWT habitat will remain in-tact, mainly within Zone B allowing these species to persist under the proposed scenario.
Microcerberidae `sp. Biologic-ISOP026`	
P*arabathynellidae* `sp. Biologic-PBAT004`	Three taxa are known only from the northern BS3 compartments assessment area (Parabathynellidae `sp. Biologic-PBAT004`, Paramelitidae `sp. Biologic-AMPH048 and Calanoida `sp. Biologic-CALA002`) are ranked as medium (Figure 9-39). Suitable habitats remain intact throughout the northern BS3 compartments in Zone B BWT under the proposed scenario. The remaining habitat is modelled up to 65 m thick above basement within the weathered Mt Newman Member of the MMIF and Wittenoom Dolomite (Figure 9-48). Groundwater profiling at bores in the northern compartment indicated suitable conditions for stygofauna (in relation to dissolved oxygen) at depths up to 90 mbgl, but most available bores were shallower in this section (Biologic 2022d). Stygofauna taxa were recorded from bores slotted at depths between 56 m and 88 m in the northern compartment and other compartments at BS3. The 3D modelling has shown that a considerable thickness and extent of BWT habitat will remain in-tact, mainly within Zone B allowing these species to persist under the proposed scenario.
Paramelitidae ‘sp Biologic-AMPH012	
Calanoida `sp. Biologic-CALA002`	

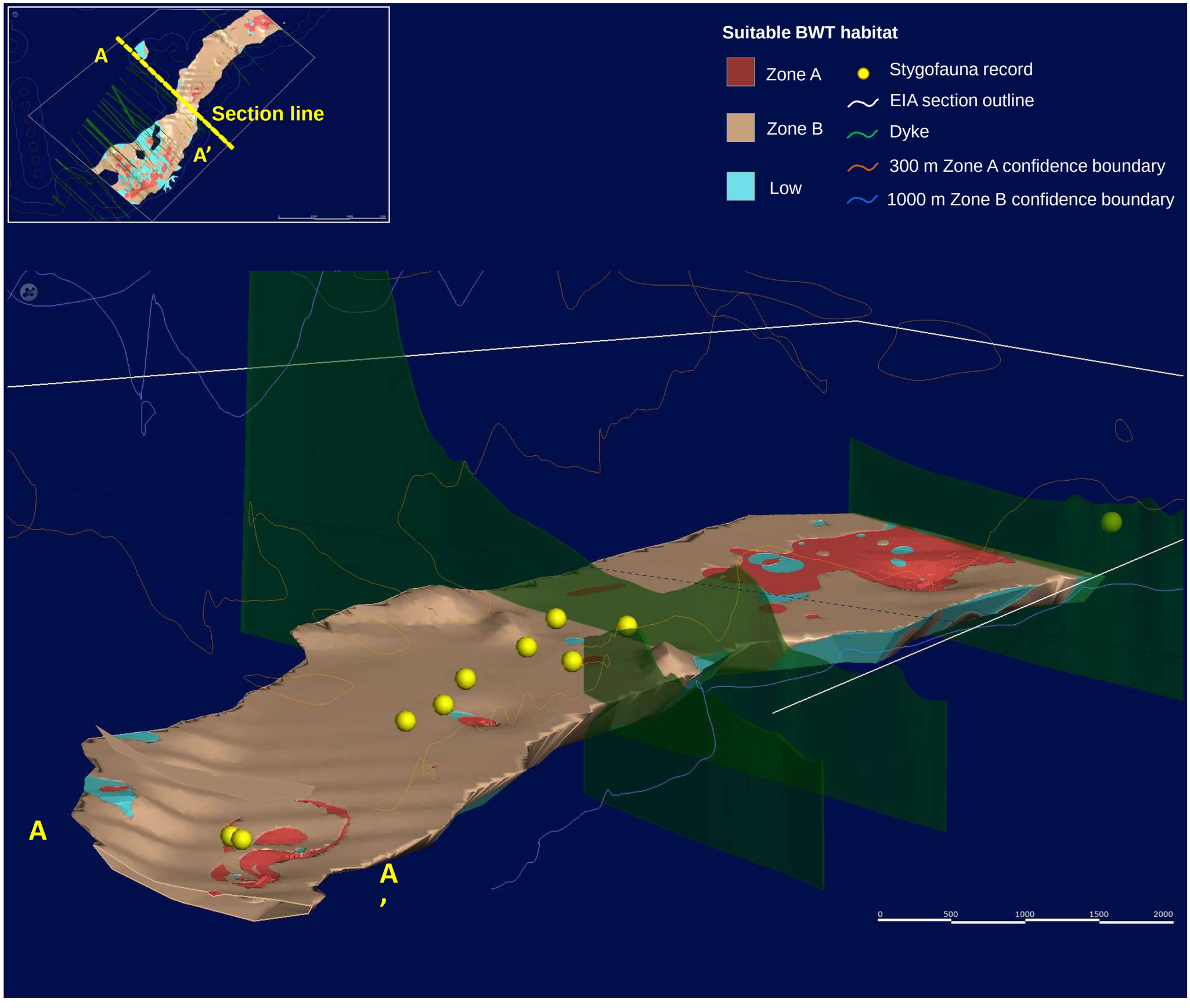

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Figure 9-48
Cross Section of the 3D Subterranean Habitat Model Showing BWT Habitats Post Mining (2050) within the BS3 Assessment Area

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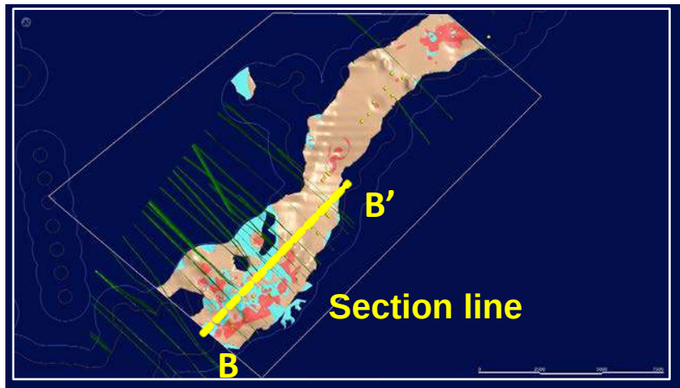

Suitable BWT habitat

- Zone A
- Zone B
- Low
- Stygofauna record
- EIA section outline
- Dyke
- 300 m Zone A confidence boundary
- 1000 m Zone B confidence boundary

B

B'

0 500 1000 1500 2000

RioTinto

Figure 9-49
Long-section of the 3D Subterranean Fauna Model Showing BWT Habitats Post Mining (2050) within the BS3 Assessment Area

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Brockman Syncline 4 Assessment Area

As no stygofauna species are known to occur within the area of direct impacts at BS4, the habitat values are considered low, and removal of this habitat will not result in any significant impacts to either habitat or species values.

9.6.1.2. Loss of Individuals or Reduction in Troglofauna Habitat

Brockman Syncline 1 Assessment Area

3D modelling has shown that AWT habitat's reasonable thickness and extent will remain intact, mainly within the BS1 assessment area (Figure 9-50 and Figure 9-51). The extent, thickness, and connectivity of the remaining AWT habitat surrounding the proposed pits (and in some cases also beneath the pits) is considered sufficient to support troglofauna species.

It should be noted that the extent of prospective suitable habitat within the BS1 assessment area is currently underrepresented in the 3D model due to the narrowness of the Development Envelope in the eastern part of BS1 and the neighbouring third-party tenements immediately north. Consequently, the habitat modelling boundary was not extended throughout the full width of prospective habitats and more suitable habitats are expected to exist at BS1, particularly within the MMIF and detrital valley.

Direct impacts of the Proposal on troglofauna species are considered medium for four taxa, and low for 13 taxa, as summarised in Table 9-24. Additional Information for species considered to have medium impact ranking is provided in Table 9-25.

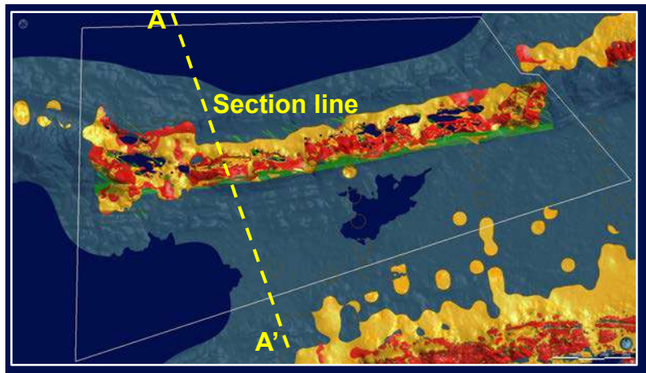
Table 9-24: Summary of Direct Impact Rank and Rationale for Troglofauna Taxa within the BS1 Assessment Area

Taxon	Likelihood of Species Occurring More Widely	Magnitude of Direct Impact	Suitability of Habitat Remaining Post Impact	Direct impact rank
Araneae				
Araneae `sp. Biologic-ARAN005`	Confirmed	Low	High	Low
Palpigradi				
Palpigradi `sp. Biologic-PALP010`	Low (potential troglobite SRE, singleton)	Medium	High	Low
Pseudoscorpiones				
Chthoniidae `sp. Biologic-PSEU004`	Confirmed	Low	High	Low
Chthoniidae `sp. Biologic-PSEU006`	Low (troglobite SRE, singleton)	Low	High	Low
Schizomida				
Draculoides `sp. Biologic-SCHI017`	Confirmed	Low	High	Low
Draculoides `sp. Biologic-SCHI019`	Confirmed	Low	High	Low
Geophilomorpha				
Geophilomorpha `sp. Biologic-CHIL007`	Medium (potential troglobite SRE, singleton)	Medium	High	Low

Taxon	Likelihood of Species Occurring More Widely	Magnitude of Direct Impact	Suitability of Habitat Remaining Post Impact	Direct impact rank
Diplura				
Japygidae `sp. Biologic-DIPL008`	Medium (potential troglobite SRE, singleton)	Low	High	Low
Japygidae `sp. Biologic-DIPL014`	Medium (potential troglobite SRE, singleton)	Medium	High	Low
Projapygidae `sp. Biologic-DIPL003`	Medium (potential troglobite SRE, singleton)	Low	High	Low
Projapygidae `sp. Biologic-DIPL013`	Medium (potential troglobite SRE, singleton)	Medium	High	Low
Blattodea				
Nocticola `sp. Biologic-BLAT005`	Confirmed	Low	High	Low
Nocticola `sp. Biologic-BLAT006`	Confirmed	Low	High	Low
Coleoptera				
Coleoptera `sp. Biologic-COLE003`	Medium (uncertain troglobite SRE, singleton)	Medium-High	High	Medium
Ptinella? `sp. BS1`	Medium (uncertain troglobite SRE, singleton)	High	High	Medium
Staphylinidae? `sp. BS1`	Medium (uncertain troglobite SRE, singleton)	High	High	Medium
Isopoda				
Armadillidae `sp. Biologic-ISOP002`	Low (potential troglobite SRE, singleton)	High	High	Medium

Table 9-25: Additional Information for Troglofauna Species Considered to have Medium Impact Ranking within the BS1 Assessment Area

Taxon	Additional Information
Coleoptera `sp. Biologic-COLE003`	*Coleoptera* `sp. Biologic-COLE003` was recorded from a single site from a direct impact area at BS1E (Table 9-13). 3D habitat modelling showed a reduction in the habitat thickness of the detrital layer which overlays the numerous geological structures (i.e., dykes) in this area and provides connectivity along strike (Figure 9-50). Whilst habitat connectivity to the east and west of the record may be limited by dykes/faults following implementation of the Proposal, habitat modelling showed that there will be enough habitat remaining beneath the record and within that compartment to sustain this taxon in the long-term.
Ptinella? `sp. BS1`	The isopod (Armadillidae `sp. Biologic-ISOP002`) and two of the beetles (*Ptinella*? `sp. BS1` and Staphylinidae? `sp. BS1`) were recorded from single sites from a direct impact area at BS1W (Table 9-13). The family Armadillidae is known to include highly restricted troglobite species throughout the Pilbara region. Troglofauna beetles in the Pilbara have varied ranges, some highly restricted species are known to occur, whilst other taxa are known to have moderate distribution ranges across multiple geological habitats (but still within the nominal limits of an SRE) (Biologic 2021a). Whilst habitat modelling showed an overall low level of impact to AWT habitats at BS1 assessment area, no habitat was modelled to remain directly beneath the known record locations of these three taxa (based on conservative estimation). Nevertheless, all three records are located at the edge of proposed pits, and suitable AWT habitats are expected to remain in the immediate vicinity of the existing troglofauna records. These remaining AWT habitats are relatively thick, well-connected, and likely extensive enough to continuously support troglofauna (Figure 9-50). While the three taxa are currently only known from a single site, it is considered likely that they occur more widely throughout the local extent of suitable, connected habitat immediately surrounding their recorded location. Thus, it is expected that they may also occur in the remaining AWT habitat immediately surrounding the recorded location.
Staphylinidae? `sp. BS1`	
*Armadillida*e `sp. Biologic-ISOP002`	



Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

A

A'

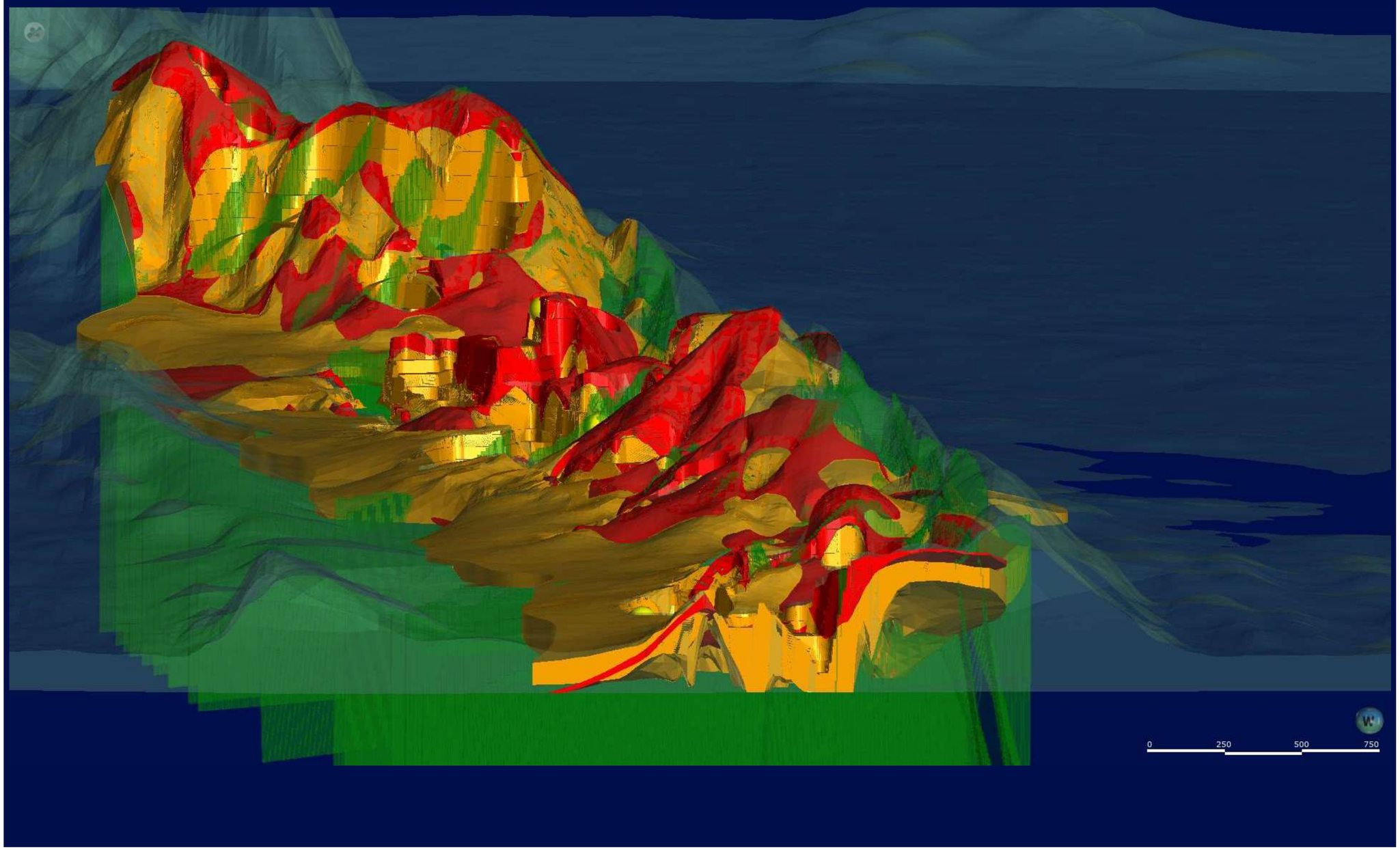


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Figure 9-50
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS1 Assessment Area

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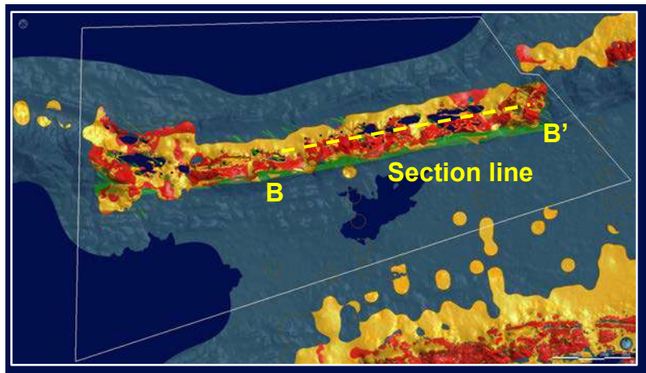

Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

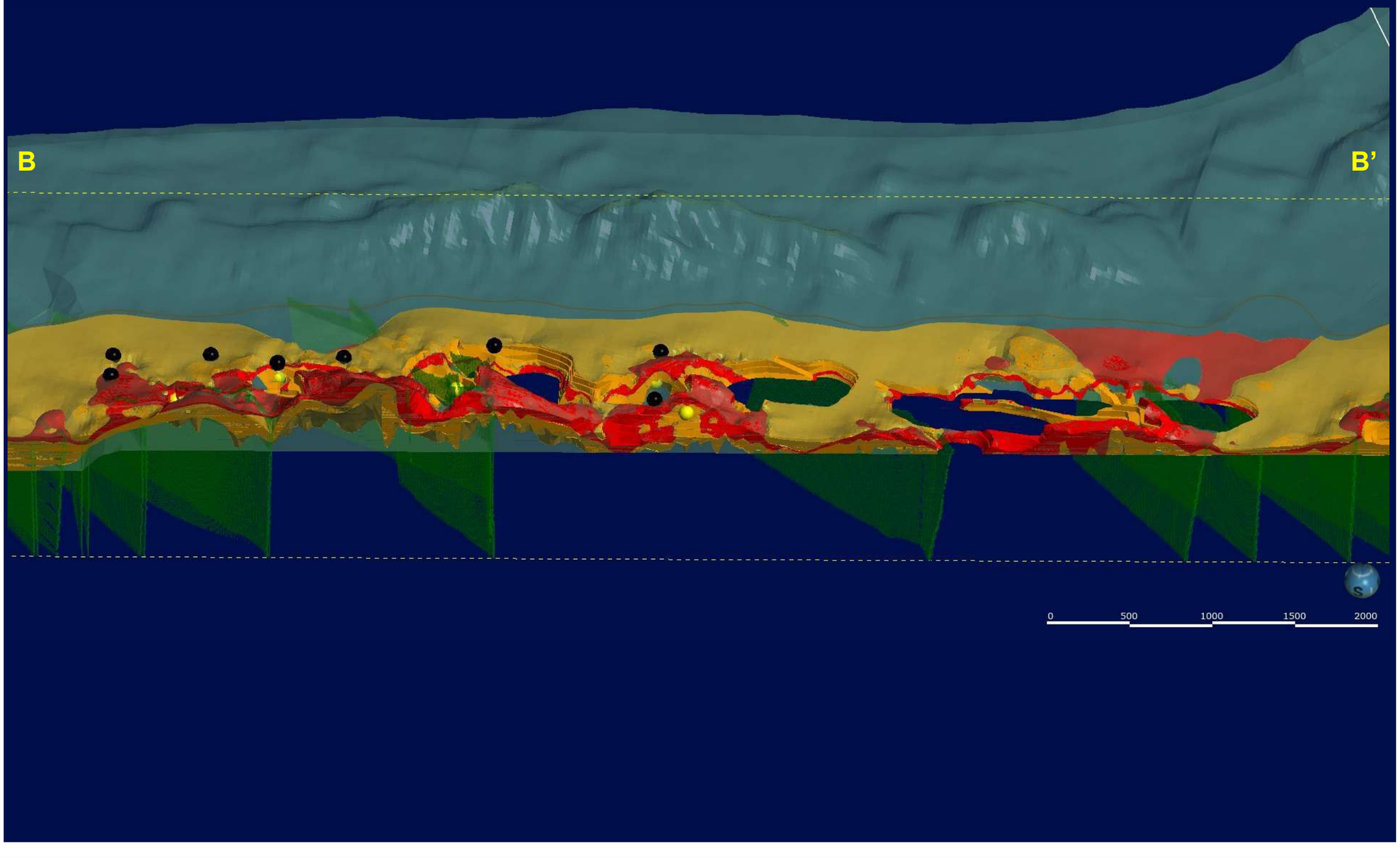

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Figure 9-51
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS1 Assessment Area

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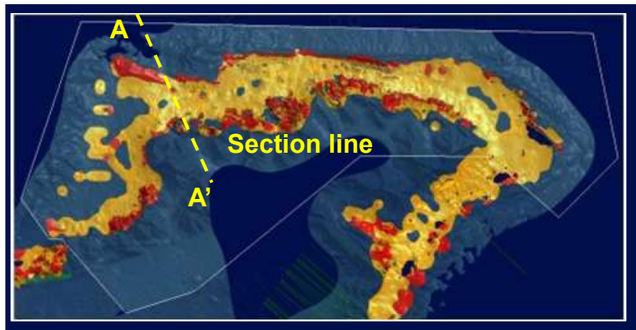
Brockman Syncline 2 Assessment Area

3D modelling has shown that extensive areas of prospective AWT habitat remain unaffected throughout the BS2 assessment area (Figure 9-52 and Figure 9-53). It is also expected that further and vast prospective AWT habitats likely exist south of the proposed pits within the Brockman Iron Formation, outside of the 3D modelling boundary.

Direct impacts of the Proposal on troglofauna species are considered low for six taxa, as summarised in Table 9-26, as such no further information is provided.

Table 9-26: Summary of Direct Impact Rank and Rationale for Troglofauna Taxa within the BS2 Assessment Area

Taxon	Likelihood of Species Occurring More Widely	Magnitude of Direct Impacts	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Palpigradi				
Palpigradi `sp. Biologic-PALP007`	Low (potential troglobite SRE, singleton)	Medium	High	Low
Pauropoda				
Pauropoda `sp. Biologic-PAUR007`	Confirmed	Low	High	Low
Symphyla				
Hanseniella `sp. Biologic-SYMP001`	Medium (potential troglobite SRE, singleton)	Low	High	Low
Hanseniella `sp. Biologic-SYMP003`	Confirmed	Low	High	Low
Blattodea				
Nocticola `sp. Biologic-BLAT008`	Confirmed	Low	High	Low
Zygentoma				
Nicoletiinae `sp. Biologic-ZYGE005`	Confirmed	Low	High	Low



Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

A

A'

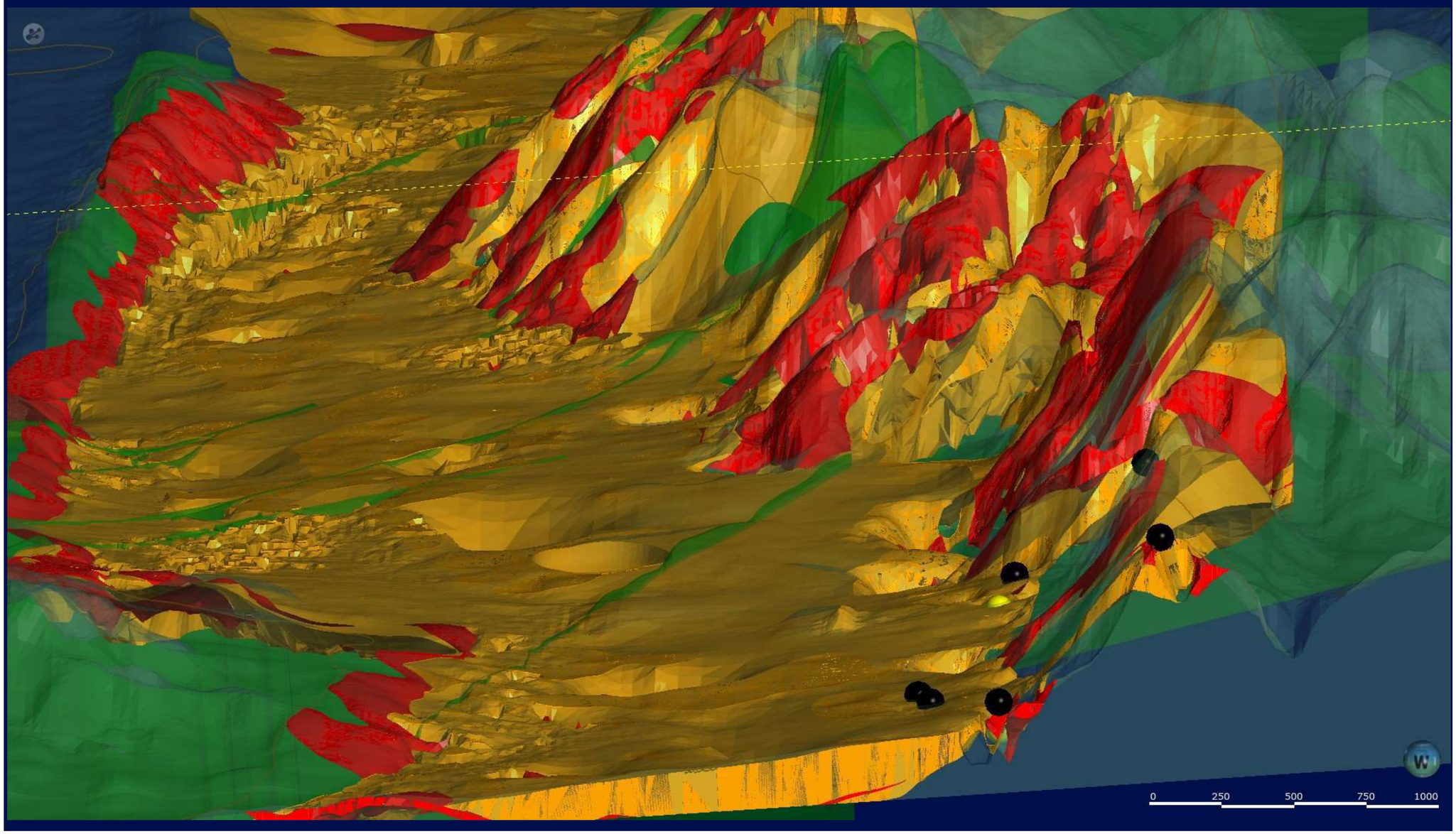


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Figure 9-52
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS2 Assessment Area

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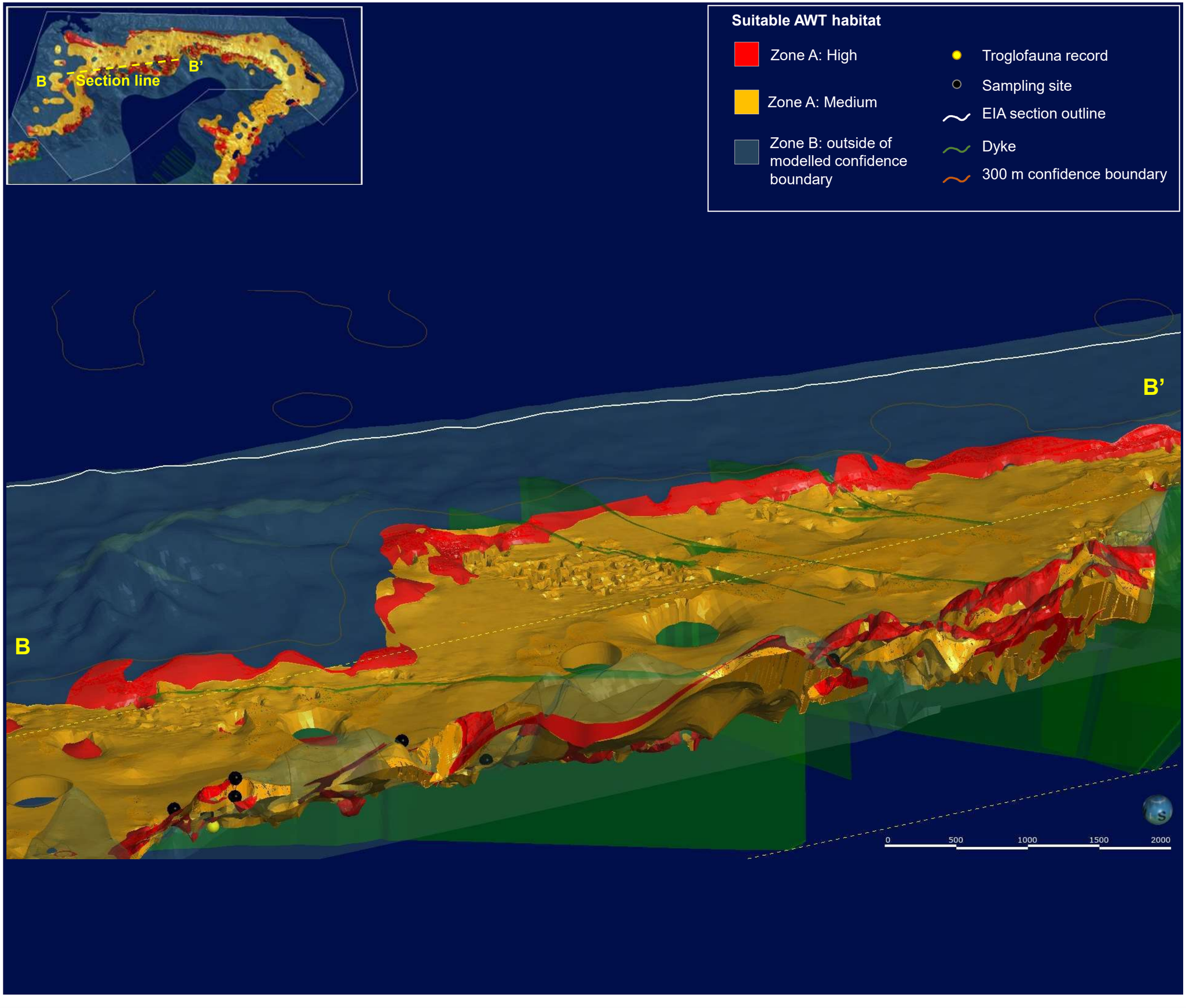

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Figure 9-53
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS2 Assessment Area

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Brockman Syncline 3 Assessment Area

3D modelling indicates that habitat connectivity will be maintained, despite a series of transverse dykes and faults throughout the BS3 assessment area. Whilst the dykes are expected to restrict the wider connectivity of habitats in the Brockman Iron Formation and MMIF parallel to the strike of the ranges (particularly in southern parts of the BS3 assessment area), they do not occur beyond the basement rocks and AWT habitats remain connected along strike via the detrital valley. The proposed pits do not remove a high proportion of the wider available AWT habitat in any given compartment (Figure 9-54 and Figure 9-55). It is also expected that further prospective AWT habitats will likely exist in the MMIF band along the eastern side of the synclinal valley, outside the 3D modelling boundary.

Direct impacts of the Proposal on troglofauna species are considered medium for three taxa, and low for 16 taxa, as summarised in Table 9-27. Additional Information for species considered to have medium impact ranking is provided in Table 9-28.

Table 9-27: Summary of Direct Impact Rank and Rationale for Troglofauna Taxa within the BS3 Assessment Area

Taxon	Likelihood of Species Occurring More Widely	Magnitude of Direct Impacts	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Araneae				
Prethopalpus `sp. Biologic-ARAN001`	Low (troglobite SRE, singleton)	High	High	Medium
Prethopalpus `sp. Biologic-ARAN023`	Low (troglobite SRE, singleton)	Low	High	Low
Palpigradi				
Palpigradi `sp. Biologic-PALP003`	Confirmed	Low	High	Low
Palpigradi `sp. Biologic-PALP004`	Confirmed	Low	High	Low
Palpigradi `sp. Biologic-PALP031`	Low (potential troglobite SRE, singleton)	Low	High	Low
Pseudoscorpiones				
Chthoniidae `sp. Biologic-PSEU007`	Low (troglobite SRE, singleton)	Low	High	Low
Pauropoda				
Pauropoda `sp. Biologic-PAUR013`	Medium (uncertain troglobite SRE, singleton)	Low	High	Low
Pauropoda `sp. Biologic-PAUR038`	Medium (uncertain troglobite SRE, singleton)	Low	High	Low
Pauropoda `sp. Biologic-PAUR039`	Medium (uncertain troglobite SRE, singleton)	High	High	Medium
Symphyla				
Hanseniella `sp. Biologic-SYMP003`	Confirmed	Low	High	Low
Diplura				
Japygidae `sp. Biologic-DIPL028`	Confirmed	Low	High	Low

Taxon	Likelihood of Species Occurring More Widely	Magnitude of Direct Impacts	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Parajapygidae `sp. Biologic-DIPL007`	Medium (potential troglobite SRE, singleton)	Low	High	Low
Projapygidae `sp. Biologic-DIPL032`	Medium (potential troglobite SRE, singleton)	Low	High	Low
Isopoda				
Buddelundia? `sp. Biologic-ISOP005`	Medium (uncertain troglobite SRE, singleton)	High	High	Medium
Isopoda `sp. Biologic-ISOP007`	Medium (potential troglobite SRE, singleton)	Low	High	Low
Blattodea				
Nocticola `sp. Biologic-BLAT008`	Confirmed	Low	High	Low
Coleoptera				
Calanoida `sp. Biologic-COLE002`	Medium (uncertain troglobite SRE, singleton)	Low	High	Low
Zygentoma				
Nicoletiinae `sp. Biologic-ZYGE006`	Medium (potential troglobite SRE, multiple sites)	Low	High	Low
Nicoletiinae `sp. Biologic-ZYGE007`	Medium (potential troglobite SRE, singleton)	Low	High	Low

Table 9-28: Additional Information for Troglofauna Species Considered to have Medium Impact Ranking within the BS3 Assessment Area

Taxon	Additional Information
Prethopalpus `sp. Biologic-ARAN001,	The pseudoscorpion *Prethopalpus* `sp. Biologic-ARAN001`, the isopod *Buddelundia*? `sp. Biologic-ISOP005`, and the pauropod Pauropoda `sp. Biologic-PAUR039` were recorded as singleton records from a direct impact area at BS3 (Figure 9-42). Troglobite pseudoscorpions tend to have very limited dispersal capabilities (Ribera et al. 2018) and are frequently recorded only from single habitats or single sites. There is a high likelihood of SRE taxa occurring in this group, with many range-restricted taxa known to occur in the Pilbara. Pauropods are frequently eyeless and pale and apparent troglomorphy does not confirm ecological adaptation to subterranean habitats in this group. However, previous studies in the Pilbara have shown that highly restricted troglobtic species are also known to occur, and recent genetic research has revealed a number of highly divergent myriapod lineages from the Pilbara and Yilgarn regions (Edgecombe et al. 2019). Therefore, Pauropoda `sp. Biologic-PAUR039` is considered to represent a potential troglobite SRE. As for *Buddelundia*? `sp. Biologic-ISOP005`, this isopod belongs to a genus that is typically terrestrial, rather than troglobite. Nevertheless, this taxon is considered potentially range-restricted based on current sampling records (Biologic 2021). Habitat modelling showed an overall low level of impact to AWT habitats within the BS3 assessment area under the proposed scenario, but no habitat was modelled to remain directly beneath the known record locations of these three taxa (based on conservative estimation). Nevertheless, all three records are located at the edge of proposed pits, and suitable AWT habitats are expected to remain in the immediate vicinity of the existing troglofauna records. These remaining AWT habitats are relatively thick, well-connected, and likely extensive enough to continuously support troglofauna (Figure 9-54). While the three taxa are currently only known from a single site, it is considered likely that they occur more widely throughout the local extent of suitable, connected habitat immediately surrounding their recorded location. Thus, it is expected that they may also occur in the remaining AWT habitat immediately surrounding the recorded location after implementation of the Proposal. In this context, the direct impacts to the three species are ranked medium.
Buddelundia? `sp. Biologic-ISOP005`	
Pauropoda `sp. Biologic-PAUR039	

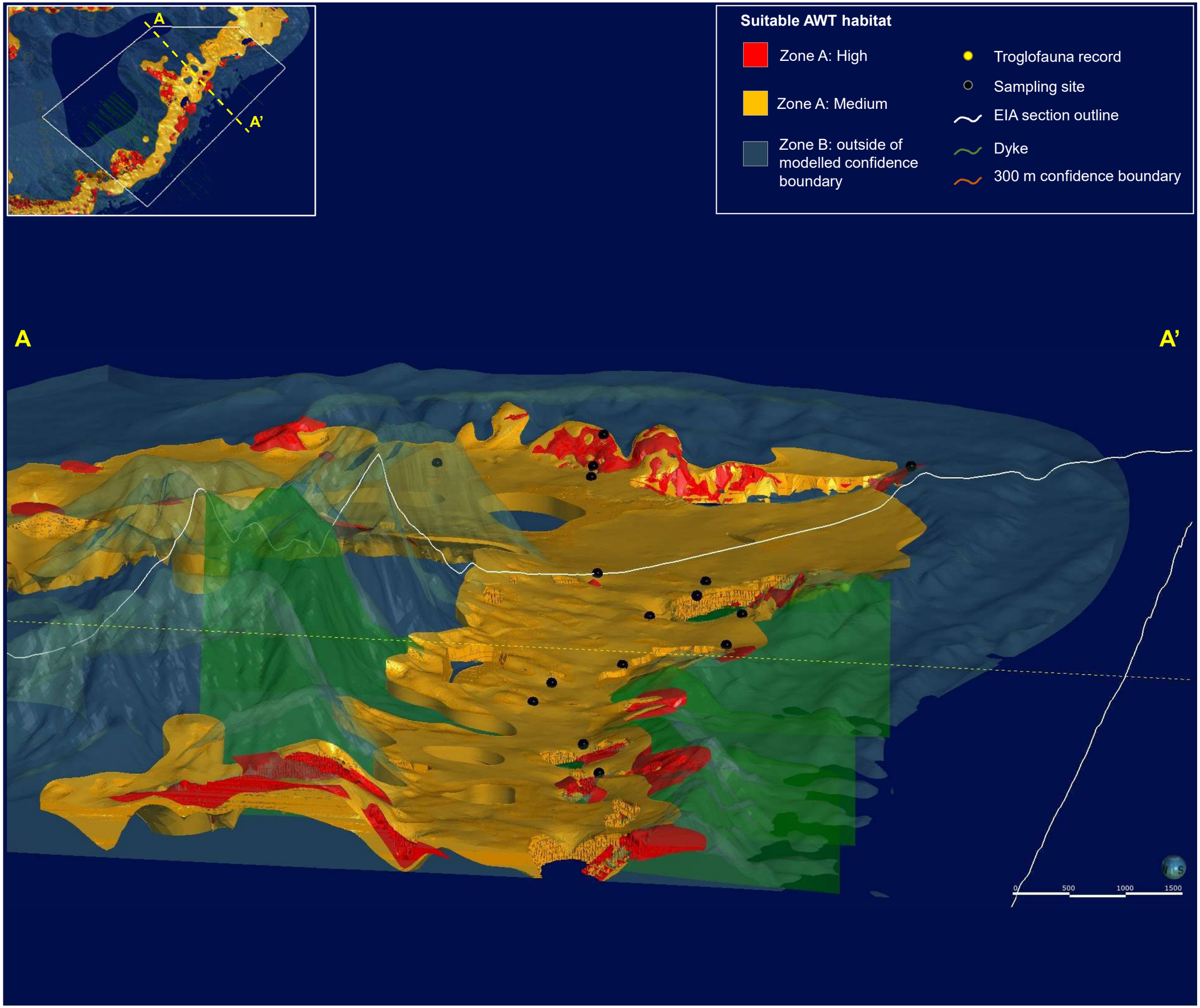

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Figure 9-54
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS3 Assessment Area

Drawn: L.Fuentes
Plan: PDE0190347v1
Date: July 2022
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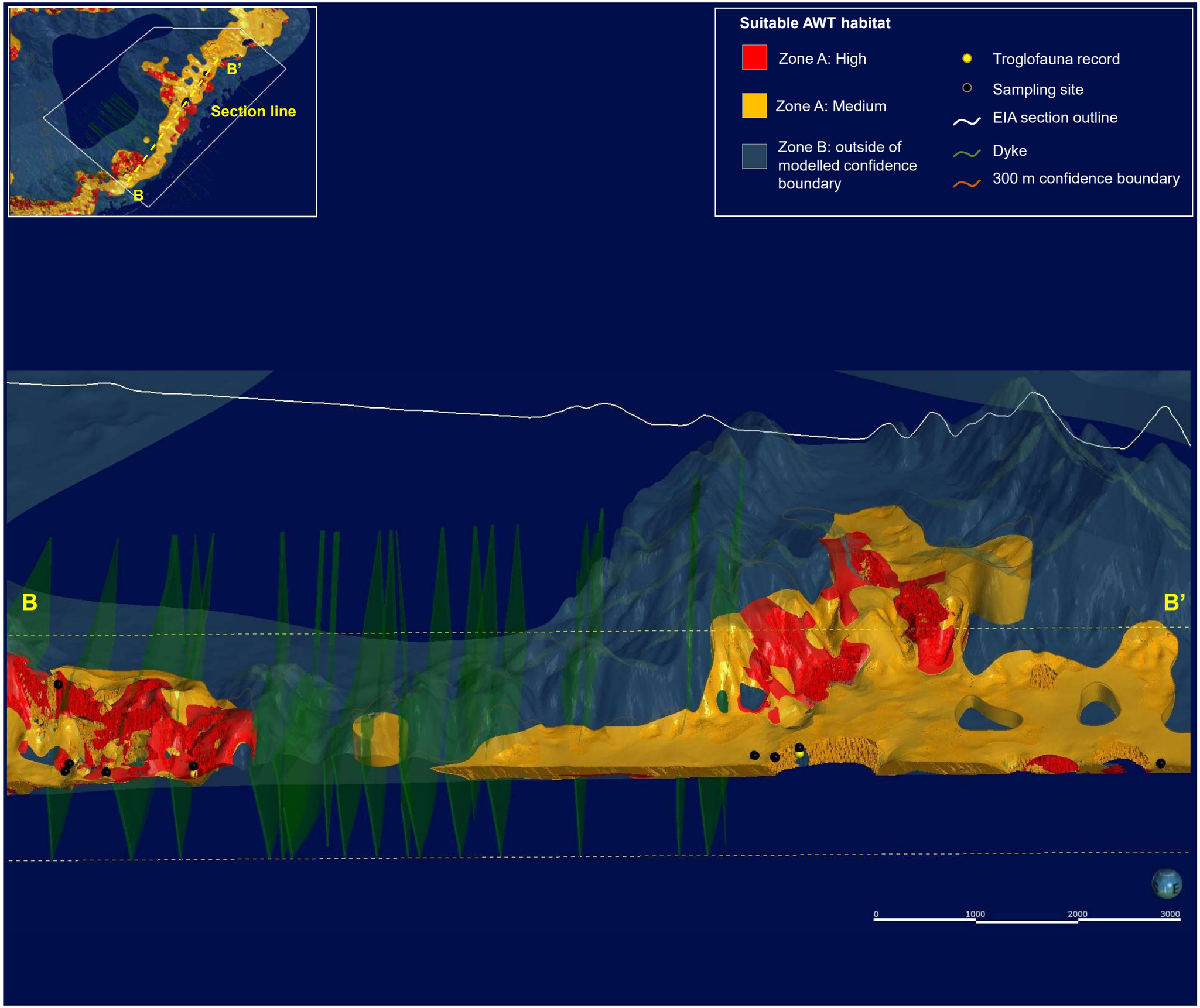

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Figure 9-55
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS3 Assessment Area

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Brockman Syncline 4 Assessment Area

3D modelling shows a moderate reduction in habitat thickness in the location of the proposed pits, but the overall extent of suitable AWT habitats remains largely unaffected (Figure 9-56 and Figure 9-57). AWT habitats are naturally variable at a localised scale throughout BS4, and connectivity along strike is likely to be affected by a series of transverse dykes and faults throughout the BS4 area. Nevertheless, the proposed pits do not appear to remove a high proportion of the wider available AWT habitat in any given compartment.

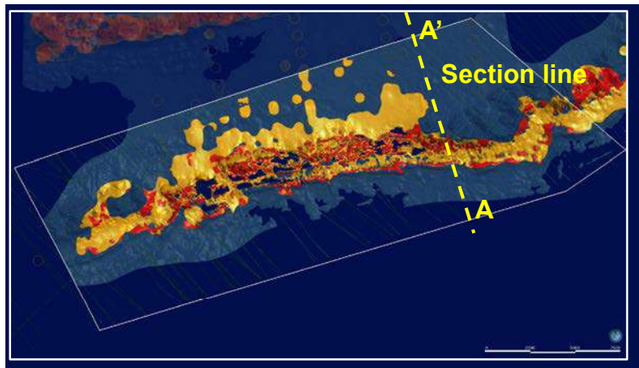
Direct impacts of the Proposal on troglofauna species are considered medium for four taxa, and low for five taxa, as summarised in Table 9-29. Additional Information for species considered to have medium impact ranking is provided in Table 9-30.

Table 9-29: Summary of Direct Impact Rank and Rationale for Troglofauna Taxa within the BS4 Assessment Area

Taxon	Likelihood of Species Occurring more Widely	Magnitude of Direct Impacts	Suitability of Habitat Remaining Post Impact	Direct Impact Rank
Pseudoscorpiones				
Chernetidae `sp. Helix marra mamba`	Low (potential troglobite SRE, singleton)	High	High	Medium
Chthoniidae `sp. Helix marra mamba`	Low (troglobite SRE, singleton)	High	High	Medium
Troglochernes sp. indet.	Low (potential troglobite SRE, singleton)	High	High	Medium
Schizomida				
Paradraculoides `sp. Helix marra mamba`	Confirmed	Low	High	Low
Diplura				
Japygidae `sp. Biologic-DIPL028`	Confirmed	Low	High	Low
Japygidae `sp. Helix marra mamba`	Medium (potential troglobite SRE, singleton)	Medium	High	Medium
Isopoda				
Armadillidae `sp. Helix-I1`	Low (potential troglobite SRE, singleton)	Low	High	Low
Armadillidae `sp. Helix-I2`	Low (potential troglobite SRE, singleton)	Low	High	Low
Coleoptera				
Staphylinidae `sp. Helix-C6`	Medium (uncertain troglobite SRE, singleton)	Low	High	Low

Table 9-30: Additional Information for Troglofauna Species Considered to have Medium Impact Ranking within the BS4 Assessment Area

Taxon	Additional Information
Chernetidae `sp. Helix marra mamba`,	*Chernetidae* `sp. Helix marra mamba`, *Chthoniidae* `sp. Helix marra mamba`, and *Troglochernes* sp. indet were recorded as singleton records from a direct impact area at BS4 (Figure 9-43). Troglobite pseudoscorpions are commonly highly range-restricted and there is a high likelihood of SRE taxa occurring in this group. Troglobite pseudoscorpions tend to have very limited dispersal capabilities (Ribera et al. 2018) and are frequently recorded only from single habitats or single sites. Habitat modelling showed an overall low level of impact to AWT habitats at BS4 under the proposed scenario, but no habitat was modelled to remain directly beneath the known record locations of these three taxa (based on conservative estimation). Nevertheless, all three records are located at the edge of proposed pits, and suitable AWT habitats are expected to remain in the immediate vicinity of the existing troglofauna records. These remaining AWT habitats are relatively thick, well-connected, and likely extensive enough to continuously support troglofauna (Figure 9-56). While the three taxa are currently only known from a single site, it is considered likely that they occur more widely throughout the local extent of suitable, connected habitat immediately surrounding their recorded location. Thus, it is expected that they may also occur in the remaining AWT habitat immediately surrounding the recorded location after implementation of the Proposal.
Chthoniidae `sp. Helix marra mamba`	
Troglochernes sp. indet.	
Japygidae `sp. Helix marra mamba`	*Japygidae* `sp. Helix marra mamba` was recorded as a singleton record from a direct impact area at BS4 (Figure 9-43). Diplura are a poorly studied group of hexapods that are always small, eyeless, and pale, therefore, apparent troglomorphy does not confirm ecological adaptation to subterranean habitats. However, the group as a whole showed a high rate of species turnover between sampling areas (Biologic, 2021a), and this taxon is therefore considered to represent a potential troglobite SRE. *Japygidae* `sp. Helix marra mamba` is located in a narrow compartment between two dykes which may limit habitat connectivity, particularly post-impact as the thickness of the detrital layer which overlays these geological structures is reduced. Nevertheless, another japygid taxon (Japygidae `sp. Biologic-DIPL028) occurring in the same compartment was found across a large linear range (> 25 km), suggesting that habitat connectivity exists beyond the compartment. Habitat modelling showed that relatively thick suitable troglofauna habitats will remain beneath the record. The record is furthermore located close to the edge of the habitat modelling boundary, and further prospective AWT habitats likely exist south of the record (outside of the 3D modelling boundary) (Figure 9-56).



Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

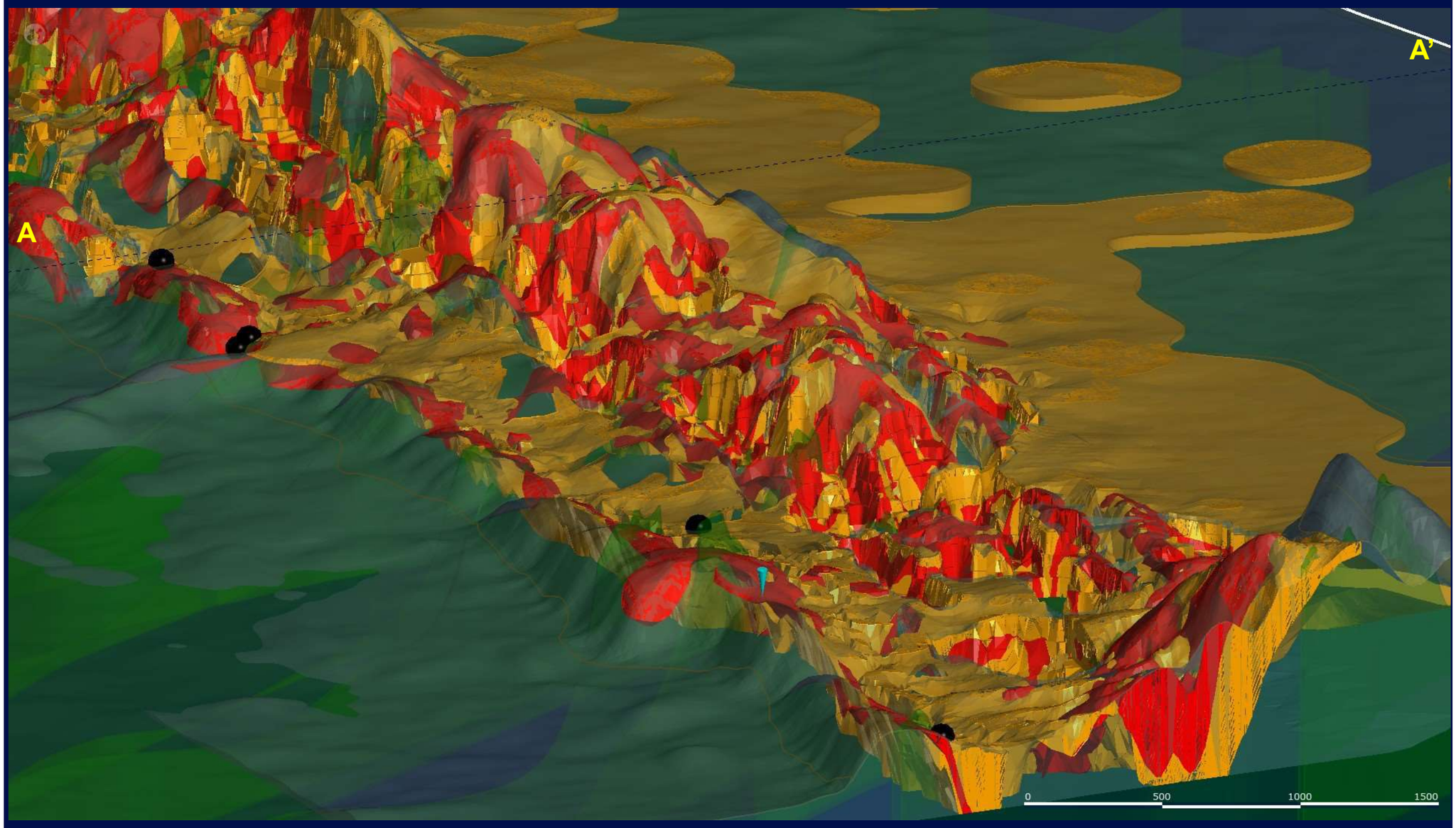


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Figure 9-56
Cross Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS4 Assessment Area

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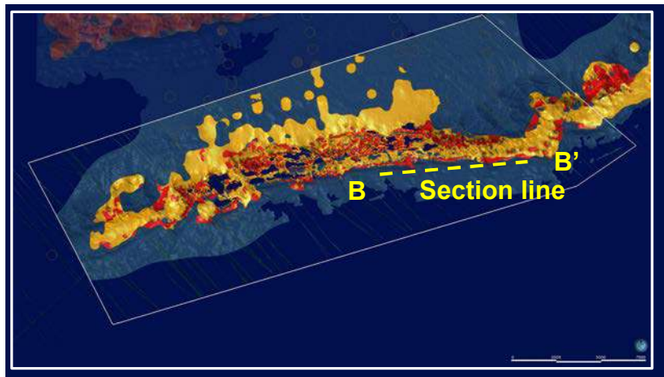

Suitable AWT habitat

- Zone A: High
- Zone A: Medium
- Zone B: outside of modelled confidence boundary
- Troglofauna record
- Sampling site
- EIA section outline
- Dyke
- 300 m confidence boundary

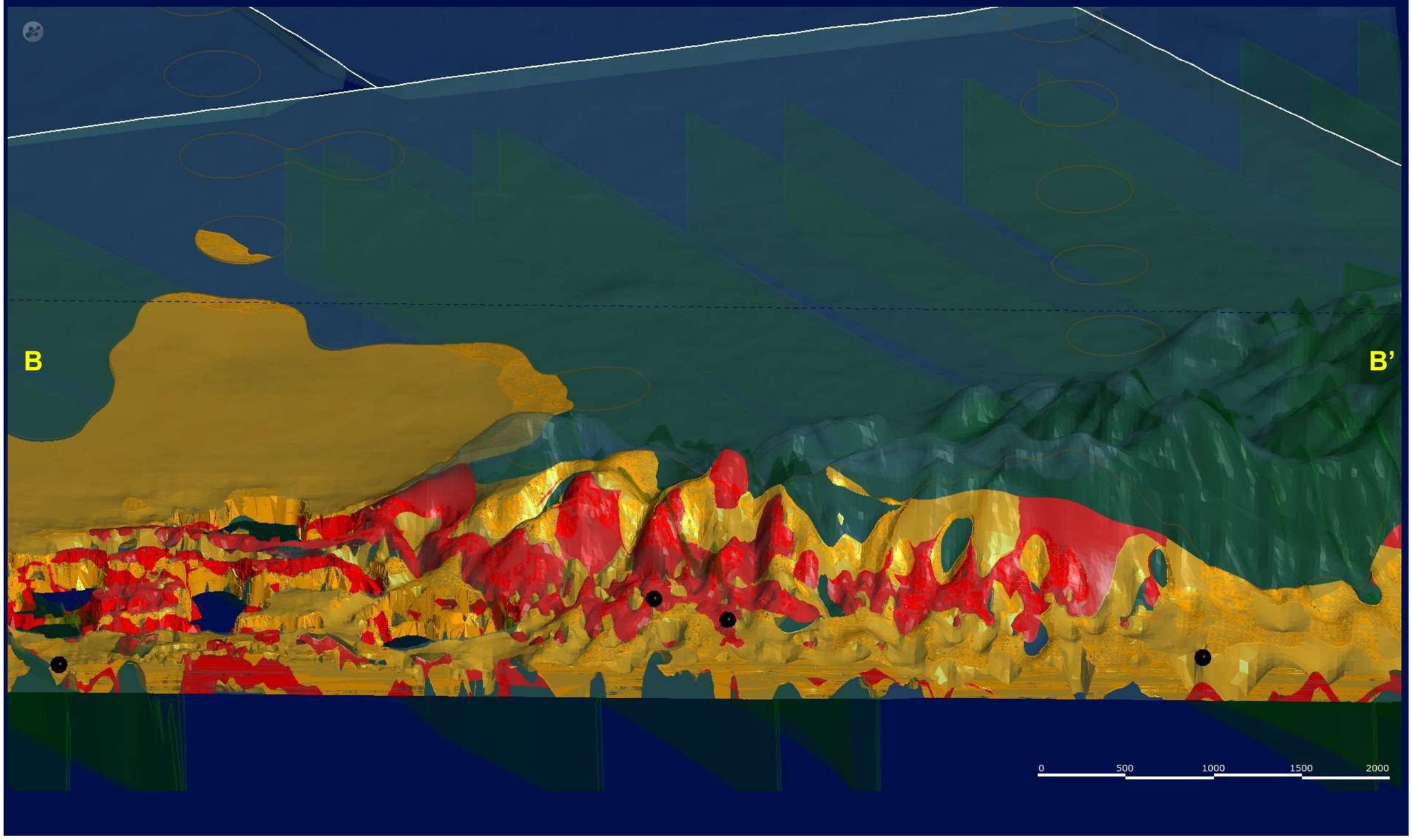

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Figure 9-57
Long Section of the 3D Subterranean Habitat Model Showing AWT Habitats Post Mining within the BS4 Assessment Area

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9.6.2. Assessment of Indirect Residual Impacts

9.6.2.1. Stygofauna

Brockman Syncline 1 Assessment Area

Indirect impacts to stygofauna habitat and species values within the BS1 assessment area are considered low, due to the fact that:

- Indirect impacts to areas beneath proposed waste landforms/stockpiles are estimated to only affect approximately 13% of the surface area of suitable BWT habitat remaining under the 'worst-case' scenario
- None of the stygofauna taxa were recorded exclusively within an indirect impact area
- Changes to surface hydrogeological flows, and environmental incidents such as spills are expected to be effectively managed under specific operational plans and procedures
- Changes to the structure or presence of BWT voids from mining activities are unlikely to propagate far from the pit walls and the ground surface. BWT habitats remaining after proposed and cumulative impacts are unlikely to be significantly affected.

Habitat fragmentation caused by dykes is likely to be increased as water tables are lowered which may preclude groundwater overtopping the dykes into the overlying detritals in this area. The magnitude of this indirect impact to stygofauna species occurring in BS1 is uncertain, given that the groundwater habitats are naturally compartmentalised from east to west, and there is no established precedent for minimum viable habitat sizes or levels of connectivity for stygofauna communities in the region. Approximately 57% and 37% of BWT will remain within this area following implementation of the Proposal and when taking cumulative imp acts into consideration.

Brockman Syncline 2 Assessment Area

Indirect impacts on stygofauna habitat and species values within the BS2 assessment area are considered low, due to the fact that:

- Indirect impacts to areas beneath proposed waste landforms/stockpiles are estimated to only affect approximately 4% of the surface area of suitable BWT habitat remaining under the 'worst-case' scenario
- There are no know subterranean fauna within close proximity to the proposed in-pit WFSFs
- Extensive areas of prospective BWT habitat remain unaffected by indirect impacts throughout the far eastern and southwestern areas of BS2
- None of the stygofauna taxa were recorded exclusively within an indirect impact area
- Changes to surface hydrogeological flows, and environmental incidents such as spills are expected to be effectively managed under specific operational plans
- Changes to the structure or presence of BWT voids from mining activities are unlikely to propagate far from the pit walls and the ground surface. BWT habitats remaining after proposed and cumulative impacts are unlikely to be significantly affected
- Habitat fragmentation is unlikely to cause a significant impact to stygofauna taxa inhabiting remnant habitats the far eastern and southwestern areas of BS2, as these areas are already inherently separated by dykes and distance.

Brockman Syncline 3 Assessment Area

Indirect impacts on stygofauna habitat and species values within the BS3 assessment area are considered low, due to the fact that:

- Indirect impacts to areas beneath proposed waste landforms/stockpiles are estimated to affect approximately 16% of the surface area of suitable BWT habitat remaining under the 'worst-case' scenario
- One species, Calanoida `sp. Biologic-CALA002` was recorded uniquely underneath a proposed waste landform/stockpile area. Suitable BWT habitat at depth within Zone B is expected to remain in-tact within the same hydrogeological compartment beyond the indirect impact area. The potential indirect impacts from waste landform/stockpiles at the surface are therefore unlikely to increase the overall risk to this taxon
- Changes to surface hydrogeological flows, and environmental incidents such as spills are expected to be effectively managed under specific operational plans and procedures
- Changes to the structure or presence of BWT voids from mining activities are unlikely to propagate far from the pit walls and the ground surface. BWT habitats remaining after proposed and cumulative impacts are unlikely to be significantly affected.

Habitat fragmentation is likely to be increased as water tables are lowered relative to the numerous perpendicular dykes dividing the BS3 section, which may preclude overtopping into the overlying detritals in this area. The magnitude of this indirect impact to stygofauna species occurring in BS3 is uncertain, given that the groundwater habitats are naturally compartmentalised from north to south, but not all of the stygofauna taxa present appear to be limited in linear range by these dykes. The degree to which some dykes at BS3 may be more fractured or more permeable than others also remain unknown. At present there is no published precedent for assessing a suitable minimum habitat size for stygofauna, given a highly fragmented and complex groundwater environment. Nevertheless, it can be inferred from the high number of dykes known to occur throughout BS3 section that the remaining habitats at depth in Zone B are likely to become more fragmented following the direct impacts of the proposal. Approximately 63% and 52% of BWT will remain within this area following implementation of the Proposal and when taking cumulative imp acts into consideration.

Brockman Syncline 4 Assessment Area

Fifteen unique stygofauna taxa were recorded at Boolgeeda Creek within the hyporheic zone (Table 9-31), which may be subject to temporarily dewatering discharge impacts during the Proposal (EMM 2021).

To date, none of these taxa are known to occur elsewhere although their recorded occurrence within the hyporheic zone of Boolgeeda Creek suggests that they inhabit near surface habitats that can be widespread throughout catchments.

Table 9-31: Indirect Impact Rankings of Stygofauna Taxa Occurring at Boolgeeda Creek

Taxon	Likelihood Restricted to Impact Area	Magnitude of Indirect Impact	Suitability of Habitat after Impact	Indirect Impact Rank
Amphipoda `sp. Biologic-AMPH009`	Unlikely	Low negative impact, potentially positive impact (temporary)	Expected to return to ephemeral system. Assumed to remain suitable.	Low
Antarctodrilus `sp. Biologic-OLIG054`	Low			
Atopobathynella `sp. BGCK`	Potential			
Atopobathynella `sp. Biologic-PBAT013`	Potential			
Atopobathynella `sp. Biologic-PBAT014`	Potential			

Taxon	Likelihood Restricted to Impact Area	Magnitude of Indirect Impact	Suitability of Habitat after Impact	Indirect Impact Rank
Bathynellidae `sp. Biologic-BATH001`	Potential			
Bathynellidae `sp. Biologic-BATH002`	Potential			
Bathynellidae `sp. Biologic-BATH003`	Potential			
Enchytraeidae `sp. Biologic-OLIG053`	Low			
Enchytraeidae `sp. Biologic-OLIG055`	Low			
Nedsia `sp. Biologic-AMPH003`	Low			
Parabathynellidae `sp. Biologic-PBAT022`	Potential			
Pezidae `sp. BGCK`	Low			
Phreodrilidae `sp. Biologic-OLIG001`	Low			
Phreodrilidae `sp. Biologic-OLIG011`	Low			

Indirect impacts on stygofauna habitat and species values within the BS4 assessment area are considered low, due to the fact that:

- Discharge into Boolgeeda Creek (in the centre of the syncline) will temporarily increase the surface and groundwater quantity in a limited section of Boolgeeda Creek north of BS4 (EMM 2021). This is likely to temporarily increase the occurrence of hyporheic habitats for stygofauna in the area, while discharge takes place
- Discharge volumes will be managed such that the wetting front under dry conditions does not extend beyond 37 km from the licensed discharge point (EMM 2021). Therefore, as the water discharge will be managed to remain minor and temporary; the indirect impacts to hyporheic stygofauna habitat and species values within Boolgeeda Creek are not expected to be significant.

9.6.2.2. Troglofauna

Brockman Syncline 1 Assessment Area

Indirect impacts to troglofauna habitat and species values within the BS1 assessment area are considered low, due to the fact that:

- Indirect impacts to areas beneath proposed waste landforms/stockpiles are estimated to only affect approximately 16% of the surface area of suitable AWT habitat remaining under the ‘worst-case’ scenario
- Only one species, Scolopendromorpha ‘sp. BS1’ was recorded exclusively underneath an indirect impact area (proposed waste landform/stockpiles), however, the habitat is continuous beyond the proposed waste landform
- The risk of inundation to troglofauna habitat (AWT) from changed hydrological flows is considered low as it is expected to be effectively managed by surface water management practices
- The risk of acid rock drainage on troglofauna habitats is considered low, as it is expected to be effectively managed by Rio Tinto’s SCARD Management Plan (Appendix C.9).

Brockman Syncline 2 Assessment Area

Indirect impacts to troglofauna habitat and species values within the BS2 assessment area are considered low, due to the fact that:

- Indirect impacts to areas beneath proposed waste landforms/stockpiles are estimated to only affect approximately 2% of the surface area of suitable AWT habitat remaining under the 'worst-case' scenario
- No troglofauna taxon included in the assessment at BS2 was recorded exclusively underneath an indirect impact area (proposed waste landform/stockpile)
- Extensive areas of prospective AWT habitat remain unaffected throughout the BS2 area
- The risk of inundation to troglofauna habitat (AWT) from changed hydrological flows is considered low as it is expected to be effectively managed by surface water management practices
- The risk of acid rock drainage on troglofauna habitats is considered low, as it is expected to be effectively managed by Rio Tinto's SCARD Management Plan.

Brockman Syncline 3 Assessment Area

Indirect impacts to troglofauna habitat and species values within the BS3 assessment area are considered low, due to the fact that:

- Indirect impacts to areas beneath proposed waste landforms/stockpiles are estimated to only affect approximately 17% of the surface area of suitable AWT habitat remaining under the 'worst-case' scenario
- No troglofauna taxon included in the assessment at BS3 was recorded exclusively underneath an indirect impact area (proposed waste landform/stockpile)
- The risk of inundation to troglofauna habitat (AWT) from changed hydrological flows is considered low as it is expected to be effectively managed by surface water management practices
- The risk of acid rock drainage on troglofauna habitats is considered low, as it is expected to be effectively managed by Rio Tinto's SCARD Management Plan.

Brockman Syncline 4 Assessment Area

Indirect impacts to troglofauna habitat and species values within the BS4 assessment area are considered low, due to the fact that:

- Indirect impacts to areas beneath proposed waste landforms/stockpiles are estimated to only affect approximately 1% of the surface area of suitable AWT habitat remaining under the 'worst-case' scenario
- No troglofauna taxon included in the assessment at BS1 was recorded exclusively underneath an indirect impact area (proposed waste landform/stockpile)
- The risk of inundation to troglofauna habitat (AWT) from changed hydrological flows is considered low as it is expected to be effectively managed by surface water management practices
- The risk of acid rock drainage on troglofauna habitats is considered low, as it is expected to be effectively managed by Rio Tinto's SCARD Management Plan.

9.6.3. Assessment of Cumulative Residual Impacts

9.6.3.1. Stygofauna

Following consideration of cumulative impacts (combined direct impacts of historical mining and future mining operations, evaporative losses from proposed pits at 2350 and impacts from other 3rd Party projects) approximately 55% of BWT habitat will be impacted within the syncline. Broken down per area, this represents:

- Approximately 65% of suitable habitat BWT within the BS1 assessment area
- Approximately 64% of suitable habitat BWT within the BS2 assessment area

- Approximately 48% of suitable habitat BWT within the BS3 assessment area
- Approximately 42% of suitable habitat BWT within the BS4 assessment area.

Despite the reduction to the extent and thickness of saturated BWT habitats throughout most sections of the syncline, 3D modelling revealed significant areas of habitat will remain intact and suitable for stygofauna species.

Twenty-one stygofauna taxa were considered 'at risk' of direct or cumulative impacts throughout the Development Envelope. The direct and cumulative impacts to these taxa are expected to be medium too low for the majority of these taxa, while only three taxa (Paramelitidae `sp. Biologic-AMPH012` within the BS2 assessment area and Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003`within the BS1 assessment area) was considered at a high risk under the cumulative impact scenario.

Neither the direct nor the cumulative impacts of the proposal are likely to completely remove suitable habitats 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.

Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003`

Cumulative impacts to Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003` were ranked as high due to modelled cumulative impacts BWT relative to their known occurrence (Figure 9-37) The remaining suitable habitat modelled within the BS1 assessment area is 35%, noting that a portion of the cumulative impacts is attributable to other Proponents operations. This habitat occurs at a depth of approximately 80 m from surface and is sufficiently oxygenated at depth (Biologic 2022b).

Paramelitidae `sp. Biologic-AMPH012

Cumulative impacts to Paramelitidae `sp. Biologic-AMPH012 were ranked as high due to modelled cumulative impacts BWT relative to its known occurrence (Figure 9-38). The remaining suitable habitat modelled within the BS2 assessment area is 36%. This habitat occurs at depth of approximately 120m from surface, is large and well-connected, and shows suitable dissolved oxygen levels (Biologic 2022b).

9.6.3.2. Troglofauna

Following consideration of cumulative impacts (combined direct impacts of historical mining and future mining operations and 3rd party impacts) 3D modelling shows only minor changes in habitat thickness, extent, or connectivity throughout the syncline under the cumulative scenario, with extensive areas of prospective AWT habitat remain unaffected. Furthermore, vast prospective AWT habitats are mapped to extend outside of the 3D modelling boundary based on 2D geological data (however have conservatively been excluded from the 3D habitat model due to lack of drilling holes in this area).

The impact rankings of troglofauna taxa are the same under both the proposed and cumulative scenarios. Impacts to 11 troglofauna taxa were ranked as 'medium', while impacts to 38 troglofauna taxa were ranked as 'low'. None of the impacts to troglofauna species values were ranked as 'high', and therefore, the troglofauna species recorded from the Development Envelope are expected to persist following the implementation of the Proposal.

9.6.4. Significance of Residual Impacts

9.6.4.1. Non-Significant Residual Impact

The proposed avoidance and management measures associated with the Proposal demonstrate non-significant residual impact to Subterranean Fauna include:

- Approximately 55% of BWT habitat will be impacted across the syncline for stygofauna, with 42 to 65% impacted within individual assessment areas under the modelled cumulative impact scenario

- Three stygofauna taxon (Paramelitidae `sp. Biologic-AMPH012`, Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003`) are considered at a high risk under the modelled cumulative impact scenario, however suitable habitats remain within and surrounding the syncline such that it is likely that these species will persist in the surrounding environments
- Approximately 10% of AWT habitat will be impacted across the syncline for troglofauna, with between 7 and 28% impacted within individual assessment areas under the modelled cumulative impact scenario
- Troglofauna species recorded from the Development Envelope are expected to persist following the implementation of the Proposal.

9.6.5. Summary of Assessment and Proposed Regulatory Mechanisms

A summary of the Subterranean Fauna assessment and the Proposed conditions and applicable DMA regulations is provided in Table 9-32.

Table 9-32: Summary of Assessment for Subterranean Fauna

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
Direct Impacts		
Loss of Individuals or reduction in stygofauna habitat	• Following consideration of cumulative impacts, approximately 55% of BWT habitat will be impacted within the syncline • 3D modelling revealed significant areas of habitat likely to remain intact and suitable for stygofauna species • Only one taxon (Paramelitidae `sp. Biologic-AMPH012`) was considered at high risk of impact at the BS3 section under the cumulative impact scenario • Neither the direct nor the cumulative impacts of the proposal are likely to completely remove suitable habitats for stygofauna species.	Proposed to be regulated through implementation conditions: • Annual dewatering limit • Other DMA processes • RiWI Act - Groundwater abstraction will be regulated through a groundwater licence and operating strategy.
Loss of individuals or reduction in troglofauna habitat	• Following consideration of cumulative impacts approximately 10% of AWT habitat will be impacted within the syncline • 3D modelling shows only minor changes in habitat thickness, extent, or connectivity throughout the syncline under the cumulative scenario, with extensive areas of prospective AWT habitat remain unaffected • Vast prospective AWT habitats are mapped to extend outside of the 3D modelling boundary based on 2D geological data (however have conservatively been excluded from the 3D habitat model due to lack of drilling holes in this area) • None of the impacts to troglofauna species values were ranked as ‘high’.	No limits proposed
Indirect Impacts		

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended conditions and DMA regulation
• Changes to surface inputs of flow/volume of water, nutrients and oxygen • Changes to the structure and presence of underground voids • Desiccation of subterranean habitat • Fragmentation of previously connected/contiguous habitat by excavation • Contamination from spills, leaching and environmental incidents.	Impacts are not significant	No limits proposed

9.7. 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.

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Subterranean Fauna are set out below:

- Minimise direct and indirect impacts to subterranean fauna, where possible

To meet the above environmental outcome the Proponent shall:

- Limit the Proposals groundwater abstraction of up to 50 GL/a.

After implementation of the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to subterranean fauna. All species recorded from the Development Envelope are expected to persist following implementation of the Proposal. Accordingly, the Proponent considers the Proposal can be managed to meet the EPA's objective to protect subterranean fauna so that biological diversity and ecological integrity are maintained.

10. AIR QUALITY

10.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021b) list the following as their objective for Air Quality:

To maintain air quality and minimise emissions so that environmental values are protected

10.2. Relevant Policy and Guidance

Air Quality is defined as 'the chemical, physical, biological and aesthetic characteristics of air' (EPA 2021k). 'Air' refers to all the air above the ground up to and including the stratosphere.

Table 10-1 presents the relevant policy and guidance for air quality

Table 10-1: Relevant Policy and Guidance for Air Quality

EPA and other State or Commonwealth policy or guidance (if relevant)	Explain how the policy and guidance has been considered
Environmental Protection Authority	
EPA Statement of Environmental Principles, Factors and Objectives (EPA 2021b)	Considered during the development of this ERD
EPA Environmental Factor Guideline – Air Quality (EPA 2021k)	Considered in the air quality modelling assessment undertaken for the Proposal and during the development of this ERD Consistent with the environmental factor guideline, this section describes: • The application of the mitigation hierarchy to avoid and minimise emissions • Characterisation of potentially harmful emissions and the pathways by which they may be released to air • Whether numerical modelling and other analyses to predict potential impacts has been undertaken using recognized standards and accepted inputs and assumptions • Whether existing background air quality, including natural variations, has been established through monitoring and accepted proxy data • Whether analysis of potential health and amenity impacts has been undertaken using recognized criteria and standards • The application of technology appropriate to the potential environmental impacts and risks • The significance of the likely change to air quality as well as the environmental values affected by those changes, in the context of existing and predicted cumulative impacts • Whether proposed mitigation is technically and practically feasible • Whether siting of the proposal's main emission sources takes into consideration current and future sensitive land uses.
Instructions on how to prepare an Environmental Review Document (EPA 2021d)	This document forms the basis of the headings and content provided in this ERD

EPA and other State or Commonwealth policy or guidance (if relevant)	Explain how the policy and guidance has been considered
Other State or Commonwealth	
National Environmental Protection (Ambient Air Quality) Measure (April 2021)	Considered during the development of this ERD
DMIRS Guideline - Management of Fibrous Minerals in Western Australian Mining Operations (DMP 2015)	Considered in the discussion on potential impacts from, and management of fibrous materials

10.3. Receiving Environment

10.3.1. Studies and Survey Effort

An air quality assessment has been undertaken for the Proposal (ETA 2021), summarised in Table 10-2 and described in further detail in the sections below.

Table 10-2: Summary of Technical Studies for Air Quality

Survey/Study Prepared for	Survey Area, Type and Timing	Consistency with Guidance
Brockman Syncline Proposal: Dust Assessment/Study (ETA 2021; Appendix G.1) Prepared for Rio Tinto	**Survey area:** Development Envelope and surrounds, including nearby sensitive receptors. **Type:** Air quality (dispersion modelling) assessment to determine potential impacts on nearby receptors associated with Proposal activities. Several sensitive receptors were assessed, including nearby homesteads and pastoral station camps/stockyards, rock pools, bat roosts, and Rio Tinto camps airport. An analysis was undertaken using Rio Tinto monitoring data (PM10 particulates) collected from existing operations to account for background dust in the region. **Timing:** Emissions were estimated for two separate mining years (Phase 1 – 2027 and Phase 2 – 2035). An analysis of background dust levels was undertaken using data collected from the following areas and time periods: • Brockman 4 (2013) • Silvergrass (August 2014 – May 2017) • Brockman 2 (2018-2019).	Assessment meets relevant EPA guidance (EPA 2021k). The study was undertaken with consideration of the following: • Characterisation of feedstock, and pollutants and contaminants (i.e., dust) that are likely to be emitted • Characterisation of and proximity to sensitive receptors • Background ambient air modelling and the impact of emissions on sensitive receptors, including likely impacts during worst, best and most likely case scenarios • Assessment against published standards and criteria

10.3.2. Sensitive Receptors

The Proposal occurs in a sparsely populated area, with no towns or communities nearby. The nearest town is Tom Price, approximately 60 km to the southeast of the Proposal. The nearest Aboriginal community, Wokathuni, is located approximately 60 km southeast of the Development Envelope.

Sensitive receptors included in the air quality assessment were (ETA 2021; Figure 10-1):

- Pastoral station homesteads:
  - Rocklea (approximately 33 km south of the Proposal)
  - Hamersley (approximately 24 km northeast of the Proposal)
- Pastoral station out camps/cattle stockyards:
  - Cheela (approximately 35 km south of the Proposal)
  - Mount Brockman (within the Development Envelope).

Habitats for conservation-significant fauna such as bat roosts and permanent or semi-permanent pools were also included in the dust modelling assessment (ETA 2021). This includes Plunge Pool (within the Development Envelope), Palm Springs (approximately 20 km from the Development Envelope) and three other pools (ETA 2021). The potential impacts of particulate emissions on fauna and fauna habitats are discussed in Section 8 and Section 15. As Plunge Pool and Palm Springs also have significant cultural heritage value, the potential impacts of particulate emissions on these places are discussed in the Social Surroundings chapter (Section 12).

Although there are no Aboriginal communities nearby, impacts on air quality from the Proposal have the potential to affect Traditional Owners accessing the areas within and around the Development Envelope. These potential impacts are discussed in Section 12.

It is noted that an unsealed public road, Mt Brockman/Homestead Silvergrass Road, intersects the Silvergrass area (Figure 2-1). Although it is not included as a specific receptor in the air quality assessment, the Proponent notes the road should be considered in its management of any related potential hazard to the public using the road.

Existing Proponent-operated mining camps and the airport were also included in the air quality assessment. However, these receptors are covered by separate DMIRS workplace health and safety regulations and are not required to be assessed as sensitive receptors under this ERD. Consideration of these facilities is, therefore, not considered further in this assessment.

10.3.3. Dust

Dust is also called ‘particulates’ or ‘airborne particulates’ and comprises a range of different sized particles. Airborne particulate matter less than 50 micrometres (µm) in diameter are referred to as Total Suspended Particulates (TSP). Finer particles less than 10 µm and 2.5 µm in diameter are called PM_{10} and $PM_{2.5}$, respectively (ETA 2021).

The National Environmental Protection Measure (NEPM) for Ambient Air Quality specifies ambient standards for the key airborne pollutants based on the protection of human health (ETA 2021). The Air NEPM standards include 1-hour and 24-hour average criteria, used to assess potential short-term health impacts, and an annual average used to assess potential longer-term impacts. A limited number of exceedances of the 1-hour and 24-hour average criteria are allowable under the NEPM, with allowable exceedances of the PM_{10} criteria based on an ‘exceptional event’ rule. The PM_{10} and $PM_{2.5}$ (24-hour) criteria were used to assess the potential health impact on community receptors within the Proposal area model domain (ETA 2021).

The ambient air quality assessment criteria adopted for the Proposal study are shown in Table 10-3

Table 10-3: Summary of Adopted Air Quality Assessment Criteria

Parameter	Criteria
PM_{10}	50* µg/m^3 (24-hour average)
	25* µg/m^3 (Annual average)
$PM_{2.5}$	25* µg/m^3 (24-hour average)
	8* µg/m^3 (Annual average)

The Pilbara region is a naturally dusty environment, with wind-blown dust a significant contributor to particulate loading. There are many events whereby dust exceeds the Air NEPM criteria, based on monitoring regularly conducted at established operations run by the Proponent within the region. An aggregated emission inventory was undertaken in 2000 estimated approximately 170 kt of particulate material was emitted due to wind erosion in the Pilbara (ETA 2021). Wildfires also accounted for a significant volume of particulate emissions, with approximately 195 kt estimated. Note that these are calculated values (i.e., not monitored data) and will vary on an annual basis depending on a range of factors, including the extent of erodible areas, area burnt, rainfall and wind speed (ETA 2021).

The leading dust emissions sources expected from Proposal operations include (ETA 2021):

- Drilling and blasting
- Handling and transfer of ore and waste materials
- Roads and haul road traffic
- Wind erosion from stockpiles and open areas.

Dust modelling for the Proposal incorporating these sources was undertaken based on two emissions scenarios (ETA 2021):

- 'Worst case' - Year 2027, corresponding with the forecast maximum mining tonnage (i.e., when the highest volumes of dust source materials are predicted to be disturbed by mining, transport and processing)
- 'Most likely' - Year 2035, representing what might typically be expected, highlighting emissions variability as the range of deposits are mined progressively through the life of mine.

The dust modelling incorporated typical dust abatement measures. Dust management is discussed in Section 10.5.

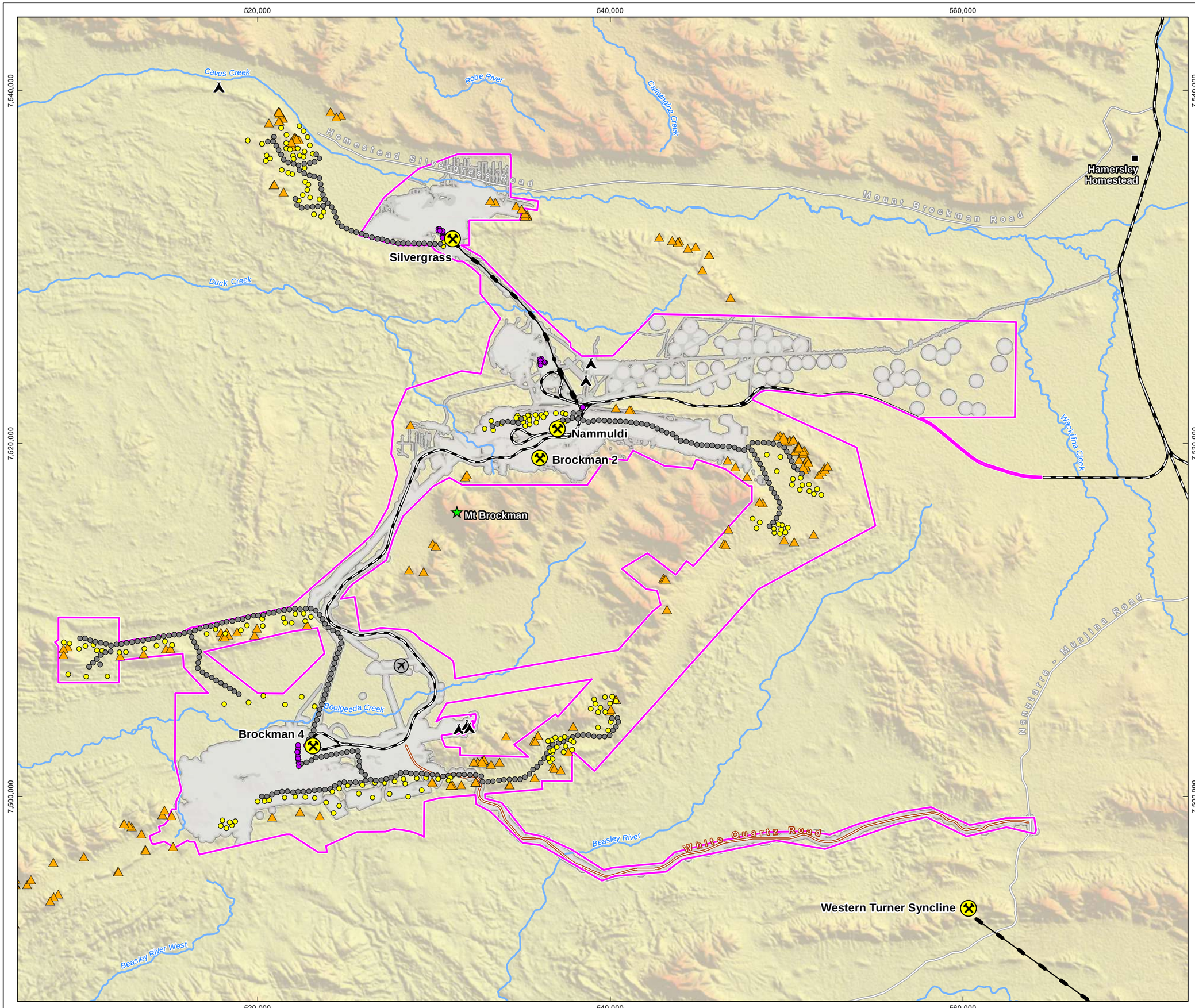
10.3.4. Fibrous Materials

Fibrous materials are anticipated to be encountered from the proposed Lens G pit in the BS2 assessment area, the Endeavour and Marra Mambas pits in the BS4 assessment area and the BS1 pit at the BS1 assessment area (Rio Tinto 2020a).

Fibrous materials can pose a significant risk to human health when fibres of a respirable size become airborne and are inhaled. Due to their fine size (microns), shape (long thin needle-like crystals), and long life within the lungs, such fibres can become a source of irritation to lung tissues which can subsequently lead to several potential lung diseases (DMP 2013).

Naturally occurring fibrous minerals can be found in many parts of Western Australia but are particularly prominent in banded iron formations of the Pilbara. At Rio Tinto Pilbara operations, fibrous minerals are generally encountered in waste material from below watertable in Marra Mambas Iron Formation but have also been encountered in other stratigraphic units, including the Brockman and Joffre iron formations (Rio Tinto 2020a). Fibrous minerals may also occur as clasts (i.e., fragments) found within the overlying alluvium.

Riebeckite is the most common mineral associated with fibrous minerals encountered at the Greater Brockman Operation (Rio Tinto 2019c). Riebeckite is usually found in fresh (unweathered) banded iron formation. The asbestiform variety of riebeckite is crocidolite, or blue asbestos and is considered the most hazardous form of asbestos (DMP 2013). The presence of riebeckite does not necessarily pose a fibrous mineral risk, but it is a precursor mineral to crocidolite; therefore, the potential to encounter crocidolite exists. If present, crocidolite seams would primarily occur within the unmineralised Marra Mambas Iron Formation. However, crocidolite may also occur in banded iron formation clasts found within overlying alluvium cover.



RioTinto

Figure 10-1
Sensitive Air Quality Receptors (Human) and Model Emission Sources

Drawn: L.Fuentes
Plan: PDE0190957v1
Date: June 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Development Envelope
- Approved Part IV Indicative Footprint

Emission Source Location

- Haul Road
- Mining
- Processing

Sensitive Receptor Location

- Airfield
- Bat Cave
- Rio Tinto Camp
- Homestead
- Topographic Feature

- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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10.4. Potential Environmental Impacts

Air emissions can affect both environmental receptors and human health if not managed correctly. The proposed operations can produce air emissions in the form of dust and may also include asbestos fibres.

Potential impacts of the Proposal to air quality have been identified as:

- Increased dust particulates through construction and operation - affecting human health and amenity at sensitive receptors
- Exposure of fibrous materials - affecting human health.

10.4.1. Increased Dust Emissions through Construction and Operation

An increase in dust emissions may result in the following:

- Health effects from inhalation of dust particles and fibres, including cardiovascular and lung diseases
- Amenity effects include:
  - Safety hazards, such as reduced visibility when driving or operating machinery
  - Nuisance build-up of dust on clothing, vehicles and outdoor areas
  - Effects on visual amenity.

The potential impacts of Proposal dust emissions concerning the key environmental factors Flora and Vegetation, Terrestrial fauna and Social Surroundings, and MNES, are discussed in Sections 7, 8, 12 and 15, respectively.

The dust modelling assessment, which factored in emission abatement controls, has forecast a slight increase in airborne dust concentrations over the operational mine areas and immediate surroundings (Table 10-4 to Table 10-5; ETA 2021). However, the Proposal will not result in air quality assessment criteria being impacted at nearby homesteads and stockyards/out camps. Additionally, the Proposal is remote from any towns or communities, and no impact from nuisance dust will occur in any of these types of residential locations (ETA 2021). It should be noted that potential impacts of dust emissions to Traditional Owners' health and cultural heritage values due to their on-going use of and connection to Country in the vicinity of the Proposal are discussed in Section 12.

Table 10-4: $PM_{2.5}$ Concentration at Key Sensitive Receptors – including Background (µg/m^3)

Receptor	Max. 24-hr Average		Annual Average		Days >25 (24-hr)	
Assessment criteria	25 µg/m^3		8 µg/m^3		25 µg/m^3	
Year	2027	2035	2027	2035	2027	2035
Mt Brockman stockyard	14	10	6.7	6.2	0	0
Rocklea homestead	6	6	5.2	5.2	0	0
Hamersley homestead	7	6	5.3	5.2	0	0
Cheela out camp	6	6	5.2	5.2	0	0

Green: below assessment criteria (50 µg/m^3)

Table 10-5: PM_{10} Concentration at Key Sensitive Receptors – including Background (µg/m³)

Receptor	Max. 24-hr average		6th highest 24-hr average		Annual average		Days >50 µg/m³	
Assessment criteria	50 µg/m³				25 µg/m³		50 µg/m³	
Year	2027	2035	2027	2035	2027	2035	2027	2035
Mt Brockman stockyard	43	34	35	32	22.7	22.0	0	0
Rocklea homestead	22	20	20	19	18.4	18.3	0	0
Hamersley homestead	23	22	21	19	18.6	18.3	0	0
Cheela out camp	22	21	20	19	18.3	18.2	0	0

10.4.2. Exposure to Fibrous Materials

Fibrous materials are expected to be exposed during Proposal operations (Rio Tinto 2020a), and this has the potential to impact on human health, including the Proposal workforce and also at sensitive receptors (e.g., homesteads described in Section 10.3).

10.4.3. Cumulative Impacts

The Proponent has considered the existing Brockman operations when assessing the potential air quality impacts from the Proposal. Therefore, this section presents cumulative impacts to air quality, based on fugitive dust emissions, from both the existing Brockman operations and the Proposal.

The FMG Eliwana Iron Ore Project (FMG Eliwana Mine) is located along the northern border of the Development Envelope adjacent to BS1 and has been included in this assessment. No other existing or reasonably foreseeable operations occur within 15 km of the Proposal and therefore is not expected to contribute to the potential cumulative impacts on air quality.

10.4.3.1. Dust Emissions

Cumulative impacts for dust emissions could only be based on PM_{10} emissions, based on information available from the FMG Eliwana Mine ERD (FMG 2018 [166]; Table 10-6). Cumulatively, the Proposal, existing operations and FMG Eliwana Mine will emit an estimated 45 kt of PM_{10} particulates per year (Table 10-6).

Table 10-6: Cumulative Predicted Fugitive Particulate PM_{10} Emissions Per Annum

Mine	Operation	Fugitive Particulate Matter (PM_{10}) (Tonnes / Year*)
BS1	Proposal	2,366
BS2	Existing Operations	353
Lens G/Diesel	Proposal	1,876
BS3	Proposal	1,014
BS4	Existing Operations	465

Mine	Operation	Fugitive Particulate Matter (PM_{10}) (Tonnes / Year*)
Sub-total		**6,074**
FMG Eliwana Mine	3rd Party	38,461
Total		**44,535**

*Predicted PM_{10} emissions for 2027, representing a worst-case scenario (ETA 2021 [99]). Predicted emissions are considerably lower in 2035 for the Proposal and existing operations.

10.4.3.2. Fibrous Materials

The impact assessment for fibrous mineral waste includes both the Proposal and existing operations as these are managed as a whole.

Fibrous minerals have been intersected in both the Brockman (Joffre and Dales Gorge members) and Marra Mamba formations for the FMG Eliwana Mine (FMG 2018 [166]). No data is available to allow a meaningful assessment of the potential cumulative emissions of asbestiform materials. However, it is expected that following the respective operations' fibrous minerals management procedures and health and safety requirements will minimise emissions and exposure to these materials within each site. Therefore, they will not present a cumulative risk.

10.5. Mitigation

10.5.1. Mitigation Hierarchy

10.5.1.1. Dust Emissions

Monitoring and mitigation strategies are currently being implemented to manage potential adverse dust impacts from the existing Greater Brockman Operations (Table 10-7). They will continue to be implemented as part of this Proposal. The Proponent has well-established strategies for dust management across all Pilbara operations and continues to investigate more opportunities to reduce their emissions.

Management of dust emissions will continue to be in accordance with environmental licence requirements for prescribed premises (or prescribed activities, as applicable at the time) issued under Part V of the EP Act. On-going monitoring plans will allow continuous assessments on dust management performance. Therefore, refinement of the management plans can be made where necessary.

10.5.1.2. Fibrous Materials

To ensure the mining workforce, Traditional Owners and any other public accessing the Development Envelope are not exposed to fibrous materials, the Proponent will implement its Fibrous Materials Management Plan (FMMP) and comply with all relevant legislation regarding the handling of fibrous materials (i.e., *Occupational Safety and Health Regulations 1996* and *Mines Safety and Inspection Regulations 1995*) (Appendix G.2).

The FMMP describes the management of fibrous minerals encountered during mine production and at closure. This includes the encapsulation of fibrous minerals with an appropriate amount of inert material in designated waste landforms (Appendix B.4), with a preference for the use of in-pit dumps. The encapsulation procedure also considers the final rehabilitation design of the landform to ensure that the material remains secure after mine closure.

Mitigation actions to address the potential impacts and the predicted outcomes for air quality are summarised in Table 10-7.

10.5.2. Mitigation of Risks at Closure

The Greater Brockman MCP (Appendix B.4) has been prepared to address closure requirements for the Proposal. Dust is not considered to be a significant closure issue for the Proposal due to its remote location but will continue to be managed during closure implementation using approaches similar to operational dust control measures and monitoring requirements. The impact and mitigation of dust after closure as applicable to Social Surroundings and is discussed in Section 12.

Table 10-7: Mitigation Measures for the Air Quality Environmental Factor

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Increased airborne dust particulates generated through construction and operation	**Measures to Minimise**			
	The Proponent has well-established mitigation and management strategies for minimising dust emissions across its operations in the Pilbara region. These strategies will continue to be implemented for the Proposal, including: • Minimising clearing as far as practicable • Using dust suppressants or watering down roads, working surfaces and stockpiles as required • Using dust collection systems and enclosed screenhouses • Restricting vehicles to designated roads and tracks • The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Covering the overland conveyor at BS1 to reduce dust generation • Sealing the low volume (LV) access road to BS1 Non-Processing Infrastructure (NPI) • Exploring opportunities to minimise dust emissions, including: ○ Program trialling products to improve product efficiency	Standard business practise	Yes - in accordance with DWER environmental licence requirements for prescribed premises (or prescribed activities, as applicable at the time) issued under Part V of the EP Act.	Proposed measures to minimise dust emissions are consistent with Rio Tinto and industry standards and will minimise dust emissions to as low as reasonably practicable.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	○ Dust reduction through technological innovation.			
	Measures to Rehabilitate			
	Areas that are no longer in use will be rehabilitated as soon as practicable to reduce wind erosion on exposed surfaces.	Standard business practise	No	• The MCP is consistent with the EP Act Precautionary Principles and follows standard practices for mine closure planning, implementation and compliance subject to regular and ongoing assessment and approval. • Rehabilitation will provide a self-sustaining, vegetated, stable landform compatible with final land use. Ongoing monitoring and rehabilitation measures will ensure that this outcome is achieved at closure.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No environmental limits proposed – managed through industry standard practice (other limits apply for occupational health and safety purposes)		• Not applicable	
Exposure of fibrous materials	**Measures to Avoid**			
	• The Proponent will ensure that any potentially fibrous materials uncovered during the mining are encapsulated, thereby avoiding the risk of airborne respirable fibrous particles. • Control measures are employed during operations to avoid any potential health risk posed by exposure to fibrous material in line with the Proponent's FMMP (Appendix [A12]) that complies with WA Legislation and guidance, including: ○ *Mine Safety and Inspection Regulation 1995* ○ *Occupational Safety and Health Act 1984* ○ *Occupational Safety and Health Regulations 1996*	Standard business practise	No	Encapsulation methods are highly effective in preventing dispersion of airborne particles and therefore will avoid any potential fibrous material becoming a risk.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	○ *Health Act 1911* ○ *Health (Asbestos) Regulations (1992)* ○ *Environmental Protection Act 1986* ○ *Environmental Protection (Controlled Waste) Regulations 2004* ○ Management of Fibrous Minerals in West Australian Mining Operations- Guideline second edition (2015) ○ Guidelines for Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (2009)			
	Measures to Minimise			
	• Training will be completed by all personnel who may be required to work in 'potentially fibrous' or 'fibrous' areas • Appropriate respiratory protection will be carried by all personnel entering 'potentially fibrous' or 'fibrous' areas • Sign will be posted and demarcated at the entrances to 'potentially fibrous' or 'fibrous' areas. • When working in a 'fibrous' area the following controls are required: ○ Respiratory protection shall be worn when not in a pressurised cab (i.e., on foot). If deemed necessary based on risk assessment, disposable overalls can be worn within a 'fibrous' area. ○ Upon exit, equipment and personnel will be inspected and cleaned, if required: • Haul trucks shall be loaded to minimise spillage during transportation of fibrous material.	Standard business practise	No	The FMMP is consistent with WA Legislation and guidance and therefore provides a high to moderate certainty that these measures will minimise any health risk of exposure to fibrous materials.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls

	• Fibrous materials will be capped in situ or encapsulated in non-fibrous (i.e., inert) mineral waste within a WRL.
	• Management measures to mitigate the risk of accidental public access will be implemented and include:
	  ○ Establishing abandonment bunds around pits to limit public access
	  ○ Ensure other closure landforms provide for safe access in accordance with the outcomes agreed through the mine closure planning process.			

	• **Measures to Rehabilitate**			
	• Tracks that are not required for monitoring and/or maintenance purposes post-closure will be rehabilitated to reduce the risk of inadvertent public access. • Access roads will be rehabilitated prior to relinquishment and physical barriers installed (e.g., earthen bunds) unless Traditional Owners or the State wish the roads to remain accessible. • Locked gates will be installed on access roads for the duration of the post-closure monitoring and maintenance period. • Review the potential visitors access the site, and install additional control measures, including abandonment bunding around pits, where appropriate.	Standard business practise	No	• As mentioned above, the MCP is consistent with the EP Act Precautionary Principles and follows standard practices for mine closure planning, implementation and compliance subject to regular and ongoing assessment and approval. • The FMMP is consistent with WA Legislation and guidance. • Rehabilitation will provide a self-sustaining, vegetated, stable landform compatible with final land use and fibrous material risk is expected to be compatible with post-mining land use. • There is a moderate level of certainty in the effectiveness of these measures.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No environmental limits proposed – managed through existing Rio Tinto FMMP management practices (Appendix [A12-FMMP]) and industry standard practice (other limits apply for occupational health and safety purposes)		Not applicable	

10.6. Assessment and Significance of Residual Impact

10.6.1. Increased Dust Particulates Through Construction and Operation

Dust concentrations attributable to the Proposal are predicted to be low outside the Proposal operational areas at all the pastoral station sensitive receptors – well below all air quality assessment criteria (Table 10-8). No exceedances of the assessment criteria for any particulate size categories were predicted to occur on any day of the year. Note the concentrations described in Table 10-8 are inclusive of background levels and, therefore, represent the predicted maximum cumulative emissions (i.e., lower concentrations can be expected in all categories for 'Proposal only' scenarios, without background) (ETA 2021). For the sensitive receptors (as well as operational area receptors and immediate surrounds), peak predicted ground level dust concentrations are predicted to occur in 2027 (shown Table 10-8, corresponding with the forecast maximum mining tonnage, with dust emissions much lower under the 'most likely' 2035 scenario (ETA 2021). Furthermore, the PM_{10} modelling results consistently show an appreciable reduction in the predicted ground level concentrations below the second-highest concentration – indicating that the maximum concentrations are infrequent (ETA 2021). Typical ground level PM_{10} concentrations are anticipated to be better represented by the sixth-highest predicted concentration as shown in Table 10-8.

Monitoring and mitigation strategies have been implemented to manage potential dust impacts on the mining areas and their surroundings. These measures include minimising clearing, dust suppression, traffic controls and progressive rehabilitation, which are discussed in detail in Section 10.5. These strategies provide opportunities for continuous identification and rectification for the causes that lead to excessive dust levels.

Table 10-8: Maximum Predicted Dust Concentration at Key Sensitive Receptors – including Background

Receptor	Category		Assessment Criteria (µg/m^3)	Max. Predicted Outcome (µg/m^3)
Hamersley homestead	$PM_{2.5}$	Maximum 24-hour average	25	7
		Annual average	8	5.3
	PM_{10}	Maximum 24-hour average	50	23
		Annual average	25	18.6
Rocklea homestead	$PM_{2.5}$	Maximum 24-hour average	25	6
		Annual average	8	5.2
	PM_{10}	Maximum 24-hour average	50	22
		Annual average	25	18.4
Cheela out camp	$PM_{2.5}$	Maximum 24-hour average	25	6
		Annual average	8	5.2
	PM_{10}	Maximum 24-hour average	50	22
		Annual average	25	18.3
Mt Brockman stockyard	$PM_{2.5}$	Maximum 24-hour average	25	14
		Annual average	8	6.7
	PM_{10}	Maximum 24-hour average	50	43
		Annual average	25	22.7

10.6.2. Exposure to Fibrous Materials

The risk of public exposure to fibrous minerals is low at the proposed site due to its remote location and the measures taken to prevent accidental public access. However, whilst public access to the site is likely to be limited, Traditional Owners will have access to cultural sites throughout the life of mine. In addition, both Traditional Owners and pastoralists will require access to parts of the Development Envelope post-closure (Section 12).

Potential health risks from exposure to fibrous materials in pit walls will be individually assessed as mining progresses and at closure. No measures will be taken where the risk is deemed to be acceptably low. If the risk is at an unacceptable level, relevant measures in line with the FMMP will be implemented to avoid or mitigate the risks (Rio Tinto 2019c, Appendix G.2). Management and mitigation measures to reduce the potential impacts from the exposure to asbestiform materials are discussed in detail in Section 10.5 Cumulative Impacts.

10.6.3. Cumulative Impacts

10.6.3.1. Dust

Modelling of predicted dust contributions from the Proposal addressed scenarios both with and without background concentrations. Therefore, the scenarios incorporating background data are considered to provide the basis for assessing cumulative impact from past and present emissions sources (ETA 2021).

Additional future emissions from other nearby reasonably foreseeable sources include yet-to-be-developed parts of the FMG Eliwana Iron Ore Project (Eliwana), located along the northern border of the Development Envelope adjacent to the BS1 assessment area. The Proponent considers no other reasonably existing or foreseeable project to be near enough to contribute to cumulative dust emissions. The associated Eliwana Railway Project ERD does not contain relevant air quality information (FMG 2018b). There are no other existing or reasonably foreseeable operations close enough to the Proposal to be considered significant contributors to potential cumulative impacts on air quality. Air quality modelling is not provided in the Eliwana ERD, only estimates the average annual volume of fugitive PM_{10} particulates potentially generated from that proposal (FMG 2018a). Therefore, meaningful characterisation of reasonably foreseeable future scenarios incorporating information from that proposal was not possible. However, the modelling undertaken for the Proposal includes a form of assessment of cumulative impacts due to the incorporation of existing background dust concentrations. Cumulatively, the Proposal, the existing Brockman operations and the FMG Eliwana mine will emit approximately 45 kt of PM_{10} particulates per annum. As discussed in Section 10.5.2, dust concentrations are not expected to impact sensitive receptors in the vicinity of the Proposal significantly.

10.6.3.2. Fibrous Materials

The primary sensitive receptor for airborne fibrous materials is the Proposal workforce. The Proponent will continue to implement its FMMP (Appendix G.2) to ensure occupational limits are not exceeded for fibrous materials (see Section 10.5). On the basis that the nearby Eliwana Iron Ore Mine will be implementing a similar approach, the potential for cumulative impacts from fibrous materials will be negligible.

No data is available to allow a critical assessment for potential cumulative impacts from asbestiform materials. However, it is expected that management in accordance with the respective operations' FMMP, health and safety requirements will minimise emissions and exposure to these materials.

10.6.4. Significance of Residual Impacts

10.6.4.1. Non-Significant Residual Impact

The proposed avoidance and management measures associated with the Proposal that demonstrate non-significant residual impacts to Air Quality (which for this Proposal relates to dust and fibrous material) include:

- Dust concentrations attributable to the Proposal are predicted to be low outside the Proposal operational areas at all sensitive receptors, and well below dust air quality assessment criteria (Section 10.6)
- The risk of exposure to fibrous minerals from the Proposal is low due to its remote location and the measures taken to prevent accidental public access. The Proponent will continue to implement its FMMP to ensure occupational limits are not exceeded for fibrous materials.

10.7. 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.

No environmental outcomes are proposed as significant impacts to air quality are unlikely to occur and as such standard business practices are considered sufficient to manage the Air Quality factor to meet the EPA's objective to maintain air quality and minimise emissions so that environmental values are protected.

11. GREENHOUSE GAS EMISSIONS

11.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2023a) lists the following as their objectives for Greenhouse Gas (GHG) Emissions:

To reduce net greenhouse gas emissions in order to minimise the risk of the environmental harm associated with climate change

GHG emissions are a key contributor to climate change, which has already had a significant effect on Western Australia's environment (EPA 2023b).

Annual Scope 1 GHG emissions associated with the Proposal will be above the EPA assessment threshold of 100 kilotonnes (kt) of carbon dioxide equivalent (CO2-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.

11.2. Relevant Policy and Guidance

11.2.1. 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) 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. The recently reformed (passed Parliament) Safeguard Mechanism applies baselines (including a year-on-year decline rate commencing 1 July 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.

11.2.2. Western Australia Policy and Guidelines

On 28 August 2019, the WA Government released its State Government 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 for GHG in April 2020 and in April 2023 published its revised factor guideline.

The guideline outlines how and when the Greenhouse Gas Emissions factor is considered by the EPA in the EIA process (EPA 2023b). It 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 detail:

- Interim and long-term emissions reduction targets the Proposal should aim to achieve throughout the Proposals life
- Best practice design, technology, management and reasonably practicable alternatives and measures appropriate to avoid, reduce or offset Scope 1 and 2 emissions from the 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 11-1 presents GHG's relevant policy and guidance and demonstrates how this has been considered for the Proposal.

Table 11-1: Relevant Policy and Guidance for Greenhouse Gas Emissions

Policy or Guidance	Explain how the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2023a)	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 2023b)	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 11.5.1 • The interim and long-term emissions reduction targets the Proponent proposes to achieve net zero emissions by 2050 (Table 11-7) • The best practice design, technology and management measures to mitigate GHG emissions and relevant benchmarking are described in Greenhouse Gas Management Plan (GHG EMP; Appendix H.1) • The Rio Tinto corporate emissions reduction targets and how the proposal is consistent with achieving those targets

Policy or 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 2021d)	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 2021f)	Considered during the development of this document and the GHG EMP.
Other State or Commonwealth	
Greenhouse Gas Emissions Policy for Major Projects (GoWA 2019)	Rio Tinto is committed to meeting the State's aspiration of net zero emissions 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 2050 • If the target is not met, commitment to offset via purchase of eligible offset units • Five-yearly progress reporting • Five-yearly formal re-submission or if significant change is triggered.
Western Australian Climate Policy (GoWA 2020b)	The Proposal includes interim and long-term emission reduction targets consistent with the State's commitment to achieving net zero emissions by 2050.
National Greenhouse and Energy Reporting Act 2007 (NGER Act) (DISER 2007)	Emissions from the BS2 and BS4 operations (including the Proposal) will be reported annually through NGER scheme, in accordance with the NGER Act, which provides for the reporting and dissemination of information related to greenhouse gas emissions, greenhouse gas projects, energy production and energy consumption.
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 Brockman Hub under the Safeguard Mechanism. The Hub will endeavour to keep its emissions at or below its baseline by: • Avoiding emissions through the electrification of fleet (as this technology becomes available) • Reducing emissions in the interim (for example through energy efficiency initiatives), and • Managing remaining excess emissions through the purchase and surrendering of 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).

11.3. Receiving Environment

11.3.1. 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 2020a).

In 2022, WA emitted an estimated 8million (M) t of CO_2-e (EPA 2020a) and has offset approximately 8.6 Mt of CO_2-e (DISER 2023a). Approximately % of WA's emissions are associated with the mining sector (DISER 2023b).

Consistent with the EPA Guideline (EPA 2023b), the geographic scope for the assessment of GHG emissions associated with the Proposal is the state of Western Australia.

11.4. Potential Environmental Impacts

Potential greenhouse gas 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 generated from the Proponent's 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 (Scope 3). In this case, largely in the manufacturing of steel.

In recognition of the impact of greenhouse gases on the climate, particularly associated with our operating footprint in Western Australia, Rio Tinto is committed to being an integral part of the solution to climate change. Rio Tinto has established a Climate Action Plan and clear Decarbonisation Strategy and RTIO has a climate action plan that seeks to reduce our 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.

11.4.1. Greenhouse Gas Emissions Estimates

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 and mobile diesel combustion (Scope 1 emissions)
- Consumption of electricity from the Proponent's Pilbara Power Generation Network (Scope 2 emissions).

It should be noted that no fugitive or transport emissions are expected from the Proposal, however, cumulative emissions from the existing operation and associated rail are discussed in Section 11.4.2.

Rio Tinto sells an iron ore blend and calculates Scope 3 emissions based on a sales portfolio. The estimated Scope 3 emissions from the Proposal are provided in Table 11-2. The GHG emissions inventory have been estimated for the Proposal using the methods and criteria from the Measurement Determination (DISER 2008).

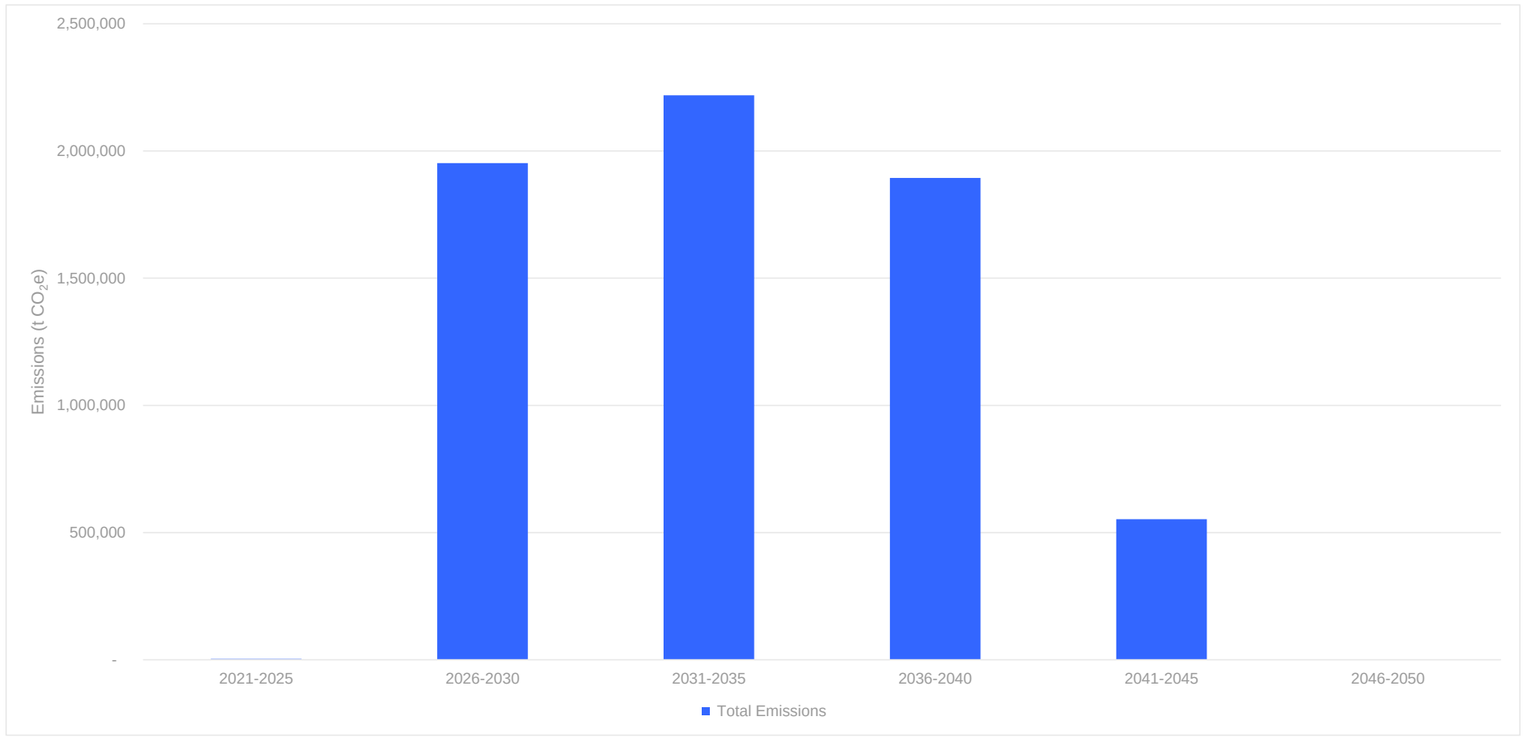
A summary of estimated annual average and total GHG emissions throughout the LoM (22-year mine life) by source and scope for the Proposal is presented in Table 11-2, with estimated annual average and total GHG emissions for the Proposal and approved operations shown in Table 11-3. Greenhouse gas emissions before abatement in five yearly intervals is shown on Figure 11-1.

Table 11-2: Estimated GHG Emissions from the Proposal

Activity	Annual Average Emission (t CO_2-e/annum)	Total Emission through the LoM (t CO_2-e)
Scope 1 Emissions		
Land clearing	1970	41,375
Diesel fuel – Mobile sources	269,713	5,663,972
Diesel fuel – Stationary sources		
Scope 2 Emissions		
Electricity	43,586	915,299
Total (Scope 1 & 2 emissions)	**315,269**	**6,620,647**
Scope 3 Emissions		
Based on a sales portfolio of the Proponent's Iron Ore Blend	48,288,429	1,014,057,013

Table 11-3: Estimate Greenhouse Gas Emissions from the Proposal and Approved Operations

Activity	Annual Average Emission (t CO_2-e/annum)	Total Emission through the LoM (t CO_2-e)
Scope 1 Emissions		
Land clearing	1,591	41,375
Diesel fuel – Mobile sources	422,610	10,987864
Diesel fuel – Stationary sources		
Scope 2 Emissions		
Electricity	67,932	1,766,219
Total (Scope 1 & 2 emissions)	**492,133**	**12,795,458**
Scope 3 Emissions		
Based on a sales portfolio of the Proponent's Iron Ore Blend	68,182,548	1,772,746,254



RioTinto

Figure 11-1
Greenhouse Gas Emissions Before Abatement at five yearly intervals

Drawn: L.Fuentes
Plan: PDE0191314v3
Date: August 2023

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11.4.2. Operational Phase Greenhouse Gas Emissions Intensity

The operational phase GHG emission intensity (Scope 1 & 2) 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 2027, however peak emission intensity occurs in 2037. 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 11-4.

Table 11-4: Proposal Greenhouse Gas Emissions Intensity

Year Peak Annual Production	SOP (kt)	Emissions (t CO_2-e pa)	Emissions Intensity (kg CO_2-e/tSOP)
Peak Intensity (2037)	33,848	298,388	8.8
Average Intensity	46,890	231,661	6.9

11.4.3. Cumulative GHG Emissions

Mine production included in the Proposal will sustain rather than increase annual ore throughput associated with existing operations within the Development Envelope. The Proposal will increase the total mine life as the existing approved mines reach the end of their productive life and are eventually replaced by the new mine pits associated with the Proposal. Therefore, the Proposal represents a continuation of iron ore mining. As a result, the Amended Proposal is expected to contribute approximately 231,661 t CO_2-e per annum (average), as follows:

- Scope 1 emissions: 199,122 t CO_2-e per annum (including land clearing)
- Scope 2 emissions: 32,539 t CO_2-e per annum.

Through the L0M, the Amended Proposal is expected to contribute 5,330,943 t CO_2-e Scope 1 and 2 emissions.

11.4.4. 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 11-5).

The operations considered for benchmarking are similar iron mines with above and below water table mining using conventional open pit methods.

Comparison of emissions intensity across individual mining operations reflects site-specific circumstances, such as waste to ore ratios, grade characteristics, topography and scale of mining. The benchmarking in Table 11-5 indicates that the performance of the Proposal is lower than the Iron Ore industry's current average GHG intensity due to latest technology that offers higher efficiency of mining equipment (e.g., mine haul trucks) to deliver more with less fuel and energy.

Table 11-5: Benchmarking Against Comparable Open Cut Iron Ore Mines in the Pilbara

Facility	Forecast emissions intensity (kg CO_2-e/t SOP)
This Proposal	6.9
Rio Tinto – Tom Price	6.8
Default Emission Intensity Iron Ore Mining Safeguard Mechanism	4.7
BHP – Jimblebar Iron Ore Mine	7.4
FMG – Eliwana Iron Ore Mine	7.0

11.5. 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.

11.5.1. Mitigation Hierarchy

In recognition of the State GHG Policy (GoWA 2020b), 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 11-6.

11.5.1.1. Measures to avoid and reduce GHG Emissions

Rio Tinto is committed to achieving net-zero GHG emissions for operations in Western Australia by 2050, consistent with the State GHG Policy and Guidelines. Emissions reductions will be achieved via abatement projects at both a Pilbara system level and through site-based energy efficiency improvements. Leveraging its integrated Pilbara-wide power generation network, abatement projects such as solar and wind renewable energy can be connected to the power network at any location, providing 'green' power to the system, reducing reliance on gas. The integrated power network provides power to all operating mine and port operations.

In line with Rio Tinto's ambition to reach net zero emissions by 2050 across all operations, internal guidelines are in place to integrate GHG considerations into the design and planning of development projects.

Strategic decisions are made throughout the development of projects to ensure energy-efficient lower-emission solutions are prioritised where practicable. Each project, in conjunction with the internal Rio Tinto Study Definition Guidelines and aligned with the State GHG Policy and Guideline, considers 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 project and across the Pilbara in a holistic, measured and consistent manner.

Specific measures implemented to avoid or reduce GHG emissions from the Proposal are identified in the Proponent's GHG EMP (Rio Tinto 2020d; Appendix H.1) and summarised in Table 11-6.

11.5.2. 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.

Australian Carbon Credit Units (ACCUs) are currently the sole prescribed carbon units allowed to reduce net emissions to meet Safeguard Mechanism obligations. 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.

Given developments in carbon offset markets and contemporary expectations in relation to the retirement of offset units, the Proponent will apply the integrity principles of the International Carbon Reduction and Offset Alliance (ICROA) in relation to the sourcing and use of credible international offset units for any remaining carbon offsetting requirements. Credible offset units sourced will be based on the principles outlined in ICROA's Technical Specification, real, measurable, permanent, additional, independently verified, and unique. Rio Tinto will only use 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.

The Proponent may also use other offset units that meet integrity principles and are based on clear, enforceable and accountable standards.

Table 11-6: Application of the Mitigation Hierarchy for Greenhouse Gas Emissions

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Predicted Outcome
Generation of GHGs through the combustion of fossil fuels and land clearing (Scope 1 Emissions) and generation of power (Scope 2 Emissions)	**Measure to Avoid**			
	• The Proposal incorporates the following best practice measures to avoid GHG emissions: • The Proponent has study and development processes that identify, assess and where practicable develop existing, innovative and new technology developments. • Solar PV power generation is being studied as part of the Pilbara Wide emissions reduction strategy. The Proposal has two locations being assessed for the second development of Solar PV in the Pilbara, connected to the existing Pilbara Power network. The installation will offset a significant portion of emissions from the Greater Brockman region • A key GHG abatement initiative incorporated within the Proposal is the construction of an overland conveyor to transport ore from the new mine pits back to the existing Brockman Hub processing plant. Using an overland conveyor to transport ore will reduce haul truck diesel consumption and deliver GHG abatement. Re-powering the Pilbara with renewable energy to enable greater electrification through use of conveyors is a key measure for achieving a reduction of Scope 1 emissions.	Proposal 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 2022d; Appendix H.1) 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 Brockman Hub (including the Proposal) will also be reported annually through NGER, in accordance with the NGER Act. The Proponent considers the Proposal can be managed to meet the EPA's objective for GHG emissions.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Predicted Outcome
	• Emission abatement projects may be implemented at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld. The Pilbara Power Network is fully integrated across all Pilbara Mining assets. Carbon abatement projects are treated holistically in their application across Rio Tinto's Pilbara operations providing net emissions reduction regardless of their physical location.			
	Measure to Minimise			
	The Proponent has carefully considered GHG abatement measures regarding the Proposal design and lifecycle. The Proposal incorporates the following best practices measures to reduce GHG emissions: • Fixed Plant: Use of variable speed drives where practicable to enable equipment to be efficiently modulated to meet changes in throughput • Installation of high efficiency LED lighting across the plant infrastructure (where practical) • Overland Conveyor: Use of variable speed drive systems on the overland conveyor to enable equipment to be efficiently modulated to meet changes in throughput • Solar PV cell powered lighting along the overland conveyor route (where practical)	Proposal specific and in many cases applied across the Pilbara	No	As per avoidance

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Predicted Outcome

	• Non-Process Infrastructure: control lighting using photoelectric cell, timer control and motion sensors when not occupied (where practical)
	• Mine Design: The ongoing design and mine plan optimisation process assess the following opportunities:
	  ○ The location of the crusher, mining area, pit exits and WRL are optimised to reduce haul distances
	  ○ Haul road layout design – designed to smooth the truck speeds to minimise stop/start and hence improve diesel use efficiency.			

	Offsetting			
	The Proponent will offset emissions where abatement is insufficient against the interim and long-term targets outlined in Section11.5.4.2 and Section 4.1.2 of the GHG EMP (Appendix H.1), broadly as follows Offsets will be delivered by retiring credible offsets units in 2025, 2030, 2035, 2040, 2045 and 2050 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. • If additional offsets are still required, the: ○ Integrate principles of the ICROA in relation to the sourcing and use of credible offsets units for carbon offsetting	Proposal specific	No	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. If additional offsets are still required, international credible offset units may be sourced to offset Proposal emissions, sourcing from verified carbon unit providers will ensure the quality and credibility. 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).

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Predicted Outcome
	○ 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.			
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	To support the State's ambition, the Proponents interim and long-term emissions reduction targets for the Proposal are to: • Reduce or abate emissions by 15% by 2025 • Reduce or abate emissions by 50% by 2030 • Reduce or abate emissions by 67% by 2035 • Reduce or abate emissions by 74% by 2040 • Reduce or abate emissions by 56% by 2045 • Reduce or abate emissions by 100% by 2050		Ministerial conditions limiting Proponents' interim and long-term emissions reduction targets set out in the GHG EMP (Rio Tinto 2022d; Appendix H.1).	

11.5.3. Rio Tinto 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 partnered an industry wide partnership initiative collaborating to identify and develop innovative mobile fleet charging solutions
- Additional partnerships have been established to fast-track development and implementation of battery electric haul solutions including haul trucks
- Rio Tinto has purchased four 7MW/h battery electric locomotives for a pilot in the Pilbara, a research and development partnership with Wabtec.

For further detail on these opportunities, please refer to the GHG EMP (Appendix H.1).

11.5.4. Emission Reduction Targets

11.5.4.1. Rio Tinto Group Level Targets

Group Level

Rio Tinto has announced its ambition to reach net zero emissions by 2050 across all operations. To support this ambition, interim global targets10 have been introduced for Scope 1 and 2 emissions, effective from 2021, to:

- Reduce absolute emissions by 15% by 2025 (approximately 4.9 Mt CO2-e equity basis)
- Reduce absolute emissions by 50% by 2030 (approximately 16.3 Mt CO2-e equity basis)
- No new purchase of diesel haul trucks and diesel locomotives beyond 2030.

The target is measured against a 2018 global equity baseline, currently 32.6M t CO2-e, which will be adjusted for divestments and acquisitions.

To support the reduction of Rio Tinto's Scope 3 emissions, several separate partnerships have been established with BlueScope Steel, POSCO, Nippon Steel Corporation, Baowu Steel and Tsinghua University in China to develop and implement new methods to reduce carbon emissions and improve environmental performance across the value chain.

11.5.4.2. Interim and Long-Term Emission Reduction Targets

To support the State's ambition, the Proponents interim and long-term emissions reduction targets for the Proposal are to:

- Reduce or abate emissions by 15% by 2025 (approximately 448 tCO_2-e)
- Reduce or abate emissions by 50% by 2030 (approximately 976,119 tCO_2-e)
- Reduce or abate emissions by 67% by 2035 (approximately 1,486,744 tCO_2-e)
- Reduce or abate emissions by 74% by 2040 (approximately 1,406,069 tCO_2-e)
- Reduce or abate emissions by 56% by 2045 (approximately 308,430 tCO_2-e)
- Reduce or abate emissions by 100% by 2050 (approximately 0 tCO_2-e).

From 2030, the Proponent is committed to delivering emissions reductions in a linear trajectory (based on five-yearly targets) to net zero GHG emissions by 2050. The estimated emission reductions resulting from the interim and long-term targets in five yearly intervals are shown in Table 11-7 and Figure 11-2. The actual emissions will be managed via the GHG EMP.

Table 11-7: Interim and Long-term Emissions Reduction Targets

Target Year	2025	2030	2035	2040	2045	2050
Total Estimated Potential Scope 1 and 2 Emissions (t CO_2-e)	2,988	1,952,238	2,218,833	1,894,128	552,459	-
Emission Reduction Target[16] (t CO_2-e)	448	976,119	1,486,744	1,406,069	308,430	-
Percentage Reduction Emissions (%)	15	50	67	74	56	100

[16] Based on forecast / estimated Scope 1 emissions. Actual emission figures will be managed via the GHG MP.

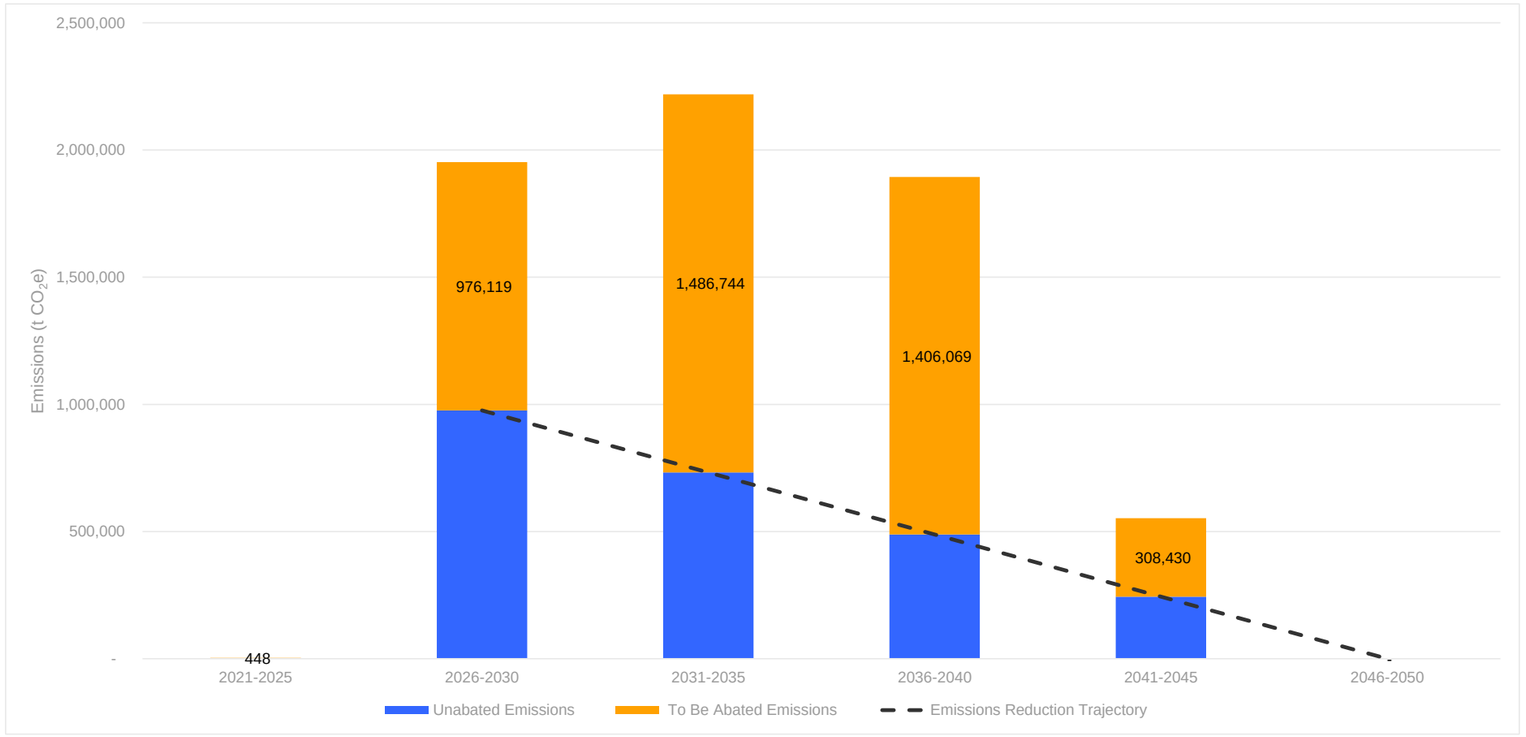

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Figure 11-2
Proposed Greenhouse Gas Emissions and Reduction Targets at Five Year Intervals

Drawn: L.Fuentes
Plan: PDE0191314v3
Date: August 2023

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11.5.4.3. Greenhouse Gas Management Plan

The Proponent has developed a Greenhouse Gas Management Plan (Rio Tinto 2022d; Appendix H.1) in accordance with the Environmental Factor Guideline: Greenhouse Gas Emissions (EPA 2020a) 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 2050 as outlined in Section 4.1.2 of the GHG MPGHG EMP
- Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 & 2 GHG emissions (Table 13 and Table 14 of the GHG EMP)
- If the target is not met, commitment to offset via the purchase of eligible offset units (Section 4.1.3 of the GHG MPGHG EMP)
- Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 GHG emissions (Table 13 and Table 14 of the GHG MPGHG EMP)
- Five yearly progress reporting as described in Section 6 of the GHG MPGHG EMP
- Five yearly formal re-submission or if a significant change is triggered as outlined in Section 7 of the GHG MPGHG EMP.

11.6. Assessment and Significance of Residual Impacts

While emissions from the overall Project will increase as a result of the implementation of this Proposal, net emissions from the Brockman Operations will decrease over the coming years as a result of:

- The closure of existing operational areas within the overall project
- The implementation of emissions reduction measures and subsequent decrease in emissions intensity.

After the avoidance and reduction measures, the Proposal is expected to contribute net GHG emissions (Scope 1 and 2 emissions) of approximately 2,460,000 t CO_2-e through the life of the project (Figure 11-3).

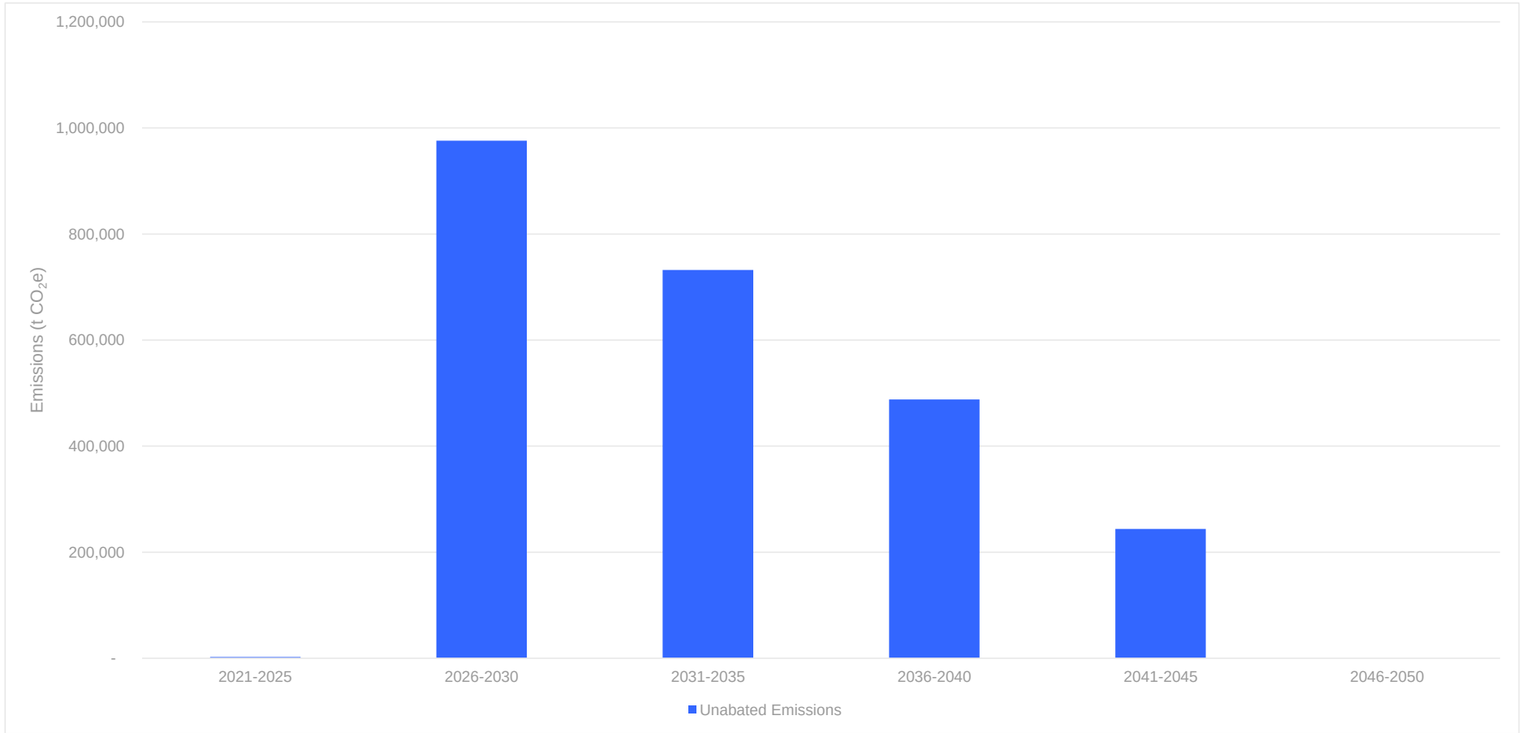

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Figure 11-3
Net Greenhouse Gas Emissions for the Proposal After Abatement at Five Yearly Intervals

Drawn: L.Fuentes
Plan: PDE0191314v3
Date: August 2023

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11.7. 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 and environmental objectives that apply to Greenhouse Gasses are set out below:

- The Proponent shall take measures to reduce emissions 15% by 2025 and 50% by 2030 and then deliver emissions reductions in a linear trajectory (based on five-yearly targets) to net zero GHG emissions by 2050.
- The Proponent shall take measures to ensure that net GHG emissions associated with the Proposal do not exceed:
    - 1,540 t CO_2-e for the period between 1 January 2024 and 31 December 2025
    - 976,119 t CO_2-e for the period between 1 January 2026 and 31 December 2030
    - 732,089 t CO_2-e for the period between 1 January 2031 and 31 December 2035
    - 488,149 t CO_2-e for the period between 1 January 2036 and 31 December 2040
    - 244,029 t CO_2-e for the period between 1 January 2041 and 31 December 2045
    - Zero t CO_2-e for every five-year period from 1 January 2046

The Proponent will implement the GHGE MP as per Appendix H.1 to meet these outcomes which is consistent with the EPA factor objective for GHG.

11.7.1. Monitoring of Proposed Outcomes

Monitoring of the Proposed environmental outcomes will include:

- Five yearly progress reporting
- Five yearly formal re-submission or if a significant change is triggered
- Five yearly interim reduction of emissions from 2025 to 2050 based on targets outlined in Table 11 4 and in Section 4.1.2 of the GHG EMP (Appendix H.1), including but not limited to:
- Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 & 2 GHG emissions
- Commitment to offset if the targets are not met
- Abatement of Scope 1 & 2 emissions in accordance with targets as set out in the GHG EMP (currently estimated at 2,870,467 t CO_2-e).

The Proponent has prepared a GHG EMP (Appendix H.1) that outlines how emissions from the Proposal are monitored and managed to minimise the contribution to global emissions

The Proposal design, combined with the Proponents' Pilbara wide emissions reductions and abatement mitigation measures, will support the Proponent's commitment to achieving net zero GHG emissions by 2050. Accordingly, the Proponent considers that the Proposal can be managed to meet the EPA's objective to minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as practicable.

12. SOCIAL SURROUNDINGS

Sections of this Chapter have been redacted at the request of the Puutu Kunti Kuruma and Pinikura People and the Muntulgura Guruma People who hold the Native Title rights and interests associated with the land underlying the Proposal.

12.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021b) 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.

12.2. Relevant Policy and Guidance

Table 12-1 presents the relevant policy and guidance for Social Surroundings.

Table 12-1: Relevant Policy and Guidance for Social Surroundings

Policy and Guidance	Explain how the Policy and Guidance have been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021b)	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 2021d)	Considered during the development of this document.
Instructions on how to prepare EP Act Part IV Environmental Management Plans (EPA 2021f).	This document forms the basis of the headings and content provided in this ERD.

Policy and Guidance	Explain how the Policy and Guidance have been Considered
Guidance Statement No. 41 – Assessment of Aboriginal Heritage (EPA 2004)	Considers Aboriginal heritage in the environmental approvals process when heritage values are linked to the environment.
Other State or Commonwealth	
Statutory Guidelines for Mine Closure Plans (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 B.4).
Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	
Engage Early Guidance for Proponents on best practice Indigenous engagement for environmental assessments under the EPBC Act (DoE 2016b)	Used as guidance during engagement.

12.3. Receiving Environment

The Proposal is located approximately 60 km west-northwest of Tom Price in the central Pilbara region of Western Australia, on the Native Title Determination Areas of the Puutu Kunti Kurrama and Pinikura People and the Eastern Guruma People and falls within the Shire of Ashburton. The surrounding area is predominantly utilised for mining activities and pastoralism.

The Proponent has consulted with Traditional Owners and stakeholders to inform this assessment. An overview of the consultation undertaken to date is outlined in Appendix B.6.

12.3.1. Recreation and Community

The following factors were used to determine the potential recreational and community uses of the land within the Development Envelope and surrounds:

- Availability of public access
- Evidence of public access
- Evidence of public camping sites
- Information sourced from surrounding pastoral stations.

No evidence of frequent or occasional access or camping by members of the general public was identified within the Development Envelope. The remote location of the Proposal means that public access is difficult and rarely occurs, except by Traditional Owners. The adjacent Cheela Plains Station provides station stay accommodation and recreational activities such as four-wheel driving, hiking, stargazing and birdwatching, however, these recreational activities are not undertaken within the Development Envelope and are not considered likely to be impacted by the Proposal.

12.3.2. European Heritage

The Proponent has investigated and not found evidence of European heritage within the Development Envelope that this Proposal may impact.

Pastoral activities have occurred within portions of the Development Envelope for decades; however, the Development Envelope does not contain any known areas or sites of European historical significance.

12.3.3. Pastoral Stations

The Development Envelope intersects three pastoral stations as shown in Figure 12-1:

- Cheela Plains Station
- Hamersley Station
- Rocklea Station.

The Proponent owns Hamersley and Rocklea Stations, and as such the impacts of the Proposal on these pastoral stations are not considered relevant to this assessment.

Cheela Plains is immediately adjacent to the Development Envelope, and the Development Envelope intersects a small portion.

One pastoral station is near the Development Envelope: Mt Stuart Station. While this pastoral station lies outside the Development Envelope, indirect impacts on pastoral activities may be relevant to this assessment.

12.3.3.1. Cheela Plains Station

Cheela Plains Station is a family-owned and managed working cattle station. Originally part of the Wyloo Station, Cheela Plains was established as a stand-alone station in 2001 with “a vision to be industry leaders in sustainable and renewable pastoral practices”. Enterprises include grazing, a contracting business, station stay accommodation and recreational activities such as four-wheel driving, hiking, stargazing and birdwatching. The station covers an area of 1,854.63 km^2 (Figure 12-1). The main Cheela Plains homestead is accessed from Nanutarra Road (Figure 12-1), approximately 29 km west of the Development Envelope boundary.

Through consultation with the Proponent, the Station Owners have expressed their preference for the Proponent to purchase the portion of the pastoral lease (approximately 300 km^2) which the Development Envelope intersects. The Proponent is working with Cheela Plains to finalise agreed terms for this acquisition. Following this, the agreement will be submitted to the Department of Planning, Lands and Heritage (DPLH) and the Foreign Investment Review Board for approval (nominally, a 12-month process; finalisation is expected in late 2023). The acquisition will also occur in consultation with Puutu Kunti Kurrama and Pinikura Aboriginal Corporation as the representative of the Traditional Owners. This portion of land will then be incorporated into and operated as part of the Hamersley Station.

12.3.3.2. Mt Stuart Station

Mt Stuart Station is used for cattle grazing and covers an area of 3,438 km^2. It is located 5 km west of the Proposal and does not intersect with the Development Envelope (Figure 12-1). The Mt Stuart Station homestead is approximately 100 km from the Proposal and is accessed via Nanutarra Road.

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Figure 12-1
Pastoral Lease Boundaries

Drawn: L.Fuentes
Plan: PDE0189549v1
Date: June 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:225,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Development Envelope
- Approved Part IV Indicative Footprint (MS 131, 867, 925, 1000)

Indicative Footprint for Brockman Syncline Proposal

- Pit
- Waste Rock Landform
- Landbridge
- Infrastructure

Rio Tinto Pastoral Station

- Hamersley Station
- Rocklea Station

Third Party Pastoral Station

- Cheela Plains Station
- Mt Stuart Station
- Conveyor
- Rio Tinto Railway
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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500,000 520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Cheela Plains Station Homestead

0 10 20 30
Kilometres

Robe River
Calvinia Creek
Weelumurra Creek
Caves Creek
Mount Brockman Road
Silvergrass
N050438 Hamersley Station
Duck Creek
Nammuldi
Brockman 2
N050372 Rocklea Station
Barnett Creek
Wacklina Creek
Pinarra Creek
N050169 Mt Stuart Station
Boolgeeda Creek
Brockman 4
N050545 Cheela Plains Station
Beasley River
White Quartz Road
Western Turner Syncline
Beasley River West
Nanutarra - Munjina Road
Hardey River

12.3.4. Native Title

Native Title rights and interests comprise either the exclusive right to possession, occupation, use and enjoyment of the relevant land or a set of non-exclusive rights which include, among others, the right to maintain and protect places of significance.

The Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma People hold the Native Title rights and interests associated with the land underlying the Proposal. The Robe River Kuruma People hold Native Title rights and interests associated with the land in proximity to the Proposal (the nearest distance to Robe River Kuruma People's Native Title boundary is approximately 19 km from the Development Envelope).

Figure 12-2 illustrates the Native Title determinations (NTDs) in proximity to the Proposal.

The Puutu Kunti Kurrama and Pinikura People received their NTD on 2 September 2015. The lands and waters within this determination cover approximately 10,888 km^2 between Onslow and Tom Price. The Puutu Kunti Kurrama and Pinikura People are two distinct Groups who each speak for their own Country within the NTD area and collectively over a shared area. They are represented by the Puutu Kunti Kurrama and Pinikura Aboriginal Corporation (PKKP AC) as their registered native title body corporate. The Puutu Kunti Kurrama and Pinikura People entered into a Claim Wide Participation Agreement with the Proponent in March 2011, and an Indigenous Land Use Agreement (ILUA) was registered with the National Native Title Tribunal on 24 April 2013.

The Eastern Guruma People received their NTD on 1 March 2007 for Part A of their claim area, which covers the lands and waters across approximately 6,500 km^2 around Tom Price and Karijini National Park. NTD for Part B of their claim area over parts of the Tom Price township was achieved on 20 November 2012. They are represented by the Wintawari Guruma Aboriginal Corporation (WGAC) as their registered native title body corporate. An ILUA was signed by Hamersley Iron, Rio Tinto Exploration Pty Ltd, Guruma Mali Wartu Aboriginal Corporation (subsequently replaced by WGAC as the registered native title body corporate), the Eastern Guruma People and the State of Western Australia on 27 November 2002. Following Eastern Guruma's NTD on 1 March 2007, a separate Body Corporate ILUA was entered into on 23 June 2008.

As per all Agreements that the Proponent holds with Traditional Owners for its Pilbara operations, these Agreements are subject to an agreement modernisation process, which is ongoing at the time of writing.

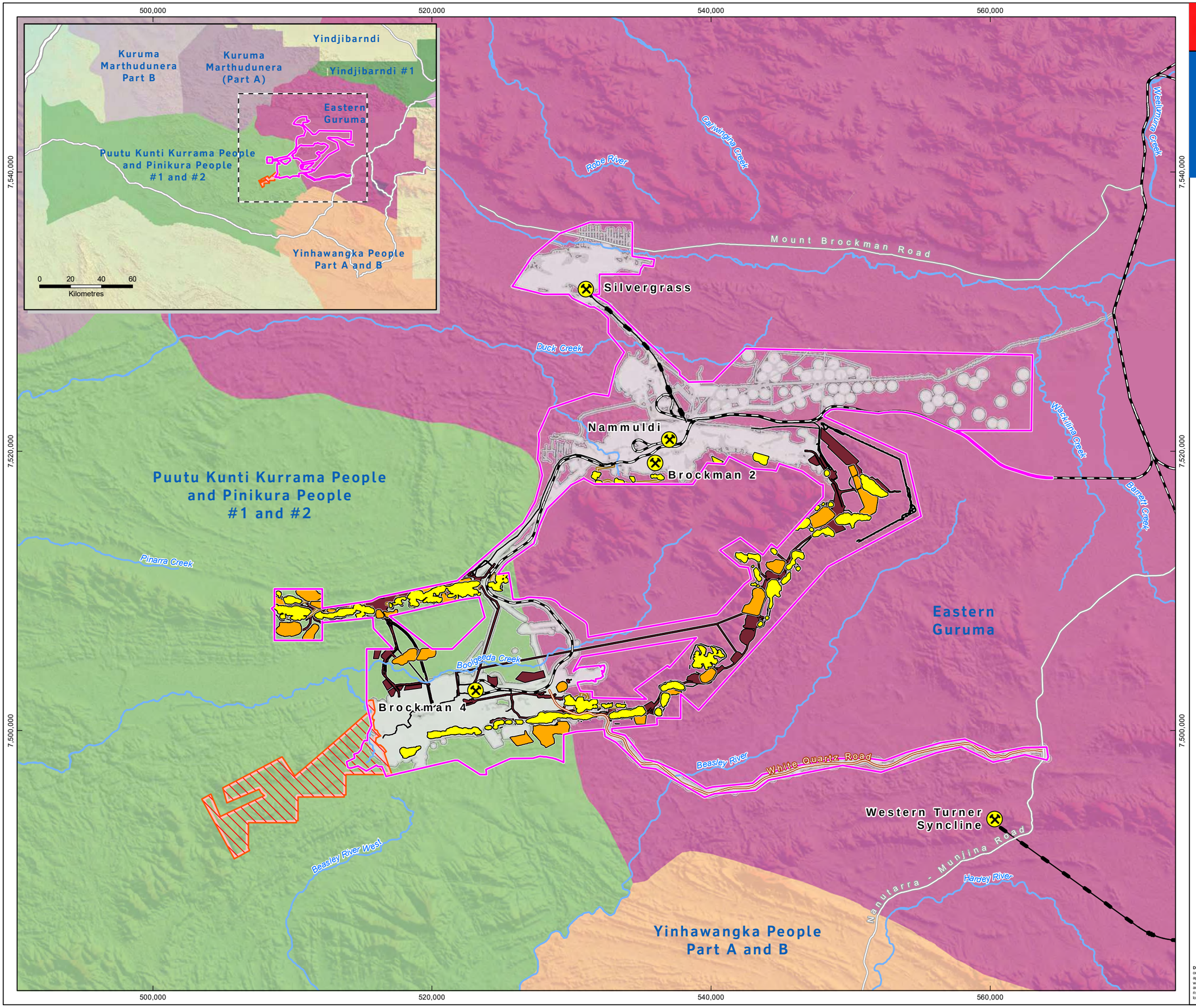

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Figure 12-2
Native Title Determination Areas

Drawn: L.Fuentes
Plan: PDE0189550v1
Date: June 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Development Envelope
- Conveyor
- Rio Tinto Railway
- Major Road
- Minor Road
- Site Access Road
- Major Creek
- Approved Part IV Indicative Footprint (MS 131, 867, 925, 1000)
- PKKP Moratorium Area

Native Title Determination Area

- Eastern Guruma
- Kuruma Marthudunera (Part A)
- Puutu Kunti Kurrama People and Pinikura People #1 and #2
- Yinhawangka People Part A and B

Indicative Footprint for Brockman Syncline Proposal'

- Pit
- Waste Rock Landform
- Landbridge
- Infrastructure

**** Privileged and Confidential ****

N

0 2 4 6 8 10
Kilometres

Map units in metres

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12.3.5. Acknowledgement of the Juukan Gorge Incident

Across Australia, there are tens of thousands of heritage places and areas of cultural significance to the Traditional Owners of this Country. These sites are evidence of one of the oldest living cultures in the world and today remain intrinsic to Aboriginal and Torres Strait Islanders' culture and customs. On 24 May 2020, a highly significant rockshelter, located in an area known as Juukan Gorge on Puutu Kunti Kurrama and Pinikura Native Title lands, was destroyed through blasting for mine pit development at the Proponent's BS4 operation and another was damaged.

A review of the events leading up to the destruction of these rockshelters identified a series of systemic failures of the Proponent's communities and heritage management processes at BS4 over an extended period of time; particularly because the decision to impact a heritage site sat with relatively junior staff as opposed to senior leaders. Both the Rio Tinto Board Review and the Inquiry of the Joint Standing Committee on Northern Australia (the Parliamentary Inquiry) undertaken in 2020 make it clear that the events at Juukan Gorge represented a breach of Rio Tinto's partners' trust and a failure to uphold Rio Tinto's values as a company.

Externally, Traditional Owner groups, the broader community and State and Commonwealth Government expect a greater recognition of community stakeholder values through the life of a project and evidence that community voices are being heard, and subsequently, social and cultural impacts are kept to a minimum.

In response, the Proponent has implemented systemic changes, including a governance framework specific to managing potential impacts on cultural heritage values and broader engagement practices. Decisions regarding heritage impacts are considered at a dedicated Heritage Management Committee chaired by the Chief Executive Officer of the Rio Tinto iron ore product group. A demonstrated effort is required to ensure that impacts to significant sites and cultural values are either avoided or mitigated and that any residual impacts proposed have been appropriately consulted on and fully understood by the affected Traditional Owners.

12.3.6. Puutu Kunti Kurrama and Pinikura Traditional Lands and Heritage

The Proponent has commissioned archaeological and ethnographic surveys within the Development Envelope with the Puutu Kunti Kurrama and Pinikura people within their NTD. The surveys were commissioned for various purposes, including:

- Inform the Proponent of the location of heritage places so that these may be avoided through project design and re-design where practicable (Section 12.5.1.2)
- Assess the cultural values of heritage places with a view to register them with DPLH, and where required in order to gain consent to investigate or disturb sites that the Proponent cannot practically avoid and are seeking to disturb.

As of 30 March 2022, archaeological and ethnographic heritage surveys within the Puutu Kunti Kurrama and Pinikura NTD have covered approximately 88% of the areas that overlap the Development Envelope (Figure 12-3). Additional archaeological and ethnographic surveys will be completed for any remaining unsurveyed areas subjected to disturbance within the Development Envelope. Heritage information can be sensitive and is treated "in confidence" with each Group. The information provided in this section may therefore be non-specific in some cases to protect the sensitivity of the detailed information.

Surveys within the Development Envelope commenced in 2003 over the Brockman 4 Evaluation Camp and exploration drilling sites, with surveys continuing over multiple survey areas every year since. In total, more than 115 heritage surveys have been completed within the sections of the Development Envelope, which overlap the Puutu Kunti Kurrama and Pinikura NTD.

Social surroundings baseline assessment and consultations have also been undertaken with Puutu Kunti Kurrama and Pinikura representatives to complement these heritage surveys and inform the

significant places and aspects of the landscape that may interact with or be impacted by the implementation of this Proposal. The first round of baseline assessments were conducted in early 2020, and a subsequent report delivered to Rio Tinto in April 2020. This report focused on deposits and areas which are now outside of the scope of this Proposal. A second round of assessment was undertaken in mid-2021, complemented by two on-Country consultations with Puutu Kunti Kurrama and Pinikura and Rio Tinto representatives. The second round of assessment did not result in a report, however feedback during this consultation informed the social surroundings elements addressed in this section of the ERD.

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12.3.8. Robe River Kuruma Traditional Lands and Heritage

The Proposal does not intersect with the lands of the Robe River Kuruma People NTD area (Kuruma Marthudunera Part A Native Title claim area (WCD2016/006; WAD6090/1998)); however, the Proposal is located approximately 19 km east and south-east of the NTD boundary.

The Proponent has engaged in a consultative process with the Robe River Kuruma People regarding potential indirect environmental impacts on their cultural values arising from this Proposal. Robe River Kuruma Aboriginal Corporation (RRK AC) is the prescribed body corporate representing the Robe River Kuruma People. RRK AC engaged Stevens Heritage Services to support Social Surroundings consultations with Robe River Kuruma representatives and to prepare a corresponding report. This report relates to the consultations in the field and at two community meetings with Robe River Kuruma People (Kuruma Marthudunera Native Title Claim), which took place between 13 - 20 July 2020 and on 25 August 2020.

Robe River Kuruma people have expressed strong views regarding places of importance and values in this part of the country. Located on Muntulgura Guruma Country is the traditional meeting place of the three Guruma Groups, namely Mallu (Palm Springs), (known as Marlumarlunha by Robe River Kuruma People), which is several kilometres upstream of the intersection of Narraminju Wuntu (Caves Creek) and Kartajirri Wuntu (Duck Creek, outside of the Development Envelope). The importance and significance of water to the Robe River Kuruma People was raised during social surrounding consultations as the single most important area of cultural concern for the Robe River Kuruma Traditional Owners in relation to this Proposal. However, the Robe River Kuruma People recognise Muntulgura Guruma Native Title Holders as the custodians of the Palm Springs area and as the Group with authority to provide direction in relation to matters pertaining to the area. On this basis, impacts to Robe River Kuruma NTD lands are not considered further in this document.

12.3.9. Identified Key Social Values

Based on the information provided in Section 12.3, the following social values were determined to be key to this assessment:

- The amenity and livelihood of Cheela Plains and Mt Stuart Pastoral Stations
- Puutu Kunti Kurrama and Pinikura heritage places and traditional uses of land
- Muntulgura Guruma heritage places and traditional uses of land.

12.4. Potential Environmental Impacts

12.4.1. Direct Impacts

A list of potential impacts has been developed from the Social Surroundings reports and from consultation with Traditional Owner groups and relevant stakeholders (i.e., pastoralists). Further detail of this consultation is provided in Section 4 and Appendix B.6.

Potential direct impacts include:

- Destruction of Aboriginal Heritage sites
- Alteration of water – direct impact to creek or pool tributaries, changes to surface water flow regimes, changes in water quality via sedimentation and alteration of groundwater levels and regimes
- Restriction of access to Country, places and sites of social, cultural and heritage significance
- Disturbance to sites and places of social, cultural and heritage significance as a result of mining
- Clearing of identified populations of culturally significant flora

- Changes to landforms which may result in altered visual landscapes within the region and at specific areas supporting social cultural heritage values
- Cumulative impacts.

[redacted]

12.4.1.3. Alteration of Water – Puutu, Kunti, Kurrama and Pinikura NTD

Pulykati Wuntu (Boolgeeda Creek) runs through the area between the BS1 range and the BS4 active mining area within the Puutu Kunti Kurrama and Pinikura NTD portion of the Development Envelope. The creek mainline is not proposed to be diverted or realigned by this Proposal. The discharge of surplus mine dewatering water to this creek, which occurs as part of the existing operations within the Development Envelope, will continue under this Proposal. Surplus water discharge may result in indirect impacts, a key concern of which is the attraction of feral animals. The Proponent has an aspirational target of zero creek discharge from iron ore dewatering activities by 2032 as part of its commitment to environmental water stewardship. This Proposal is being developed consistent with that target. The creek mainline will also be impacted by the BS1 conveyor crossing from BS1 to BS4 assessment area by way of truss bridge concrete pillar footings.

No permanent or ephemeral pools are recorded within the Puutu Kunti Kurrama and Pinikura NTD portion of the Development Envelope. However, there are areas where water is known to persist for periods of time. One such area is between the DP8 and DP9 WRLs. DP8 is part of the existing BS4 footprint, while DP9 forms part of the footprint in this Proposal. Below and between these two WRLs is a tributary, at the base of which water is known to pool for a period of time throughout the year. Puutu Kunti Kurrama and Pinikura representatives have expressed concern regarding potential sedimentation from these dumps filling in the depression where water pools over time. Redesign efforts to these dumps have greatly reduced the likelihood of sedimentation to the area, as detailed in Section 12.5. Part of this area sits within DPLH25129 Cultural Complex.

BWT mining is proposed to the Brockman Syncline aquifer within the Puutu Kunti Kurrama and Pinikura NTD portion of the Development Envelope to enable mining at BS1 and at BS4 assessment areas. In some areas this will recover post mining naturally, but in other areas it is not expected to recover to pre-mining water levels.

12.4.1.4. Alteration of Water – Muntulgura Guruma NTD

Within the Eastern Guruma NTD boundary, Duck Creek, Boolgeeda Creek and Caves Creek are all intersected by the Development Envelope. The mainline channels of these creeks are not proposed to be diverted or otherwise realigned by this Proposal.

The discharge of surplus mine dewatering water to Boolgeeda and Duck Creek, which occurs as part of the existing operations within the Development Envelope, will continue under this Proposal. Muntulgura Guruma representatives have expressed concerns about this as a wasteful use of water which is a precious resource. The Proponent has an aspirational target of zero creek discharge from iron ore dewatering activities by 2032 as part of its commitment to environmental water stewardship and this Proposal is being developed consistent with that target.

Two key pools are associated with this Proposal within Eastern Guruma NTD within the Development Envelope, namely Plunge Pool and Kurwillinha Pool.

Plunge Pool is a groundwater connected pool located south of Mt Brockman within the Pulykati cultural catchment. Measures described in Section 6.6.1.4 have been included in the planning for this Proposal to avoid changes to groundwater levels near the pool. However, mining in this area is expected to result in the removal of up to 66% of the Pool's contributing surface water catchment at closure.

Kurwillinha Pool is a surface water sustained pool located at the end of a small gorge in the BS4 assessment area. It is at an elevation of 555 mRL, which is more than 50 m higher than the pre-mining water table in this area, therefore, it is not connected to the underlying aquifer system. This pool has been recorded to dry out in the hotter months. The Proposal includes mining of the Endeavour deposit, which intersects with the catchment of Kurwillinha Pool and may reduce the pool's contributing catchment by up to two thirds. Hydrological modelling has determined that the reduced catchment area would continue to produce sufficient runoff to fill the pool in a similar frequency to that of the baseline conditions (refer to Section 6.4.1.4).

In addition to these impacts there will be catchment loss with the small tributaries within the Development Envelope, resulting in overall catchment reductions for the Duck and Boolgeeda Creek systems. Diversion of surface flows in the tributaries may be constructed to divert flows around active mining areas, which changes the flow path, albeit at a micro level. This is discussed further in Section 6.6.1.4.

BWT mining is proposed for the Brockman Syncline aquifer within the Eastern Guruma NTD portion of the Development Envelope to enable mining at Lens G, Diesel, Creekside, Endeavour and Marra Mamba deposits. In some areas the water table will recover post mining naturally, but in other areas it is not expected to recover to pre-mining water levels due to low recharge. In some areas pit lakes are expected to form in mine pit voids where backfill of the pit to above post mining recovered water levels is not prescribed in the Brockman Operation MCP. Not all below-water table pits that are not backfilled will form pit lakes (Section 6.6.2.3; Appendix B.3).

12.4.1.5. Restriction of Access

Restriction of Access for Traditional Owners

Access to Country is integral for Traditional Owners to be able to practice and pass on culture and customs and meet obligations to care for Country. Feedback from the Traditional Owners has been that access is difficult and that this Proposal has the potential to impede access further.

For Puutu Kunti Kurrama and Pinikura People, in addition to this general concern, they have expressed that there is a need to have the ability to move from west to east across the landscape. The conveyor proposed from BS1 assessment area to BS4 assessment area has the potential to impact this.

Muntulgura Guruma People have expressed that access to the cultural catchments intersected by this Proposal has diminished since mining operations commenced in the area in 1992 (Brockman 2 under MS 131). Of the four cultural catchments intersected by the Development Envelope, WGAC has indicated they have six known access points into three of the cultural catchments, and one of the catchments has no unrestricted access. Access to these catchments is reliant on access to Mt Brockman Road.

Restriction of Access for Pastoralists

The Cheela Plains Station currently use the White Quartz Road to access Tom Price, including for high clearance cattle trains traversing through the BS4 assessment area between BS4 and BS1. The conveyor planned from BS1 to BS4 has the potential to impact this access.

12.4.1.6. Clearing of Identified Populations of Culturally Significant Flora

The importance of culturally significant flora has been identified through surveys and consultation. Both Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma representatives have identified several species of significance. These plants may be food sources or have ceremonial or medicinal purposes. To date no specific areas where particular species were traditionally gathered and/or are still gathered has been identified for protection. The Proponent is proposing measures in relation to culturally significant flora with both Groups within their respective SCHMPs.

12.4.1.7. Visual Impact

The landscape and visual environment will be altered by this Proposal, in some cases permanently. These changes have been assessed using a custom built three-dimension digital model. Areas selected for visual impact assessment are based on consultation to date with Traditional Owner representatives pertaining to areas of importance and/or concern.

Impacts to Visual Amenity for Puutu Kunti Kurrama and Pinikura People

The range that extends west to east immediately north of existing BS4 operations is an undeveloped deposit known as BS1. This area has been a focal point of consultation with Puutu Kunti Kurrama and Pinikura representatives. Figure 12-7 to Figure 12-13 demonstrate how this area may be impacted from a visual amenity perspective.

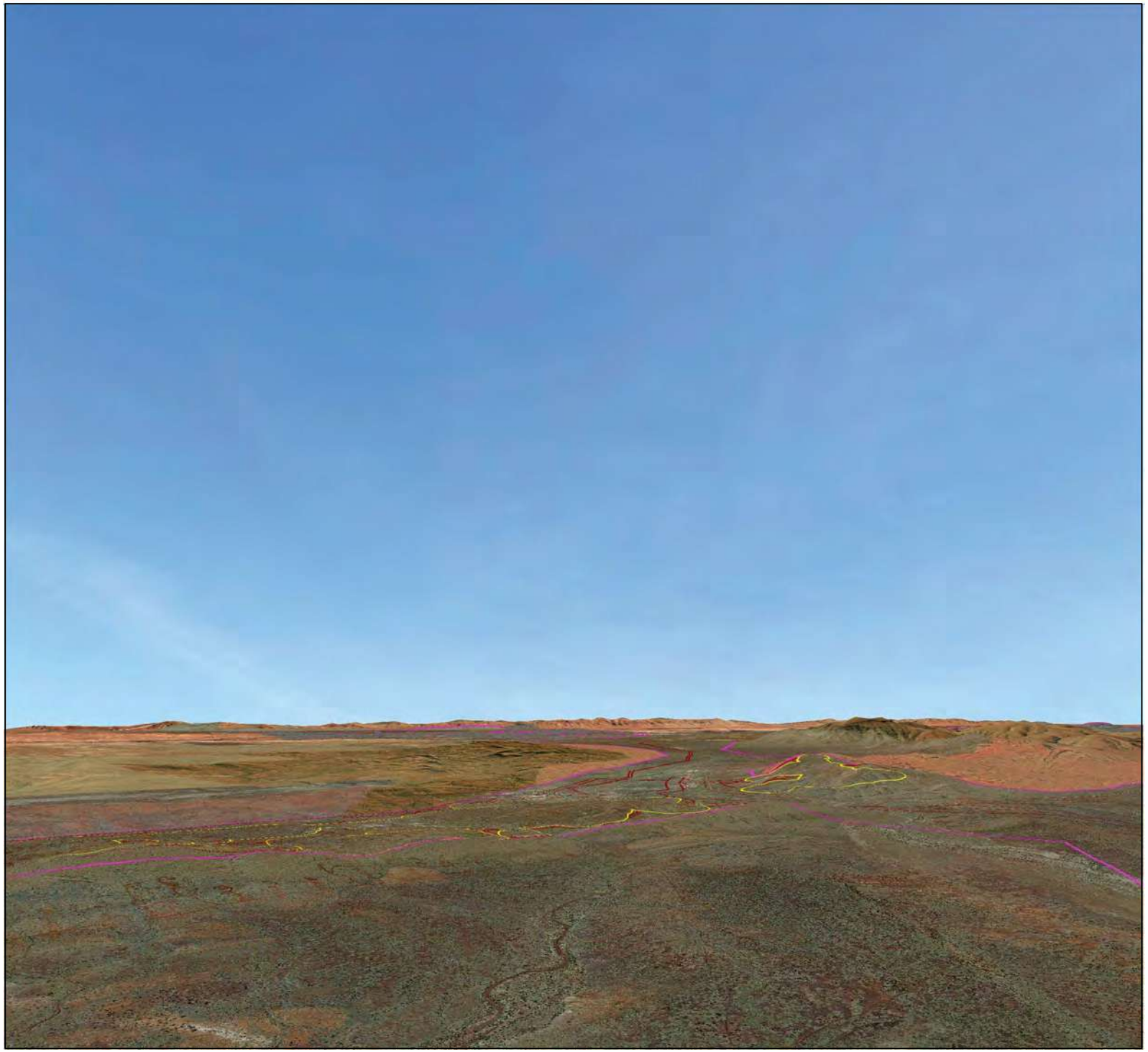

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Figure 12-7
BS1 Range
Northeast View

Drawn: L.Fuentes
Plan: PDE0189554v1
Date: September 2022

Scale: NTS@A4
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Figure 12-8
BS1 Range
Southeast View

Drawn: L.Fuentes
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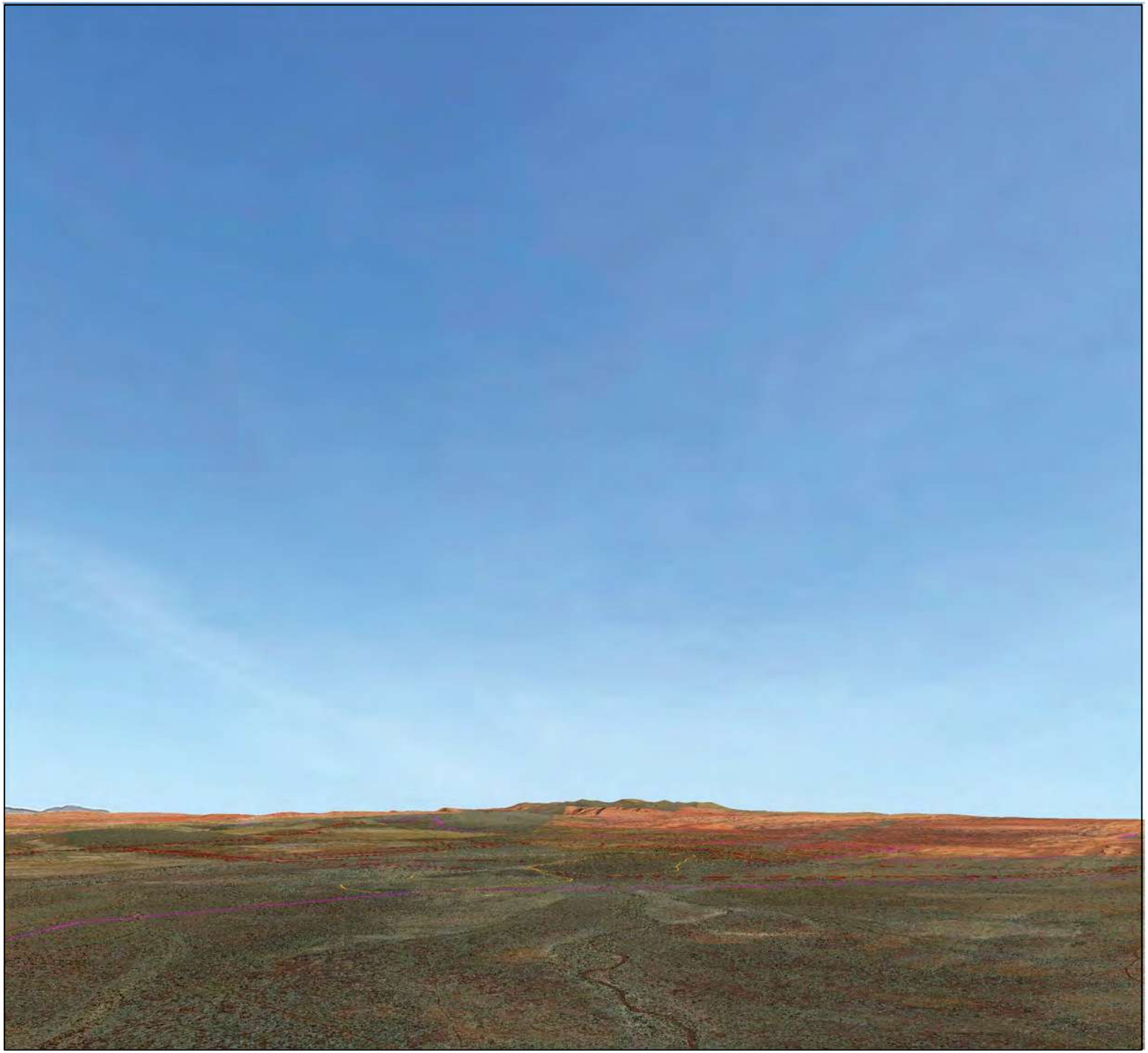

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Figure 12-9
BS1 Range
Southwest View

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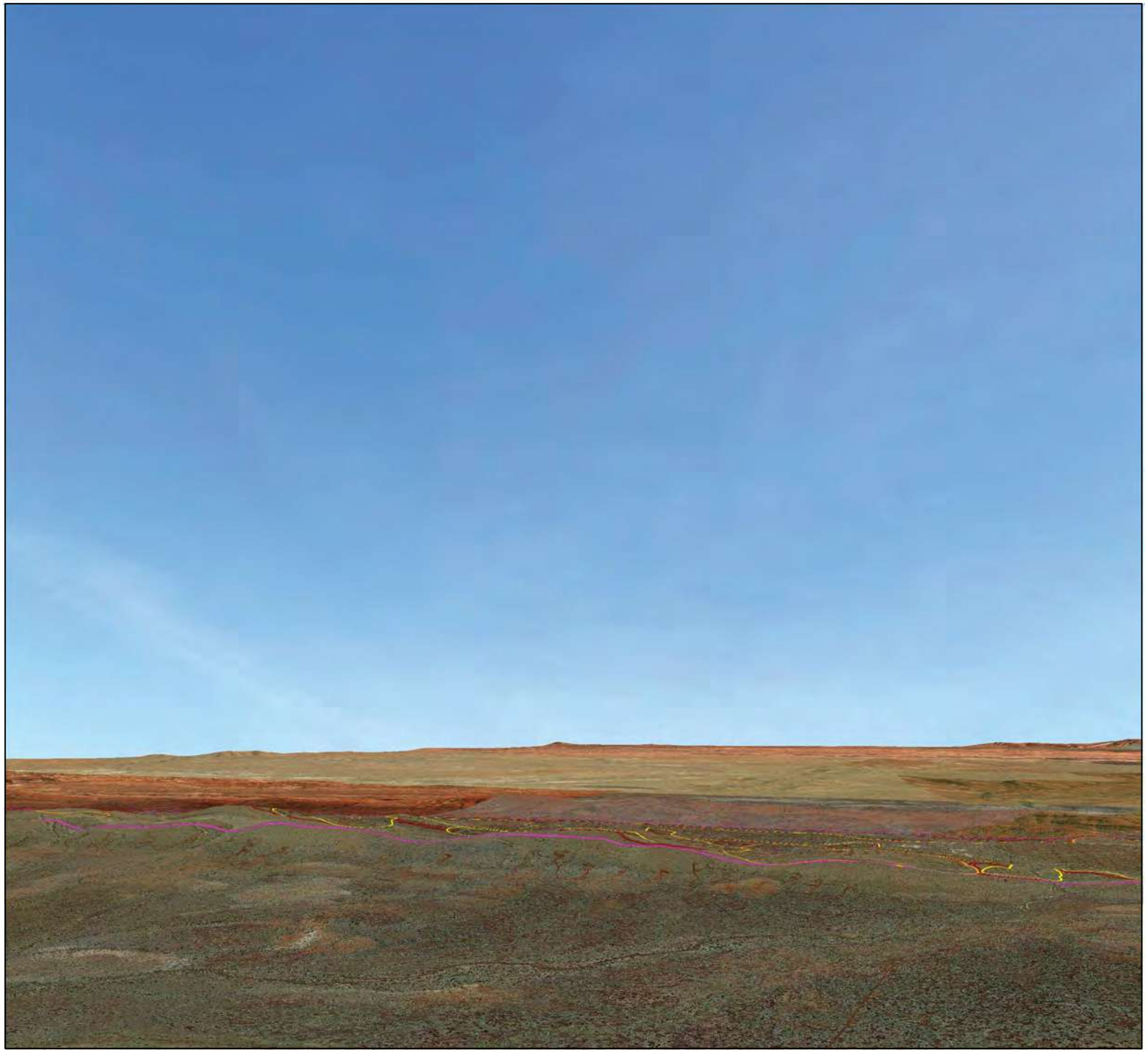

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Figure 12-10
BS1 Range
Northwest View

Drawn: L.Fuentes
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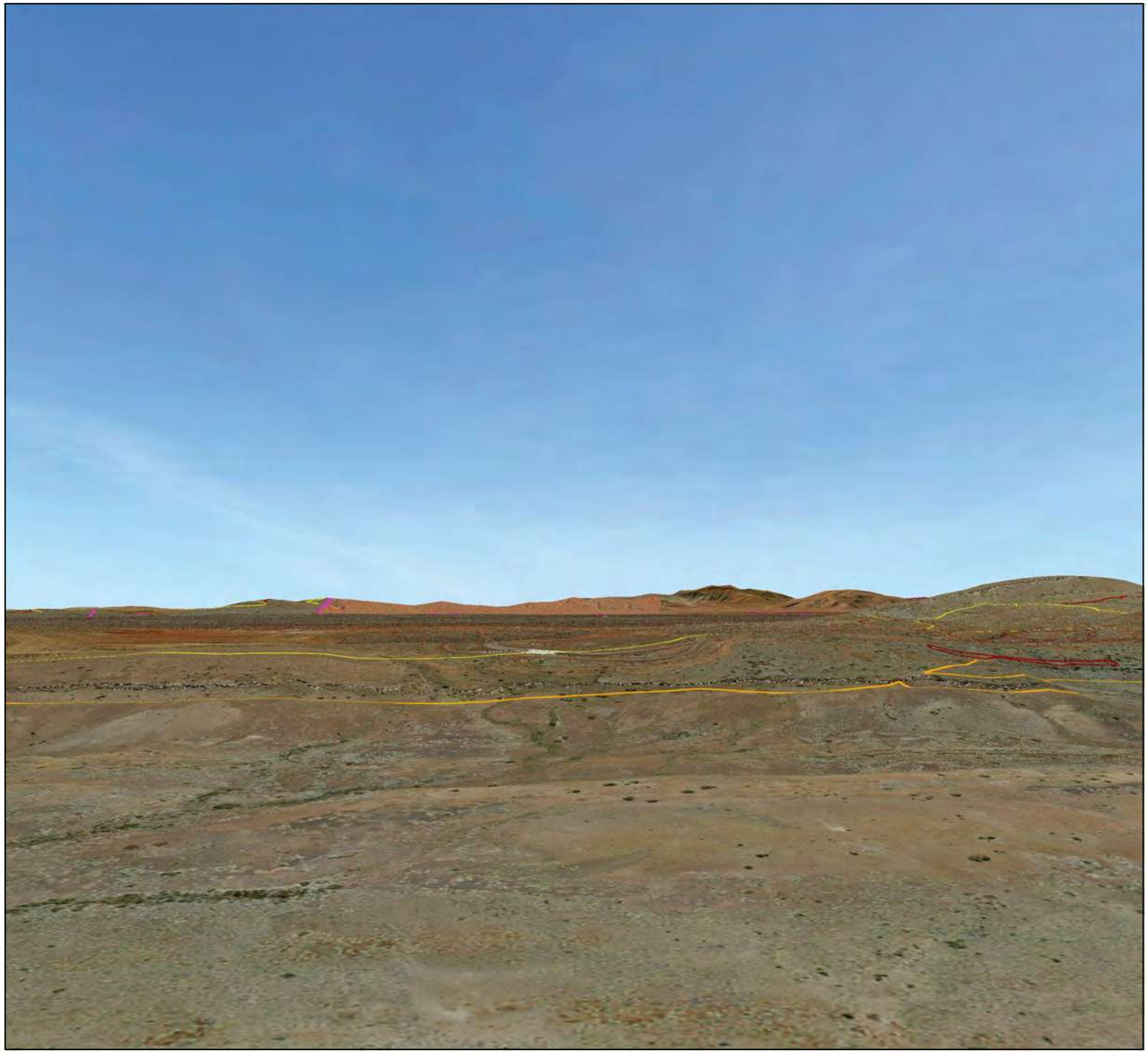

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Figure 12-11
BS4 MM Waste Rock Landform
DP9 - North View

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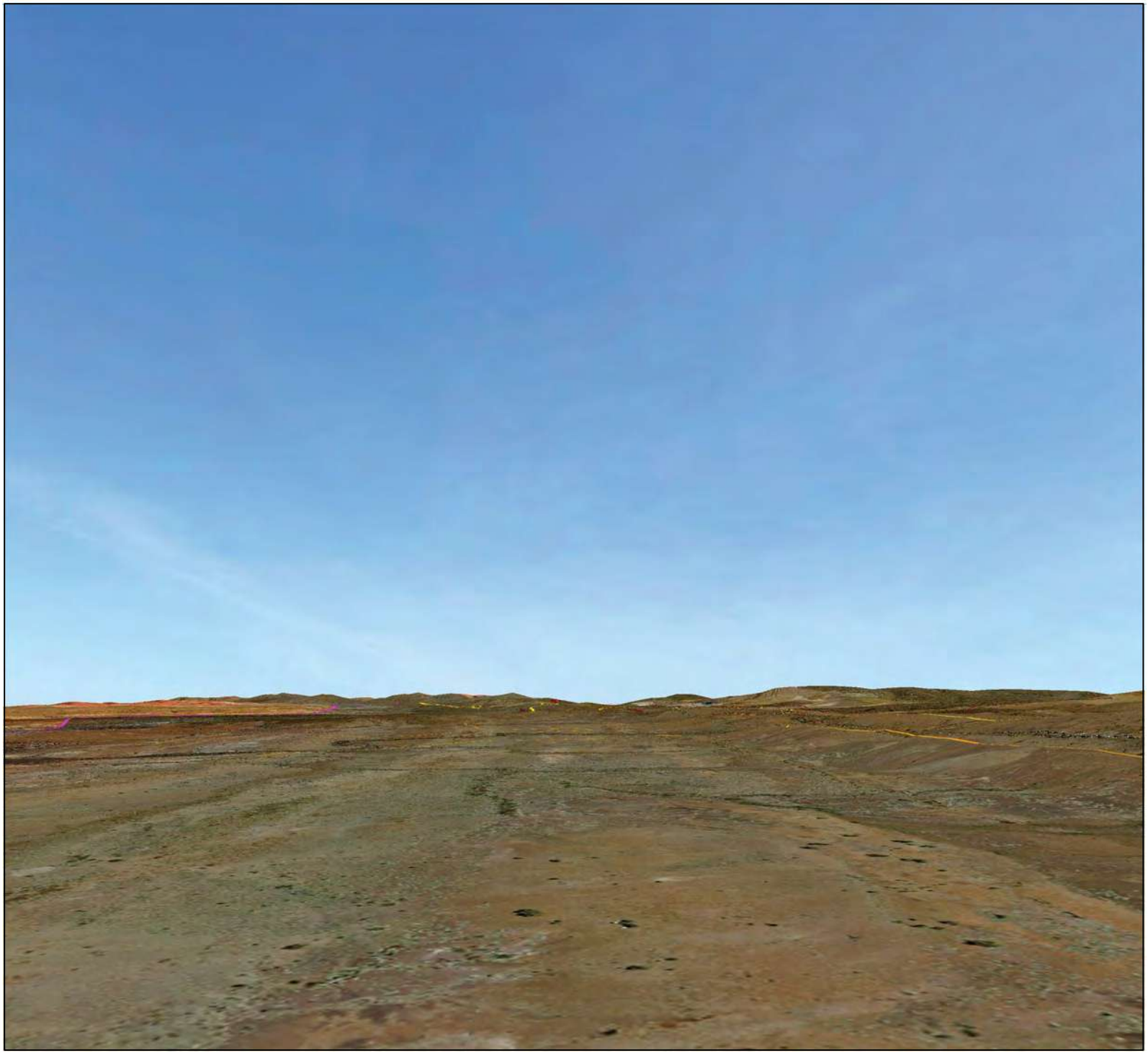

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Figure 12-12
BS4 MM Waste Rock Landform
DP9 - West View

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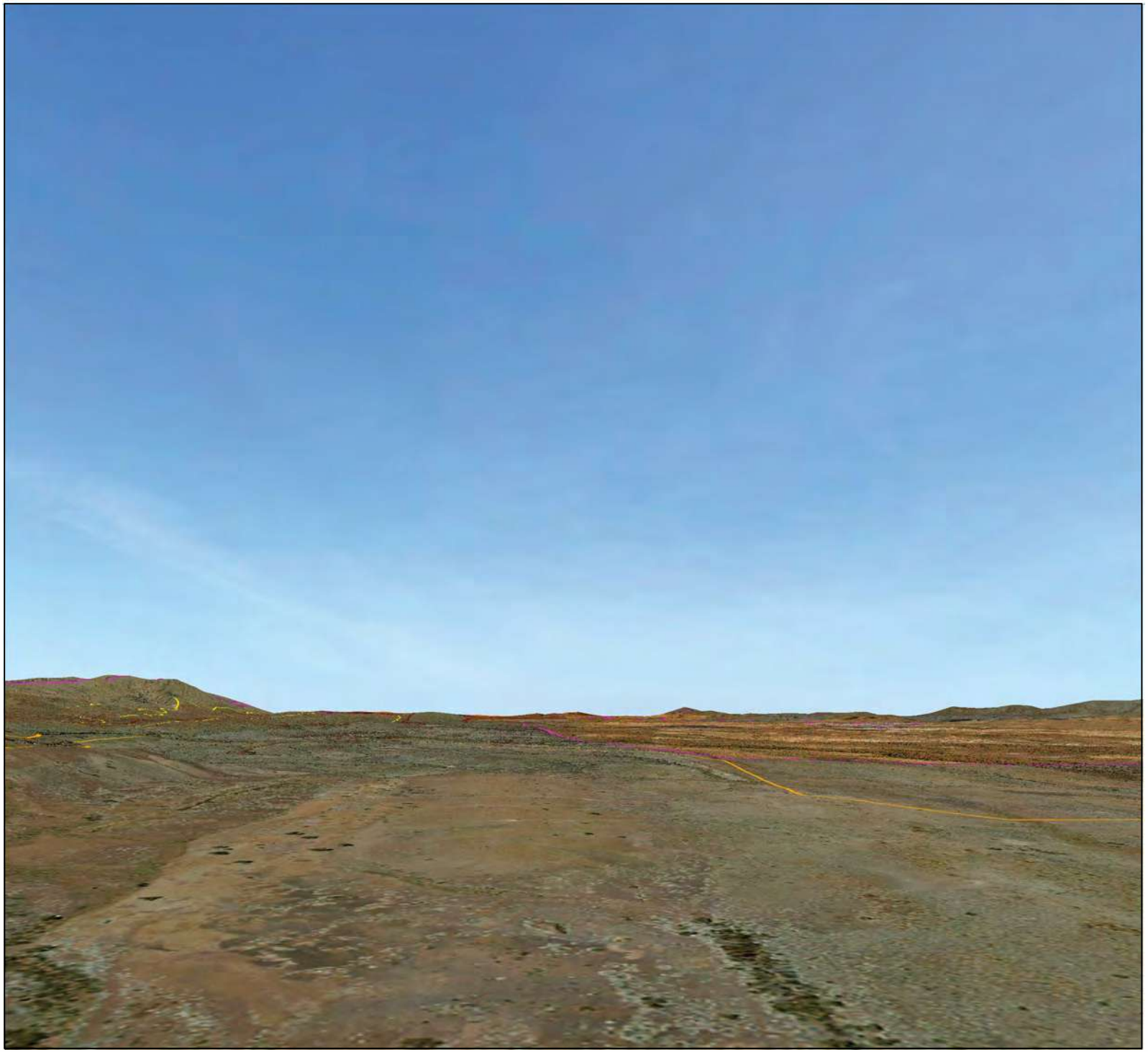

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Figure 12-13
BS4MM Waste Rock Landform
DP9 - East View

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Impacts to Visual Amenity for Muntulgura Guruma People

Mt Brockman (Jawunpa) is a highly significant landform and has been a focal point of consultation with Muntulgura Guruma representatives with regards to visual amenity. Figure 12-14 to Figure 12-17 demonstrate how this area may be impacted from a visual amenity perspective. Additionally, a visual amenity assessment for Kurwillinha Pool was also conducted (Figure 12-18 to Figure 12-20).

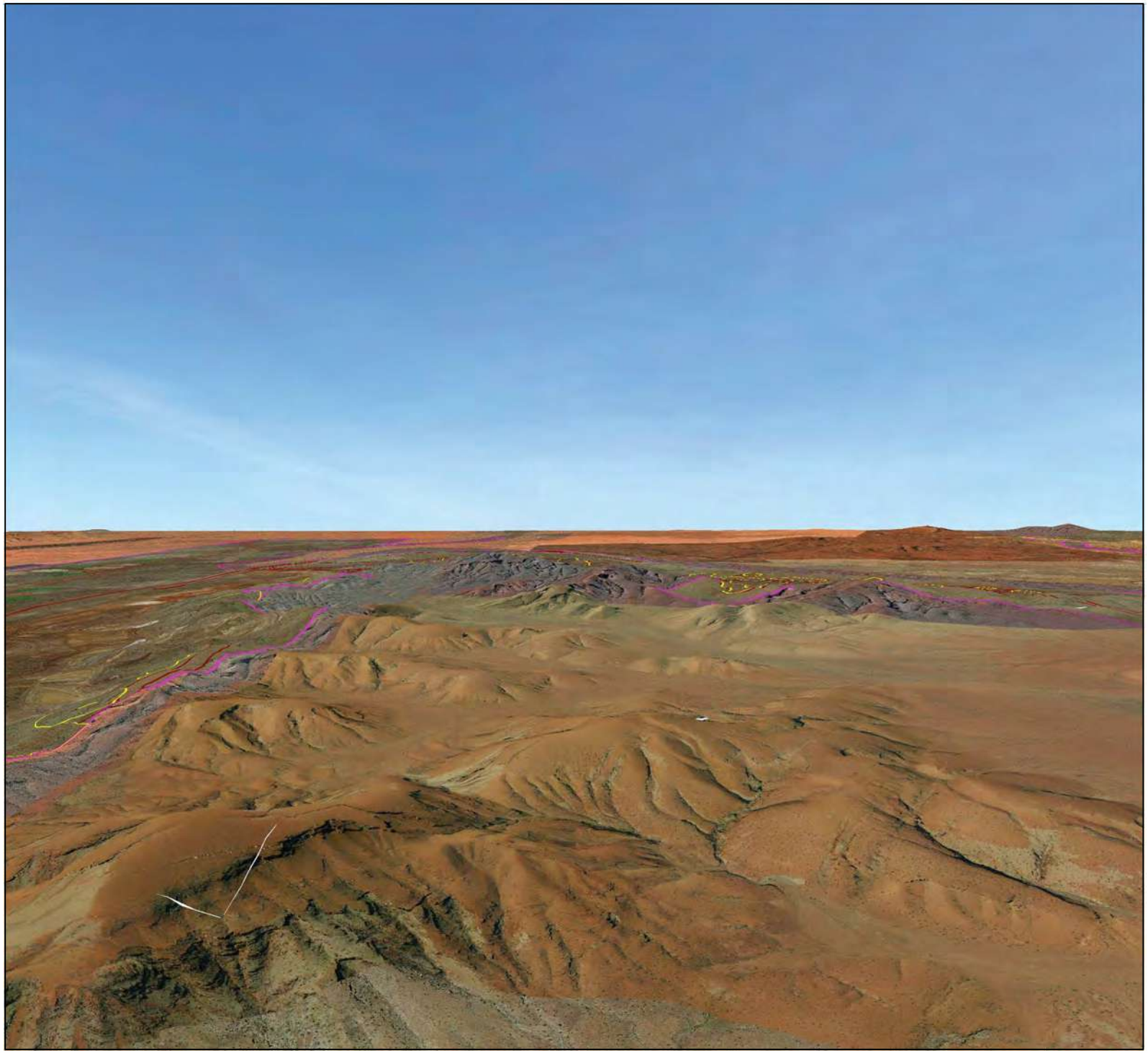

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Figure 12-14
Mount Brockman (Jawunpa) West View

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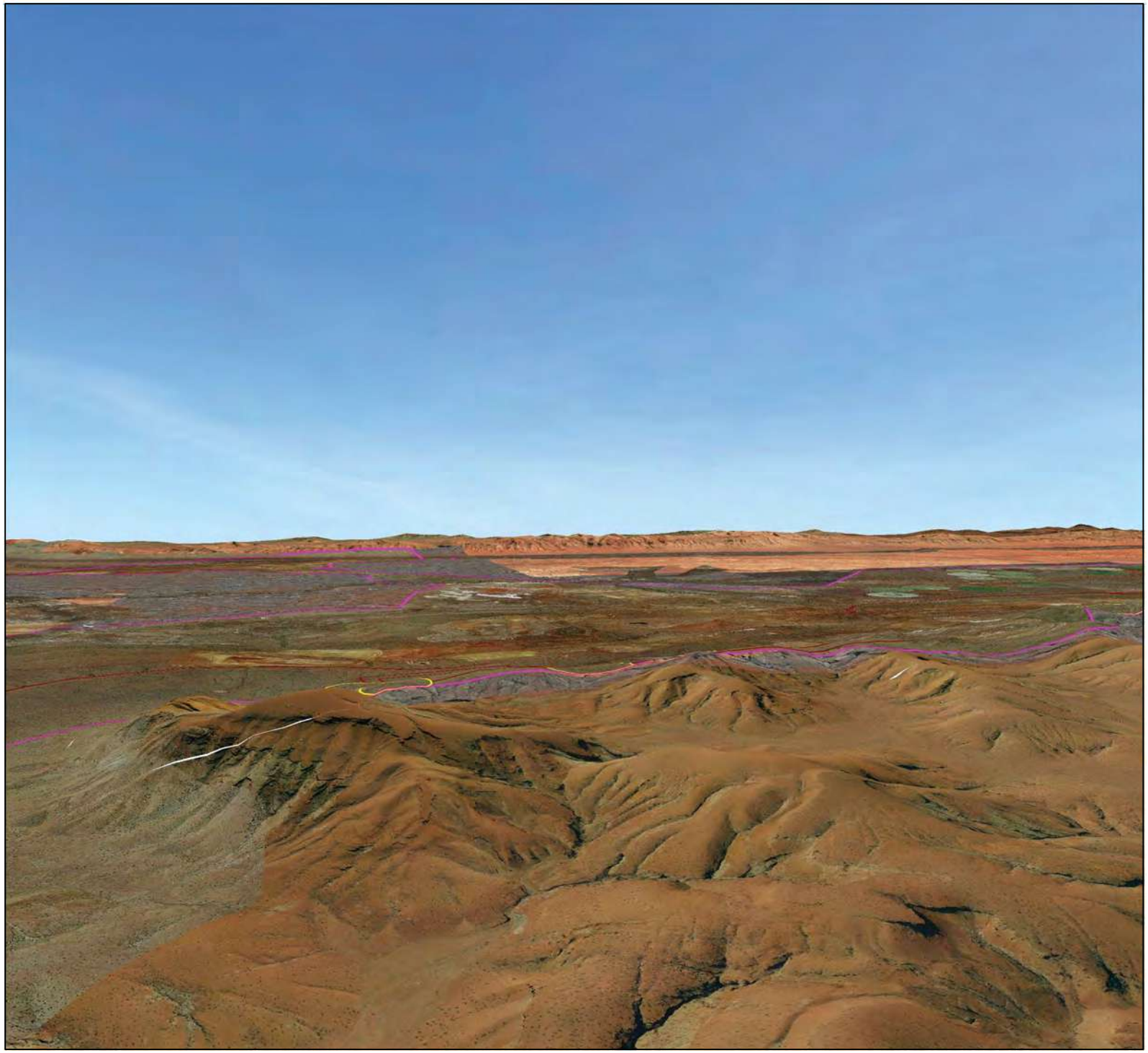

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Figure 12-15
Mount Brockman (Jawunpa) North View

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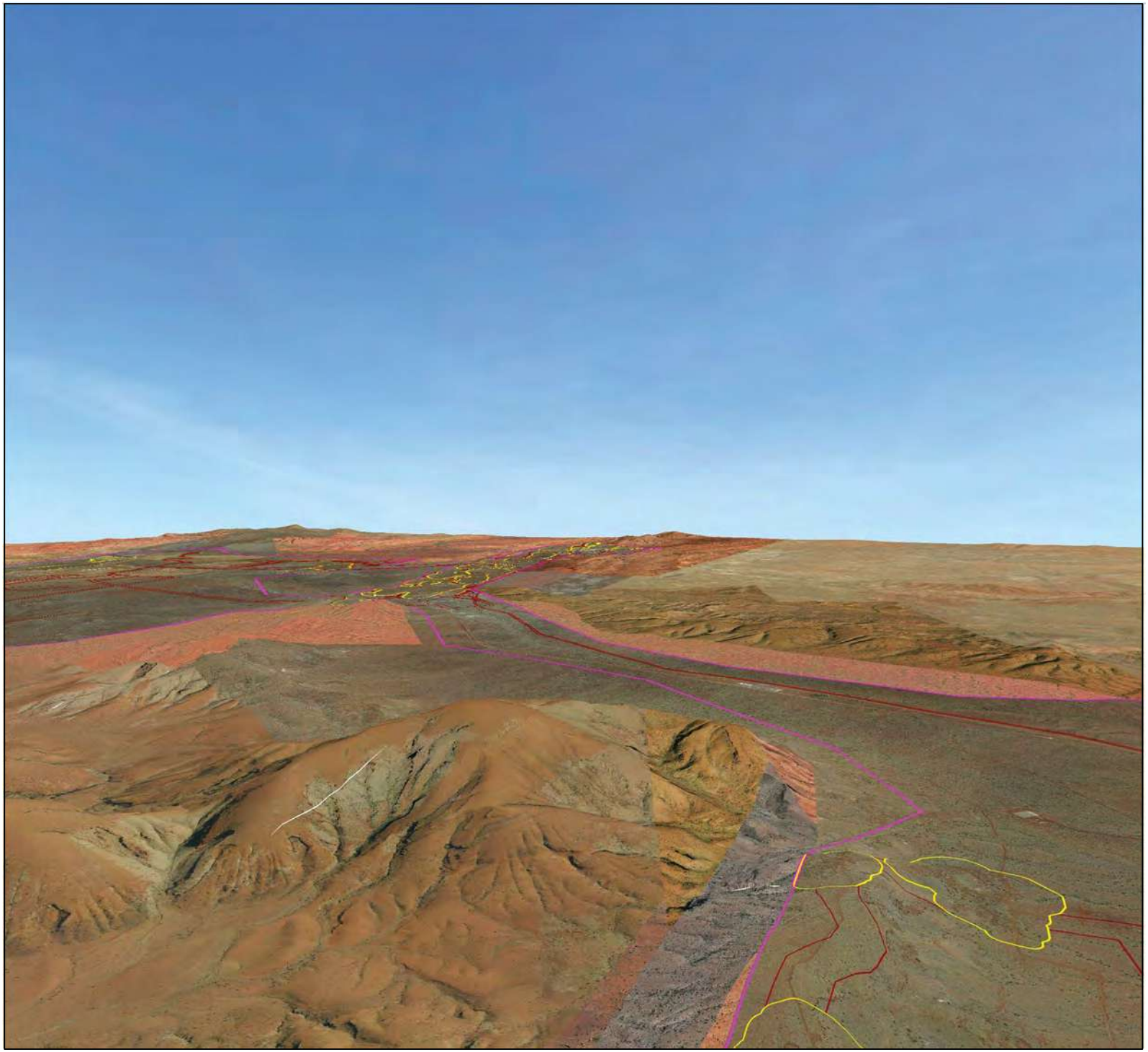

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Figure 12-16
Mount Brockman (Jawunpa) Southwest View

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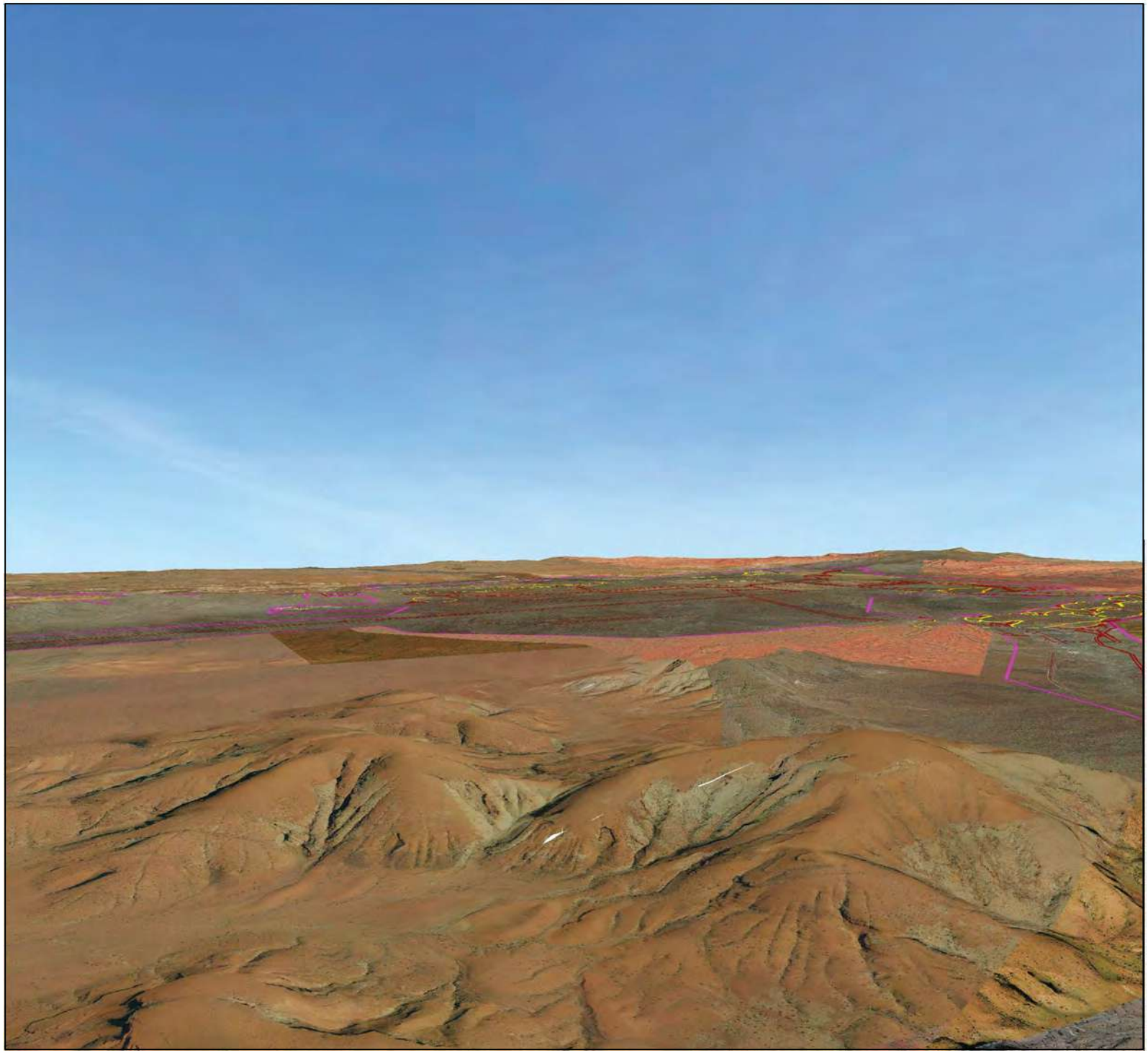

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Figure 12-17
Mount Brockman (Jawumpa) South View

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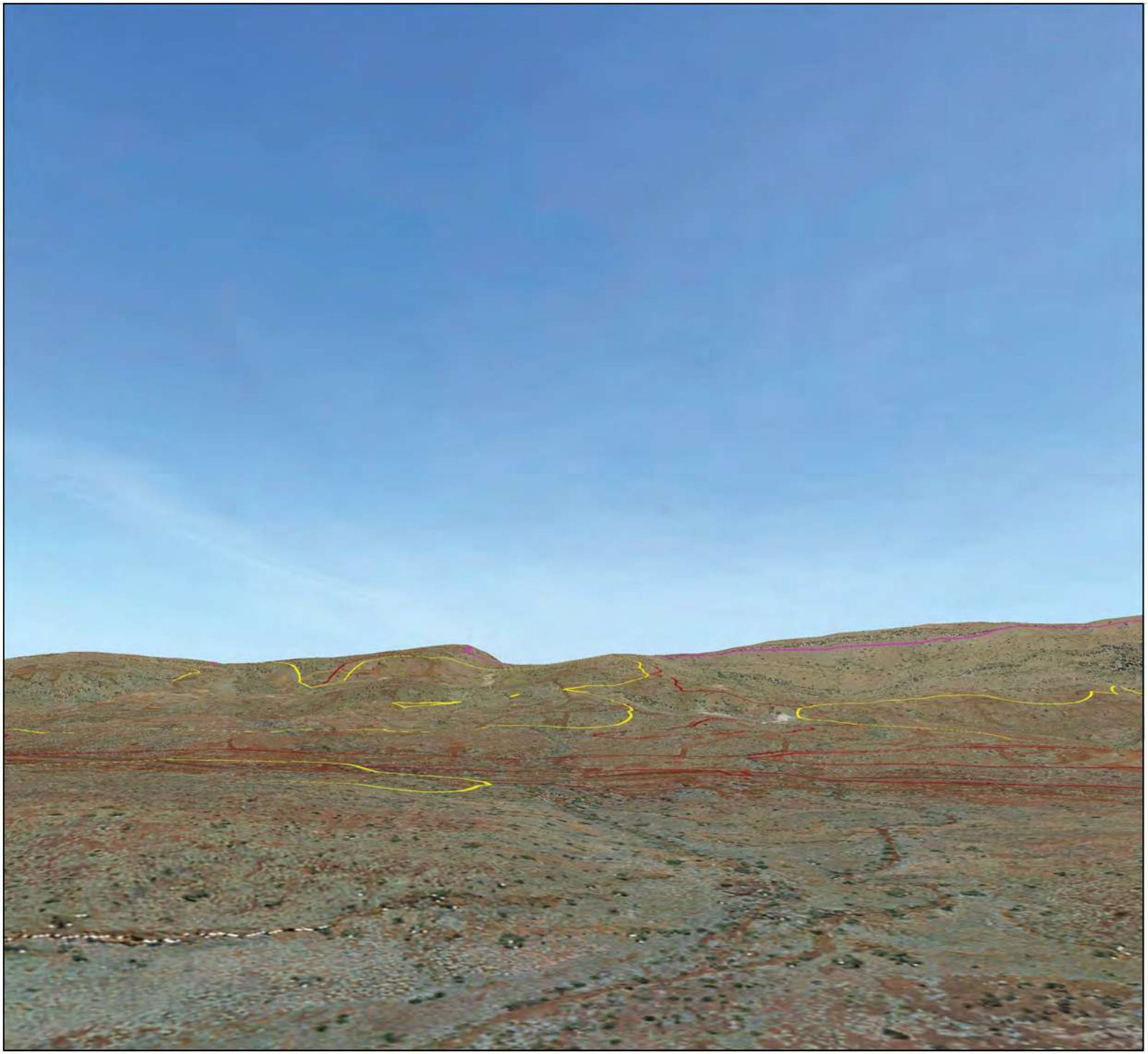

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Figure 12-18
Kurwillinha Pool
North View

Drawn: L.Fuentes
Plan: PDE0189554v1
Date: September 2022

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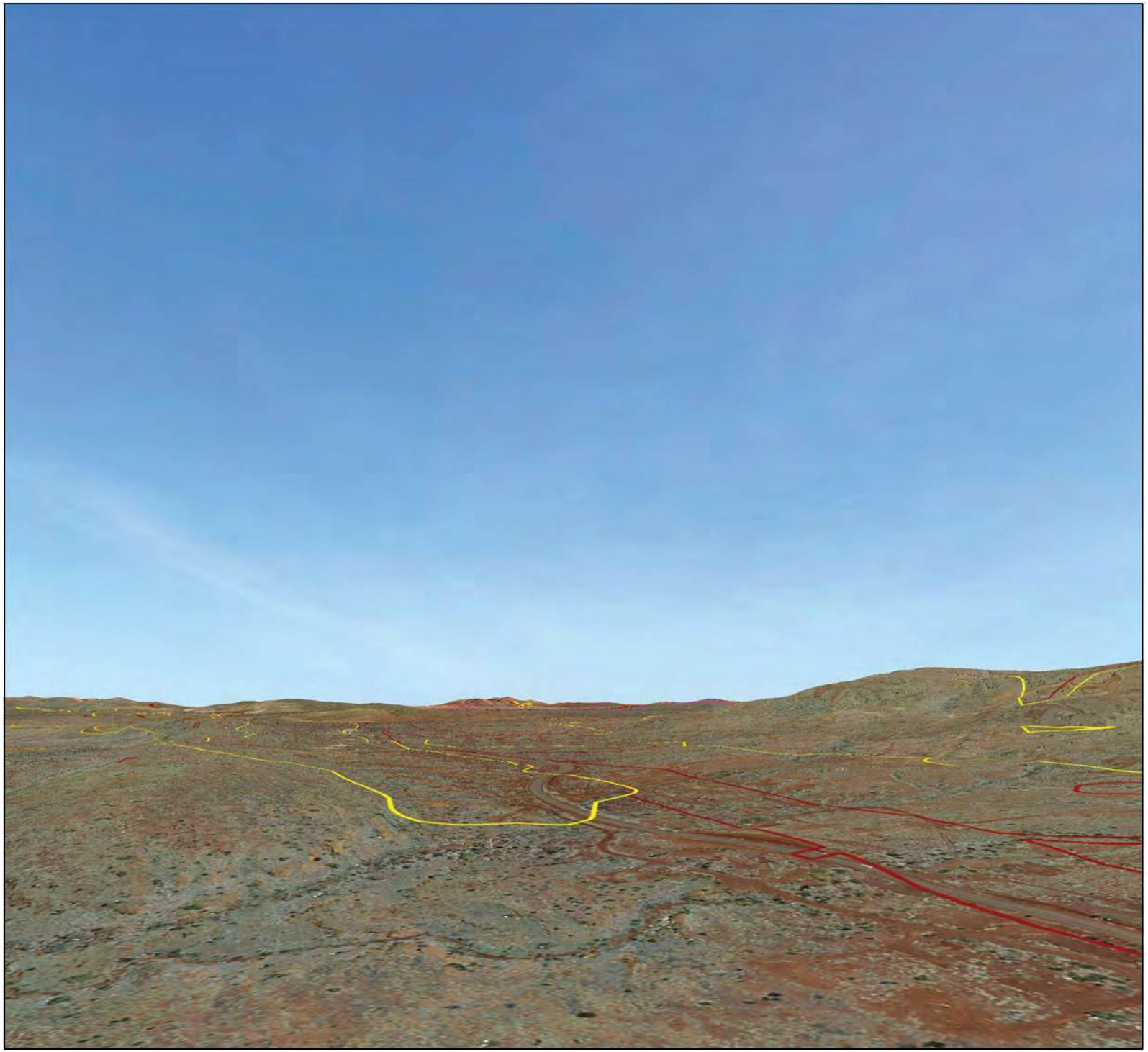

RioTinto

Figure 12-19
Kurwillinha Pool
West View

Drawn: L.Fuentes
Plan: PDE0189554v1
Date: September 2022

Scale: NTS@A4
GIS.Team@riotinto.com

Legend

Development Envelope

Conceptual Footprint

Pit
Waste Rock Landform
Infrastructure

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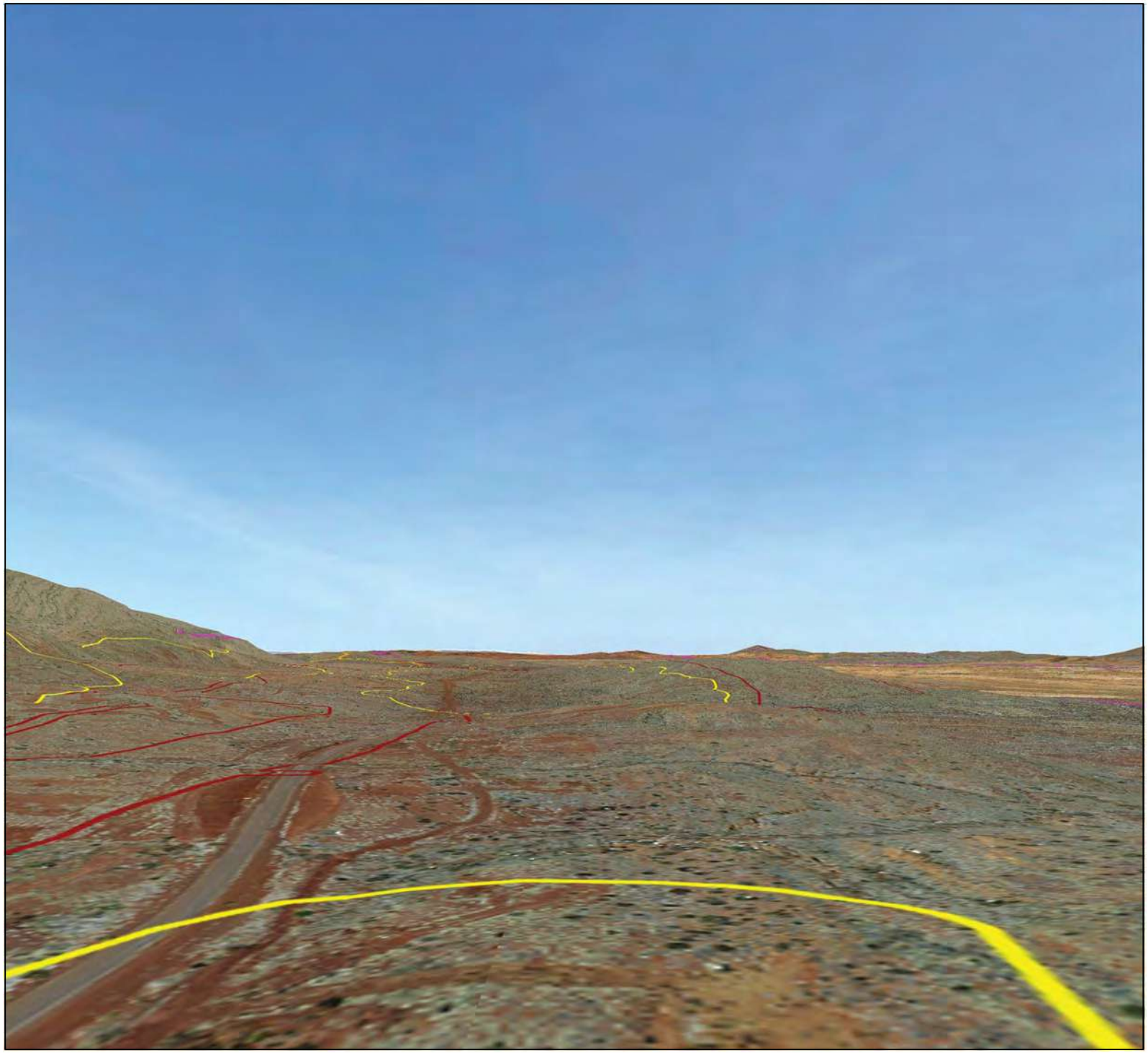

RioTinto

Figure 12-20
Kurwillinha Pool
East View

Drawn: L.Fuentes
Plan: PDE0189554v1
Date: September 2022

Scale: NTS@A4
GIS.Team@riotinto.com

Legend

Development Envelope

Conceptual Footprint

Pit
Waste Rock Landform
Infrastructure

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12.4.2. Indirect Impacts

Potential indirect impacts of the Proposal to Social Surroundings can be the result of changes to the physical and biological attributes of the environment affecting social cultural heritage values. These include:

- Alteration of the experience and enjoyment of Country due to dust and noise
- Disturbance of animals that are used socially or culturally, or which have cultural associations due to habitat clearing, dust, noise and vibration
- Impacts for Pastoralists associated with surplus water discharge to creeks, namely attraction of feral animals and issues with retention of cattle on stations.

12.5. Mitigation

The Proponent will apply 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**: Engagement and consultation, including in-field consultation, with Traditional Owner groups, pastoralists and stakeholders which will inform the Proposal design, with the aim of avoiding impacts to sites, places and values of social and cultural significance wherever practicable
- **Minimise**: The Proponent in consultation with Traditional Owners, pastoralists and other key 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
- **Mitigate (Rehabilitate)**: Rehabilitation and final closure landform design will consider Traditional Owner and pastoralists views including regarding visual amenity, post-closure access to sites and places of social and cultural significance, remediation of impacts arising during the operational phase and inclusion of culturally significant flora species to the extent practicable. Rehabilitation activities will be undertaken progressively over the life of the mine and opportunities to involve Traditional Owner groups in the rehabilitation of their country will be explored. The Proponent has prepared and will implement a MCP in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020b) for the Proposal in this regard.

An SCHMP has been co-developed with each Traditional Owner group (one plan per Group). The SCHMPs focus on addressing Traditional Owner concerns regarding impacts to social and cultural values and activities within the Development Envelope and facilitating consultation and ongoing involvement of the Traditional Owners with respect to the development, operation and closure of the Proposal. Direct impacts to heritage sites will primarily be addressed by relevant approvals and mechanisms under Aboriginal heritage legislation, i.e., as required under the ACH Act.

Each SCHMP has been prepared in collaboration with, reviewed and agreed to with each relevant Traditional Owner group. The Proponent expects implementation of the SCHMPs to be required as a condition of approval under the EP Act.

Table 12-3 summarises how the EPA's mitigation hierarchy (avoid, minimise and mitigate (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 these tables may change subject to further consultation and reflect current understanding.

12.5.1. Overarching Avoidance and Minimisation Measures

One key overarching impact avoidance measures has been implemented since the referral of the Proposal:

- Revision of the Greater Brockman Life of Mine Water Management Guiding Principles (a water management strategy guiding water use for the operations within the Development Envelope, including surplus water from dewatering).

Based on current information and ongoing technical work and consultation, the Proponent has removed the below areas from the scope of the Proposal through a s.43A application and deferred them for further consideration. Deferral of operations in and around these areas recognises the need for further planning and extensive consultation with Traditional Owners as part of any potential future proposal. Any related future proposal would be subject to separate EP Act and EPBC Act referral and environmental impact assessment, along with assessment and approvals under other legislation such as, most prominently, the ACH Act (Figure 12-21):

- Silvergrass West – on Muntulgura Guruma Country
- B2SW including Maybelline – on Muntulgura Guruma Country
- Vivash, including Atlantis – on Puutu Kunti Kurrama and Pinikura Country
- Marra Mamba pits S and T– on Puutu Kunti Kurrama and Pinikura Country.

Removing these deposits from the Proposal reduced the overall disturbance footprint of the Proposal from 9,977 ha to 7,896 ha, a reduction of 2,081 ha.

As described in Section 6.3.8, the Proponent is changing how it approaches surplus water management across its operations (not just at the Proposal) under a revised Water Management Strategy. The development of deposits within this Proposal will operationalise this strategy, with the Proponent's goal to reduce surplus water discharge to creek systems to as low as reasonably practicable. While the Proposal includes an incremental increase in surplus water discharge, this is considered an interim measure while pit capacity at Brockman operations is made available for water storage. Water stored in pits will be used for operational purposes instead of developing additional borefields in the future. This water will be returned to the groundwater system via natural infiltration and managed aquifer recharge. The Proponent has an aspirational target of zero creek discharge from iron ore dewatering activities by 2032 as part of its commitment to environmental water stewardship and this Proposal is being developed consistent with that target.

12.5.1.1. Access to Country

The Proponent holds existing Land Access Protocols (LAPs) with Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma. These have both been recognised as unsuitable in their current form. The Proponent is committed to improving these Protocols and has been working on revising these documents with both Groups. The revised LAPs 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 SCHMPs for both Groups.

12.5.1.2. Integrated Heritage Management Process

The Proponent has an internal governance system known as the Integrated Heritage Management Process (IHMP) which aims to ensure all activities that impact cultural heritage places, or have the potential to, including those for which an existing regulatory approval is in place are subject to thorough review before impact proceeds, to ensure Traditional Owners have provided their consent or non-objection in relation to the activity proposed. This review includes all operations, projects, drilling operations, and exploration areas. IHMP is an additional step of assurance in conjunction with existing processes such as those described in Table 12-3. IHMP is applied across planning horizons to proactively avoid where practicable, and otherwise minimise and mitigate impacts to cultural places.

IHMP involves the:

- Identification of cultural heritage sites/places close to/within 350 m of proposed activities.
- Completion of a heritage site risk assessment and an impact assessment.
- Recommendation of controls to minimise the risk of impact to the site. A final decision is made by a senior leader. Any direct impact to an area requires engagement with the relevant Traditional Owner groups.
- Publish recommended approach to the internal heritage databases and GIS.

This process will be applied to new heritage sites, cultural landscapes and values as they are recorded in future.

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Figure 12-21
Brockman Syncline
Full Scope Proposal

Drawn: L.Fuentes
Plan: PDE0191100v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Amendments to Development Envelope

- Removed from Referred Development Envelope
- Added to Development Envelope
- Approved Part IV Indicative Footprint (MS 131, 867, 925, 1000)

Conceptual Footprint for Brockman Syncline Proposal

- Pit
- Waste Rock Landform
- Landbridge
- Infrastructure
- Pit
- Waste Rock Landform
- Infrastructure

Native Title Determination Area

- Eastern Guruma
- Puutu Kunti Kurrama People and Pinikura People #1 and #2
- Yinhawangka People Part A and B

- Rio Tinto Mine
- Conveyor
- Rio Tinto Railway
- Major Road
- Minor Road
- Site Access Road
- Major Creek

**** Privileged and Confidential ****

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Caves Creek
Robe River
Duck Creek
Boolgeeda Creek
Beasley River West
Beasley River
Barnett Creek
Wackiina Creek

Silvergrass
Nammuldi
Brockman 2
Brockman 4

Eastern Guruma
Puutu Kunti Kurrama People and Pinikura People #1 and #2
Yinhawangka People Part A and B

0 2 4 6
Kilometres

12.5.2. Puutu Kunti Kurrama and Pinikura Impact Avoidance and Minimisation Measures

This section details the additional impact avoidance and minimisation measures implemented at the Proposal as a result of ongoing discussions with the Puutu Kunti Kurrama and Pinikura representatives.

In May 2022, the Proponent and the Puutu Kunti Kurrama and Pinikura People signed a Heads of Agreement outlining the co-management model and principles for managing heritage sites that fall within the Proponents mining leases on Puutu Kunti Kurrama and Pinikura Country. This agreement outlines key co-management principles, including communication on equal terms between parties, clear delineation of mine areas and greater control and involvement of traditional owners over mining activities.

12.5.2.1. DP8 and DP9 Waste Rock Landforms

The Proposal includes an extension to DP8 waste landform as previously approved under MS 1000 and a new DP9 waste landform in the BS4 assessment area. Between these two waste landforms are several heritage sites within a gully system, encompassed by a larger site boundary. In March 2021, Puutu Kunti Kurrama and Pinikura members visited the area with the Proponent's representatives, including mine planners. The Traditional Owners expressed concerns about these waste landforms potentially contributing sediment to the gully system and filling up a natural surface water pool depression at the base.

The waste landform designs for DP8 and DP9 have been amended in response to these concerns. The key change included the incorporation of a 150 m offset to the waste landform toe (rehabilitation design) from the 1 in 100 AEP floodplain extent to reduce sediment load risk. The revised designs were discussed with Puutu Kunti Kurrama and Pinikura Aboriginal Corporation staff (Heritage Manager) and then presented to Puutu Kunti Kurrama and Pinikura members at a Heritage Advisory Committee on two occasions during 2021. Members indicated they were supportive of the revised designs. It is acknowledged that several heritage sites remain within the waste landform conceptual footprints and the Proponent will continue to consult with Puutu Kunti Kurrama and Pinikura representatives regarding these sites. Level 1 archaeological recording took place on these sites in Q3 2021 whereby the larger site boundary (i.e., encompassing all sites as a cluster) was recorded.

Figure 12-22 and Figure 12-23 shows the changes made to the DP8 and DP9 waste rock landform designs, with the original designs shown in white and the revised designs in green.

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Figure 12-22
Waste Rock Landform Original and Revised Indicative Footprints DPB

Drawn: L Fuentes
Plan: PDED191102v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:12,500 @A3
GIS.Team@riotinto.com

RioTinto

Figure 12-23

Waste Rock Landform Original and Revised Indicative Footprint - DP09

Drawn: L Fuentes
Plan: PDED191102v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:12,500 @A3
GIS.Team@riotinto.com

12.5.2.2. Ore Transport from the BS1 Deposit to BS4 Plant

The Proposal includes the transport of ore from the BS1 deposit back to the BS4 plant for processing and train load out. This will require the crossing of Pulykati Wuntu (Boolgeeda Creek).

In an initial meeting (March 2021), the options for this transport corridor presented to Puutu Kunti Kurrama and Pinikura representatives included an eastern and a central haul road route. A western route was also shared but the Proponent stated that this had been eliminated as unviable due to the distance it traversed, its disturbance requirements and the need to cross Pulykati Wuntu (Boolgeeda Creek) as well as Purlykuti Wuntu (Purlykuti Wunti is a feeder tributary to Pulykati Wunti). A conveyor option was also presented for the central route. However, the Proponent described that it was not the preferred option due to higher construction costs. The Puutu Kunti Kurrama and Pinikura preferred the conveyor option as they considered that it would help reduce dust loads within the valley between BS1 and BS4 and avoid indirect impacts to some existing mature trees next to Boolgeeda Creek. The Proponent accepted this preference and pursued a conveyor design as base case, while also working on an improved haul road design until an acceptable crusher design and conveyor alignment is agreed.

The Proponent then held a separate on-Country consult on the BS1 range with Puutu Kunti Kurrama and Pinikura representatives. At this meeting, Puutu Kunti Kurrama and Pinikura members advised that the central route for crossing of Boolgeeda Creek was their preference over the eastern route. Puutu Kunti Kurrama and Pinikura members requested that the Proponent further refine the design at this location, as the proximity of the crusher to known heritage sites was not acceptable. In addition, the central route minimises the visual amenity impacts on BS1 due to the infrastructure associated with the conveyor (ROM pad, stockpiles, workshop/offices).

The Proponent has subsequently undertaken further engineering design to determine alternative configurations of infrastructure at BS1. Six options, including the Proponents preferred option, were initially shared with PKKP AC in March 2022 and discussed in person in May 2022. At the time of writing, Rio Tinto is awaiting feedback from Puutu Kunti Kurrama and Pinikura representatives on the alternate design options. Surveys of the new proposed route is also underway to support the decision process.

12.5.2.3. BS1 Range – Haul Road and Waste Rock Landform Design

At the BS1 Range, the design of ancillary items (waste rock landforms, haul roads etc.) continues to evolve as studies in this area progress. During the initial design phases, the main arterial haul road was optimised for operational haul (straight lines with minimal deviation). In subsequent study phases, the revised haul road design now avoids heritage sites. Topsoil stockpiles have also been located to avoid heritage sites. The Puutu Kunti Kurrama and Pinikura SCHMP prescribes a consultation framework to ensure Puutu Kunti Kurrama and Pinikura representatives are actively involved and consulted regarding appropriate design amendments as planning evolves.

There are three waste rock landforms planned between BS1 and BS4 as part of the development of the BS1 deposit. During consultation on Country with Puutu Kunti Kurrama and Pinikura members, the Group highlighted that the line of sight west to east across the valley in this area was important for the Group for two reasons:

- [redacted]

[redacted]

In response, the Proponent is undertaking optimisation work to amend its mine plan to consider removal of these waste rock landforms and instead send mineral waste material to other waste rock landforms or in-pit areas. In the event this cannot be achieved, The Proponent has committed to removing these three waste rock landforms at closure so as to restore visual amenity in this area.

12.5.2.4. Hydrology

Five temporary diversions are proposed at BS1 for tributaries to Boolgeeda Creek in order to maintain surface water flows on Puutu Kunti Kurrama and Pinikura Country. Opportunities to partially buttress BS1 pits that intersect the main Boolgeeda Creek tributaries and reduce catchment loss to Boolgeeda Creek are being investigated through the closure planning process. The final surface water closure strategy in these areas needs to be determined (remove diversions, make diversions permanent landscape features or undertake partial pit buttressing) in consultation with Puutu Kunti Kurrama and Pinikura representatives. No further diversion drains are planned within the BS4 assessment area as part of the Proposal.

12.5.2.5. Impacts to Culturally Significant Flora

To date, no specific areas where particular species were traditionally gathered and/or are still gathered has been identified for protection by Puutu Kunti Kurrama and Pinikura. The Proponent is proposing measures in relation to culturally significant flora within the SCHMP. A targeted ethnobotanical survey was undertaken in May 2022 as a first stage to a series of surveys and consultations to identify plants that are culturally significant to the Puutu Kunti Kurrama and Pinikura People and agree management approaches where required. The Puutu Kunti Kurrama and Pinikura SCHMP includes a framework of management measures in this regard.

12.5.3. Muntulgura Guruma Impact Avoidance and Minimisation Measures

12.5.3.1. Lens G and Diesel Deposits

The mine planning process optimises a mine largely based on orebody resource definition and grade targets before constraints are gradually built into the design. At the Lens G deposit there were initially two satellite pits proposed in addition to the main Lens G pit. As the cultural landscape became better understood in this area through ethnographic and archaeological surveys and baseline fauna surveys; these two satellite mine pits were removed from the mine plan to avoid impacts on heritage sites and important fauna habitat. These areas are identified on the Proponent's internal GIS system as exclusion zones.

12.5.3.2. Infrastructure Alignment

Throughout the Proposal, haul roads have been designed to avoid heritage sites and minimise impacts to water drainage channels to the extent practicable.

The final design of the Lens G haul road is pending further detailed design and consultation with Traditional Owners. However, the Lens G haul road design will include culverts along its extent to allow water flow under the road and to sustain mulga growth in this area. Maintaining water flow to support mulga growth within the area of the Lens G haul road was requested by the Muntulgura Guruma Traditional Owners as this species has a number of cultural uses.

12.5.3.3. Changes to Waste Rock Landforms

Mineral waste rock landform designs have been adjusted to avoid heritage sites and water flow through the Marra Mamba ridge at BS4 assessment area, which is near the boundary on the periphery of the Eastern Guruma NTD area near Pit O. One waste rock landform has been removed, while two others have had a substantial footprint reduction (Figure 12-24). The Muntulgura Guruma SCHMP will include management measures and an agreed consultation framework to ensure that Muntulgura Guruma representatives are actively involved and consulted regarding appropriate design amendments as planning evolves.

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Figure 12-24
Waste Rock Landform Changes

Drawn: L.Fuentes
Plan: PDE0191101v1
Date: September 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:35,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Approved Part IV Indicative Footprint (MS 131, 867, 925, 1000)

Conceptual Footprint for Brockman Syncline Proposal

- Pit
- Waste Rock Landform
- Landbridge
- Infrastructure

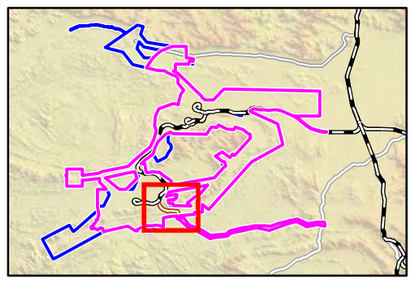
Original Scope Proposal

- Development Envelope
- Waste Rock Landform Outline
- Pit
- Infrastructure

Native Title Determination Area

- Eastern Guruma
- Puutu Kunti Kurrama People and Pinikura People #1 and #2

- Rio Tinto Railway
- Site Access
- Major Creek



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0 0.5 1 1.5 2
Kilometres

Map units in metres

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527,500
530,000
532,500
535,000

7,505,000
7,502,500
7,500,000
7,497,500

Boolgeeda Creek

See MAP 1

See MAP 2

White Quartz Road

12.5.3.4. Hydrology

Nine diversion drains are proposed within the Beasley River catchment as part of this Proposal. These drains are to provide flood protection to pits as well as ensuring continued flow to downstream ecosystems. The closure strategy in these areas is yet to be determined, however options include removing diversions, and/or partial pit backfill to reinstate natural flows. The final closure strategy for the diversion will be determined in consultation with Muntulgura Guruma representatives.

12.5.3.5. Plunge Pool

The following environmental outcomes are proposed in relation to Plunge Pool:

- No measurable drawdown of groundwater levels at Plunge Pool as a result of mine dewatering attributable to the Proposal
- Minimise changes to the hydrological regime of Plunge Pool to ensure environmental and cultural heritage values are maintained.

The following environmental objectives are proposed in relation to Plunge Pool:

- Avoid where possible and otherwise minimise impacts to water quality and sedimentation in Plunge Pool as a result of the Proposal.

To meet the requirements of the above the Proponent intends to implement an EMP, SCHMP and MCP that incorporates the following as a minimum:

- No mining activity within the Plunge Pool catchment unless culturally safe mining in some areas is mutually agree with the Muntulgura Guruma People. This applies specifically to the BS3, MM-J and Orbe deposits and associated landforms.
- No construction of waste rock landforms in the area immediately north of the Plunge Pool catchment
- Should mining within the Plunge Pool catchment be mutually agreed with the Muntulgura Guruma People:
    - Limit mining of the BS3 deposit (1 km north of Plunge Pool) to AWT
    - Backfill BS3 Extension deposits MM-J and Creekside (9 km northeast of Plunge Pool) to above the post-mining recovered groundwater level at closure
    - Ensure that the surface water catchment of Plunge Pool is maintained to the extent that environmental and cultural heritage values are not compromised.
- Agreed measures to monitor the health of the catchment that corresponds to its cultural values in agreement with Muntulgura Guruma
- Subject to access to Plunge Pool being approved by the Muntulgura Guruma People:
    - Undertake at least two years of water quality and sediment monitoring at Plunge Pool to establish site specific water quality thresholds prior to mining BS3 and/or Creekside deposits
    - Undertake at least two years of bathymetric monitoring of Plunge Pool to establish site specific sedimentation thresholds prior to mining BS3 and/or Creekside deposits
- Details of the mining methods and limits that are deemed culturally safe prior to mining commencing.

12.5.3.6. Kurwillinha Pool

The initial pit designs extended the Endeavour pits over areas near the Kurwillinha Pool area. The mine plan has now been amended to ensure the area is not intercepted directly by pit development.

Table 12-3: Mitigation Measures for the Social Surroundings Factor

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Puutu Kunti Kurrama and Pinikura NTD				
Direct Impacts				
Direct impact to heritage sites	**Measures to Avoid**			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to prioritise avoidance of impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process. The Proponent will employ the following avoidance measures: • Places identified as significant by the Puutu Kunti Kurrama and Pinikura 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 avoidance will be prioritised, including through the creation of heritage exclusion zones where this is determined necessary in consultation with the Puutu Kunti Kurrama and Pinikura 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.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People, which identifies processes to be followed with regards to heritage sites to be avoided (Appendix I.1)	Yes – ACH Act and *Aboriginal Heritage Act 1972* (AH 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 process which involves Traditional Owner consultation throughout and consists of 4 steps as described in 12.5.1.2 • These controls are considered effective in avoiding unacceptable direct impacts to heritage sites.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Minimise			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to minimise impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process. The Proponent will employ the following minimisation measures: • Ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Utilise existing disturbed areas wherever possible • Conduct a site induction program to provide information on heritage protection and ground disturbance authorisation procedures.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to the minimisation of impacts to heritage sites (Appendix I.1)	Yes – ACH Act AH Act – Section 16 and 18 Applications	• 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 utilisation of existing disturbed areas for the construction of Proposal elements minimises the amount of disturbance to heritage sites • The Proponent also utilises its IHMP as an additional step of assurance. The IHMP is a process which involves Traditional Owner consultation throughout and consists of 4 steps as described in Section 12.5.1.2 • These controls are considered effective in minimising direct impacts to 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 Puutu Kunti Kurrama and Pinikura People	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards	Yes – ACH Act and AH Act – Section 16 and 18 Applications	• Salvage of cultural material is considered the most effective mechanism for mitigation when a cultural heritage site is impacted

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• 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 WGAC on behalf of the Puutu Kunti Kurrama and Pinikura members.	to the mitigation of impacts to heritage sites (Appendix I.1)		• 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 heritage sites.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Puutu Kunti Kurrama and Pinikura SCHMP		Ministerial condition requiring the Proponent to Implement the Puutu Kunti Kurrama and Pinikura SCHMP during all phases of the Proposal.	
Impacts to water	**Measures to Avoid**			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to prioritise avoidance of impacts to culturally significant water values identified through consultation, surveys, and the Social Surroundings baseline assessment process.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to the avoidance of impacts to culturally significant water values (Appendix I.1)	Yes – Groundwater Operating Strategies developed as part of the Groundwater Licences requires Proponents to provide detail on those pits to be mined BWT and management of groundwater levels.	Groundwater levels at Plunge Pool will not be affected by the Proposal. This avoidance strategy removes the potential impact source and therefore has a high level of certainty. Avoidance is the first and preferred strategy in the EPA mitigation hierarchy.
	Measures to Minimise			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to rehabilitate impacts to culturally significant water values identified through consultation, surveys, and the Social Surroundings baseline assessment process.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama	No	The water management strategy provides a robust decision-making framework to ensure outcomes are achieved.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	The Proponent will employ the following minimisation measures: • The water management strategy includes the preferential discharge of surplus water to mine pits when they are available. This strategy will result in recharge at those locations and minimise the total export of water and groundwater drawdown within the Brockman syncline aquifers.	and Pinikura People which identifies processes to be followed with regards to the minimisation of impacts to water (Appendix I.1)		
	Measures to Rehabilitate			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to rehabilitate impacts to culturally significant water values identified through consultation, surveys, and the Social Surroundings baseline assessment process.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to the rehabilitation of impacts to water (Appendix I.1)	No	This closure strategy is consistent with the EP Act precautionary principle.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Puutu Kunti Kurrama and Pinikura SCHMP		Ministerial condition requiring the Proponent to Implement the Puutu Kunti Kurrama and Pinikura SCHMP during all phases of the Proposal.	
Indirect Impacts				
Impacts to culturally significant flora and fauna	**Measures to Avoid**			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to prioritise avoidance of impacts to culturally significant flora and fauna values identified through consultation, surveys, and the Social Surroundings baseline assessment process where possible.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama	No	• Avoidance is the most effective mechanism for reducing direct impacts to culturally significant flora and fauna values

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	The Proponent will employ the following avoidance measures: • Culturally significant biological values identified by the Puutu Kunti Kurrama and Pinikura People and/or their supporting consultants through the Social Surroundings baseline assessment process will be recorded in the Proponent's GIS system and avoidance will be prioritised. • 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.	and Pinikura People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the avoidance of these (Appendix I.1)		• 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 Minimise			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to minimise 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: • Ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Utilise existing disturbed areas wherever possible • Conduct a site induction program to provide information on heritage protection and ground disturbance authorisation procedures.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the minimisation of impacts to these (Appendix I.1)	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. • The utilisation of existing disturbed areas for the construction of Proposal elements minimises the amount of clearing required. • These controls are considered effective in avoiding direct impacts to culturally significant flora and fauna values.
	Measures to Rehabilitate			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. In addition, the Proponent will: • Share the MCP with PKKP AC and seek their feedback on proposed closure strategies (the Closure Plan is nominally updated every three years) • Assess rehabilitation seed mixes and seek to incorporate identified culturally significant species (bush tucker/medicine) where practical • Monitor rehabilitation areas for return of bush tucker and bush medicine species.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the minimisation of impacts to these (Appendix I.1)	No	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020ab). 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).
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Puutu Kunti Kurrama and Pinikura SCHMP		Ministerial condition requiring the Proponent to Implement the Puutu Kunti Kurrama and Pinikura SCHMP during all phases of the Proposal.	
	Measures to Avoid			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Impacts to access	Implement avoidance measures detailed in the Puutu Kunti Kurrama and Pinikura SCHMP (Appendix I.1). A summary of these measures is provided below. • The Proponent's planning includes a step that considers whether and how access may be preserved to the identified locations for traditional activities. These areas will be documented in the LAP • The Proponent will prepare and maintain a LAP that is endorsed by PKKP AC. 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.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the minimisation of impacts to these (Appendix I.1)	Yes – Mining Act and *Mine Safety and Inspection Act 1994 (WA)*	• Minutes of Consultation Meetings included in SCHMP Compliance Assessment Report • SCHMP Compliance Assessment Report summarises status of LAP and gate card status for Puutu Kunti Kurrama and Pinikura members. • All instances of access requests from The Proponent to PKKP AC documented in the SCHMP Compliance Assessment Report
	Measures to Minimise			
	The Puutu Kunti Kurrama and Pinikura will be consulted regarding measures to minimise impacts to access. These will be detailed in the Puutu Kunti Kurrama and Pinikura SCHMP (Appendix I.1) and implemented accordingly.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the minimisation of impacts to these (Appendix I.1)	Yes – Mining Act and *Mine Safety and Inspection Act 1994(WA)*	These controls are considered effective in minimising direct impacts to Puutu Kunti Kurrama and Pinikura People's access to country.
	Measures to Rehabilitate			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Implement mitigation measures detailed in the Puutu Kunti Kurrama and Pinikura SCHMP (Appendix I.1). A summary of these measures is provided below: • Hold at least one meeting per year with PKKP AC at which closure is discussed • Share the relevant sections of the MCP with PKKP AC and seek their feedback on proposed closure strategies incorporating feedback regarding provision of access to areas of traditional activities made inaccessible during the life of the mine.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the minimisation of impacts to these (Appendix I.1)	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 2020ab. 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.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Puutu Kunti Kurrama and Pinikura SCHMP		Ministerial condition requiring the Proponent to Implement the Puutu Kunti Kurrama and Pinikura SCHMP during all phases of the Proposal.	
Impacts to visual amenity	**Measures to Avoid**			
	Rio Tinto is currently considering whether the building of three additional waste landforms at BS1 (between BS1 and BS4) can be avoided, following consultations with Puutu Kunti Kurrama and Pinikura. If this is not practicable Rio Tinto commits to removing the three WRLs at closure. This commitment is outlined in the MCP.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to impacts to visual amenity to be avoided (Appendix I.1).	No	Avoidance is the most effective mechanism for reducing direct impacts to visual amenity values.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Minimise			
	A BS1 conveyor option was selected in preference to a haul road option following Puutu Kunti Kurrama and Pinikura feedback. This option moves infrastructure further back onto the BS1 range to lessen the impact south looking north up to the range (outside of line of sight). The crusher has also been moved to the east to lessen the cultural impact to the amenity of the ridge.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to impacts to visual amenity to be minimised (Appendix I.1.	No	The relocation of the planned infrastructure was done in response to feedback from the Puutu Kunti Kurrama and Pinikura People and therefore is likely to be effective in lessening visual impacts to the cultural landscape.
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. In addition, the Proponent will: • Design final landforms, including heights and slope angles to be sympathetic with the aesthetic values of the surrounding landscape • Consult with Puutu Kunti Kurrama and Pinikura regarding the proposed closure landform design, including proposed visual impact from key vantage points of cultural heritage importance • Conduct a final landform visual impact assessment of the Brockman Operation closure landform during closure study phase (approximately 10 years from closure).	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People, which identifies processes to be followed with regards to rehabilitation (Appendix I.1)	No	This closure strategy is consistent with the EP Act precautionary principle.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Puutu Kunti Kurrama and Pinikura SCHMP		Ministerial condition requiring the Proponent to Implement the Puutu Kunti Kurrama and Pinikura SCHMP during all phases of the Proposal.	
Impacts to significant heritage places through dust deposition	**Measures to Minimise**			
	The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura People to minimise impacts to culturally significant heritage sites caused by dust. The Proponent will employ the following minimisation measures: • Independent dust modelling has been completed to identify sources and concentrations of dust prior to commencement of construction • Consult with Puutu Kunti Kurrama and Pinikura regarding dust monitoring processes and trigger levels and practices for managing dust • Identify locations where dust levels are above trigger levels (4 g/m2/month) and intersect with significant heritage places to be protected • Establish dust deposition bottles at significant heritage places that have been identified may exceed trigger levels (4 g/m2/month) in consultation with affected Puutu Kunti Kurrama and Pinikura representatives • Where monitoring confirms dust is above trigger levels (4 g/m2/month), at significant heritage places the Proponent will implement practicable dust suppression controls to limit impacts, in consultation with Puutu Kunti Kurrama and Pinikura representatives • On an ongoing basis, identify and implement practices and technologies for further reducing dust emissions. Practices and technologies tested will require to be practical for implementation in the mining context, cost effective and should draw on recognised industry best practice.	A Proposal specific SCHMP has been developed in consultation with the Puutu Kunti Kurrama and Pinikura People which identifies processes to be followed with regards to surveys required to identify culturally significant biological values and the minimisation of impacts to these (Appendix I.1)	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 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 having a high level of certainty.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	No limits proposed – managed through industry standard practice.		N/A.	
Eastern Guruma NTD				
Direct Impacts				
Direct impact to heritage sites	**Measures to Avoid**			
	The Proponent will work in collaboration with the Muntulgura Guruma People to prioritise avoidance of impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process. The Proponent will employ the following avoidance measures: • Heritage places will be recorded and managed in the Proponent's GIS system as exclusion zones • 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 • In addition to this, changes to the mine plan have been made to avoid direct impact to sites (refer to Sections 11.4.1 and 11.5.1 for specific details).	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to heritage sites to be avoided (Appendix I.2).	Yes – ACH Act and AH 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 IHMP as an additional step of assurance. The IHMP is a systematized management system which provides for improved governance of Heritage values. These controls are considered effective in avoiding unacceptable direct impacts to heritage sites.
	Measures to Minimise			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	The Proponent will work in collaboration with the Muntulgura Guruma People to minimise impacts to those areas identified as significant heritage sites through the archaeological and ethnographic surveys or the Social Surroundings baseline assessment process. The Proponent will employ the following minimisation measures: • Ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Utilise existing disturbed areas wherever possible • Install drainage culverts in the Lens G haul road to maintain surface water flow to culturally significant mulga thickets • Conduct a site induction program to provide information on heritage protection and ground disturbance authorisation procedures.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the minimisation of impacts to heritage sites (Appendix I.2).	Yes – ACH Act and AH Act - Section 16 and 18 Applications	• 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 utilisation of existing disturbed areas for the construction of Proposal elements minimises the amount of disturbance to heritage sites. • 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. • These controls are considered effective in minimising direct impacts to 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 cultural salvage: • Cultural material will be salvaged by suitably qualified professionals and with the participation of the Muntulgura Guruma People • Cultural material will be salvaged in accordance with authorisation under required legislation and in line with the Proponent's Salvaged Materials Procedure	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the mitigation of impacts to heritage sites (Appendix I.2).	Yes -ACH Act and AH Act – Section 16 and 18 Applications	• 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.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Salvaged material will be stored in accordance with directions from WGAC on behalf of the Muntulgura Guruma members • The details of the salvaged cultural material will be recorded in the Heritage Information Management System.			• These controls are considered effective in mitigating direct impacts to heritage sites.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Muntulgura Guruma SCHMP		Ministerial condition requiring the Proponent to Implement the Muntulgura Guruma SCHMP during all phases of the Proposal.	
Impacts to water	**Measures to Avoid**			
	The Proponent will work in collaboration with the Muntulgura Guruma People to prioritise avoidance of impacts to culturally significant water values identified through consultation, surveys, and the Social Surroundings baseline assessment process. The Proponent will employ the following avoidance measures: • Avoid the placement of infrastructure that impacts creek lines where practicable • Construct creek diversions where required to maintain flows while the mine is operating • Avoid placement of infrastructure that impacts watersheds where practicable • Avoid below water table mining activities where practicable • Avoid changes to surface flow and discharge that impacts pools where practicable.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to impacts to water to be avoided (Appendix I.2).	No	• Avoidance is the most effective mechanism for reducing direct impacts to culturally significant water values. • These controls are considered effective in avoiding unacceptable direct impacts to identified water values.
	Measures to Minimise			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	The Proponent will work in collaboration with the Muntulgura Guruma People to minimise impacts to culturally significant water values identified through consultation, surveys, and the Social Surroundings baseline assessment process. The Proponent will employ the following minimisation measures: • Minimise discharge of water or application for other uses to absolute operational requirements • Manage staged reduction of surplus water discharge into existing creek systems to minimise impact on ecological systems • Modify water monitoring program to include identified sites and implement reporting and remediation mechanisms outlined in the SCHMP (Appendix I.1) • Minimise mining that requires drawdown from aquifers.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the minimisation of impacts to water (Appendix I.2).	No	• Monitoring and minimisation of water wastage are established protocols for the Proponent's operations. The implementation of additional monitoring and reporting mechanisms will align with internal systems already in place. • These controls are considered effective in minimising impacts to water.
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. In addition to the obligations outlined in the MCP the Proponent will undertake the following measures: • Reducing evaporation and further impacts to the water table by backfilling of pits • Rehabilitate creek lines following staged operations and closure where required • Managed aquifer recharge back into same local aquifer systems prior to closure.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the rehabilitation of impacts to water (Appendix I.2).	No	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020ab. 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.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Ministerial condition requiring the Proponent to Implement the Muntulgura Guruma SCHMP during all phases of the Proposal.		Muntulgura Guruma SCHMP	
	Measures to Avoid			

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Impacts to culturally significant flora and fauna	The Proponent will work in collaboration with the Muntulgura Guruma People to prioritise avoidance of impacts to culturally significant flora and fauna values identified through consultation, surveys, and the Social Surroundings baseline assessment process. The Proponent will employ the following avoidance measures: • Culturally significant biological values identified by the Muntulgura Guruma People and/or their supporting consultants through the Social Surroundings baseline assessment process will be recorded in the Proponent's GIS system and avoidance will be prioritised, including through the creation of exclusion zones where this is determined necessary in consultation with the Puutu Kunti Kurrama and Pinikura 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	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to impacts to culturally significant flora and fauna to be avoided (Appendix I.2).	No	• Avoidance is the most effective mechanism for reducing direct impacts to culturally significant flora and fauna. • 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 direct impacts to culturally significant flora and fauna.
	Measures to Minimise			
	The Proponent will work in collaboration with the Muntulgura Guruma People to minimise impacts to culturally significant flora and fauna values identified through consultation, surveys, and the Social Surroundings baseline assessment process. The Proponent will employ the following minimisation measures:	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the minimisation of	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.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System • Utilise existing disturbed areas wherever possible • Conduct a site induction program to provide information on cultural heritage protection and ground disturbance authorisation procedures.	impacts to culturally significant flora and fauna (Appendix I.2).		• The utilisation of existing disturbed areas for the construction of Proposal elements minimises the amount of disturbance to areas containing culturally significant flora and fauna. • These controls are considered effective in minimising direct impacts to areas containing culturally significant flora and fauna.
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. In addition to the obligations outlined in the MCP the Proponent will undertake the following measures: • Share relevant sections of the MCP with WGAC and seek their feedback on proposed closure strategies (the Closure Plan is nominally updated every three years) • Assess rehabilitation seed mixes and seek to incorporate identified culturally significant species (bush tucker/medicine) where practical • Monitor rehabilitation areas for return of bush tucker and bush medicine species.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the rehabilitation of impacts to water (Appendix I.2).	No	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020ab. 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.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Muntulgura Guruma SCHMP		Ministerial condition requiring the Proponent to Implement the Muntulgura Guruma SCHMP during all phases of the Proposal.	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Impacts to access	**Measures to Avoid**			
	The Proponent will work in collaboration with the Muntulgura Guruma People to prioritise avoidance of impacts to accessing country. The Proponent will employ the following avoidance measures: • Areas requiring continued access identified by the Muntulgura Guruma People and/or their supporting consultants through the Social Surroundings baseline assessment process will be recorded in the Proponent's GIS system. These areas will be documented in the LAP • The Proponent will prepare and maintain a LAP that is endorsed by WGAC. 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.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to impacts access to be avoided (Appendix I.2).	Yes –Mining Act and *Mine Safety and Inspection Act 1994 (WA).*	• Avoidance is the most effective mechanism for reducing direct impacts to access. • 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 access to significant areas will be retained for Muntulgura Guruma People. These controls are considered effective in avoiding direct impacts to Muntulgura Guruma People's access to country.
	Measures to Minimise			
	The Proponent will work in collaboration with the Muntulgura Guruma People to minimise impacts to accessing country. The Proponent will employ the following minimisation measures: • 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.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the minimisation of impacts to access (Appendix I.2).	Yes –Mining Act and *Mine Safety and Inspection Act 1994 (WA).*	These controls are considered effective in minimising direct impacts to Muntulgura Guruma People's access to country.
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's.	A Proposal specific SCHMP has been	Yes –Mining Act and *Mine Safety and*	Statutory Guidelines for MCPs are available and are consistent with

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	In addition to the obligations outlined in the MCP the Proponent will undertake the following measures: • The Proponent will incorporate feedback into the MCP regarding provision of access to areas of traditional activities made inaccessible during the life of the mine.	developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the mitigation/rehabilitation of impacts to access (Appendix I.2).	*Inspection Act 1994 (WA).*	industry-leading practice (DMIRS 2020ab. 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.
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Muntulgura Guruma SCHMP		Ministerial condition requiring the Proponent to Implement the Muntulgura Guruma SCHMP during all phases of the Proposal.	
Impacts to visual amenity	**Measures to Avoid**			
	Management of any visual amenity impacts as a result of this Proposal will be as outlined in the Muntulgura Guruma SCHMP framework, for which there will be ongoing consultation with Muntulgura Guruma.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People, which identifies processes to be followed with regards to impacts to visual amenity to be avoided (Appendix I.2).	No	Avoidance is the most effective mechanism for reducing direct impacts to visual amenity values.
	Measures to Rehabilitate			
	The Proponent has prepared an MCP following DMIRS Guidelines for Preparing MCP's. In addition, the Proponent will: • Design final landforms, including heights and slope angles to be sympathetic with the aesthetic values of the surrounding landscape	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People, which identifies processes to be	No	This closure strategy is consistent with the EP Act precautionary principle.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	• Consult with Muntulgura Guruma regarding the proposed closure landform design, including proposed visual impact from key vantage points of cultural heritage importance • Conduct a final landform visual impact assessment of the Brockman Operation closure landform during closure study phase (approximately 10 years from closure).	followed with regards to rehabilitation (Appendix I.2).		
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	Muntulgura Guruma SCHMP		Ministerial condition requiring the Proponent to Implement the Muntulgura Guruma SCHMP during all phases of the Proposal.	
Impacts to key culturally significant heritage sites by including noise, dust, and vibration	**Measures to Minimise**			
	The Proponent will work in collaboration with the Muntulgura Guruma People to minimise impacts to culturally significant heritage sites caused by noise, dust and vibration. The Proponent will employ the following minimisation measures: • Complete a desktop review, identifying source levels, and transmission (under a range of conditions), distances from key infrastructure at which point National Environmental Protection Measures or other appropriate standards are reached • Consult with Muntulgura Guruma to define suitable trigger levels for further investigation and actions • Identify locations where levels above identified trigger levels intersect with the locations to be protected • Establish noise and/or dust and/or vibration monitors at locations at risk of significant harm • Where monitoring confirms exposure above trigger levels, implement practicable controls to reduce impacts in consultation with EG Group.	A Proposal specific SCHMP has been developed in consultation with the Muntulgura Guruma People which identifies processes to be followed with regards to the minimisation of impacts to culturally significant heritage sites caused by noise, dust and vibration. (Appendix I.2).	No	• These measures have been developed to meet the current industry standards for managing dust, noise, and vibration levels. The management strategy will manage 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 Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Proposed Limits on Impact to Ensure Environmental Outcomes		**Mechanism for Limit**	
	No limits proposed – managed through industry standard practice.			

12.6. Assessment and Significance of Residual Impact

This section identifies residual impacts to Social Surroundings after the application of the avoidance, minimisation and mitigation hierarchy 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 based on the views of Traditional Owners and therefore, ongoing consultation with Muntulgura Guruma and Puutu, Kunti, Kurrama and Pinikura members is vital.

12.6.1. Cheela Plains and Mt Stuart Pastoral Stations

The Proponent is in the process of purchasing the portion of Cheela Plains Pastoral Station that intersects with the Development Envelope and transferring it to become part of Hamersley Station. It is deemed that there will be no further direct impacts on Cheela Plains Station once this transfer is completed. There are no direct impacts expected for Mt Stuart Station.

Indirect impacts to the Pastoral Stations, in particular Mt Stuart Station, is limited to changes to Boolgeeda Creek from mine water discharge. Surplus water discharge to Boolgeeda Creek currently occurs as part of existing operations, and the Proposal includes the continuation of this discharge early in mine life. As mine pits become available to take this water, discharge to Boolgeeda Creek will be phased out. Mt Stuart Station have expressed concerns regarding the attraction of cattle to the discharged water. In the interim period, while discharge continues to be required, fencing will be installed on the Mt Stuart Station boundary. Once installed it is considered that this impact will be mitigated, and no residual impacts are anticipated for Mt Stuart Station. The Station Owners have also expressed concerns regarding feral animal attraction to surplus water discharge. It is deemed that these impacts will be appropriately managed by measures undertaken in accordance with the operational environmental management system and processes, which include requirements for feral animal management.

With the implementation of these mitigation measures, the Proposal is able to be implemented without significant residual impacts on the Cheela Plains or Mt Stuart Pastoral Stations.

12.6.2. Puutu Kunti Kurrama and Pinikura Traditional Lands and Heritage

Rio Tinto has endeavoured to avoid, manage and mitigate as many significant impacts as practicable when developing this Proposal. Though changes to the Proposal have been made to minimise impacts and captured within the co-developed SCHMPs, disturbance is required to implement this Proposal and undertake mining activity and therefore this will still result in some direct and indirect impacts to Puutu Kunti Kurrama and Pinikura Aboriginal Heritage, cultural values and the traditional usage of the land. These impacts need to be considered locally and also regionally, considering cumulative impacts on Puutu Kunti Kurrama and Pinikura Country. Any impact to a heritage place will only occur after appropriate consultation with Puutu Kunti Kurrama and Pinikura representatives and in accordance with necessary approvals under the ACH Act.

Rio Tinto acknowledges that the Puutu Kunti Kurrama and Pinikura People should determine whether impacts on their heritage places and lands are significant. In order to ensure that the Puutu Kunti Kurrama and Pinikura People have been sufficiently informed of the residual impacts on their heritage places and land, the following steps are to be undertaken prior to any disturbance within Puutu Kunti Kurrama and Pinikura land:

- Archaeological and ethnographic surveys have been conducted over land that may be potentially impacted
- Significant sites and places have been recorded

- Potential impacts to sites and lands have been adequately described and discussed with the Puutu Kunti Kurrama and Pinikura People, and sites have been avoided and impacts otherwise minimised, to the extent practicable, in consultation with Puutu Kunti Kurrama and Pinikura representatives
- The scale of indirect impacts such as amenity (dust, noise, visual), access restrictions, hydrological changes, weeds, introduced fauna and incomplete rehabilitation have been adequately described and discussed with Puutu Kunti Kurrama and Pinikura People
- Measures to avoid and minimise indirect impacts have been developed in consultation with the Puutu Kunti Kurrama and Pinikura People. Third-party technical advice has been sought and provided if required to verify the effectiveness of any proposed measures
- A SCHMP has been prepared and the content has been agreed to between the Puutu Kunti Kurrama and Pinikura People and the Proponent. It is anticipated that the EPA will impose a condition requiring the implementation of this SCHMP as part of the Ministerial Statement for this Proposal
- The Puutu Kunti Kurrama and Pinikura People have determined that the SCHMP addresses their concerns and provides adequate commitments to avoid, minimise and rehabilitate impacts to heritage places and the traditional uses of Puutu Kunti Kurrama and Pinikura land.

The Proponent and PKKP AC, representing the Puutu Kunti Kurrama and Pinikura People, have commenced and will continue to progress through the steps listed. The outcomes of this process to date are summarised below for context and underpins the SCHMP framework.

The disturbance footprint of the Proposal has been revised based on ongoing consultation with the Puutu Kunti Kurrama and Pinikura People to avoid impacting heritage cluster five, and this will be managed through the use of the Proponent's IHMP. In addition to this, changes to the mine plan have been made to avoid direct impact to sites, such as:

- Re-designing the DP8 and DP9 waste rock landforms
- Selecting a conveyor option and preferred alignment for ore transport between the BS1 Deposit and B4 Plant through direct consultation with Puutu Kunti Kurrama and Pinikura representatives
- Re-designing and changes to the mine closure strategy for the WRLs associated with mining at the BS1 Range
- Measures to retain natural hydrology regimes including diversions where deemed required during the operational stage of mining.

Through the studies phases and ongoing mine plan revisions, the placement of infrastructure, mine development and supporting disturbance will continue to consider the location of significant heritage sites and seek reasonable options for impact avoidance.

The Proposal will require the disturbance of up to 3,359 ha of vegetation within Puutu Kunti Kurrama and Pinikura Land. These vegetated areas may otherwise have been utilised for traditional purposes.

Unavoidable access restrictions and indirect impacts on heritage places and traditional uses of the land will also occur as a result of the Proposal. Decisions on the appropriate management of these impacts has been and will be subject to regular and continued consultation with the Puutu Kunti Kurrama and Pinikura People and have been detailed in the Puutu Kunti Kurrama and Pinikura Brockman Syncline Proposal SCHMP, which has been co-developed by Puutu Kunti Kurrama and Pinikura representatives and Rio Tinto. Access to Country will be managed under the LAP.

12.6.3. Muntulgura Guruma Traditional Lands and Heritage

The Proponent has endeavoured to avoid, manage, and mitigate as many significant impacts as practicable when developing this Proposal. Though changes to the Proposal have been made to minimise impacts and captured within the co-developed SCHMPs, the Proposal will result in direct and

indirect impacts to Muntulgura Guruma Aboriginal Heritage, cultural values and the traditional usage of the land. These impacts need to be considered locally and regionally, considering cumulative impacts on Muntulgura Guruma Country.

The Proponent acknowledges that the Muntulgura Guruma People should determine whether impacts on their heritage places and lands are deemed significant. To ensure that the Muntulgura Guruma People have been sufficiently informed of the residual impacts on their Heritage Places and land the following steps are to be undertaken before any disturbance within Muntulgura Guruma land:

- Archaeological and ethnographic surveys have been conducted over land that may be potentially impacted (approximately 85% covered to date)
- Significant sites and places have been recorded
- Potential impacts to sites and lands have been adequately described and discussed with the Muntulgura Guruma People, and sites have been avoided and minimised in consultation with Muntulgura Guruma People
- The scale of direct and indirect impacts such as amenity (dust, noise, visual), access restrictions, hydrological changes, impacts to culturally significant flora and fauna feral animals have been adequately described and discussed with Muntulgura Guruma People, with careful consideration of cumulative impacts
- Measures to avoid and minimise indirect impacts have been developed in consultation with the Muntulgura Guruma People. Third-party technical advice has been sought and provided if required to verify the effectiveness of any proposed measures
- A SCHMP has been prepared with Muntulgura Guruma representatives and the content has been agreed to by the Muntulgura Guruma People and the Proponent. It is anticipated that the EPA will impose a condition requiring the implementation of this SCHMP as part of the Ministerial Statement for this Proposal
- The Muntulgura Guruma People determine that the SCHMP addresses their concerns and provides adequate commitments to avoid, minimise and rehabilitate impacts to Heritage Places and the traditional uses of Muntulgura Guruma Country.

The Proponent and Muntulgura Guruma have commenced and will continue to progress through the steps listed above. The outcomes of this process to date are summarised below for context.

The disturbance footprint of the Proposal has been revised based on feedback in Social Surroundings reports and consultation with the Muntulgura Guruma People to avoid direct impact to sites, including:

- Re-designing the Lens G Diesel deposits
- Selecting infrastructure alignments based on lowest impact
- Re-design and mine closure planning for mineral waste landform near Pit 0 in the BS4 assessment area
- Measures to minimise impacts to hydrological regimes, including at Plunge Pool and Kurwillinha Pool
- No diversion or realignment of the mainline channel of Boolgeeda Creek, Duck Creek or Caves Creek associated with this Proposal.

Through the studies, phases and ongoing mine plan revisions, the placement of infrastructure, mine development and supporting disturbance will continue to consider the location of significant heritage sites and seek reasonable options for impact avoidance.

The Proposal will require the disturbance of up to 4,546 ha of vegetation within Muntulgura Guruma Country. These vegetated areas may otherwise have been utilised for traditional purposes.

Disturbance is required to implement this Proposal and undertake mining activity; therefore, some unavoidable access restrictions and indirect impacts on heritage places and traditional uses of the land

will also occur as a result of the Proposal. Decisions on the appropriate management of these impacts has been and will be subject to regular and continued consultation with and direction from the Muntulgura Guruma People and will be detailed in the Muntulgura Guruma Brockman Syncline Proposal SCHMP, which is being prepared with WGAC as representatives of the Muntulgura Guruma People. Any impact to a heritage place will only occur after appropriate consultation with Muntulgura Guruma representatives and in accordance with necessary approvals under the ACH Act. Access to Country will be managed under the LAP.

12.6.4. Significance of Residual Impacts

12.6.4.1. Non-Significant Residual Impact

The proposed avoidance and management measures associated with the Proposal that demonstrate non-significant residual impacts to Social Surroundings include:

- Pastoral activities (Hamersley and Rocklea Station) across the Development Envelope are managed by the Proponent. The Proponent is in the process of purchasing the portion of the Cheela Plains Pastoral station upon which the Proposal is located. Indirect impacts to Cheela Plains Pastoral Station will not be significantly different to those already authorised under MS 1000
- There are no predicted significant impacts predicted to the general public. The Development Envelope is not frequented by member of the public for recreational activities
- No European heritage sites have been documented within the Development Envelope.

12.6.4.2. Significant Residual Impacts

After application of mitigation measures, the following significant residual impacts are predicted to Social Surroundings:

- Direct and indirect impacts to Aboriginal Heritage, cultural values and the traditional usage of the land for the Puutu Kunti Kurrama and Pinikura People. These impacts will be managed through the implementation of the co-developed SCHMP
- Direct and indirect impacts to Aboriginal Heritage, cultural values and the traditional usage of the land for the Muntulgura Guruma People. These impacts will be managed through implementation of the co-developed SCHMP.

12.7. Social Surroundings 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 outcomes that apply to Social Surroundings are set out below:

- Subject to reasonable health and safety requirements, the Proponent will facilitate the Puutu Kunti Kurrama and Pinikura People ongoing access and connection to Country within the Development Envelope.
- Subject to reasonable health and safety requirements, the Proponent will facilitate the Muntulgura Guruma People ongoing access and connection to Country within the Development Envelope.

- In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated objectives that apply to Social Surroundings are set out below:
- Avoid, where practicable, and otherwise minimise direct and indirect impacts as a result of implementation of the Proposal to Puutu Kunti Kurrama and Pinikura cultural heritage values in accordance with the SCHMP. Where approved impact occurs, mitigation measures will be applied i.e., rehabilitation of disturbed areas once no longer required for mining purposes.
- Avoid, where practicable, and otherwise minimise direct and indirect impacts as a result of implementation of the Proposal to Eastern Guruma cultural heritage values in accordance with the SCHMP. Where approved impact occurs, mitigation measures will be applied i.e., rehabilitation of disturbed areas once no longer required for mining purposes.

The Proponent will implement the SCHMPs as per Appendix I.1 to achieve these outcomes.

Based on this assessment, the Proposal was assessed as having a significant residual impact on social surroundings related environmental values in relation to the Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma Peoples Traditional Lands, specifically those related to the preservation of cultural amenity of the area within and nearby to the Proposal.

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 addition, required measures and management approaches have been agreed upon in the Puutu Kunti Kurrama and Pinikura SCHMP and the Muntulgura Guruma SCHMP. The co-developed SCHMPs will ensure the Proponent continues to apply the EPA's mitigation hierarchy (avoid, minimise, mitigate) to all activities undertaken concerning this Proposal through consultation and partnership with the Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma People and their representatives. A condition requiring the implementation of these SCHMPs is expected for this Proposal.

Subject to conditions recommended in Table 12-3 and implementation of the SCHMP, the Proponent considers that the Proposal can be managed to meet the EPA's objective to protect Social Surroundings from significant harm.

13. 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.

13.1. 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 Proposal area and counterbalance significant residual impacts.

Environmental offsets should 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 of 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 guideline. 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 Environmental Offsets Policy (DSEWPaC 2012a).

The mitigation hierarchy of 'avoid, minimise, rehabilitate and offset' has been considered in the assessment of 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.

13.2. Relevant Policy and Guidance

13.2.1. West Australian Environmental Offsets Policy

The Government of Western Australia's 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.

13.2.2. 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.

13.2.3. EP Act

13.2.3.1. 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 focussed on longer term strategic outcomes.

Specifically, the offsets of this Proposal will 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, 2021).

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.

13.2.3.2. 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 2020a).

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 2020a). For example, the EPA recognises Australian Carbon Credit Units 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).

13.2.4. EPBC Act

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.

13.2.5. 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.

13.3. Assessment and Significance of Residual Impact – EP Act

13.3.1. 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 (Chapter 7, 8 and 14) and summarised in Table 13-1.

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 13-2.

The Proposal will result in clearing up to 7,896 ha of native vegetation in the Hamersley IBRA subregion. Following application of the mitigation hierarchy, the following residual environmental impacts are considered significant residual impacts and therefore require an offset:

Clearing approximately 7,716 ha of native vegetation in good to excellent condition, including:

- Approximately 4,532 ha of native vegetation (in good to excellent condition) which does not overlap significant fauna habitat
- Up to 6 ha of high local significance riparian vegetation
- Up to 331 ha of critical (Gorge/Gully (264 ha) and Debris Slope/Rocky Outcrop (67 ha)) (breeding and roosting) habitat for Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python
- Approximately 140 ha of supporting (Major (25 ha) and Minor (114 ha) Creekline) habitat for MNES species as per the following home ranges for each species:
    - 1 km of a Northern Quoll record
    - 10 km's of a category 2 or 3 Pilbara Leaf-nosed Bat roost/s as well as a permanent water source (Plunge Pool)
    - 5 km's of an isolated category 2 Ghost Bat roost, and/or a category 2 Ghost Bat roost within an apartment block and/or a category 3 Ghost Bat roost within an apartment block
    - 1 km of a Pilbara Olive Python record.
- Approximately 2,806 ha of supporting (Alluvial (65 ha), Colluvial (2,638 ha) and Hardpan (104 ha) Plain) habitat for MNES species as per the following home ranges for each species:
    - 10 km's of a category 2 or 3 Pilbara Leaf-nosed Bat roost/s as well as a permanent water source (Plunge Pool)
    - 5 km's of an isolated category 2 Ghost Bat roost, and/or a category 2 Ghost Bat roost within an apartment block and/or a category 3 Ghost Bat roost within an apartment block.

13.3.2. Greenhouse Gas Emissions

After the avoidance and reduction measures, the Proposal is expected to contribute net GHG emissions (Scope 1 emissions) of approximately 2,410,000 t $CO_{2\text{-}e}$ through the project's life, with five-year targets set to progress to net zero by 2050. 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 Section 13.5.2.

Table 13-1: Quantification of Residual Impact to be Offset

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
Environmental Factor: Inland Waters				

Context/Key Survey Findings:
 	
The Development Envelope comprises the following Inland Water values:
• Plunge Pool – a permanent pool with:
  ○ Cultural significance for Muntulgura Guruma
  ○ High value to fauna
  ○ GDE's associated with Plunge Pool
• Boolgeeda and Duck Creeks, including riparian vegetation
• Kurwillinha and Ridge Pools – ephemeral pools with:
  ○ Cultural significance to Muntulgura Guruma
  ○ Moderate value to fauna
• Aquifers supporting stygofauna
• Aquifers supporting groundwater dependent vegetation
• Culturally important mulga communities in the BS2 assessment area.
Predicted Impact/ Outcomes:
• No third-party water users
• Groundwater levels that support the base water level in Plunge Pool (which has been placed in a MEZ) will be maintained
• A catchment area of no less than 7 km2 will be maintained within the catchment that supports Plunge Pool No permanent pools are affected by groundwater drawdown as a result of the Proposal
• Groundwater drawdown may affect up to 103 ha of GDVs
• Surface water catchment reductions of 3.1% in the Beasley River and 3.3% in Boolgeeda Creek
• No increase in the approved wetting front to Boolgeeda Creek (37 km) or the approved wetting front to Duck Creek, which is expected to be limited to within 67 km of the discharge outlet
• Natural low flow paths and functioning of Boolgeeda and Duck Creek will be maintained within the Development Envelope
• Five pit lakes are expected to form and are likely to be groundwater sinks
• The waste fines solids are likely to be NAF and considered low risk given the neutral pH of the supernatant and NAF solids.
	The Proposal has been designed to manage and minimise the following potential impacts to Inland Waters:
	
	Avoidance
	• Avoidance of groundwater drawdown at Plunge Pool by committing to no BWT mining at the BS3 deposit
	• Avoiding groundwater mounding from surplus water discharge by limiting discharge to pits to only occur where pit lakes would not be expected to cause mounding in areas of shallow watertable (i.e., <20m bgl)
	• Limiting change to surface hydrological regimes of creeklines as a result of surplus water discharge will be minimised by storing surplus water in mine pits as they become available for storage/ passive infiltration
	• Limiting degradation of surface water quality at Duck Creek and Boolgeeda Creek by limiting water discharges to creeks where the discharge water quality is compatible with the receiving environment.
	Minimisation
	• Limit extent of changes to the surface hydrological regime by minimising discharge to surface water systems where practicable via alternative surplus water management methods, including discharge to the NAP (as approved under MS 925) and storage in completed mine pits
	• Surface water discharge is only expected to be required early in mine life before completed mine pits are available.
	• Limiting alteration to surface water flows due to installation of project infrastructure by:
	  ○ Designing linear infrastructure 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
	  ○ Designing the Lens G haul road with major culverts to maintain flows within the broad valley between Lens G and Diesel deposits
	• Reduce potential indirect impacts to surface water quality within Duck Creek and Boolgeeda Creek
	• Reduce risk of sedimentation in Plunge Pool by:
	  ○ Constructing water management structures in key risk areas to minimise the discharge of sediment-laden runoff from the site (e.g., banks, sediment traps, catch bunds)
		The Proponent will:
		• Implement a mine closure strategy that includes backfilling of the BS3 Extension deposits (MM-J and Creekside) to recovered post-mining water levels to minimise the long-term drawdown in aquifers that are 9 km upgradient of Plunge Pool
		• Implement the water management strategy, which includes the preferential storage of surplus water to mine pits when they are available. This strategy will result in passive recharge at those locations and minimise the total export of water and groundwater drawdown within the Brockman syncline aquifers
		• Remove all linear infrastructure at closure unless required for future use identified through the mine closure planning process
		• Effective management of PAF materials requires progressive waste characterisation, closure planning and monitoring. These aspects will continue to be addressed through the Mine closure planning process.
			Can the environmental values be rehabilitated? Evidence?
			• Backfilling of key pits is an effective means of avoiding the long-term effects of evaporation from pits predicted to form pit lakes in the vicinity of key environmental values
			• Stabilisation of landforms is a standard closure objective with well-established techniques to ensure that runoff from closure landforms does not create erosion and sedimentation
			• Removal of linear structures will reinstate uninterrupted flows.
			Operator experience in undertaking rehabilitation?
			Rio Tinto conducts rehabilitation activities progressively at all its operations in the Pilbara. All rehabilitation is undertaken according to the Rio Tinto Iron Ore 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 Handbook addresses:
			• Soil resource management
			• Rehabilitation techniques
			• Local provenance species seeding practices
			• Records and data management
			• Ongoing monitoring.
			What is the type of vegetation being rehabilitated?
			The Proponent purchases appropriate local provenance seeds available 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.
			Time scale
			Once areas have been signed off by internal stakeholders 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
				The Proponent considers that potential impacts can be managed and that residual impacts will not be significant.

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	**Rehabilitation Type**	**Likely Rehabilitation Success**	
	○ Implementing leaky weir sediment traps or similar within the Plunge Pool catchment to minimise sediment contributions to Plunge Pool.		where practicable, however, the majority of the rehabilitation will be undertaken at closure. **Credibility of the rehabilitation proposed (evidence of demonstrated success)** Rehabilitation success across existing Greater Brockman operational areas has been variable to date. Some areas indicate positive performance and very good rehabilitation, and poor rehabilitation outcomes are observed in some other historical areas. Further work is being undertaken to understand where rehab has been less successful in historical areas to inform focus areas for further studies. 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.	
Environmental Factor: Flora and Vegetation				
Context/Key Survey Findings The Development Envelope comprises the following Flora and Vegetation values: • 51,743 ha of native vegetation in good to excellent condition within the Development Envelope. • One Regionally Significant vegetation type P33: that represents the Priority 1 PEC 'Brockman Iron Cracking Clay Communities of the Hamersley Range' (Cracking Clay PEC). • Seven vegetation types considered to be of high local significance within the Development Envelope (C3(DkCk), C6, C28, G3, H35, H36 and P27). • 37 vegetation types considered to be of moderate local significance. • Two GDE features of likely high groundwater dependence (Feature 355 Plunge Pool and Feature 109 Duck Creek Catchment), and nine GDE features of likely moderate dependence. • 1,509 ha of riparian vegetation of which 136.2 and 407.5 ha are considered to be of high and moderate local significance • Two Priority 1 flora species (*Hibiscus* sp. Mt Brockman (E. Thoma ET 1354) and *Tetratheca butcheriana*) and 25 P2/3/4 species within the Development Envelope **Predicted Impact/Outcomes**	The Proposal has been designed to manage and minimise the following potential impacts to Flora and Vegetation: **Avoidance** • Avoidance of clearing of vegetation type P33, which is representative of the Priority 1 PEC – Brockman Cracking Clay Communities of the Hamersley Range • Avoidance of clearing of any *Tetratheca butcheriana* (P1) individuals by delineation of a 100 m MEZ around the population within the Development Envelope • Avoiding impacts to GDEs by: ○ Avoiding BWT mining and associated dewatering close to Plunge Pool ○ Avoiding the need to develop a non-potable water supply borefield • Avoidance of introduction of new weeds species entering the Development Envelope by employing weed hygiene management measures and washdowns for new equipment coming to site **Minimisation** • Minimisation of impacts to riparian vegetation from surplus water discharge within Boolgeeda Creek and Duck Creek from by ensuring that the discharge wetting front remains within the existing approved discharge footprint (refer above to Inland Waters)	**The Proponent will:** • Undertake progressive rehabilitation to minimise cleared areas and revegetate using local native species • 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 area. • Backfill the BS3 Extension deposits (MM-J and Creekside) to above post mining recovered water levels to minimise the long-term drawdown in aquifers that are 9 km upgradient of Plunge Pool • Discharge surplus water to mine pits preferentially. This strategy will result in recharge at those locations and minimise the total export of water and groundwater drawdown within the BS aquifers • Spray weeds during progressive rehabilitation over the life of the mine • Include indicative closure completion criteria to ensure that the only weed species recorded within rehabilitation areas are also present within the local uncleared area.	**Can the environmental values be rehabilitated? Evidence?** All rehabilitation is undertaken in accordance with the Proponent's Rehabilitation Procedures (Appendix J.1). **Operator experience in undertaking rehabilitation?** Rio Tinto conducts rehabilitation activities progressively at all its operations in the Pilbara. All rehabilitation is undertaken according to the Rio Tinto Iron Ore 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 Handbook addresses: • Soil resource management • Rehabilitation techniques • Local provenance species seeding practices • Records and data management • Ongoing monitoring. **What is the type of vegetation being rehabilitated?** 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	**Extent** Clearing up to 7,716 ha native vegetation in Good to Excellent condition. **Quality** 7,716 ha of native vegetation is in Good to Excellent condition, including up to 6 ha of high value riparian vegetation. **Land tenure** Not applicable. **Time scale** Clearing will be undertaken progressively.

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	

• No impact to the Themeda grasslands on cracking clays TEC which is 1.2 km outside of the Development Envelope
• No impact to Priority 1 PEC "Brockman Cracking Clay Communities of the Hamersley Range
• No impact to vegetation type P33
• No significant impact to vegetation units of high local significance through the use of upper limits of clearing which will be conditioned
• No direct impact on known *Tetratheca butcheriana* (P1) individuals which have been placed in a MEZ
• No significant impact to Priority 1 and 2 species through the use of upper limits of clearing which will be conditioned
• Clearing of 7,896 ha of native vegetation, of which approximately 7,716 ha is in good to excellent condition, including up to 6 ha of high local significance riparian vegetation
	• Minimise clearing of native vegetation by reducing the total extent of clearing required from 9,977 ha (as referred) to 7,896 ha (amended via s.43A)
	• Minimising disturbance to six Priority Flora species by modifying the Conceptual Footprint
	• Limiting indirect disturbance to riparian vegetation by:
	• Limiting the use of abstraction groundwater to specific purposes only
	• Minimising discharge to surface water systems
	• Managing controlled discharge/ discharge to Boolgeeda Creek and Duck Creek within existing approved discharge extents
	• Minimising groundwater mounding near GDV vegetation by selection of pits for water storage away from these receptors.
	• Minimising the threat of new weeds species and spread of existing weed species through existing operations weed management strategies
	• Limiting potential for indirect degradation of vegetation through dust deposition by:
	• Adopting existing operations dust suppression techniques
	• Limiting the clearing to what is required to safely operate
	• The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna.
	• Limiting potential for indirect degradation of vegetation through potential increase in fire by:
	  ○ Implementing proactive fire management measures (e.g., maintaining fire breaks, hot works procedures)
	  ○ Locating firefighting equipment around the site and in vehicles.
			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 of the rehabilitation will be undertaken at closure.
			
			<u>Credibility of the rehabilitation proposed (evidence of demonstrated success)</u>
			
			Rehabilitation success across existing Greater Brockman 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 J.1 and summarised below:
			
			• The Proponent's Nammuldi Lens C Waste Dump Rehabilitation has been free of weed species since the establishment and has generally been statistically comparable to analogues with respect to most parameters
			• The Proponent's BS2 Waste Dump West rehabilitation site has shown high species richness and recruitment occurring within the system, particularly by Acacia shrubs. The species diversity indices are high and there is no significant difference between the rehabilitated area and the reference sites in terms of average species richness per quadrat, plant density, or cover. The area remains stable with minor riling observed and no weeds established in the rehabilitation area. Waste Dump West is an example of highly successful rehabilitation of a substantial age that is representative of analogous vegetation in the surrounding area.	

Environmental Factor: Terrestrial Fauna				

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	

Context/Key Survey Findings
 	
The Development Envelope comprises the following terrestrial fauna values:
• Critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitats for the Northern Quoll (EN), Pilbara Leaf-nosed Bat (VU), Ghost Bat (VU) and Pilbara Olive Python (VU) and potential SRE species.
• Supporting Major and Minor Creekline (foraging and dispersal) habitat for the Northern Quoll (EN), Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, when within the species home range.
• Supporting Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat for the Pilbara Leaf-nosed Bat and Ghost Bat, when within the species home range.
• Suitable habitat for the Grey Falcon (VU), Fork-tailed Swift (MI), Peregrine Falcon (OS), Gane's Blind Snake (P1), Western Pebble-mound Mouse (P4), Lined Soil-crevice Skink (P4), Long-tailed Dunnart (P4) and Short-tailed Mouse (P4)
• One category 2 roost for the Pilbara leaf-nosed bat (Upper Beasley River Roost), located 670 m outside the Development Envelope
• 102 category 4 roosts for the Pilbara leaf-nosed bat within the Development Envelope
• Eight category 2 roosts, 78 category 3 roosts and 45 category 4 roosts for the Ghost Bat within the Development Envelope.
• Plunge Pool, a permanent groundwater sustained water feature within the Development Envelope that is considered highly significant as a source of drinking water and foraging resources for significant fauna for all of the year.
• Ridge Pool, an ephemeral pool located 140 m outside of the Development Envelope that is considered highly significant as a source of drinking water and foraging resources for significant fauna for most of the year.
 	
Predicted Impact/Outcome
• 72 and 87% of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python and supports potential SRE's will remain within the Development Envelope
• The significant category 2 (Upper Beasley River Roost) Pilbara Leaf-nosed Bat roost is located outside of the Development Envelope and will not be directly impacted by the Proposal
	The Proposal has been designed to manage and minimise the following potential impacts to terrestrial fauna:
	
	Avoidance
	• Retention of critical fauna habitat through:
	  ○ Establishing of MEZs around 106 significant caves, critical cave clusters, water features and high significance habitat within the Development Envelope
	  ○ Maintaining habitat connectivity by ensuring the landform corridors such as drainage lines to remain intact
	  ○ Avoiding known MRZs and MEZs by including them in the Proponent's GIS system
	  ○ Ensuring clearing occurs only in approved ground disturbance areas
	• Avoiding fauna habitat degradation associated with construction operation activity, including dust and altered fire regime by implementing proactive fire management measures (e.g., maintaining fire breaks, hot works procedures)
	  ○ Avoiding displacement of fauna due to disturbance from noise and/or vibration through:
	  ○ Application of vibration limits to 'apartment block' and isolated category 2 and 3 bat roosts within the Development Envelope
	Minimisation
	• Minimising degradation of fauna habitat by
	• Designing the Development Envelope and Conceptual Footprint to minimise practicable disturbance of high significance Gorge/Gully and Debris Slope/Rocky Outcrop habitats
	• Restricting clearing of high significance habitat to authorised extents
	• Minimising impacts to significant habitat types by including the known locations of significant fauna habitat types in the Proponent's GIS system
	• Ensuring clearing occurs in the approved areas through continued implementation of the Proponents Approvals Request system.
	• Minimising loss of individuals as a result of clearing or other interactions by:
	• Limiting most light vehicle movements outside of operating mine areas to daylight hours
	• Undertaking progressive clearing to allow fauna to migrate away from clearing activities or machinery movement
		The Proponent will:
		• Implement a MCP to ensure that vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use. Final landforms are stable and consider ecological and hydrological factors
		• Minimise surface water ponding through design, construction and rehabilitation
		• Conduct rehabilitation according to the Rio Tinto Iron Ore Rehabilitation Handbook, including fauna and habitat monitoring.
			Credibility of the rehabilitation proposed (evidence of demonstrated success)
			
			The Proponent's rehabilitation showed success in the Len C rehabilitated site. Fauna habitat matched or exceeded those in the reference site for total percent perennial cover, shrub and litter cover, with observations suggesting species that utilise shrubs and litter, such as small mammals, birds, reptiles and invertebrates would be expected to readily utilise these habitats.
			
			In the Proponent's rehabilitated Brockman 4 Borrow Pits, perennial vegetation has developed in the rehabilitation areas in the past ten years and would be expected to provide good habitat for vertebrates, and invertebrate fauna. The most common birds observed was seed-eating species, particularly Zebra Finches, Painted Finches, Budgerigars and Spinifex Pigeons. In addition, insectivores and predatory birds have also been observed. Kangaroo and Dingo/Dog scats have also been noted. Several flora species have been observed to be flowering or fruiting, providing both a direct food source (nectar and seeds) and likely also attracting invertebrates as a secondary food source, as well as contributing to the soil seed bank to sustain the vegetation in the longer term.
				Extent
				
				Clearing up to 331 ha of critical Gorge/Gully and Debris Slope/Rocky/Outcrop (roosting and breeding habitat) and approximately 2,946 ha of supporting Major and Minor Creekline and Alluvial, Colluvial and hardpan Plain (foraging and dispersal) habitats, when within a species home range.
				
				Quality
				• Critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitat for MNES species
				• Supporting Major and Minor Creekline and Alluvial, Colluvial and hardpan Plain (foraging and dispersal) habitats for MNES species
				Land tenure
				
				Not applicable.
				
				Time scale
				
				Clearing will be undertaken progressively.

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
• All significant Ghost Bat roosts (isolated category 2 roosts outside an apartment block (3) and apartment block roosts (20)) will be retained within the Development Envelope and placed in MRZs/MEZs and managed via an EMP (**Table 8-9** and **Table 14-19**, • Of the 25 water features known within the Development Envelope, 13 have been placed in MRZs/MEZs, including the permanent groundwater sustained Plunge Pool and managed via and EMP (**Figure 8-30** and **Figure 14-25**) • No potential SRE species are considered to have a high risk from the Proposal or were recorded from isolated/restricted habitat types within the Development Envelope • Clearing of up to 7,896 ha of fauna habitat, comprising: ○ 264 ha of critical Gorge/Gull (breeding and roosting) habitat which will be managed via upper limits of clearing and offset ○ 67 ha of critical Debris Slope/Rocky Outcrop (breeding and roosting) habitat which will be managed via upper limits of clearing and offset ○ 25 ha of supporting Major Creekline (foraging and dispersal) habitat, when within an MNES species home range which will be offset ○ 114 ha of supporting Minor Creekline (foraging and dispersal) habitat, when within an MNES species home range which will be offset ○ 65 ha of supporting Alluvial Plain (foraging and dispersal) habitat, when within an MNES species home range which will be offset ○ 2,638 ha of supporting Colluvial Plain (foraging and dispersal) habitat, when within an MNES species home range which will be offset ○ 104 ha of supporting Hardpan Plain (foraging and dispersal) habitat, when within an MNES species home range which will be offset ○ 4,619 ha of other habitats (not considered critical breeding and/or supporting habitat for MNES species)	• Clearing will commence, where possible, from a disturbed vegetation edge to an undisturbed area (to encourage mobile fauna to relocate to adjacent areas naturally). • The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Confining vehicle traffic to defined roads and tracks • Removing any roadkill from trafficable areas to reduce the risk of an increase in predators • Placing reflectors on any top strand of barbed wire fences (where required by legislation) to prevent entanglement of bat species • Providing site induction programs on significant fauna including their appearance and habitats, as well as standard operating procedures in the event of fauna interactions • Placing egress points at artificial water sources • Minimising habitat degradation associated with construction and operation activity, including dust and altered fire regimes by: • Restricting topsoil and overburden stripping and other high dust generating activities if risk-based assessment measures determine that dust cannot be adequately controlled • Restricting vehicles from accessing rehabilitated surfaces except for management purposes • Implementing measures such as maintaining fire breaks, hot works procedures and fire equipment in buildings and vehicles • Providing fire response procedures and personnel training • Minimising potential displacement of fauna due to disturbances from light, noise and/or vibration by: • Minimising light overspill by directing lighting in mining areas towards mining activities • Ensure equipment design is specified to be within Australian standard noise limits or equivalent • Minimising the potential for an increase in abundance and diversity of pest species by: • Fencing the landfills and cover the putrescible wastes			

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	• Design and construct the borrow pits in a way to minimise surface water ponding after rehabilitation • Undertaking feral animal control as required, in co-operation with regional control programs and the Traditional Owners.			
Environmental Factor: Subterranean Fauna				
Context/Key Survey Findings • Extensive, highly suitable, complex BWT habitats suitable for stygofauna • A diverse stygofauna assemblage, particularly within the BS1 and BS3 assessment areas • Extensive, thick, well-connected AWT habitats suitable for troglofauna • A diverse troglofauna assemblage occurring in each section of the syncline **Predicted Impact** • Approximately 45% of BWT habitat will remain across the syncline for stygofauna, with 35 to 58% remaining within individual assessment areas under the modelled cumulative impact scenario • Three stygofauna taxon (Paramelitidae `sp. Biologic-AMPH012`, Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003`) are considered at a high risk under the modelled cumulative impact scenario, however suitable habitats remain within and surrounding the syncline such that it is likely that these species will persist in the surrounding environments. • Approximately 90% of AWT habitat will remain within the syncline for troglofauna, with 72 to 93% remaining within individual assessment areas under the modelled cumulative impact scenario. • Troglofauna species recorded from the Development Envelope are expected to persist following the implementation of the Proposal	The Proposal has been designed to manage and minimise the following potential impacts to subterranean fauna: **Avoidance** Pit dewatering will be minimised to that required to safely access below water table resources. • The water management strategy includes the preferential discharge of surplus water to mine pits when they are available. This strategy will result in recharge at those locations and minimise the total export of water and groundwater drawdown within the Brockman syncline aquifers. • Groundwater will be abstracted compliant with an approved Groundwater Licence and Operating Strategy, which will include the development of trigger and threshold levels for groundwater quality and levels. • Updating/recalibration of groundwater models at least annually for the first five years reducing to tri-annually should no difference be observed between predicted and actual modelling. **Minimisation** • Backfill of pits to reduce the potential drawdown extent post closure • Clearing and/or disturbance to remain within the approved Development Envelope. • Appropriate design of waste landforms specifically encapsulation of PAF waste rock and minimisation of oxidation to prevent changes to groundwater quality. • Appropriate design of hazardous material storages in accordance with relevant guidelines and Australian Standards. • Construction and maintenance of surface water drainage systems to control and contain runoff from mining areas and divert clean stormwater away from pits and other mining disturbance areas. • Construction of TSF as per approved designs to minimise seepage. • Monitoring of groundwater quality during operations.	**The Proponent will:** • Backfill of pits to reduce the potential drawdown extent post closure • Backfill of pits with moderate or high risk of forming acidic pit lakes	**Can the environmental values be rehabilitated? Evidence?** • Backfilling of key pits is an effective means of avoiding the long-term effects of evaporation from pits predicted to form pit lakes in the vicinity of key environmental values	The Proponent considers that potential impacts can be managed and that residual impacts will not be significant.

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	• Provision of spill kits and implementation of spill management procedures.			
Environmental Factor: Air Quality				

<u>Context/Key Survey Findings:</u>
 	
The key findings of the assessment are as follows:
 	
• The leading dust emissions sources expected from Proposal operations include, drilling and blasting, handling and transfer of ore and waste materials, unsealed roads and haul road traffic, wind erosion from stockpiles and open areas.
• Forecast show a slight increase in airborne dust concentrations over the operational mine areas and immediate surroundings
<u>Predicted Impact/Outcomes</u>
 	
• Impacting human health from inhalation of dust particles including cardiovascular and lung diseases
• Impact on the following amenities:
  ○ Safety hazards
  ○ Nuisance build-up of dust
  ○ Visual amenity
• Exposure of fibrous materials to the employees and contractors during explorations, operations and closure activities.
	The Proponent is committed to managing and minimise the potential impacts to air quality by:
	
	<u>Avoidance</u>
	
	• Ensuring fibrous materials encountered during mining are encapsulated to avoid the risk of respirable fibrous materials becoming airborne
	<u>Minimisation</u>
	
	• Minimising clearing to that which is required to safely operate as far as possible
	• Using dust suppressants or water sprays on roads, working surfaces and stockpiles as required
	• Using dust collection systems and enclosed screenhouses
	• Restricting vehicle traffic to designated roads ad tracks
	• The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna.
	• Capping fibrous materials in situ or encapsulate it in non-fibrous (i.e., inert) mineral waste within a WRL.
	• Mitigating the risk of accidental public access through:
	• Establishing abandonment bunds around pits to limit public access
	• Installing other physical barriers (e.g., earthen bunds) where appropriate to prevent access to unsafe areas, unless Traditional Owners or the State wish the roads to remain accessible
	• Installing locked gates on main access roads (and any alternative unsealed access roads if these are required to remain open post-closure) for the duration of the post-closure monitoring and maintenance period.
		<u>The Proponent will:</u>
		
		• Undertake progressive rehabilitation on areas that are no longer in use to reduce wind erosion on exposed surfaces
		• Ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use
		• Rehabilitate tracks that are not required for monitoring or maintenance to reduce the risk of inadvertent public access
		• Rehabilitate all access roads prior to relinquishment and install physical barriers (earthen bunds) unless Traditional owners or the State wish the roads to remain accessible
		• Install locked gates on the access roads for the duration of the post-closure monitoring and maintenance period
		• Review the potential visitors access the site, and install additional control measures, including abandonment bunding around pits, where appropriate.
			Not Applicable	The Proponent considers that potential impacts can be managed and that residual impacts will not be significant.

Environmental Factor: Greenhouse Gas Emissions				

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
Predicted Impact/Outcomes • Scope 1 emissions approximately 2,410,000 t CO_2-e in through the life of the Proposal (0.005% of WA's GHG emissions in 2020 level • Scope 2 emissions associated with the Proposal will be approximately 748,000 t CO_2-e through the life of the Proposal.	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. • Solar PV power generation is being studied as part of the Pilbara Wide emissions reduction strategy. The Proposal has two locations being assessed for the second development of Solar PV in the Pilbara, connected to the existing Pilbara Power network. The installation will offset a significant portion of emissions from the Greater Brockman region • A key GHG abatement initiative incorporated within the Proposal is the construction of an overland conveyor to transport ore from the new mine pits back to the existing Brockman Hub processing plant. Using an overland conveyor to transport ore will reduce haul truck diesel consumption and deliver GHG abatement. Re-powering the Pilbara with renewable energy to enable greater electrification through use of conveyors is a key measure for achieving reduction of Scope 1 emissions. **Minimisation** • Use of variable speed drives where practicable to enable equipment to be efficiently modulated to meet changes in throughput. • Installation of high efficiency LED lighting across the plant infrastructure (where practical). • Solar PV cell powered lighting along the overland conveyor route (where practical). • Non-Process Infrastructure: control lighting using photoelectric cell, timer control and motion sensors when not occupied (where practical). • Emission abatement projects may be implemented at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld. The Pilbara Power Network is fully integrated across all of the Pilbara Mining assets. Carbon abatement projects are treated holistically in their application across Rio Tinto's Pilbara operations providing net emissions reduction regardless of their physical location.	Net emissions from the Proposal are expected to decrease over the coming years as a result of: • The closure of existing operational areas within the overall project • The implementation of emissions reduction measures and subsequent decrease in emissions intensity • Retirement of credible offset units where abatement is insufficient against the interim and long-term 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.

Existing Environment/Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
Environmental Factor: Social Surroundings				
Context/Key Survey Findings The Development Envelope contains the following Social Surroundings-related environmental values: • Aboriginal heritage cultural values and traditional usage of the land to the Puutu Kunti Kurrama and Pinikura People • Aboriginal heritage cultural values and traditional usage of the land to the Muntulgura Guruma People **Predicated Impact/Outcomes** • Direct and indirect impacts to Aboriginal Heritage, cultural values and the traditional usage of the land for the Puutu Kunti Kurrama and Pinikura People • Direct and indirect impacts to Aboriginal Heritage, cultural values and the traditional usage of the land for the Muntulgura Guruma People	The Proposal has been designed to manage and minimise the following potential impacts to Social Surroundings: **Avoidance** The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma People to prioritise avoidance of impacts to those areas identified as significant. This will be guided by the SCHMPs **Minimisation** The Proponent will work in collaboration with the Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma People to prioritise minimisation of impacts to those areas identified as significant. This will be guided by the SCHMPs **Mitigate** Where direct impact to a heritage place is deemed unavoidable, cultural material will be salvaged by suitably qualified professionals and with the participation of the Puutu Kunti Kurrama and Pinikura or Muntulgura Guruma People and stored in accordance with the directions from each group.	**The Proponent will:** • Work in collaboration with the Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma People during rehabilitation of the site • Consult with Puutu Kunti Kurrama and Pinikura and Muntulgura Guruma 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	Not applicable	**Extent** Clearing up to 3,359 ha on Puutu Kunti Kurrama and Pinikura Land Clearing up to 4,546 ha on Muntulgura Guruma land **Quality** 7,716 ha of native vegetation is in Good to Excellent condition, including up to 6 ha of high value riparian vegetation. **Land tenure** Not applicable. **Time scale** Clearing will be undertaken progressively.

Table 13-2: Residual Impact Significance Model (RISM)

Part IV Environmental Factors	Flora and Vegetation			Terrestrial Fauna		Subterranean Fauna	
Part V Clearing Principal	**Threatened Flora**	**Threatened Ecological Communities**	**Remnant Vegetation**	**Wetlands and Waterways**	**Conservation Areas**	**High Biological Diversity**	**Habitat for Fauna**
The residual impact is environmentally unacceptable and cannot be offset	None identified	None identified	None identified	None identified	None identified	None identified	None identified
Significant residual impact that will require an offset	None identified	None identified	• The Proposal is located within the Hamersley IBRA subregion. • Clearing up to 7,716 ha of native vegetation in good to excellent condition of which 4,619 ha does not overlap critical fauna habitats, or supporting habitats when within the species home range, within the Development Envelope, including up to 6 ha of high local significance riparian vegetation. • Contribution to the PEOF will be made at a dollar rate per ha of cleared vegetation in good to excellent condition (Refer to Section 13.5).	None identified	None identified	None identified	None identified	Clearing up to 311 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitat for the: • Northern Quoll • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python Clearing approximately 140 ha of supporting Major and Minor Creekline (foraging and dispersal) habitat within the home range of the: • Northern Quoll • Pilbara Leaf-nosed Bat • Ghost Bats • Pilbara Olive Python Clearing approximately 3,564 ha of supporting Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat within the home range of the: • Pilbara Leaf-nosed Bat • Ghost Bats
Significant residual impacts that may require an offset	None identified	None identified	None identified	None identified	None identified	None identified	None identified
Residual impacts that are not significant	No Threatened flora species listed under the BC Act or EPBC Act have been recorded within the Development Envelope.	No TECs listed under the BC Act or EPBC 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.	No conservation areas (i.e., conservation reserve or ESA) are present within the Development Envelope.	No biodiversity hotspots or habitat supporting migratory species have been identified within the Development Envelope.	The Proposal is not expected to significantly impact the Grey Falcon, Fork-tailed Swift and Oriental Plover (MNES species) as suitable habitat is widespread throughout the Pilbara region

13.4. Assessment of Residual Significant Impact – EPBC Act

Residual significant 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).

Seven MNES species have been recorded (Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python and Fork-tailed Swift) or are considered likely to occur (Grey Falcon and Oriental Plover) 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 residual significant impacts to the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, and Pilbara Olive Python due to the clearing of:

- Up to 331 ha of critical (roosting and breeding) habitat
- Approximately 2,946 ha of supporting (foraging and dispersal) habitat, when within the species home range.

No residual significant impacts are predicted for the Grey Falcon, Fork-tailed Swift and Oriental Plover as the Proposal is unlikely to result in a substantial loss or modification of important habitats for these species.

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 Brockman and other locations across the Pilbara have informed suitable distances for defining the individual fauna species' home range, which comprise; 1 km from known records of Northern Quoll; 10 km from the Upper Beasley River Roost and Plunge Pool habitat for Pilbara Leaf-nosed Bats; and 5 km around category 2 and category 3 apartment block caves for Ghost Bats, and 1 km from Pilbara Olive Python records. These areas were mapped and consolidated into a single GIS spatial layer incorporating all supporting habitats and included in the Impact Reconciliation Plan (Figure 13-1). Figure 13-2 presents this layer over supporting habitats which will be offset within a species home range.

A detailed assessment of residual impacts for each MNES species are discussed in Section 14.

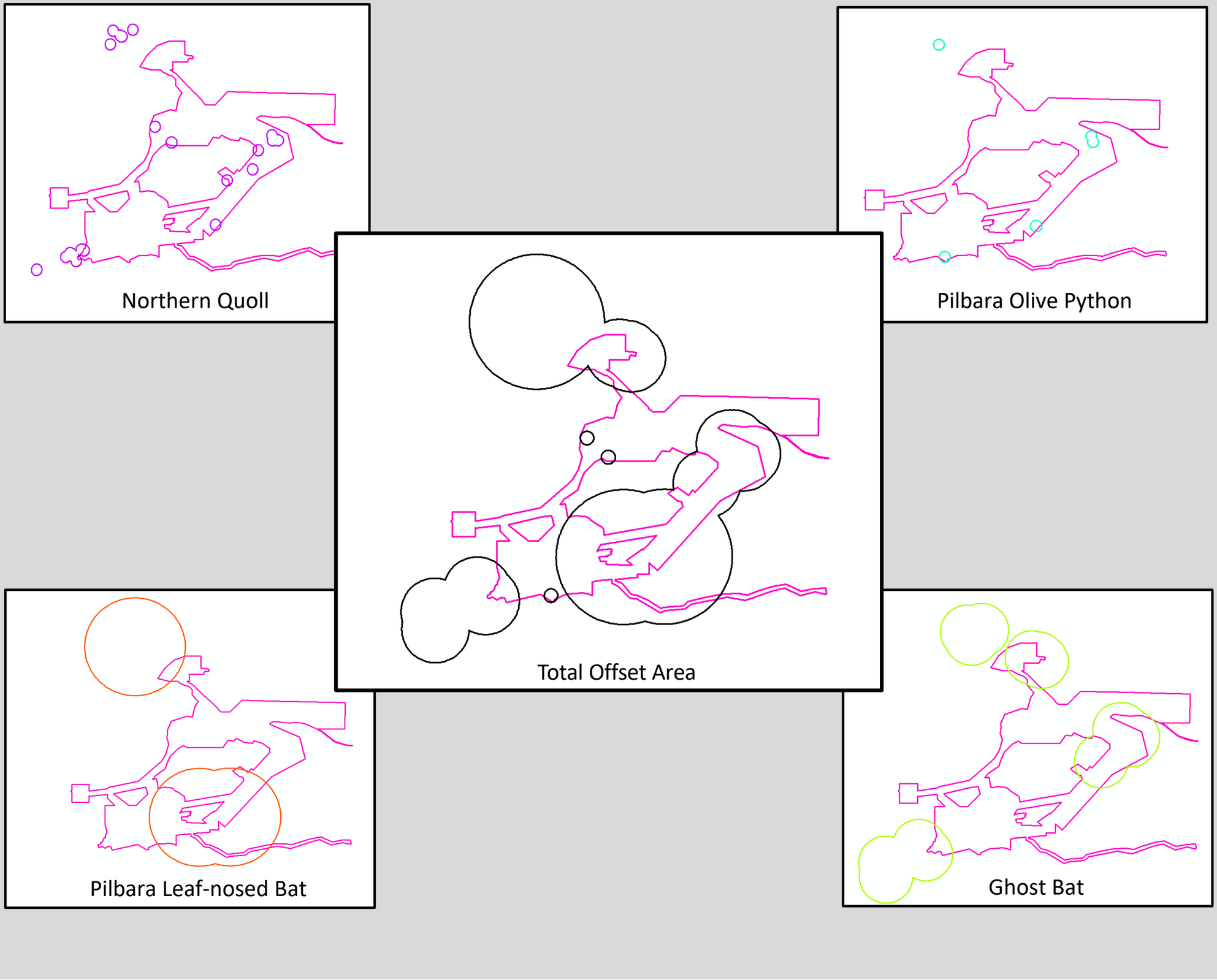

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Figure 13-1
Significant Species Home Range Utilised to Determine Total Offset Area for Supporting Habitat

Drawn: L.Fuentes
Plan: PDE0191389v1
Date: July 2022

NTS @A3
GIS.Team@riotinto.com

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Figure 13-2
Habitat Depicted over Significant Species Home Ranges

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Total Offset Buffer
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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500,000
520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

13.4.1. 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) (Biologic 2022a).

Denning habitat within the Development Envelope satisfies the definition of critical habitat under the Northern Quoll Referral Guideline (DoE 2016a), including rocky habitats such as Gorge/Gully and Debris Slope/Rocky Outcrop.

Foraging and dispersal habitat adjacent to denning habitat in the Development Envelope includes Major and Minor Creeklines. Rocky habitats adjoining Major and Minor Creeklines have heightened importance given the denning habitat's proximity to the foraging and dispersal area.

Despite considerable sampling effort throughout the survey area to date, records of the species are relatively sparse. The exception to this is the population occurring outside of the Development Envelope at Vivash (southwest of BS4 assessment area), which is considered a high-density population based on the number of individuals recorded over several sampling events and, therefore, an important population as defined by DoE (2016a)

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 331 ha (14% in the survey area and 25% of the Development Envelope) of critical Gorge/Gully (264 ha) and Debris Slope/Rocky Outcrop (67 ha) (denning and breeding) habitats (Figure 13-2)
- Clearing of approximately 140 ha of supporting Major (25 ha) and Minor (114 ha) Creekline (foraging and dispersal) habitats within 1 km of known Northern Quoll records (Figure 13-2).

These are considered to be residual significant impacts after the mitigation hierarchy has been applied, and offsets are proposed.

13.4.2. Pilbara Leaf-nosed Bat

Most caves known from the survey area are located within the Gorge/Gully and Debris Slope/Rocky Outcrop habitat types. For this reason and because Gorge/Gully and Debris Slopes/Rocky Outcrop habitat types are regarded as priority foraging habitat for the species, they are considered critical roosting, breeding and foraging habitat for the species. Foraging and dispersal habitat is represented by the Major and Minor Creekline habitats and Plains (combined Alluvial, Colluvial and Hardpan Plain habitats).

Caves within the Development Envelope have the potential to support both Pilbara Leaf-nosed Bats and Ghost Bats within the Development Envelope including as refuge through to breeding habitats. Up to 25 of the 131 known caves are proposed to be removed as a result of the Proposal. The 25 caves that the Proposal will remove have been assessed as lower value habitats, either being nocturnal refuge (category 4) or of no usage and not considered significant to the survival of the Pilbara Leaf-nosed Bat (Table 13-3 and Figure 13-3). A total of 106 caves (either classified as category 4 or of no usage to the Pilbara Leaf-nosed Bat will remain within the Development Envelope. The only known permanent roost (Upper Beasley River Roost) is outside the Development Envelope and will not be impacted.

After application of the mitigation hierarchy, the Proposal is expected to result in the following residual impact to the Pilbara Leaf-nosed Bat:

- Clearing up to a maximum of 331 ha (14% in the survey area and 25% of the Development Envelope) of critical Gorge/Gully (Priority 1 and 2 foraging) (264ha) and Debris Slope/Rocky Outcrop (Priority 3 foraging) (67 ha) (roosting and breeding) habitats (Figure 13-2)
- Clearing of approximately 2,946 ha of supporting Major (25 ha) and Minor (114 ha) Creekline and Alluvial (65 ha), Colluvial (2,638 ha) and Hardpan Plain (104 ha) (foraging and dispersal) habitats

within 10 km of the Upper Beasley River Roost and Plunge Pool (a significant water feature) (Figure 13-2).

These are considered to be residual significant impacts after the mitigation hierarchy has been applied, and offsets are proposed.

13.4.3. Ghost Bat

As most Ghost Bat Roosts are located within Gorge/Gully and Debris Slope/Rocky Outcrop 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 (~6 km) between roosting sites. For these reasons, foraging and dispersal habitat is represented by the Major Creekline and Minor Creekline habitats; and Alluvial Plain, Colluvial Plain, and Hardpan Plain habitats, in the Development Envelope.

Of the 131 caves within the Development Envelope which may support Ghost Bats, up to 25 will be removed (Table 13-3 and Figure 13-3), comprising:

- Fourteen category 3 roosts
- Eleven category 4 roosts

Category 3 and 4 roosts are not considered critical habitat for the Ghost Bat. All significant roosts (including category 2 roosts and apartment block roosts) will be retained within MEZs and MRZs. Of the 66 non-significant (category 3) and 42 non-significant (category 4) Ghost Bat roosts within the Development Envelope, post implementation of the Proposal it is predicted that 52 and 31 will be retained and placed in MRZs/MEZS and managed via an EMP

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 331 ha (14% in the survey area and 25% of the Development Envelope) of critical Gorge/Gully (264 ha) and Debris Slope/Rocky Outcrop (67 ha) (roosting and breeding) habitats (Figure 13-2)
- Clearing of approximately 2,946 ha of supporting Major (25 ha) and Minor (114 ha) Creekline and Alluvial (65 ha), Colluvial (2,638 ha) and Hardpan Plain (104 ha) (foraging and dispersal) habitats within 5 km from a category 2 cave or category 3 cave associated with an ‘apartment block’ (Figure 13-2).

These are considered to be residual significant impacts after the mitigation hierarchy has been applied, and offsets are proposed.

Table 13-3: Caves to be Impacted within the Development Envelope and their Significance to the Pilbara Leaf-nosed and Ghost Bat

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
B2BAT06	Category 3	-	Category 4	-
BS4MM-Aug16-13	Category 3	-	No Usage	-
BS4MMJul16-11	Category 3	-	No Usage	-
C1	Category 4	-	Category 4	
C2	Category 4	-	Category 4	
CBRK-053	Category 3	-	Category 4	
CBRK-084	Category 3	-	Category 4	
CBRK-086	Category 3	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-094	Category 4	-	Category 4	
CBRK-096	Category 4	-	Category 4	
CBRK-098	Category 4	-	Category 4	
CBRK-102	Category 4	-	Category 4	
CBRK-103	Category 3	-	Category 4	
CBRK-104	Category 3	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-107	Category 4	-	Category 4	
CBRK-108	Category 3	-	Category 4	
CBRK-124	Category 4	-	Category 4	
CBRK-138	Category 4	-	Category 4	
CBRK-144	Category 3	-	Category 4	
CBRK-145	Category 4	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-151	Category 3	-	Category 4	
GBS_CA_04	Category 4	-	Category 4	
GBS_CA_06	Category 3	-	No usage	-
GBS_CA_21	Category 3	-	No usage	
MAMCAM11-01	Category 3	-	Category 4	

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Figure 13-3
Category 3 and 4 Non-critical Roosts to be Impacted by the Proposal

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint
- Impacted Cave Location

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

Cave Name	Cave Category	
	Ghost Bat	Pilbara Leaf-nosed Bat
B2BAT06	Category 3	Category 4
BS4MM-Aug16-13	Category 3	No Usage
BS4MMJul16-11	Category 3	No Usage
C1	Category 4	Category 4
C2	Category 4	Category 4
CBRK-053	Category 3	Category 4
CBRK-084	Category 3	Category 4
CBRK-086	Category 3	Category 4
CBRK-094	Category 4	Category 4
CBRK-096	Category 4	Category 4
CBRK-098	Category 4	Category 4
CBRK-102	Category 4	Category 4
CBRK-103	Category 3	Category 4
CBRK-104	Category 3	Category 4
CBRK-107	Category 4	Category 4
CBRK-108	Category 3	Category 4
CBRK-124	Category 4	Category 4
CBRK-138	Category 4	Category 4
CBRK-144	Category 3	Category 4
CBRK-145	Category 4	Category 4
CBRK-151	Category 3	Category 4
GBS_CA_04	Category 4	Category 4
GBS_CA_06	Category 3	No usage
GBS_CA_21	Category 3	No usage
MAMCAM11-01	Category 3	Category 4

N

0 2 4 6 8 10
Kilometres

Map units in metres

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13.4.4. Pilbara Olive Python

The Gorge/Gully and Debris Slope/Rocky Outcrop habitats provide critical breeding and shelter habitat. Major Creekline and Minor Creekline habitats mapped within the Development Envelope also provide foraging and dispersal habitat for the species, particularly in areas adjacent to or providing connectivity between Gorge/Gully Debris Slope/Rocky Outcrop habitats. This habitat is necessary for the long-term maintenance and maintaining the species' genetic diversity (DAWE 2013).

Key surface water features that are associated with Gorge/Gully habitat include:

- Plunge Pool – a permanent water feature in BS3 assessment area
- Ridge Pool – a surface water-fed pool (outside the Development Envelope) with reduced evaporation due to shading from a nearby overhanging rock shelf
- Ephemeral pools associated with creeks within the Development Envelope.

Direct impact to these pools will all be avoided by the Proposal, and indirect impacts will be minimized so as to maintain the hydrological functioning of these pools.

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 331 ha (14% in the survey area and 25% of the Development Envelope) of critical Gorge/Gully (264 ha) and Debris Slope/Rocky Outcrop (67 ha) (shelter and breeding) habitats (Figure 13-2)
- Clearing of approximately 140 ha of supporting Major (25 ha) and Minor (114 ha) Creekline (foraging and dispersal) habitats within 1 km of known Pilbara Olive Python records (Figure 13-2).

These are considered to be residual significant impacts after the mitigation hierarchy has been applied, and offsets are proposed.

13.4.5. 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 13-4. Differing offset rates apply, with higher rates applicable to the most significant values impacted (discussed in Section 13.5).

Table 13-4: Summary of Residual Significant Impacts on MNES Species Habitat

Habitat Type	Value for Species	Species	Habitat Use	Offset Area (ha)	Offset Required
Gorge/Gully	High Value Critical Denning/ Breeding/ Roosting	Northern Quoll	Denning and foraging	264	Yes
		Ghost Bat	Roosting and foraging		Yes
		Pilbara Leaf-nosed Bat	Roosting and foraging		Yes
		Pilbara Olive Python	Breeding and shelter		Yes
Debris Slope/Rocky Outcrop	High Value Critical Denning/ Breeding/ Roosting	Northern Quoll	Denning and foraging	67	Yes
		Ghost Bat	Roosting and foraging		Yes
		Pilbara Leaf-nosed Bat	Roosting and foraging		Yes
		Pilbara Olive Python	Breeding and shelter		Yes
Major Creekline	Moderate Value Supporting Foraging/ Dispersal	Northern Quoll	Foraging and dispersal	25	Yes
		Ghost Bat	Foraging and dispersal		Yes
		Pilbara Leaf-nosed Bat	Foraging and dispersal		Yes
		Pilbara Olive Python	Foraging and dispersal		Yes
Minor Creekline	Moderate Value Supporting Foraging/ Dispersal	Northern Quoll	Foraging and dispersal	114	Yes
		Ghost Bat	Foraging and dispersal		Yes
		Pilbara Leaf-nosed Bat	Foraging and dispersal		Yes
		Pilbara Olive Python	Foraging and dispersal		Yes
Alluvial Plain	Low Value	Northern Quoll	Foraging and dispersal	65	No
	Moderate Value Supporting Foraging/ Dispersal	Ghost Bat	Foraging and dispersal		Yes
		Pilbara Leaf-nosed Bat	Foraging and dispersal		Yes
	Low Value	Pilbara Olive Python	Foraging and dispersal		No
Colluvial Plain	Low Value	Northern Quoll	Foraging and dispersal	2,638	No
	Moderate Value Supporting Foraging/ Dispersal	Ghost Bat	Foraging and dispersal		Yes
		Pilbara Leaf-nosed Bat	Foraging and dispersal		Yes
	Low Value	Pilbara Olive Python	Foraging and dispersal		No
Hardpan	Low Value	Northern Quoll	Foraging and dispersal	104	No
	Moderate Value Supporting Foraging/ Dispersal	Ghost Bat	Foraging and dispersal		Yes
		Pilbara Leaf-nosed Bat	Foraging and dispersal		Yes
	Low Value	Pilbara Olive Python	Foraging and dispersal		No

13.5. Proposed Offsets

13.5.1. Biodiversity Factors

The Proponent proposes environmental offsets for biodiversity factors in financial contributions to the PEOF at the specified rates outlined in Table 13-5 to clear native vegetation in 'Good to Excellent' condition and high and moderate (when within a species home range) significance critical habitats for MNES species. 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) (DWER 2021).

In addition, rates pertaining to EPBC Act offsets for residual impacts of clearing of critical breeding, denning and roosting habitat and supporting foraging and dispersal habitat for MNES species (Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python are also included in Table 13-5.

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 J.2) 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 13-5.

The total offset value is approximately $10,008,184 (Table 13-5). 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 to the take of that habitat type in the first instance. Table 13-5 presents the proposed environmental offsets for the Proposal under the EP Act and EPBC Act based on the information provided in Section 13.3.

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 J.2. The PCD specifies that the total clearing extent will not exceed 7,896 ha.

Table 13-5: Environmental Values from the Proposal that are Required to be Offset

Environmental Value	IBRA Subregion	Potential Extent of Significant Residual Impact and/or Residual Significant Impact	Proposed Offset Rate*
Clearing of critical (breeding, denning and roosting) habitat for MNES species: Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, comprising: • Gorge/Gully • Debris Slope/Rocky Outcrop	Hamersley	Up to 331 ha	$3,306/ha
Clearing of supporting (foraging and dispersal) habitat for MNES species: Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, comprising: • Major Creekline • Minor Creekline. Supporting habitat is defined as: • Northern Quoll (1 km from known records) • Pilbara Leaf-nosed Bat (10 km from Upper Beasley River Roost and Plunge Pool) • Ghost Bat (5 km from category 2 and category 3 roosts, associated with apartment blocks) • Pilbara Olive Python (1 km from known records)		Approximately 140 ha	$1,653/ha
Clearing of supporting (foraging and dispersal) habitat for MNES species: Pilbara Leaf-nosed Bat and Ghost Bat, comprising: • Alluvial Plain • Colluvial Plain • Hardpan Plain Supporting habitat is defined as: • Pilbara Leaf-nosed Bat (10 km from Upper Beasley River Roost and Plunge Pool) • Ghost Bat (5 km from category 2 and category 3 roosts, associated with apartment blocks)		Approximately 2,806 ha	$1,653/ha

Environmental Value	IBRA Subregion	Potential Extent of Significant Residual Impact and/or Residual Significant Impact	Proposed Offset Rate*
Clearing of high value riparian vegetation (C3 Duck Creek)		Up to 6 ha	$1,780/ha
Clearing of good to excellent condition vegetation		Approximately 4,532 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 condition would be offset at the higher rate, not the sum of the base rate and higher rate).*

13.5.2. 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, 2045 and 2050 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
- 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.
- 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.

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.

13.6. 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 13-6 and Table 13-7 summarise how these principles have been considered during the development of the offsets approach.

Table 13-6: Consideration 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 Conceptual Footprint from 9,977 ha to 7,896 ha. In particular, the Proposal has been designed to minimise direct impacts to the following: • Priority 1 flora species *Tetratheca butcheriana* (No direct or indirect impacts) • Six Priority flora species • Connectivity of supporting habitat – landform corridors such as Major Creekline • Important roost sites for MNES Bat species (no direct impacts and minimising indirect impacts) • Surface water systems (by maintaining functional catchments which support pools and proposed management options for surplus water) • Maintaining sufficient AWT and BWT habitats for subterranean fauna • Plunge Pool (no direct or indirect impacts) • 106 bat roosts within the Development Envelope By applying the mitigation hierarchy to the Proposal, the Proponent has ensured that all practicable avoidance and minimisation measures have been considered and pursued where appropriate. Offsets have only been considered for those significant residual impacts that cannot be avoided or minimised.
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 because 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 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. Due to tenure constraints, on-ground conservation actions are difficult for a single Proponent to implement. Contribution to the PEOF 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.

Principle	Response
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 most 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 PEOF provides a strategic, coordinated approach to applying 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 via being a participant in the working group for the establishment of the PEOF.

Table 13-7: 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	The proposed offsets address both the EP Act and EPBC Act requirements according to recent, similar offset determinations.
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 and 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 2019). Offsets are also documented in the publicly available Environmental Offsets Register.

13.7. Stakeholder Consultation Regarding Offsets

The Proponent has had preliminary discussions with the EPA regarding providing offsets for significant residual impacts to native vegetation in good to excellent condition and critical and supporting habitats for MNES. Further consultation will be undertaken during the assessment process.

14. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

To be consistent with the EPBC Act, the Proposal is referred to as the Proposed Action in this chapter. Further information regarding the Proposed Action is presented in Section 2.

Within this Section, MNES fauna species are defined as the threatened fauna listed under the EPBC Act, recorded within the Development Envelope.

14.1. Controlling Provision (EPBC 2019/8518)

The Proposed Action was referred to DAWE (now Department of Climate Change, Energy, the Environment and Water, DCCEEW) on 25 September 2019 (EPBC 2019/8518). On 31 October 2019, the Environment Minister determined that the Proposed Action constitutes a Controlled Action under s. 75 of the EPBC Act and, therefore, requires assessment and a decision on whether approval should be granted under the EPBC Act.

The controlling provision was listed threatened species and communities. The relevant MNES for this Proposed Action are:

- Northern Quoll (*Dasyurus hallucatus*) – Endangered
- Ghost Bat (*Macroderma gigas*) – Vulnerable
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – Vulnerable
- Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable
- Grey Falcon (*Falco hypoleucos*) – Vulnerable
- Fork-tailed Swift (*Apus pacificus*) – Migratory.

14.2. Relevant Policy and Guidelines

The significance and management of potential impacts on MNES have been assessed in the context of:

- 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
- Ensuring 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).

14.2.1. Approved Conservation Advice and Recovery Plans

Approved conservation advice and recovery plans for MNES known or likely to occur in the Development Envelope are identified in Table 14-1. These guidance documents identify overall conservation objectives, critical habitat, important populations, key threats and priority management actions. They are relevant to the assessment process. 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.

There are no recovery plans for the Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python, Grey Falcon or the Fork-tailed Swift.

Table 14-1: 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)	National Recovery Objective: '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: • 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 2016b)	Primary Conservation Actions: • Protect roost sites from mining, human disturbance and collapse • Replace the top strands of barbed wire in fences near roost sites with single-strand wire. • Conservation and Management Actions: • Active mitigation of threats • Captive breeding • Quarantining isolated populations • Translocation • Community engagement • Reduce disturbance of roost sites. • Survey and Monitoring Priorities: • Survey to define definition better • Establish or enhance monitoring program.
Information Sheet A review of Ghost Bat ecology, threats and survey requirements (Bat Call WA 2021c)	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 2016a)	National Conservation Objectives: • Ensure activities within Pilbara Leaf-nosed Bat range do not have a significant impact under the EPBC Act

Guidance	Objective/Priorities
	• Eliminate key threats to the Pilbara Leaf-nosed Bat and halt predicted decline through best practice mining design and construction and better coordinated regional management • Protect and manage all known roost sites to support the recovery and long-term persistence • Identify and protect sufficient high-value foraging habitat around roost sites to support the long-term persistence of colonies • Support coordinated research on the occurrence, population size and ecological requirements of Pilbara Leaf-nosed bat. Priority Conservation Actions: • Discover new occurrences • Discover new roosts • Confirm diurnal roosts • Protect roosts • Monitor the population • Assess and protect foraging habitat • Develop and support coordinated research • Encourage submission of occurrence data • Suitably control public access to all known roost sites on both private and public lands • Implement a separate regional management plan.
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)	Regional and Local Priority Actions: • Habitat Loss, Disturbance and Modification • Identify populations of high conservation priority • Ensure road widening, maintenance activities, and gas infrastructure development (or development activities) in areas where the Olive Python (Pilbara subspecies) occurs do not adversely impact known populations • Manage any changes to hydrology that may result in changes to the water table levels, increased run-off, sedimentation or pollution • Investigate further formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure. • Animal Predation or Competition • Implement a Threat Abatement Plan for the control and eradication of foxes and cats in the local region. • Conservation Information • Raise awareness of the Olive Python (Pilbara subspecies) within the local community • Use road signage to raise awareness of the Olive Python (Pilbara subspecies) with road users on or near roads. • Enable Recovery of Additional Sites and/or Populations • Investigate options for linking, enhancing or establishing an additional population.

Guidance	Objective/Priorities
Conservation Advice *Falco hypoleucos* Grey Falcon (TSSC 2020)	Conservation and Management Priorities: • Habitat loss, disturbance and modifications • 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. • Invasive species • Control invasive Cats in areas where Grey Falcons are known to occur, especially in known roosting and nesting areas.
Referral guideline for 14 birds listed as migratory species under the EPBC Act (DoE 2015a)	There is no approved Conservation Advice, Listing Advice or Recovery Plan for Fork-tailed Swift (*Apus pacificus*). 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.

14.2.2. 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 the associated objectives for each plan are outlined in Table 14-2.

Table 14-2: Threat Abatement Plans

Threat Abatement Plan	Objectives
Threat abatement plan for predation by feral Cats (DoE 2015b)	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 • 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:

Threat Abatement Plan	Objectives
	○ Sustained management, where control is implemented on a continuing, regular basis, or ○ Intermittent management, where control is implemented at critical periods 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)	The focus of this TAP is 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: • To identify priority native species and ecological communities (including protected matters under the EPBC Act) at risk from the impact of Cane Toads • To reduce the impact of Cane Toads on populations of priority native species and ecological communities • 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 adverse 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: • Develop an understanding of the extent and spread pathways of infestation by the five listed grasses • Support and facilitate coordinated management strategies through the design of tools, systems, and guidelines • Identify and prioritise key assets and areas for strategic management. • Build capacity and raise awareness among stakeholders • Implement coordinated, cost-effective on-ground management strategies in high-priority areas • Monitor, evaluate and report on the effectiveness of management programs.

Feral Cats (*Felis catus*) were recorded within the Development Envelope and are known from the surrounding area (Stantec 2020a; Biologic 2020d). Clearing habitat may create an opportunity for feral Cats to increase their range.

No European Red Foxes (*Vulpes vulpes*) were recorded within the Development Envelope (Stantec 2020a; Biologic 2020d). This species tends to be located near the coast, and the Proposed Action is unlikely to increase its opportunity to establish further inland. Therefore, the actions documented in the TAP for predation by the European Red Fox (DEWHA 2008b); are not relevant to the Proposed Action.

The Cane Toad (*Rhinella marin*a) is yet to establish in the Pilbara and is not expected to be introduced by the Proposed Action. 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 as they relate to research and identification of Cane Toad impacts.

No grass species listed within this TAP (DSEWPaC 2012b) have been recorded within or surrounding the Development Envelope. The actions documented within this TAP are not relevant to the Proposed Action.

14.2.3. 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.

14.2.4. Other Policy and Guidance

The following policy and guidance statements were also considered in the design of Flora and Vegetation, Terrestrial Fauna and targeted MNES surveys and in the impact assessment for MNES:

- EPA Statement of Environmental Principles, Factors and Objectives (EPA 2021b)
- 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 2020b)
- Interim guideline for preliminary surveys of Night Parrot (Pezoporus occidentalis) in Western Australia (DPaW 2017)
- Guidelines for surveys to detect the presence of Bilbies and assess the importance of habitat in Western Australia (DBCA 2019c)
- 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)
- National Light Pollution Guidelines for Wildlife, including Marine Turtles, Seabirds and Migratory Shorebirds (DotEE 2020).

14.3. 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 ss 18 and 18A of the EPBC Act recorded within the Development Envelope and surroundings.

14.3.1. Survey Effort

Over 300 flora and vegetation and ten proposal-specific terrestrial fauna surveys (including targeted surveys to assess the presence of MNES) have been undertaken within and surrounding the Development Envelope (Biota 2016b, Biota 2019d, Stantec 2020a and Biologic 2020d, 2021d, 2022a; 2022c). The total survey area refers to a 75,397 ha area and covers the entirety of the Development Envelope (63,343 ha) and beyond (Figure 14-1). A summary of key investigations is outlined in Table 7-2 in Section 7.3 and Table 8-2.

in Section 8.3. An MNES consolidation report that combines all the terrestrial fauna surveys conducted within the survey area has been prepared and includes the results of the VHF tracking program and scat monitoring and analysis (Biologic 2022a).

The survey effort for targeted MNES species covers the entire Development Envelopment and surrounding area. The surveys were conducted by qualified and experienced ecologists (Section 7.3 and 8.3) and the survey effort is consistent with relevant guidance and appropriate to gauge the size, presence, and abundance of the local MNES fauna species and identify any EPBC-listed ecological communities (Biologic 2020d;2021d; 2022a; 2022c). These surveys included targeted searches within habitats likely to be utilised by MNES fauna species recorded within the survey area (Gorge/Gully, Debris Slope/Rocky Outcrop, Major Creekline, caves and water features). Details of the survey effort for MNES are provided in Table 14-3 and presented in Biologic 2021c for each species.

An extrapolated mapping exercise was undertaken up to 10 km from the survey area to provide context for the habitat values within the Development Envelope (Biologic 2021c). The mapped extrapolation area covered approximately 332,568.79 ha (it does not include the Development Envelope).

Table 14-3: Summary of Technical Studies for MNES Fauna

Study/Survey/Prepared for	Type and Timing	Survey Effort
Brockman Syncline Proposal Detailed Fauna Survey 2019 (Stantec 2020a; Appendix E.1) Prepared for Rio Tinto.	**Type:** Two-phase detailed fauna survey and Short-Range Endemic (SRE) assessment **Timing:** 16 to 28 May and 8 to 21 September 2019 (Level 2 survey); 13 to 23 August 2019 (Level 1 and Targeted).	Systemic sampling methods: • Trapping (364 nights at eight sites totalling 2,912 trapping nights for each phase) • Avifauna census (140 minutes at eight sites for each phase) • Systemic searching (one person hour at eight sites for each phase) • Spotlighting (one person hour at eight sites for each phase) • Motion cameras (two cameras at eight sites for seven nights) • Ultrasonic bat recorders (one unit at eight sites for two nights) Targeted sampling methods: • Targeted Northern Quoll motion cameras (476 nights across 91 locations) • Targeted bat echolocation recording (32 locations over 148 nights) • Night Parrot acoustic recording (four units over two nights) • Targeted searches for evidence of Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python and migratory shorebirds • Opportunistic records.
Greater Brockman and Nammuldi-Silvergrass Hub: Consolidated Fauna Habitat Mapping (Stantec 2021b; Appendix E.2) Prepared for Rio Tinto**.**	**Survey area:** Greater Brockman Operation. Consolidated area comprised 75,087 ha. **Type:** Consolidate previous fauna habitat mapping. Includes desktop assessment to consolidate available habitat mapping, ground-truthing to validate or refine the delineation of fauna habitat and refine mapping into a single mapping layer. **Timing:** May, August and September 2019.	There is no specific guidance for desktop fauna habitat consolidation. The desktop assessment consolidates fauna habitat mapping within the whole Development Envelope as originally referred (i.e., the mapping now also extends outside the Development Envelope due to reductions in the size of the Development Envelope). Field work (ground truthing) was led by experienced zoologists comprising Samantha Lostrom (Stantec), Mike Brown (Red Dog Environmental) and Ray Lloyd (Fauna Track).
Brockman Syncline Targeted Vertebrate Fauna Survey (Biologic 2020d) Prepared for Rio Tinto	**Type**: Targeted vertebrate fauna assessment. **Timing:** 27 August to 09 September 2019, 03 October to 10 October 2019, 04 November to 12 November	• Northern Quoll camera transects (25 motion camera transects left for a total of 3,050 sampling nights) • Pilbara Leaf-nosed Bat and Ghost targeted cave searches (102 targeted searches equating to 296 person hours)

Study/Survey/Prepared for	Type and Timing	Survey Effort
	2019 and 19 November 2019 to 27 November 2019.	• Pilbara Leaf-nosed Bat and Ghost Bat ultrasonic recorders (89 locations totalling 160 nights) • Night Parrot acoustic recorders (21 locations totalling 135 recording nights) • Opportunistic records.
Brockman 2 Deposits: Detailed Fauna Survey Phase 1 and 2 (Biota 2019d) Appendix E.3 Prepared for Rio Tinto	**Type:** Two-phase detailed fauna survey and SRE assessment. The sampling effort included systematic trapping at 11 locations, with a total of 2,083 trap nights. **Timing:** 13 to 24 November 2018 and 7 to 18 March 2019.	• Trapping (2,083 nights) • Avifauna sampling (censuses at 11 sites totalling 22 hours) • Remote cameras (78 nights) • Bat echolocation recordings (17 locations totalling 40 nights) • Night Parrot recordings (eight locations totalling 25 nights) • Habitat-specific searches for fauna • Opportunistic records.
Brockman Syncline 4 Marra Mambas: Level 2 Fauna Survey (Biota 2016b; Appendix E.3) Prepared for Rio Tinto	**Type**: Single season Level 2 Vertebrate Fauna Survey. The sampling effort included systematic trapping at five locations, with a total of 960 trap nights. **Timing:** 30 July to 9 August 2015.	• Trapping (960 days) • Bat echolocation recordings (six locations totalling 15 nights) • Motion sensor cameras (eight sites totalling 23 nights) • Avifauna sampling (18 census surveys at nine locations totalling 12 hours) • Habitat-specific searches for fauna • Opportunistic sampling.
Brockman Syncline 2020-2021 Fauna Matters of National Environmental Significance Study (Biologic 2022c; Appendix E.8) Prepared for Rio Tinto	**Type:** Two-phased targeted MNES survey **Timing:** Between March 2020 and July 2021	• Motion sensor cameras (for up to 82 nights) • VHF and UHF tracking • Targeted trapping (totalling 550 trap nights) • Targeted searches (42) • Bat echolocation recording (Ultrasonic recorders) (24 locations totalling 62 nights) • Scat monitoring
Matters of National Environmental Significance Consolidated Report – Brockman (Biologic 2022a; Appendix E.9) Prepared for Rio Tinto	**Type:** Consolidation of previous surveys, including terrestrial fauna and targeted surveys, VHF tracking and scat analysis **Timing**: February 2022	Combined total survey effort for MNES species within the survey area: Northern Quoll: • Trapping by Cage, Elliot and Camera traps for 6,522 nights • At least 340 hours of targeted searches, over 123 sites • VHF tracking of four individuals for a total of 160 days

Study/Survey/Prepared for	Type and Timing	Survey Effort
		Pilbara Leaf-nosed Bat: • Ultrasonic recorders at 195 locations for 633 sampling nights • One infrared camera trap at one site for four nights • Harp-traps at three sites for 17 sampling nights • At least 340 hours of targeted searches within suitable habitat • A minimum of 183 cave assessment • VHF tracking of ten individuals for a total of 70 days Ghost Bat: • Ultrasonic recorders at 195 locations for 633 sampling nights • Six infrared camera traps at four sites for a total of 99 sampling nights • Sheet traps at 35 sites for a total of 75 sampling nights • At least 340 hours of targeted searches within suitable habitat • A minimum of 183 cave assessment • Scat monitoring to establish the number of individuals • VHF tracking of nine individuals for a total of 49 days Pilbara Olive Python • At least 340 hours of targeted searches within suitable habitat Grey Falcon • Approximately 107 hours of Avifauna census • Approximately 340 hours of opportunistic searches

14.3.2. EPBC Act Protected Matter Search

A search of the EPBC Act Protected Matters Search Tool (PMST) was undertaken for the Proposed Action (DAWE 2021b) for MNES potentially occurring within 20 km of the Development Envelope with the following findings (Appendix K.1):

- No flora species protected under the EPBC Act were identified in the PMST database search as having the potential to be present within 20 km of the Development Envelope (DAWE 2021b)
- No ecological communities are protected under the EPBC Act as having the potential to be present within 20 km of the Development Envelope (DAWE 2021b)
- Seven listed threatened fauna species and nine migratory species (one of which is also threatened; Curlew Sandpiper) as having the potential for the species or species habitat to occur within 20 km of the Development Envelope (DAWE 2021b) and are listed in Table 14-4.

14.3.3. Likelihood of Occurrence

No flora or ecological communities listed under the EPBC Act were recorded within the survey area (Biota 2019a; Mattiske 2019; Stantec 2019; Biologic 2020a) and are therefore not considered further in this Section.

- Five EPBC-listed fauna species have been recorded within the survey area. One species, Grey Falcon, is highly likely to occur, and another species, Oriental Plover (*Charadrius veredus*), has the potential to occur. The other nine species identified in the desktop assessment and PMST are considered unlikely to occur due to lack of suitable habitat within the survey area (Table 14-4).
- Table 14-4 describes the likelihood of fauna species listed under the EPBC Act identified in the PMST to occur within the Development Envelope.

Species considered unlikely to occur in the Development Envelope are not discussed further as the Proposed Action is unlikely to affect those species

Table 14-4: EPBC Act Listed Fauna Species and the Likelihood of Occurrence within the Development Envelope

Species	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** One individual recorded within the Development Envelope at BS4 assessment area. Multiple scat records throughout the Development Envelope within BS2, BS3, BS4 and Lens G/Diesel assessment areas. Recorded in Gorge/Gully, Debris Slope/Rocky Outcrop and Midslope/Upper Slope habitat types.
Ghost Bat (*Macroderma gigas*)	Vulnerable	Rocky gorges and breakaways with caves and crevices.	**Recorded** Recorded throughout the Development Envelope using echolocation recordings and secondary evidence such as scats within roosts and observations of individual bats. They were recorded in all fauna habitat types except in Major Creekline and Plateau. The Development Envelope contains 131 roosts for the Ghost Bat consisting of: • Eight category 2 Ghost Bat roosts in Lens G/Diesel and BS4 assessment areas and Silvergrass • Seventy-eight (78) category 3 Ghost Bat roosts in BS1, BS2, BS4 and Lens G/Diesel assessment areas and Silvergrass • Forty-five (45) category 4 Ghost Bat roosts in BS1, BS2, BS4 and Lens G/Diesel assessment areas and Silvergrass.
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** Recorded throughout the Development Envelope using echolocation recordings in nine fauna habitat types - Gorge/Gully, Debris Slope/Rocky Outcrop, Colluvial Plain, Major Creekline, Minor Creekline, Footslope, Gently Sloping Rise, Midslope/ Upper Slope and Pediment Slope fauna habitat types. The Development Envelope contains 131 roosts, of which 102 have the potential to be nocturnal refuges (category 4 roosts) for the Pilbara Leaf-nosed Bat and 29 caves that have no usage.

Species	Conservation Status	Broad Habitat Type	Likelihood of Occurrence within Development Envelope
Reptiles			
Pilbara Olive Python (*Liasis olivaceus barroni*)	Vulnerable	Escarpments, deep gorges, water holes and rock piles associated with permanent pools in rocky areas.	**Recorded** Seven individuals have been recorded within the Development Envelope, including four individuals at Plunge Pool in BS3 assessment area. Remains were found in a cave in Lens G/Diesel assessment area, and multiple skin slough were recorded throughout the Development Envelope. Recorded in Gorge/Gully, Debris Slope/Rocky Outcrop and Gently Sloping Rise habitat types.
Birds			
Curlew Sandpiper (*Calidris ferruginea*)	Critically Endangered, Migratory	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creekline flats, tidal flats or grassy edges of wetlands.	**Unlikely** This species was not recorded in the Development Envelope or surrounding area, and suitable habitat does not occur (Biota 2019d; Stantec 2020a).
Night Parrot (*Pezoporus occidentalis*)	Endangered	Treeless or sparsely wooded long unburnt spinifex hummock plains often interspersed with chenopods. Habitat types most likely to support these features: • Colluvial Plain • Alluvial Plain.	**Unlikely** Suitable habitats within the Development Envelope had been affected by fire and cattle and typically lacked the old-growth *Triodia* that indicates suitable Night Parrot habitat. A targeted (acoustic recorders) survey has been undertaken in the most suitable habitats, where no calls were recorded (Biologic 2020d). A total of 21 acoustic sites were surveyed, and the recordings were deemed good quality (Biologic 2020d). The species is typically elusive and rare and has not been recorded within the Development Envelope or within 190 km. There have been five contemporary records of the species within Western Australia: • Near Fortescue Marsh – Pilbara (DBCA 2019c) • Near Wiluna – Goldfields (DBCA 2019c) • Lake Disappointment – Great Sandy Desert (DBCA 2019c) • Across 100 km of the Great Sandy Desert (Collins 2021) • Martu Country (extending from Wiluna in the south to the Great Sandy Desert in the North) (Australian Geographic 2020).

Species	Conservation Status	Broad Habitat Type	Likelihood of Occurrence within Development Envelope
			These sightings are more than 190 km from the Proposed Action and Biologic 2022d concluded that the species is unlikely to occur.
Australian Painted snipe (*Rostratula australis*)	Endangered	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creekline flats, tidal flats or grassy edges of wetlands.	**Unlikely** The species has not been recorded in the Development Envelope or surrounding area, and suitable habitat does not occur (Biota 2019d; Stantec 2020a).
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.	**Highly likely to occur** A pair of Grey Falcons with a chick (in a nest) was recorded within powerlines near the NAP, but outside of the Development Envelope (Biologic 2021d). This species was not previously known to occur within the Brockman area.
Fork-tailed Swift (*Apus pacificus*)	Migratory	Variety of habitats and is entirely aerial inhabits.	**Recorded** A non-breeding visitor to Australia and an exclusive aerial forager. The species was recorded within BS4 assessment area (in Minor Creekline habitat) during a 2014 survey. This species may fly over the Development Envelope on an irregular basis, although it would not depend on its habitats (Biota 2016b; Stantec 2020a).
Oriental Plover (*Charadrius veredus*)	Migratory	Open grasslands in arid and semi-arid zones and estuarine or coastal environments.	**Potential to occur** The Hardpan Plain and Alluvial Plain habitats in the Development Envelope provide marginal habitat for this species. However, there have been limited records of this species in the surrounding area, indicating the species is not common in the region.
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).	**Unlikely** The Development Envelope occurs on the outer edges of the species' irregular range. This species has not been recorded in the surrounding area (Biota 2019d; Stantec 2020a).
Grey Wagtail (*Motacilla cinerea*)	Migratory	Fast flowing water.	**Unlikely** This species has not been recorded within the Development Envelope or the surrounding areas (Biota 2019d; Stantec 2020a). The Development Envelope does not contain suitable habitat for this species.

Species	Conservation Status	Broad Habitat Type	Likelihood of Occurrence within Development Envelope
Yellow Wagtail (*Motacilla flava*)	Migratory	Saltworks, paddocks and marshes.	**Unlikely** This species has not been recorded within the Development Envelope or surrounding area. The Development Envelope does not contain suitable habitat for this species (Biota 2019d; Stantec 2020a).
Common Sandpiper (*Tringa hypoleucos*)	Migratory	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creekline flats, tidal flats or grassy edges of wetlands.	**Unlikely** The species has been recorded in the surrounding area, although no suitable habitat occurs within the Development Envelope (Stantec 2020a). Limited recordings of this species have occurred in the surrounding areas, indicating that the species are not common in the region.
Sharp-tailed Sandpiper (*Calidris acuminata*)	Migratory	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creekline flats, tidal flats or grassy edges of wetlands.	**Unlikely** The species has been recorded in the surrounding area, although no suitable habitat occurs within the Development Envelope (Stantec 2020a). Limited recordings of the species have occurred in the surrounding areas indicating the species is not common in the region.
Pectoral Sandpiper (*Calidris melanotos*)	Migratory	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creekline flats, tidal flats or grassy edges of wetlands.	**Unlikely** This species has not been recorded within the Development Envelope or surrounding area (Stantec 2020a). Suitable habitat does not occur within the Development Envelope.

Source: Biota 2019d); Stantec (2020a)

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Mount Brockman Road
Silvergrass Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra Munjina Road

RioTinto

Figure 14-11
Spatial Extent of Terrestrial Fauna Surveys Conducted for the Proposal, Including MNES

Drawn: L.Fuentes
Plan: PDE0189717v2
Date: August 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Fauna and Fauna Habitat Surveys

- Single-phase Detailed Survey
- Multiple-phase Detailed Survey
- Systematic Survey
- Targeted
- Fauna Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road

N

0 2 4 6 8 10
Kilometres

Map units in metres

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14.3.3.1. MNES Species Recorded in Low Numbers

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 survey area. However, there is one record of three individuals (two breeding adults with a chick on a nest on top of a power line) within the Plains habitat in 2020, approximately 760 m outside the survey area (Biologic 2022a). The next closest record is approximately 37.9 km north-north-west of the survey area. Recommended management measures include retaining artificial structures with known Grey Falcon nests (TSSC 2020). The Proposed Action will not disturb this area, and the pilon will remain in place; therefore, the Grey Falcon nest site will not be impacted.

Potential suitable breeding and nesting habitat and supporting foraging and dispersal habitat is available in Major Creekline and Minor Creekline habitat types within the Development Envelope (523 ha, 1% of Major and 627 ha, 1% of Minor Creekline) and the survey area (746 ha, 1% of Major and 880 ha, 1% of Minor Creekline). The Proposed Action will clear approximately 255 ha (22%) of Major Creekline habitat within the Development Envelope (16% in the survey area). As this habitat type will not be directly impacted beyond the clearing required for the construction of essential infrastructure (e.g., narrow crossings), it is considered that the Proposed Action will not result in a significant residual impact to this species.

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 B.3).

It is considered that as disturbance of the nest site will be avoided and habitat loss will be minimised, all reasonable measures to mitigate potential impacts to Grey Falcon have been implemented and that residual impacts will not be significant. Therefore, this species is not discussed further in this assessment.

Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift (Migratory) is recorded sporadically within WA. They are scattered along the coast of the south-west Pilbara and north through much of the Pilbara region. It can also be found in the north and east Kimberley region. This species is found in various habitats, including riparian woodland and tea-tree swamps, low scrub and heathland; they can also be found in grasslands and sandplains covered with spinifex (DAWE 2021a).

The Fork-tailed Swift was recorded in 2014 flying over a minor creekline at BS4 assessment area (Biota 2016b). This species is exclusively an aerial forager in Australia with an extensive foraging range. This species does not depend on any habitat within the Development Envelope for survival (Stantec 2020a).

The Proposed Action is unlikely to cause substantial loss or modification of important habitats for this species or cause disruption to an ecologically significant proportion of the population (1% or 1,000 individuals) (DoE 2015a). It is considered that there will be no significant impact to this species from the Proposed Action; therefore, this species is not discussed further in this assessment.

Oriental Plover (*Charadrius veredus*)

The Oriental Plover (Migratory) is considered to have the potential to occur as the Development Envelope is within the species range. However, due to the lack of records in the surrounding area and the occurrence of only marginally suitable habitat (Hardpan Plain and Alluvial Plain), it is considered there will be no significant impact to this species, and therefore this species is not discussed further in this assessment.

14.3.4. Habitat Suitability for MNES and Proposed Clearing

The EPBC Act Significant Impact Guidelines 1.1 (DoE 2013) 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 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 (Biologic 2020d). Table 14-5 describes the criteria used to assign each significance rating.

Table 14-5: Habitat Significance Assessment Criteria for MNES Fauna Species Under the EPBC Act

Habitat Significance	Criteria
High	Provides core breeding/refugia/shelter sites (i.e., denning, roosting or permanent water sources) for MNES fauna species. These habitats are considered critical to 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 breeding activities. 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.

Source: Biologic 2020d

A total of 12 broad fauna habitat types were mapped within the survey area (Table 14-6). Six out of the 12 are considered high to moderate significance to MNES fauna species. These habitat types provide roosting, denning, shelter, foraging and dispersal habitat. The extent of MNES fauna habitat and their significance within the Development Envelope and survey area is shown in Table 14-6 and Figure 14-2 MNES fauna habitats are described in detail regarding their importance and use by MNES fauna species in Sections 14.6 to 14.9. The Proponent has suggested an upper limit of clearing for fauna habitat types classified as high significance to MNES species; all other fauna habitat types are approximate clearing values.

In addition to broad scale fauna habitat mapping, desktop extrapolated fauna habitat mapping was completed within a 10 km buffer of the survey area to define additional potential habitat for MNES species. The same level of detail was not possible via desktop extrapolation; therefore, changes to scale, nomenclature and categories have occurred (Table 14-7 and Figure 14-3).

For this assessment, the definition of critical habitat is habitat used for breeding, such as denning, roosting and nesting. Supporting habitat is any foraging habitat within the home breeding range of a MNES species.

Table 14-6: Matters of National Environmental Significance Fauna Habitat within the Survey Area

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)*	Extent within Development Envelope (ha)**	Representative Photograph
High Significance							
Gorge/Gully • Limited extent • Of high significance • High SRE potential	Gorge/Gully habitat is characterised by large rock faces and gorges usually associated with ridges, with high potential to support caves, overhangs, crevices and alcoves. These areas, particularly gorges, also have the potential to hold temporary water sources during inundation owing to the presence of bedrock. This habitat was predominantly located adjacent to the Midslope /upper slope habitats. However, it also occurred adjacent to the Footslopes and Gently Sloping Rise habitats.	Vegetation within this habitat type tended to include *Eucalyptus* and *Grevillea* species over *Triodia* and tussock grasses.	Microhabitats are provided in this habitat type in the form of rocky crevices, cracks, caves, semi-permanent water sources and dense vegetation.	**Critical breeding/roosting habitat for:** • Northern Quoll • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python **Suitable habitat for:** • Long-tailed Dunnart • Gane's Blind Snake	1,654.6	944.9	
Debris Slope/Rocky Outcrop • Limited extent • Of high significance • High SRE potential	The Debris Slope/Rocky outcrop habitat comprised rocky areas ranging from large boulders forming crevices and shelters to small rock faces. This habitat contains conglomerates, ironstone and shale, which may form a shelter for fauna, and caves or alcoves; however, not to the extent of the Gorge /Gully habitat. This habitat generally occurred near Gently Sloping Rise habitat.	Vegetation within the upper and mid storey contains a low to sparse cover of trees and shrubs, including *Eucalyptus*, *Acacia*, and occasionally *Ficus*. In areas where exposed bedrock is absent, lower vegetation includes *Triodia.* hummock grassland. In shaded areas, this is replaced with sparse cover of *Cymbopogon* tussock grassland.	Microhabitats are provided in this habitat type in the form of rocky crevices and shelters. Leaf litter and woody debris is present within some locations.	**Critical breeding/roosting habitat for:** • Northern Quoll • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python **Suitable habitat for:** • Long-tailed Dunnart • Gane's Blind Snake	637.7	514.7	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)*	Extent within Development Envelope (ha)**	Representative Photograph
Moderate Significance							
Major Creekline • Limited extent • Of moderate significance • Moderate SRE potential	The major creekline habitat supported an upper story of relatively tall and mature *Eucalyptus* or *Corymbia*. Lower vegetation comprised soft *Triodia* sp. and tussock grasses (e.g., Buffel Grass), which are both considered palatable to livestock, often leading to degradation	Relatively tall and mature *Eucalyptus* or *Corymbia*. Lower strata of soft *Triodia* and tussock grasses (e.g., Buffel Grass).	Semi-permanent and ephemeral water sources are important temporary resources for aquatic and terrestrial fauna. Mature trees would provide shelter and roosting habitat for avifauna, whilst the increased leaf litter and woody debris may also provide shelter for small mammals.	**Critical breeding/nesting habitat for:** • Grey Falcon **Supporting foraging/dispersal habitat for**: • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python • Northern Quoll **Suitable habitat for:** • Peregrine Falcon	766.0	572.5	
Minor Creekline • Limited extent • Of moderate significance • Moderate SRE potential	Minor creekline habitat usually lacked a tall dense upper storey but with a dense mid storey. Substrate was typically sandy channels or clay banks, with relatively dense fringing vegetation including sparse *Eucalyptus* sp., and *Acacia* sp. over tussock grasses including *Cenchrus ciliaris* (Buffel Grass) and *Triodia* sp hummock grasses. Limited extent The substrate typically comprises sandy channels or clay banks with relatively dense fringing vegetation.	A dense mid storey of vegetation, including sparse *Eucalyptus* and *Acacia* over tussock grasses and *Triodia* hummock grasses.	Larger *Eucalyptus* trees may potentially provide hollows and nesting opportunities in Mature trees. Microhabitats would be found in areas that have an abundance of leaf litter and woody debris.	**Critical breeding/nesting habitat for:** • Grey Falcon **Supporting foraging/dispersal habitat for**: • Pilbara Leaf-nosed Bat • Ghost Bat • Pilbara Olive Python • Northern Quoll	904.2	766.7	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)*	Extent within Development Envelope (ha)**	Representative Photograph
Alluvial Plain • Widespread • Of moderate significance • Low/Moderate SRE potential	The Alluvial Plain habitat occurs in flat areas in association with creeklines and depressions. The habitat generally supports increased shrub cover, tussock grasses and clay-based soils.	Vegetation comprised of Mulga, *Acacia*, *Hakea* and *Eucalyptus*. Areas prone to inundation will support tussock grasses, and hummock grasses dominate the remaining areas.	Woody debris and leaf litter were common within this habitat type compared to others which may result in some microhabitats.	**Supporting foraging/dispersal habitat for:** • Pilbara Leaf-nosed Bat • Ghost Bat • Grey Falcon **Suitable habitat for:** • Lined Soil-crevice Skink • Short-tailed Mouse	3,361.4	2,611.0	
Colluvial Plain • Widespread • Of moderate significance • Low/Moderate SRE potential	Colluvial Plain habitat is usually associated with Alluvial Plains or drainage lines, which provide depositional surfaces. Substrates within this habitat are typically less stony than that of the adjacent pediment slopes and tend to have a higher shrub cover owing to the increased influence of drainage.	Vegetation comprises *Eucalyptus leucophloia*, or *Corymbia deserticola,* over scattered *Acacia* and a lower story dominated by *Triodia*.	This habitat type may result in some formation of microhabitats due to woody debris and leaf litter availability.	**Supporting foraging/dispersal habitat for:** • Pilbara Leaf-nosed Bat • Ghost Bat • Grey Falcon **Suitable habitat for:** • Western Pebble-mound Mouse	25,299.0	21,516.1	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)*	Extent within Development Envelope (ha)**	Representative Photograph
Gently Sloping Rise • Widespread • Of moderate significance • Low SRE potential	The Gently Sloping Rise habitat type occurs at the base of the Footslope habitat. Typically, the substrate is dominated by coarse fragments.	Vegetation within this habit type contains sparse *Eucalyptus* and *Corymbia* over shrubs, including *Hakea* and *Acacia* over a high cover of *Triodia* hummock grassland.	As this habitat type contains very little woody debris and leaf litter and only occasionally hosts exposed bedrock it is of limited to no value in the formation of microhabitats.	**Suitable habitat for:** • Western Pebble-mound Mouse	14,243.0	11,073.2	
Hardpan Plain • Limited extent • Of moderate significance • Low SRE potential	Hardpan habitats comprise flat clay-based plains dominated by stands of mulga, with a high proportion of the substrate comprising bare soil. This habitat type would experience sheet flow following rain.	Vegetation comprises mulga and *Hakea* and a lower storey of shrubs, *Triodia* and tussock grasses.	Due to the large amount of woody debris this habitat type would provide shelter for mammals and reptiles.	**Supporting foraging/dispersal habitat for:** • Pilbara Leaf-nosed Bat • Ghost Bat • Grey Falcon	1,175.3	1,175.3	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)*	Extent within Development Envelope (ha)**	Representative Photograph
Midslope/ Upper Slope • Widespread • Of moderate significance • Low SRE potential	The Midslope/Upper Slope habitat type comprised steep slopes leading into lower footslopes. This habitat was characterised by steep slopes with a high proportion of coarse fragments dominated by ironstone.	Vegetation within this habitat types comprises a sparse upper storey of *Eucalyptus leucophloia*, over sparse *Grevillea, Hakea* and *Acacia* shrubs, with a high cover of *Triodia* hummock grassland.	The presence of *Eucalyptus leucophloia* occasionally provided small or rarely large hollows, which may be used by nesting or roosting birds. Gullies, crevices, alcoves and outcropping may also provide suitable microhabitats.	**Suitable habitat for:** • Western Pebble-mound Mouse	6,898.8	4,840.5	
Low Significance							
Footslope • Widespread • Of limited significance • Low SRE potential	The Footslope habitat is typically downslope from the steeper midslope/upper slope habitat. This habitat type is characterised by gently to moderately inclined slopes with coarse fragments dominated by ironstone. Gently to moderately inclined slopes with coarse fragments dominated by ironstone. Aside from reduced slope angle, Footslope habitat differed from midslope/upper slope areas by having less rocky areas and a high *Triodia* cover.	Vegetation in this habitat type tended to comprise a sparse upper story of *Eucalyptus leucophloia* over a low to sparse cover of shrubs and trees, including *Hakea* sp. and *Acacia* sp., over a high cover of *Triodia* hummock grassland.	Microhabitats are generally not found within the habitat type as it contains limited rocky areas and is sparse in tree cover.	**Suitable habitat for:** • Western Pebble-mound Mouse	4,761.1	3,562.1	

Habitat Type	Fauna Habitat Description	Related Vegetation Types	Microhabitats	Value for Significant Fauna	Extent within the Survey Area (ha)*	Extent within Development Envelope (ha)**	Representative Photograph
Pediment Slope • Widespread • Of limited significance • Low SRE potential	The Pediment Slope habitat is characterised by gently sloping or flat areas, usually associated with low rises or footslopes. Most areas of this habitat would be influenced by laminar sheet flow but would be unlikely to support ponding.	The upper and mid-story of this habitat type typically contains *Acacia*, *Grevillea* and *Hakea* shrubs over a stony substrate with a high cover of *Triodia*.	Microhabitats tend not to form within this habitat type due to the lack of dense shrubs and stony substrate.	**Suitable habitat for:** • Western Pebble-mound Mouse	5,336.1	4,733.2	
Plateau • Limited extent • Of limited significance • Low SRE potential	The plateau habitat represents the most elevated habitat in the survey area and is either flat or crested, with gently sloping spinifex hummock grasslands over a substrate with coarse fragments dominated by ironstone. This habitat tends to be more exposed and only supports a sparse vegetation cover in the mid and upper stratum, with limited debris for shelter by fauna.	This habitat type is composed of a sparse cover of vegetation in the mid and upper layers with spinifex grasslands covering the lower stratum.	Due to the rocky substrate, which is not conducive to forming crevice's, cracks and caves and the limited woody debris or dense vegetation found within this habitat type it is considered to provide limited to low value to the formation of microhabitats.	**Suitable habitat for:** • Western Pebble-mound Mouse	205.6	101.4	
Total					**65,242.8**	**62,411.6**	**-**

Table 14-7: Extrapolated Matters of National Environmental Significance Fauna Habitat

Extrapolated Habitat Type	Value to MNES species	Corresponding Broad Scale Habitat Type/s	Extent in the Extrapolated Survey Area	
			ha	%
Gorge/Gully	High Significance (Critical habitat)	• Gorge/Gully • Debris Slope	11,491	3.5
Hillslope	Low Significance (Limited habitat)	• Footslope • Midslope/Upper Slope • Plateau	83,263	25.0
Gentle Slope Rising	Low Significance (Limited habitat)	• Gentle Slope Rising • Pediment Slope (some instances) • Minor Creekline (some instances)	74,960	22.6
Major Creekline	Moderate Significance (Supporting habitat when within the home range of breeding habitat)	• Major Creekline	4,270	1.3
Plains	Moderate Significance (Supporting habitat when within the home range of breeding habitat)	• Alluvial Plain • Colluvial Plain • Hardpan Plain • Minor Creekline (some instances) • Pediment Slope (some instances)	158,585	47.7
Total			**332,569**	**100**

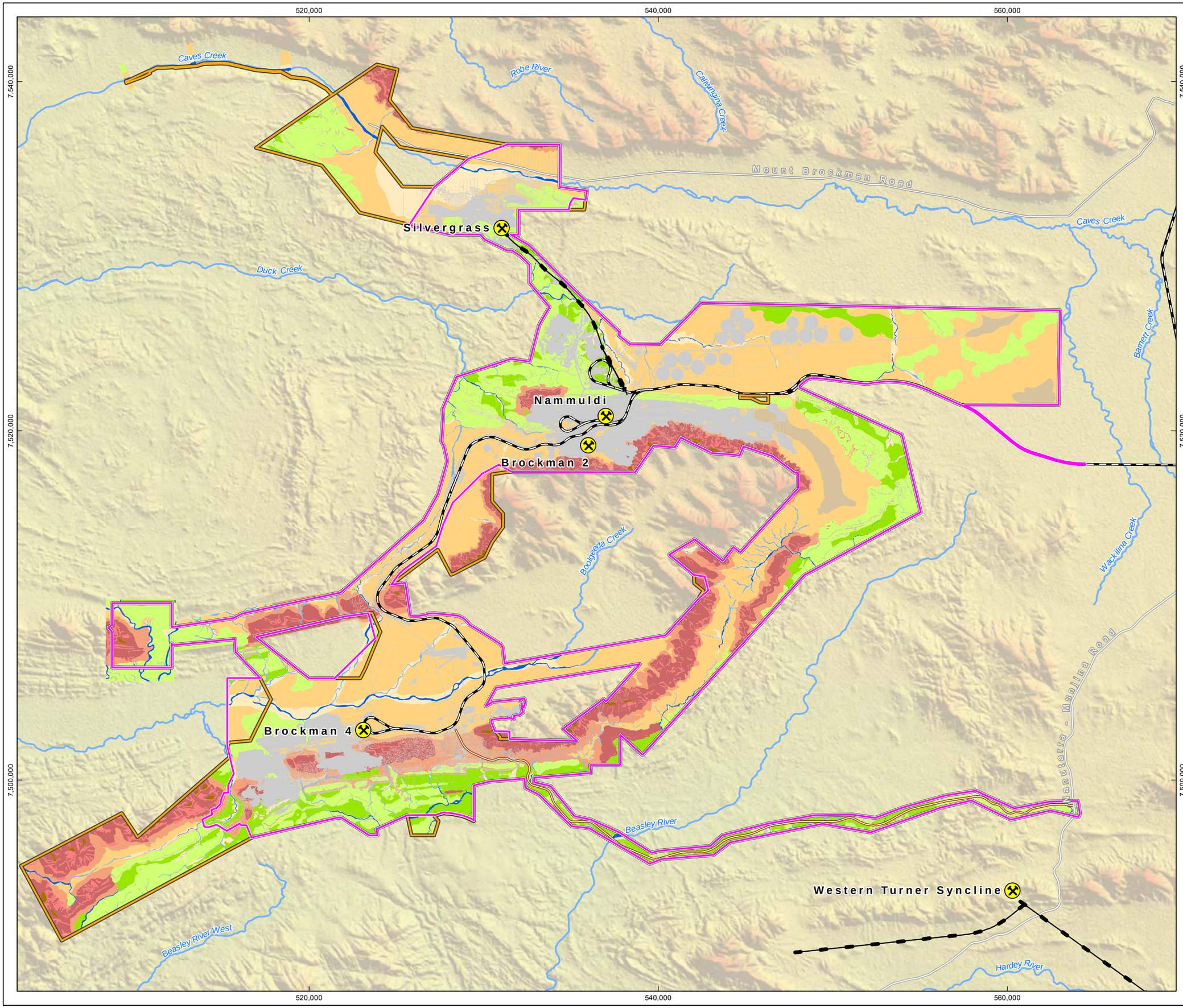

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Figure 14-2
Matters of National Environmental Significance Fauna Habitat within the Survey Area
Overview

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres
Map units in metres

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Figure 14-2
Matters of national Environmental Significance Fauna Habitat within the Survey Area
Map A

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Caves Creek
Robe River
Duck Creek
Silvergrass
Nammuldi
Brockman 2

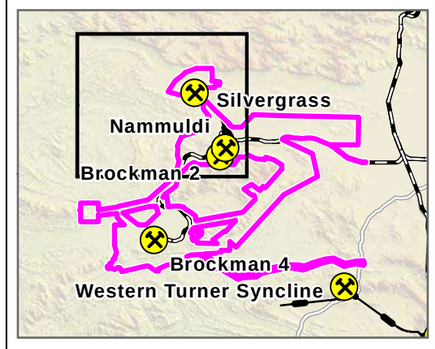
Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6
Kilometres
Map units in metres

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Figure 14-2
Matters of National Environmental Significance Fauna Habitat within the Survey Area
Map B

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

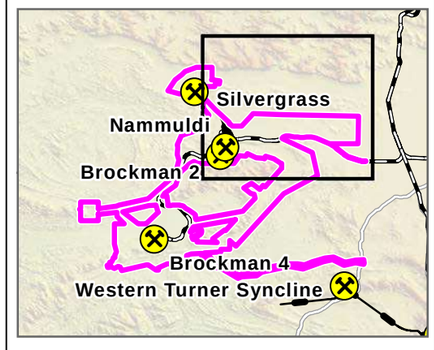
Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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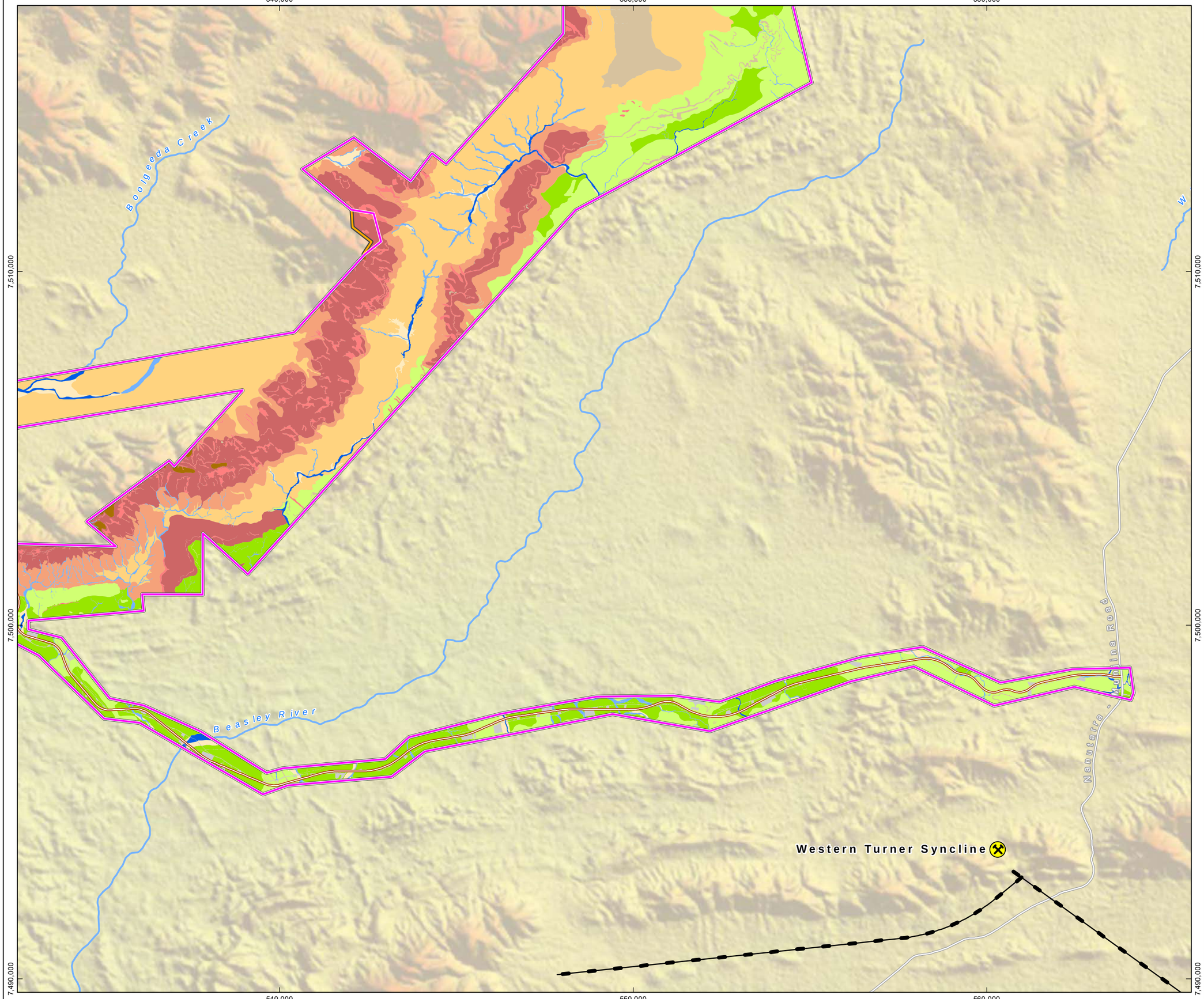
RioTinto

Figure 14-2
Matters of National Environmental Significance Fauna Habitat within the Survey Area
Map C

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



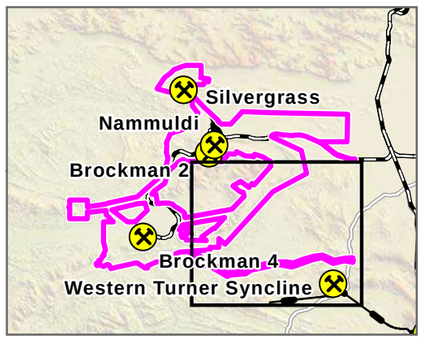
Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek



N

0 2 4 6

Kilometres

Map units in metres

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RioTinto

Figure 14-2
Matters of National Environmental Significance Fauna Habitat within the Survey Area
Map D

Drawn: L.Fuentes
Plan: PDE0189719v2
Date: April 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Brockman 4

Beasley River West

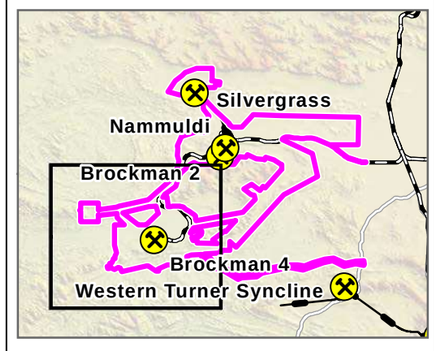
Legend

- Development Envelope
- Survey Area

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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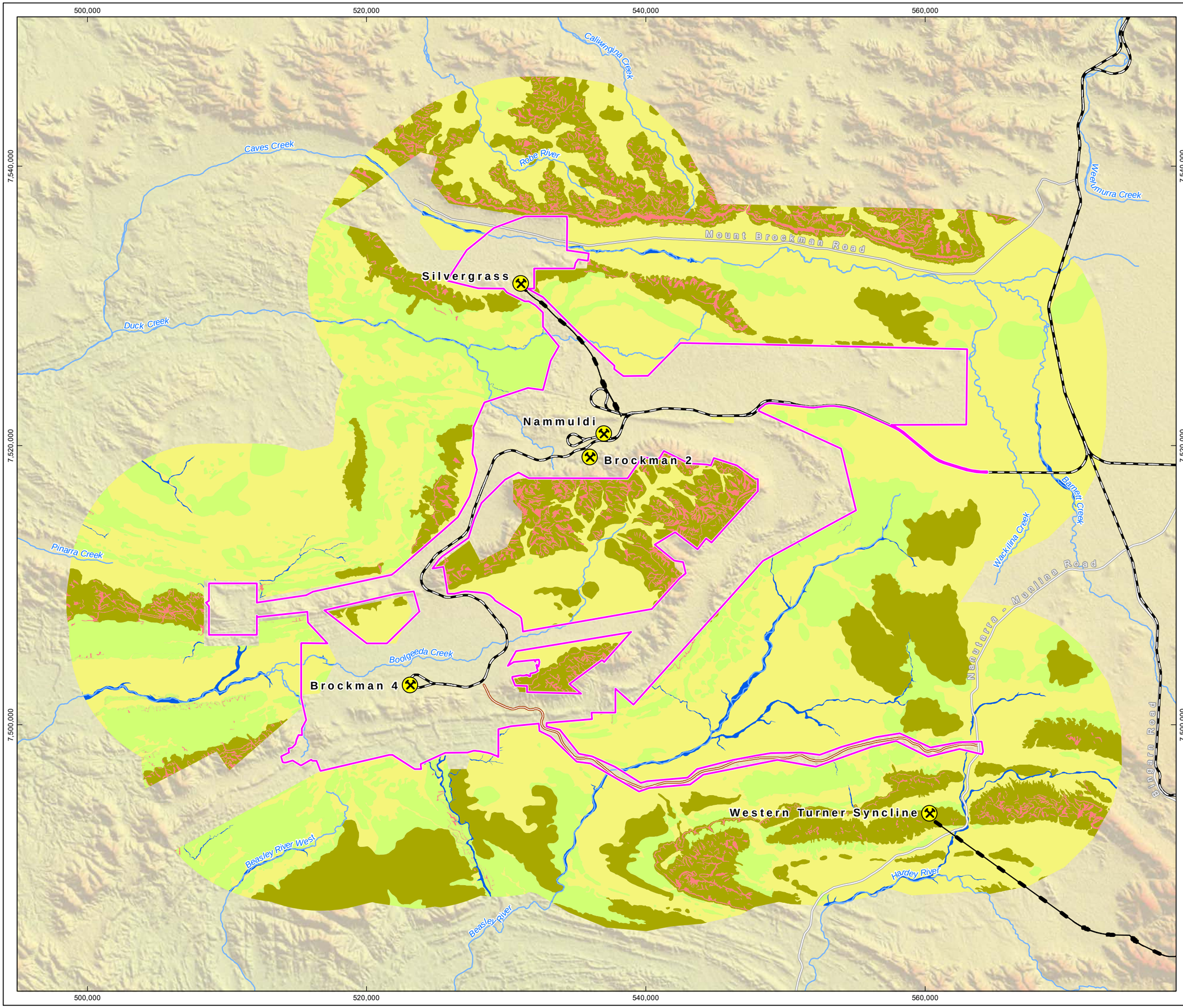

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Figure 14-3
Extrapolated Matters of National Environmental Significance Fauna Habitat Mapping within 10 km of the Development Envelope

Drawn: L.Fuentes
Plan: PDE0189720v1
Date: July 2022
Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Fauna Habitat - Extrapolated

- Gently Sloping Rise
- Gorge Gully and Free Face
- Hillslope
- Major Creekline
- Plains

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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14.3.4.1. 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 MNES species; Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, and Pilbara Olive Python. A total of 208 caves have been recorded from the survey area, 131 occur within the Development Envelope. The caves vary in complexity from small, shallow overhangs to deep, complex caves (which include a secondary chamber) with a higher range of habitat values. A further 28 caves are also known from the extrapolation area (Table 14-8 and Figure 14-4).

Regarding the Development Envelope, the highest concentration of caves (77) (including complex caves (19)) occurs at the BS2 through to the BS3 assessment area. BS1 and BS4 assessment areas had a lower number (18, 13 and 34) and concentration of caves (Figure 14-4). These differences in cave numbers and concentration are most likely due to the geological attributes of each area. Within the Development Envelope most caves occur in Gorge/Gully (86) and Debris Slope/Rocky Outcrop (36) habitat types (Biologic 2022 a). Further detailed information relating to cave usage and suitability to MNES species is provided in Section 14.7 and 14.8.

Water Features

There is only one permanent groundwater sustained water feature within the Development Envelope; Plunge Pool in the BS3 assessment area. A further 24 water features are known from the survey area, of which 21 occur within the Development Envelope. Of these water features, 19 are ephemeral and two are year-round artificial water bodies (discharge points) (Table 14-9 and Figure 14-5). A further 12 water features are known from the wider extrapolation area, comprising four permanent pools, three ephemeral pools (including Ridge Pool which is located 140 m from the Development Envelope), two year-round artificial water bodies and three of unknown value (Figure 14-5). There are likely to be many more ephemeral water features that occur after rainfall but do not persist for more than a few weeks.

Two water features, Plunge Pool and Ridge Pool are considered highly significant to fauna locally as they provide drinking and foraging resources for all (Plunge Pool), or most (Ridge Pool), of the year. All remaining water features are still likely to provide habitat for fauna species, though this will be limited to periods when inundated with water, primarily following large rainfall events.

Table 14-8: Caves within and Surrounding the Proposal

Cave Name	Image	Cave Name	Image	Cave Name	Image
Inside Development Envelope					
B2BAT06	-	BS4MM-Aug16-18	-	B4jul16-26-27	-
BS4MM-Aug16-19	-	B4jun16-09	-	BS4MMJul16-11	-
B4jun16-36	-	BS4MMJul16-13	-	B4June16-26	-
BS4MMJul16-14	-	BS4MM-Aug16-03	-	BS4MMJul16-15	-
BS4MM-Aug16-04	-	BS4MMJul16-17	-	BS4MM-Aug16-13	-
BS4MMJul16-30	-	BS4MM-Aug16-15	-	C1	
C2		C8	-	CBRK-000	

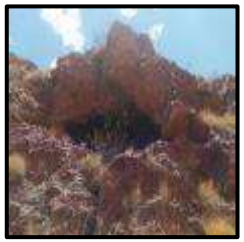
Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-006		CBRK-045		CBRK-052	
CBRK-053		CBRK-055		CBRK-057	
CBRK-059		CBRK-061		CBRK-063	
CBRK-065		CBRK-067		CBRK-069	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-071		CBRK-073		CBRK-074	
CBRK-075		CBRK-076		CBRK-077	
CBRK-078		CBRK-079		CBRK-080	
CBRK-081		CBRK-082		CBRK-083	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-084		CBRK-085		CBRK-086	
CBRK-087		CBRK-089		CBRK-090	
CBRK-091		CBRK-092		CBRK-093	
CBRK-094		CBRK-095		CBRK-096	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-097		CBRK-098		CBRK-099	
CBRK-100		CBRK-101		CBRK-102	
CBRK-103		CBRK-104		CBRK-105	
CBRK-106		CBRK-107		CBRK-108	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-109		CBRK-110		CBRK-111	
CBRK-113		CBRK-116		CBRK-119	
CBRK-120		CBRK-121		CBRK-122	
CBRK-123		CBRK-124		CBRK-125	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-126		CBRK-136		CBRK-137	
CBRK-138		CBRK-139		CBRK-140	
CBRK-141		CBRK-142		CBRK-143	
CBRK-144		CBRK-145		CBRK-147	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-148		CBRK-149		CBRK-150	
CBRK-151		CBRK-152		CBRK-153	
CBRK-154		CBRK-173		CBRK-174	
CBRK-199		GBS_CA_03	-	GBS_CA_04	

Cave Name	Image	Cave Name	Image	Cave Name	Image
GBS_CA_05		GBS_CA_06	-	GBS_CA_08	-
GBS_CA_09	-	GBS_CA_10	-	GBS_CA_11	-
GBS_CA_12	-	GBS_CA_14		GBS_CA_15	
GBS_CA_16		GBS_CA_17	-	GBS_CA_18	
GBS_CA_20		GBS_CA_21		GBS_CA_22	-

Cave Name	Image	Cave Name	Image	Cave Name	Image
MAMBAT81-01		MAMBAT93-01	-	MAMCAM11-01	
MMBAT01		MMBAT02		MMBAT03	
MMBAT04		MME05		MME06	
NWTBAT01	-	NWTBAT02	-		

Cave Name	Image	Cave Name	Image	Cave Name	Image
Outside Development Envelope					
C3		C4		C5	
C6		C7	-	CBRK-001	
CBRK-002		CBRK-003		CBRK-004	
CBRK-005		CBRK-007		CBRK-008	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-009		CBRK-010		CBRK-011	
CBRK-012		CBRK-013		CBRK-014	
CBRK-015		CBRK-016		CBRK-017	
CBRK-018		CBRK-020		CBRK-021	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-022		CBRK-023		CBRK-024	
CBRK-025		CBRK-026		CBRK-028	
CBRK-030		CBRK-031		CBRK-032	
CBRK-033		CBRK-034	-	CBRK-035	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-036		CBRK-037		CBRK-038	
CBRK-039		CBRK-040		CBRK-041	
CBRK-042		CBRK-043		CBRK-044	
CBRK-046		CBRK-047		CBRK-048	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-049		CBRK-050		CBRK-051	
CBRK-054		CBRK-056		CBRK-058	
CBRK-060		CBRK-062		CBRK-064	
CBRK-066		CBRK-068		CBRK-070	

Cave Name	Image	Cave Name	Image	Cave Name	Image
CBRK-072		CBRK-088		CBRK-112	
CBRK-114		CBRK-115		CBRK-146	
CBRK-175		CBRK-176		CBRK-177	
CBRK-178		CBKT-04		GBS_CA_01	

Cave Name	Image	Cave Name	Image	Cave Name	Image
GBS_CA_02		GBS_CA_07	-	GBS_CA_13	
GBS_CA_19		SIV15EH	-		

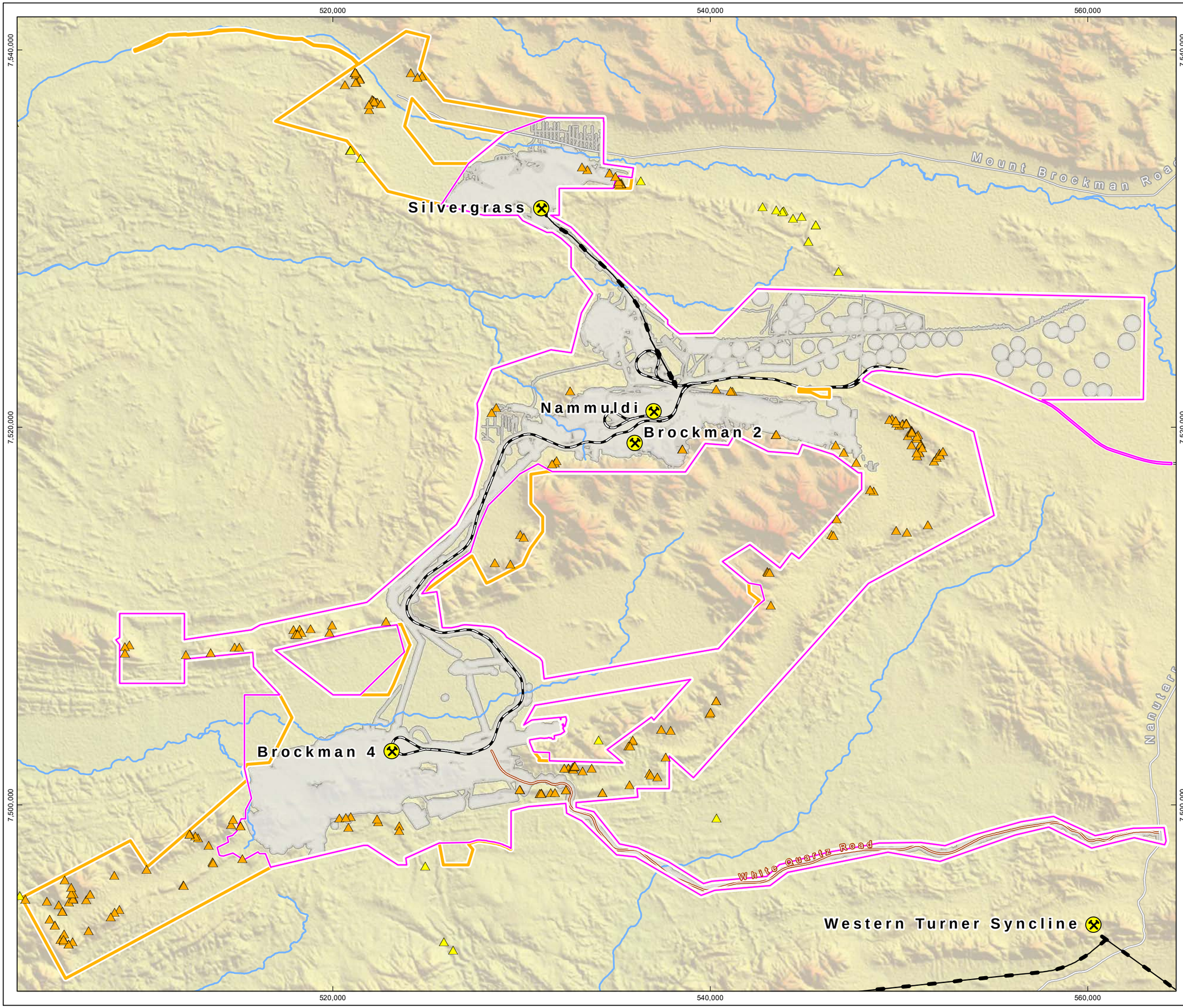


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Figure 14-4
Caves Recorded within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

CBRK-001
CBRK-177
CBRK-015
CBRK-017
CBRK-005
CBRK-007
CBRK-003
CBRK-009
CBRK-039
CBRK-025
CBRK-011
CBRK-031
CBRK-013
CBRK-021
CBRK-080
CBRK-078
CBRK-027
CBRK-029
CBRK-019
CBRK-082
C8
CAVE 03
C7
C3 (Cave 10)
CBRK-178
C4 (Cave 06)
Silvergrass
NWTBAT02
NWTBAT01
CBRK-045
Nammuldi
CBRK-074
(NEBBAT01)
CBRK-090
Brockman 2
CBRK-086
BKEBAT03
BKEBAT01
CBRK-084
B2BAT06

RioTinto

Figure 14-4
Caves Recorded within and Surrounding the Proposal Map A

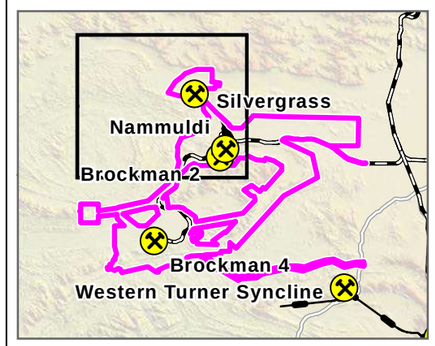
Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3
Kilometres

Map units in metres

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RioTinto

Figure 14-4
Caves Recorded within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

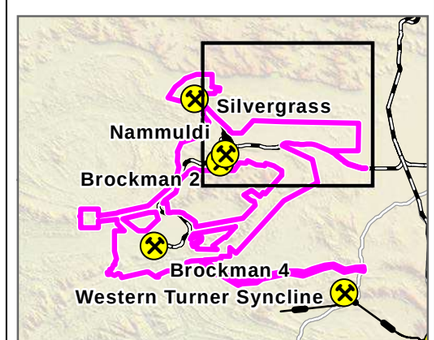
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



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0 1 2 3
Kilometres

Map units in metres

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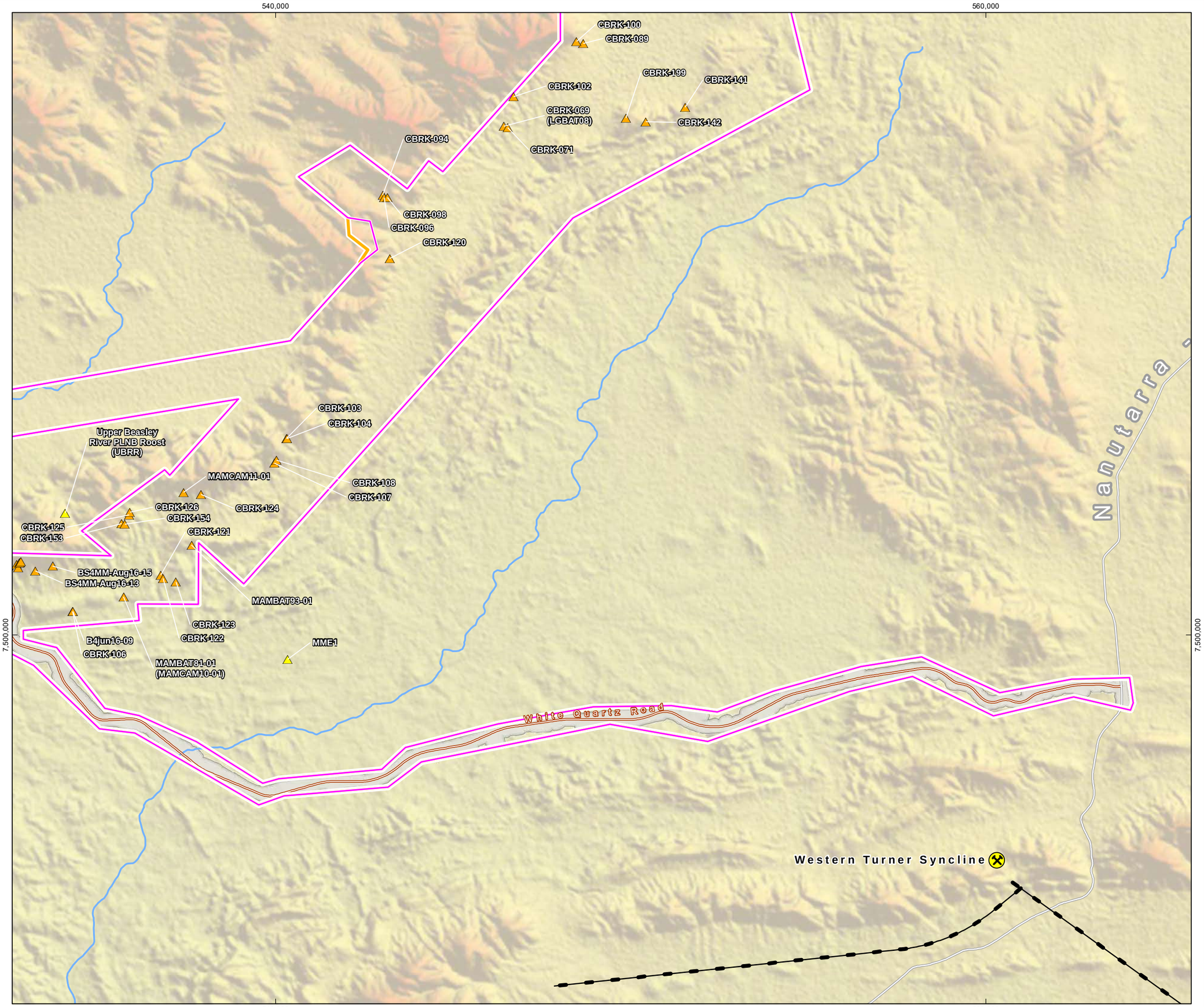


Figure 14-4
Caves Recorded within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

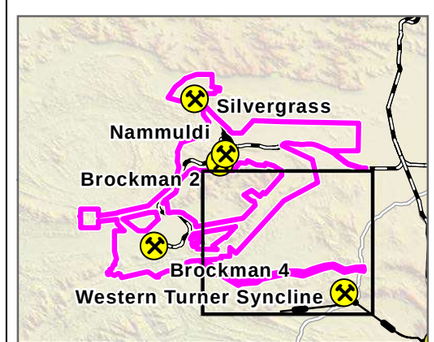
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek



N

0 1 2 3

Kilometres

Map units in metres

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7,510,000 7,500,000 7,490,000

CBRK-088
CBRK-051 (B2BAT05)
CBRK-047
CBRK-049
GBS_CA_06
CBRK-145
CBRK-151
CBRK-143
CBRK-000
CBRK-119
GBS_CA_21
CBRK-138
CBRK-053
GBS_CA_04
CBRK-144
CBRK-116
GBS_CA_03
CBRK-136
CBRK-137
GBS_CA_20
GBS_CA_22
CBRK-139
BS4MM-Aug16-04
BS4MMJul16-14
Upper Beasley River PLNB Roost (UBRR)
B4jul16-26-27
CBRK-111
BS4MMJul16-15
BS4MMJul16-17
Brockman 4
BS4MM-Aug16-03
CBRK-110
BS4MM-Aug16-15
BS4MM-Aug16-13
B4June16-26
BS4MMJul16-30
MME06 (MMBAT06)
BS4MMJul16-13
BS4MMJul16-11
MME05 (MMBAT05, MME5)
CBRK-004
CBRK-002
CBRK-054
CBRK-056
CBRK-060
CBRK-058
GBS_CA_05
CBRK-052
MMBAT01
MMBAT02 (MME2)
CBRK-109
CBRK-174
CBRK-106
B4jun16-09
White Quartz Road
CBRK-147
MMBAT03 (MMHarp01, MME3)
CBRK-140
CBRK-152
MMBAT04 (MME4)
B4jun16-36
BS4MM-Aug16-18
BS4MM-Aug16-19
CBRK-173
CBRK-048
CBRK-050
CBRK-044
CBRK-016
CBRK-066
CBRK-114
CBRK-046
CBRK-012
CBRK-008
CBRK-036
CBRK-042
CBRK-010
CBRK-006
CBRK-014
BRLANA04
CBKT-05
CBRK-145
CBRK-040
CBRK-115
CBRK-018
GBS_CA_07
CBRK-064
CBRK-062
CBRK-068
GBS_CA_13
GBS_CA_01
CBRK-070
CBRK-022
CBRK-072
CBKT-04
CBRK-020
CBRK-112
BRLANA03
BRLANA05
CBRK-024
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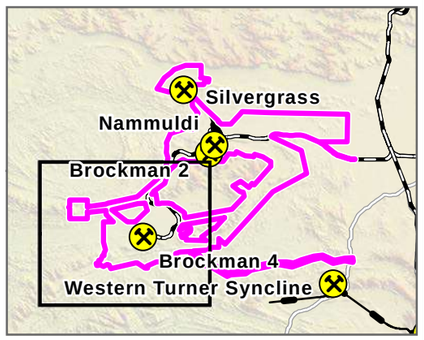

N

0 1 2 3

Kilometres

Map units in metres

RioTinto

Figure 14-4
Caves Recorded within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Cave Location

- Survey Area
- Extrapolated Area
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek

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Table 14-9: Water Features Recorded within and Surrounding the Proposal

Water Feature	Image	Water Feature	Image	Water Feature	Image
Inside Development Envelope					
B1		B2		B3	
B4		WBRK-01		WBRK-02 (Artificial)	
WBRK-03		WBRK-08		WBRK-09	

Water Feature	Image	Water Feature	Image	Water Feature	Image
WBRK-10 (Artificial)		WBRK-11		WBRK-12	
WBRK-13		WBRK-14		BROF	-
MAMBAT81-02		MAMCAM09-02		MAMCAM13-01	
LGCAM04	-	SGBAT04	-	Bat rec 9	
No Name	-	No Name	-		

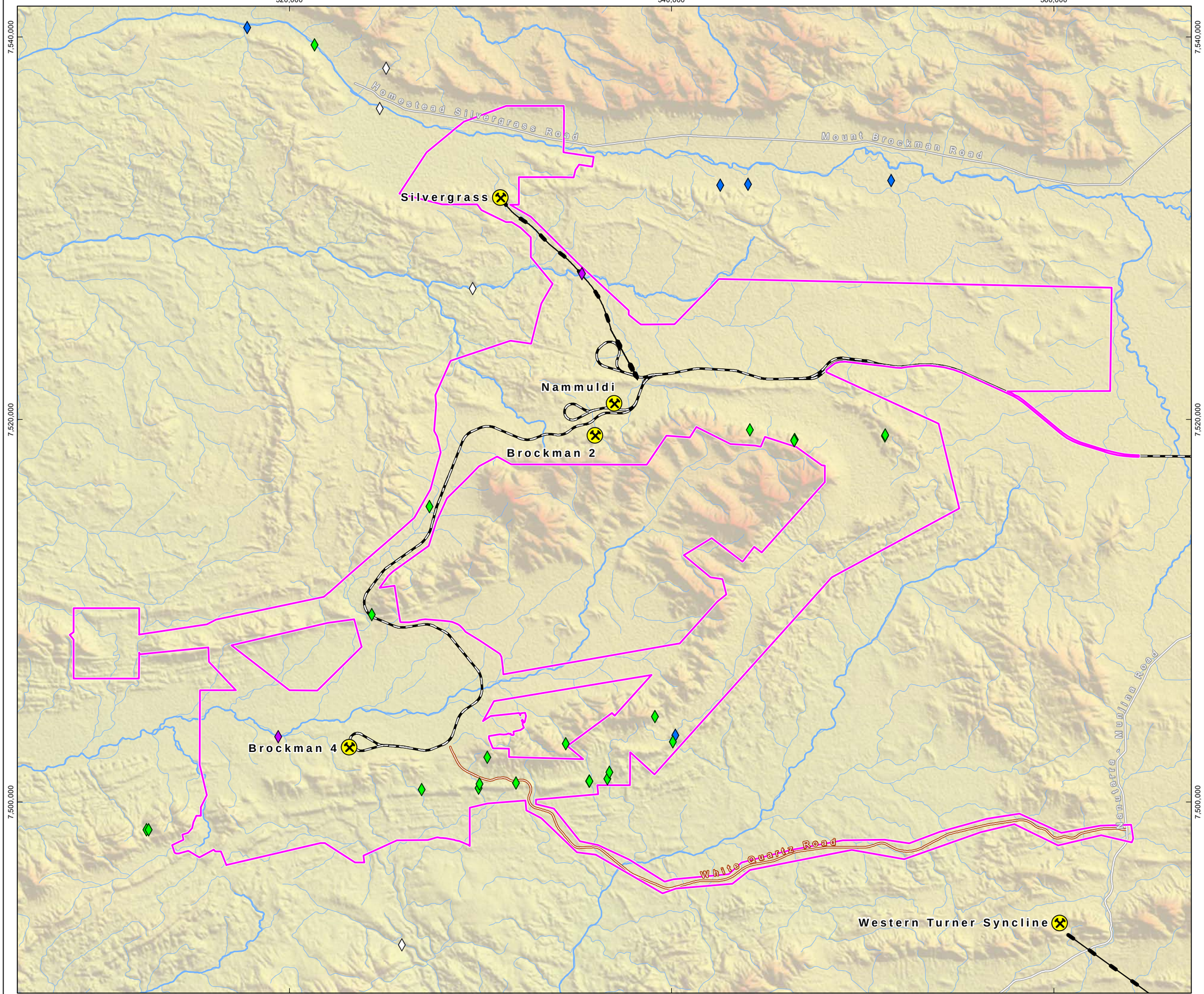
Water Feature	Image	Water Feature	Image	Water Feature	Image
Oustside Development Envelope					
WBRK-04		WBRK-06			

RioTinto

Figure 14-5
Water Features Recorded within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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RioTinto

Figure 14-5
Water Features Recorded within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

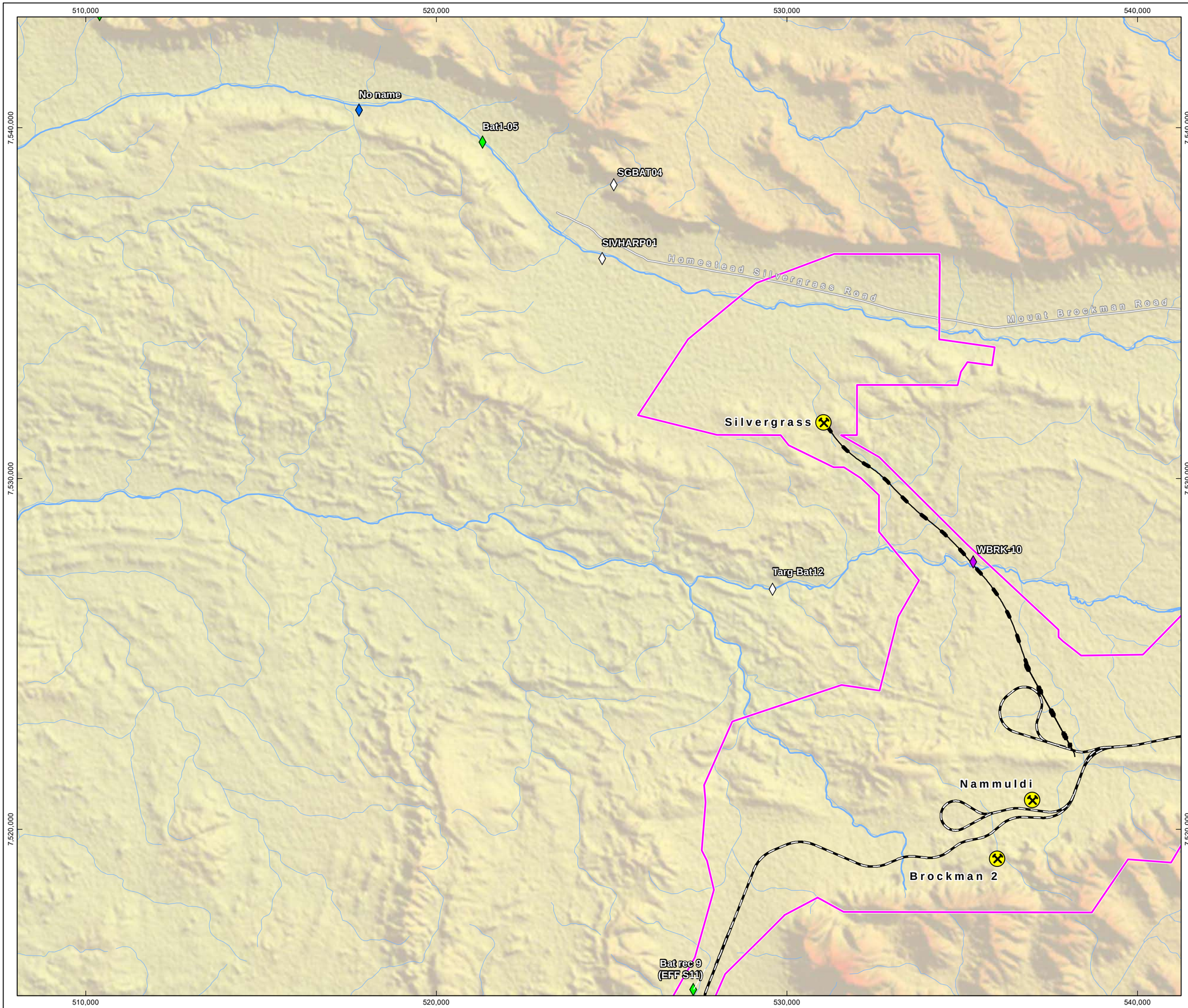
Legend

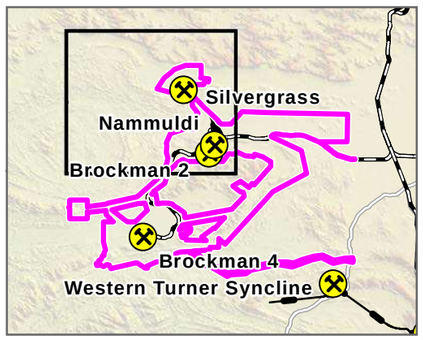
- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek





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0 1 2 3

Kilometres

Map units in metres

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RioTinto

Figure 14-5
Water Features Recorded within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



N

0 1 2 3
Kilometres

Map units in metres

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Mount Brockman Road
No name
No name
No name
WBRK-10
WBRK-11
WBRK-12
Nammuldi
Brockman 2
B1
B2
B3
B4

RioTinto

Figure 14-5
Water Features Recorded within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

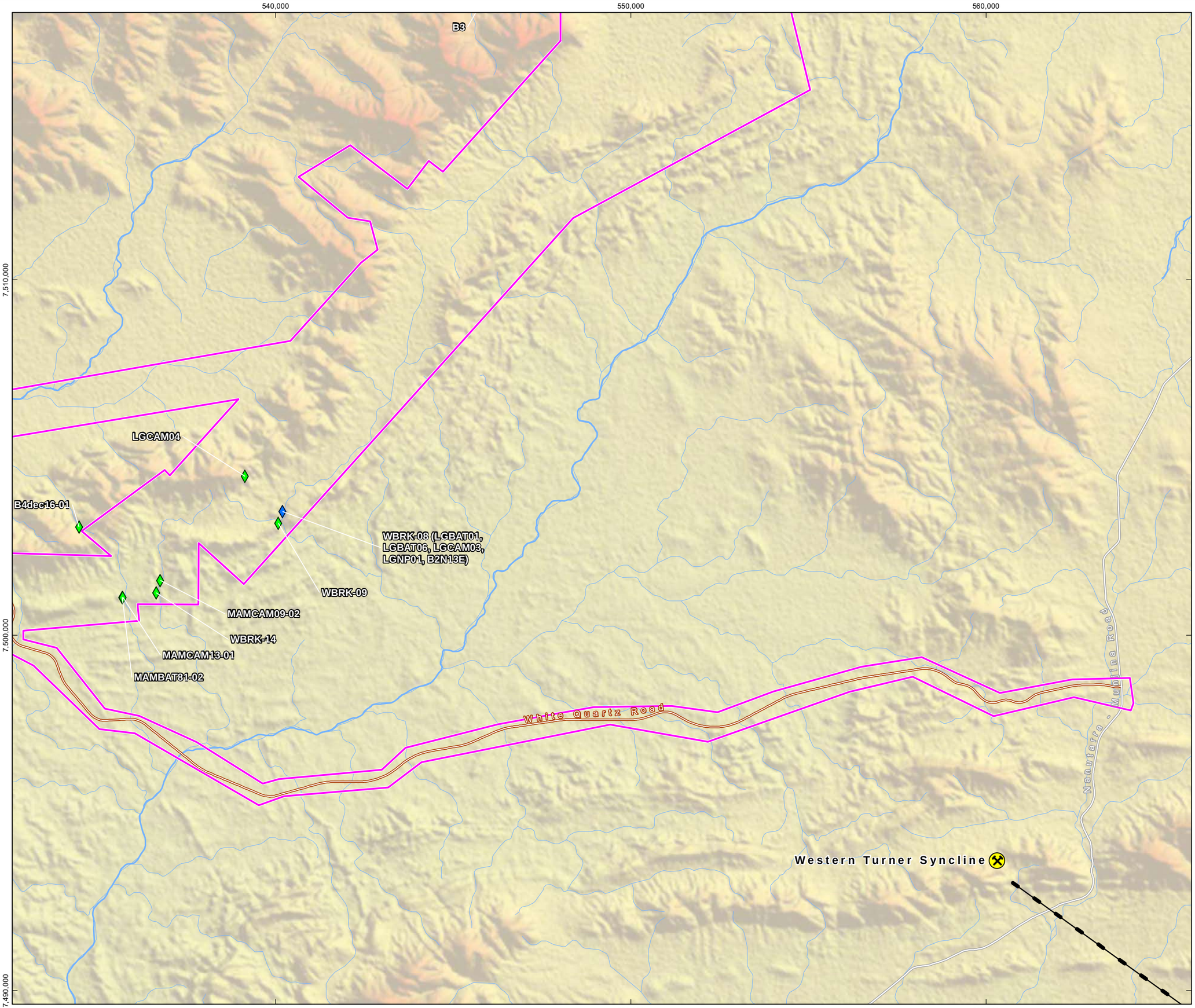
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

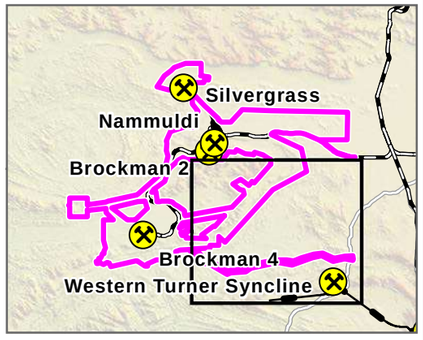
Legend

- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown
- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek
- Minor Creek





N

0 1 2 3
Kilometres

Map units in metres

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RioTinto

Figure 14-5
Water Features Recorded within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

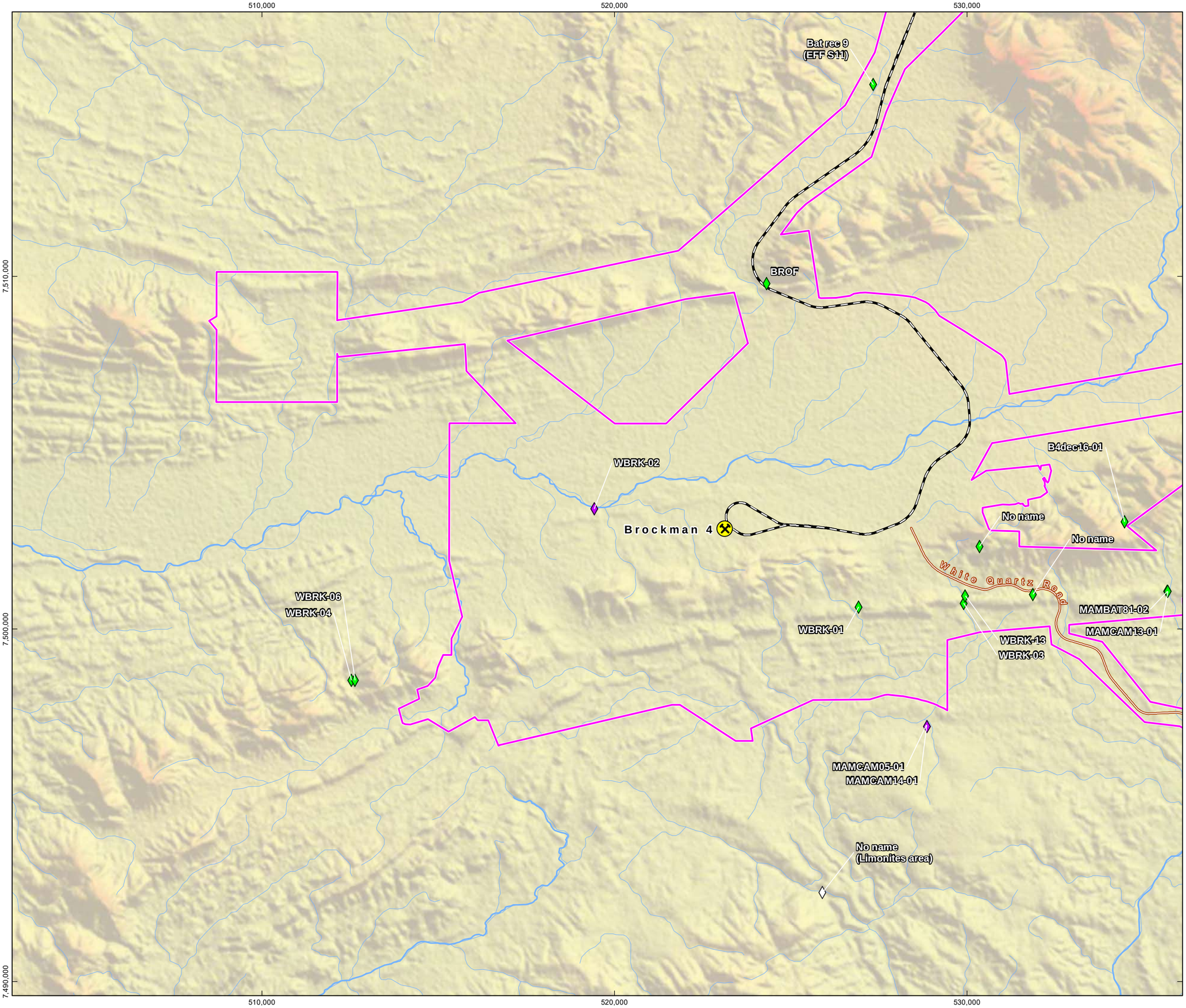
Legend

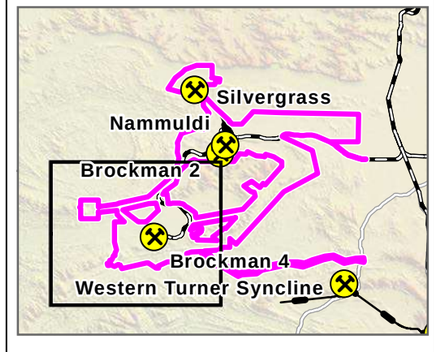
- Development Envelope

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek
- Minor Creek





N

0 1 2 3

Kilometres

Map units in metres

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14.4. Summary of Potential Impacts to MNES

14.4.1. Direct Impacts to MNES

Direct impacts on MNES comprise:

- Loss of fauna habitat as a result of clearing and habitat fragmentation
- Loss of fauna individuals

14.4.1.1. Loss of Fauna Habitat as Result of Clearing

Habitat loss can lead to the direct mortality of individuals, forced relocation of fauna and reduction of foraging and breeding habitat. Development of the Proposed Action would result in clearing up to 7,896 ha of native fauna habitat within a 63,343 ha Development Envelope. Total areas for clearing for each high significance habitat type are presented in Table 14-10 and each moderate to low significance habitat type in Table 14-11, whilst Figure 14-6 shows a Conceptual Footprint over habitat types, which shows that:

- Development of the Proposal would result in clearing up to 7,896 ha of native fauna habitat within a 63,343 ha Development Envelope. The proposed clearing represents approximately 10% of the survey area and 12% of the Development Envelope
- Most clearing will occur within the Colluvial Plain habitat type, with approximately 3,266.1 ha (4% of the survey area and 5% of the Development Envelope) to be cleared.

Of the habitat types identified as critical (breeding, denning and roosting) habitats to MNES species (Figure 14-7), up to:

- 264.0 ha of Gorge/Gully habitat will be cleared (representing 27.9% of Gorge/Gully habitat mapped within the Development Envelope)
- 67.0 ha of Debris Slope/Rocky Outcrop habitat will be cleared (representing 15% of Debris Slope/Rocky Outcrop habitat mapped within the Development Envelope)

Of the habitat types considered to be supporting (foraging and dispersal) habitat within the home range of MNES species, that being:

- 1 km from a Norther Quoll Record
- 10 km from a category 2 or 3 Pilbara Leaf-nosed Bat Roost and 10 km from a permanent water source for the Pilbara Leaf-nosed Bat (Plunge Pool)
- 5 km from an isolated category 2 Ghost Bat Roost and/or a category 2 and/ 3 Ghost Bat Roosts within an apartment block
- 1 km from a Pilbara Olive Python record

Noting the above

- 25 ha and 114 ha of Major and Minor Creekline habitat types will be cleared (representing 4.4 and 14.9 % of this habitat type mapped within the Development Envelope)
- 65, 2,638 and 104 ha of Alluvial, Colluvial and Hardpan Plain habitat types will be cleared (representing 2.5, 12.3 and 8.8 % of these habitat types mapped within the Development Envelope).

It is noted that species home ranges overlap within the Development Envelope.

Additionally, the Proposal will result in the clearing of:

- A total of 25 potential Pilbara Leaf-nosed Bat of Ghost Bat roosts comprising:
    - 25 category 4 Pilbara Leaf-nosed Bat roosts which are not considered critical habitat for the species (Table 14-12 and Figure 14-8)

- 14 category 3 and 11 category 4 Ghost Bat roosts which are not considered critical habitat for the species (Table 14-12 and Figure 14-9 and Figure 14-10)

- Four known ephemeral pools, considered of lower significance to fauna (Table 14-13 and Figure 14-11).

The implications of habitat loss (critical breeding and roosting habitat and supporting foraging and dispersal habitat (when within the home range of the species) for each MNES species are discussed in Sections 14.6 to 14.9.

14.4.1.2. Fragmentation of Fauna Habitats

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 impact of habitat fragmentation as a result of clearing for the Proposal has the potential to be most apparent within BS1 assessment area as a cumulative effect, given the proximity to the adjacent Eliwana project, and is discussed in Section 8.4.3. Additionally, three areas which are entirely surrounded by the proposed Development Envelope and conceptual footprint may lead to fragmentation, namely a small area north of BS4 (1,480 ha), Mount Brockman south of BS2 (17,485 ha) and the surrounding area near Ridge Pool (1,873 ha). These areas total 20,838 ha in total.

14.4.1.3. Loss of Fauna Individuals

Fauna within the Development Envelope may be at risk of displacement, injury or mortality from vehicle and machinery movements, particularly when foraging nocturnally. To avoid and minimise the potential for interaction with vehicle and machinery movements, most construction activities for the Proposed Action will occur during daylight hours, reducing the risk of encounters with nocturnal MNES fauna during the construction phase. While vehicle movements will increase temporarily during the construction period and roads will expand into the proposed new mining areas, overall vehicle movements during the operational phase will not increase from the existing number or frequency of vehicle movements associated with the current operation.

The Proponent will implement management measures to avoid and minimise the loss of fauna individuals such as:

- Progressive clearing to allow fauna to migrate away from clearing activities and machinery movements
- Clearing will commence, where possible, from a disturbed vegetation edge to an undisturbed area (to encourage mobile fauna to relocate to adjacent areas naturally).
- Implementation of MRZ/MEZs, which will restrict heavy machinery in areas where there is a higher likelihood of species occurring
- Awareness training to identify 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, vehicle and machinery movements are not expected to significantly impact the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat or Pilbara Olive Python population.

Species-specific impacts, such as bat entanglement in barbed-wire fencing, are discussed in Sections 14.6 to 14.9.

Table 14-10: Indicative Disturbance – High Significance MNES Fauna Habitat Types

Fauna Habitat Type	Mapped Fauna Habitat Extent *			Percentage of Survey Area Impacted by the Proposed Action (%)	Percentage of Development Envelope Impacted by the Proposed Action (%)	Upper Limit of Assessed Impact for Project Flexibility (ha, (%))
	Survey Area (ha)*	Development Envelope (ha)**	Approximate Impact by the Proposed Action (ha)			
High Significance (Critical habitat)						
Gorge/Gully	1,654.6	944.9	221	13.4	23.4	264.0 (27.9)
Debris Slope/ Rocky Outcrop	637.7	514.7	20	3.1	3.9	67.0 (13.0)
Total	**2,292.3**	**1,459.6**	**241.0**	**10.5**	**16.5**	**331.0 (22.7)**

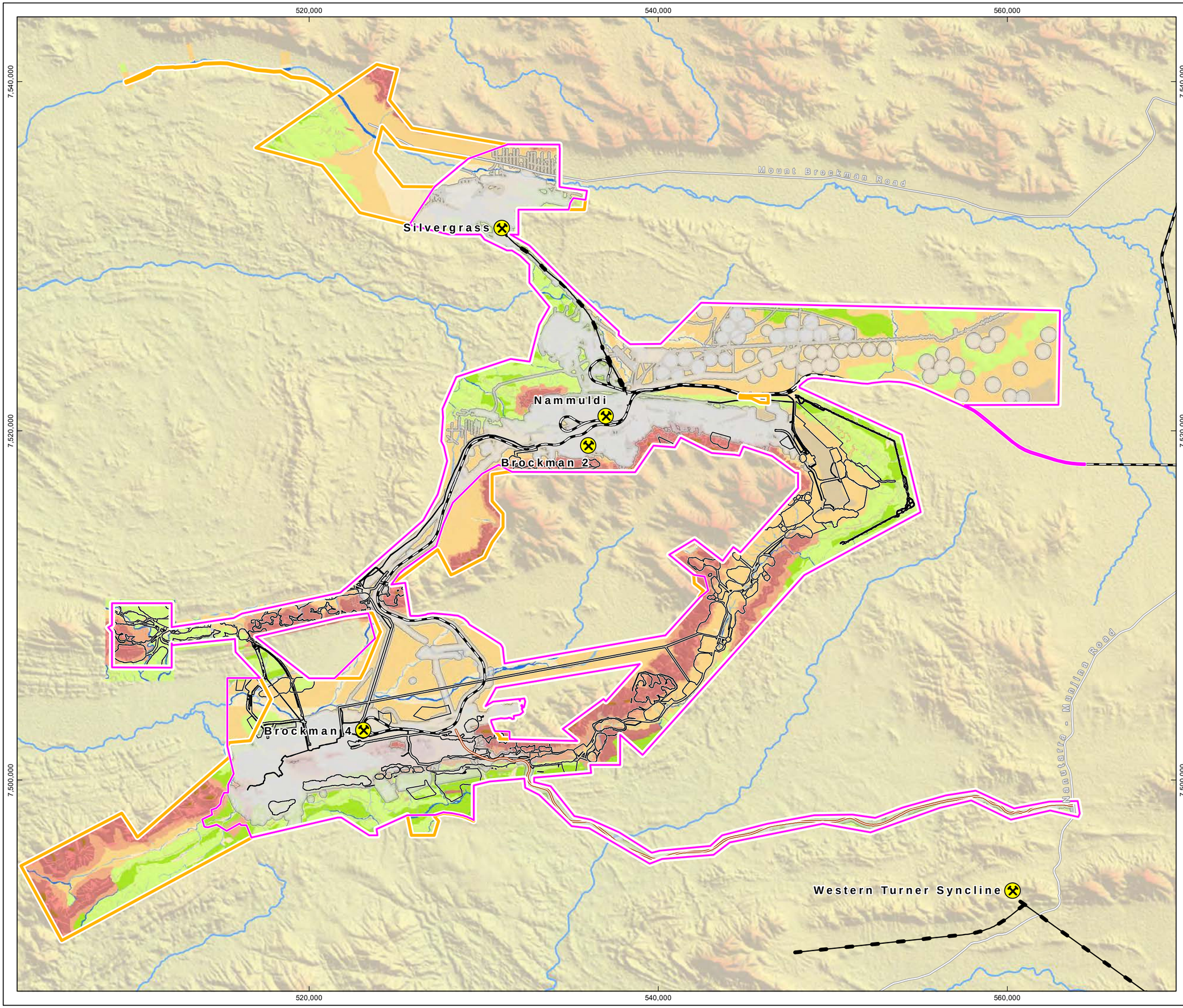
**Area rounded to nearest ha. **Extent in Development Envelope excludes the Approved Footprint.*

Table 14-11: Indicative Disturbance – Moderate and Low Significance MNES Fauna Habitat Types

Fauna Habitat Type	Mapped Fauna Habitat Extent*			Percentage of Survey Area Impacted by the Proposed Action (%)	Percentage of Development Envelope Impacted by the Proposed Action (%)
	Survey Area (ha)*	Development Envelope (ha)**	Approximate Impact by the Proposed Action (ha)*		
Moderate Significance (Supporting habitat, within species home range)					
Alluvial Plain	3,361.4	2611.0	166.1	4.9	6.4
Colluvial Plain	25,299	21,516.0	3,226.1	12.9	15.2
Gently Sloping Rise	14,243.0	11,073.2	1,151.9	8.1	10.4
Hardpan Plain	1,175.3	1,175.3	104.0	8.8	8.8
Major Creekline	766.0	572.5	68.9	9.0	12.0
Midslope/Upper Slope	6,898.8	4,840.5	1,224.0	17.7	25.3
Minor Creekline	904.2	766.7	186.4	20.6	24.3

Fauna Habitat Type	Mapped Fauna Habitat Extent*			Percentage of Survey Area Impacted by the Proposed Action (%)	Percentage of Development Envelope Impacted by the Proposed Action (%)
	Survey Area (ha)*	Development Envelope (ha)**	Approximate Impact by the Proposed Action (ha)*		
Low Significance (Limited habitat)					
Footslope	4,761.1	3,562.1	1,042.6	21.9	29.3
Pediment Slope	5,336.1	4,733.2	259.7	4.9	5.5
Plateau	205.6	101.4	12.8	6.2	12.6
Total	**62,950.5**	**50,951.9**	**7,442.5**	**11.9**	**14.6**

**Area rounded to nearest ha. **Extent in Development Envelope excludes the Approved Footprint.*



RioTinto

Figure 14-6 Conceptual Footprint in the Context of Mapped Fauna Habitat Types Overview

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres
Map units in metres

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Silvergrass
Nammuldi
Brockman 2

RioTinto

Figure 14-6
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Map A

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

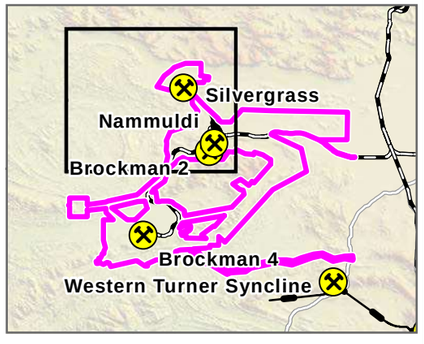
Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6
Kilometres
Map units in metres

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RioTinto

Figure 14-6
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Map B

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

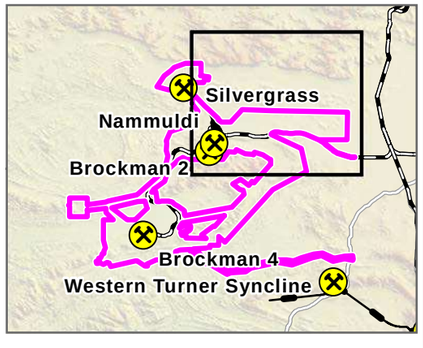
Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Hardpan plain
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 2 4 6

Kilometres

Map units in metres

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7,540,000 7,530,000 7,520,000

Mount Brockman Road

Nammuldi

Brockman 2

RioTinto

Figure 14-7
Conceptual Footprint in the Context of Potential Significant Habitat Map C

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

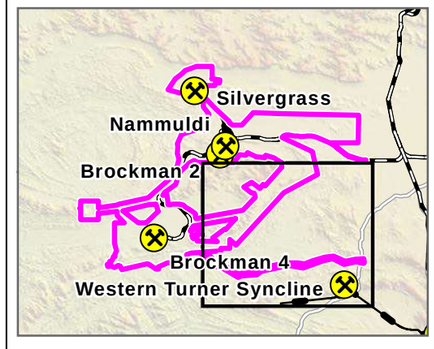
Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Hardpan Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Brockman 4

RioTinto

Figure 14-6
Conceptual Footprint in the Context of Mapped Fauna Habitat Types Map D

Drawn: L.Fuentes
Plan: PDE0189738v3
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

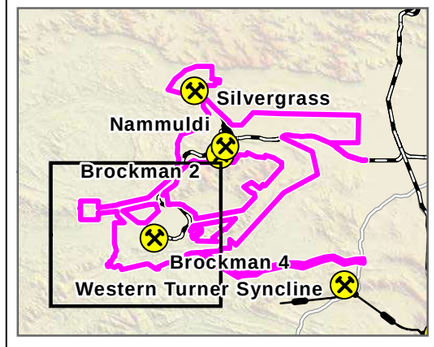
Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Fauna Habitat

- Alluvial plain
- Colluvial plain
- Debris slope/rocky outcrop
- Disturbed
- Footslope
- Gently sloping rise
- Gorge/gully and free face
- Major creekline
- Minor creekline
- Midslope/upper slope
- Pediment slope
- Plateau

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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RioTinto

Figure 14-7
Conceptual Footprint in the Context of Potential Significant Habitat Overview

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Hardpan Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Wanutarra - Munjina Road

RioTinto

Figure 14-7
Conceptual Footprint in the Context of Potential Significant Habitat
Map A

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

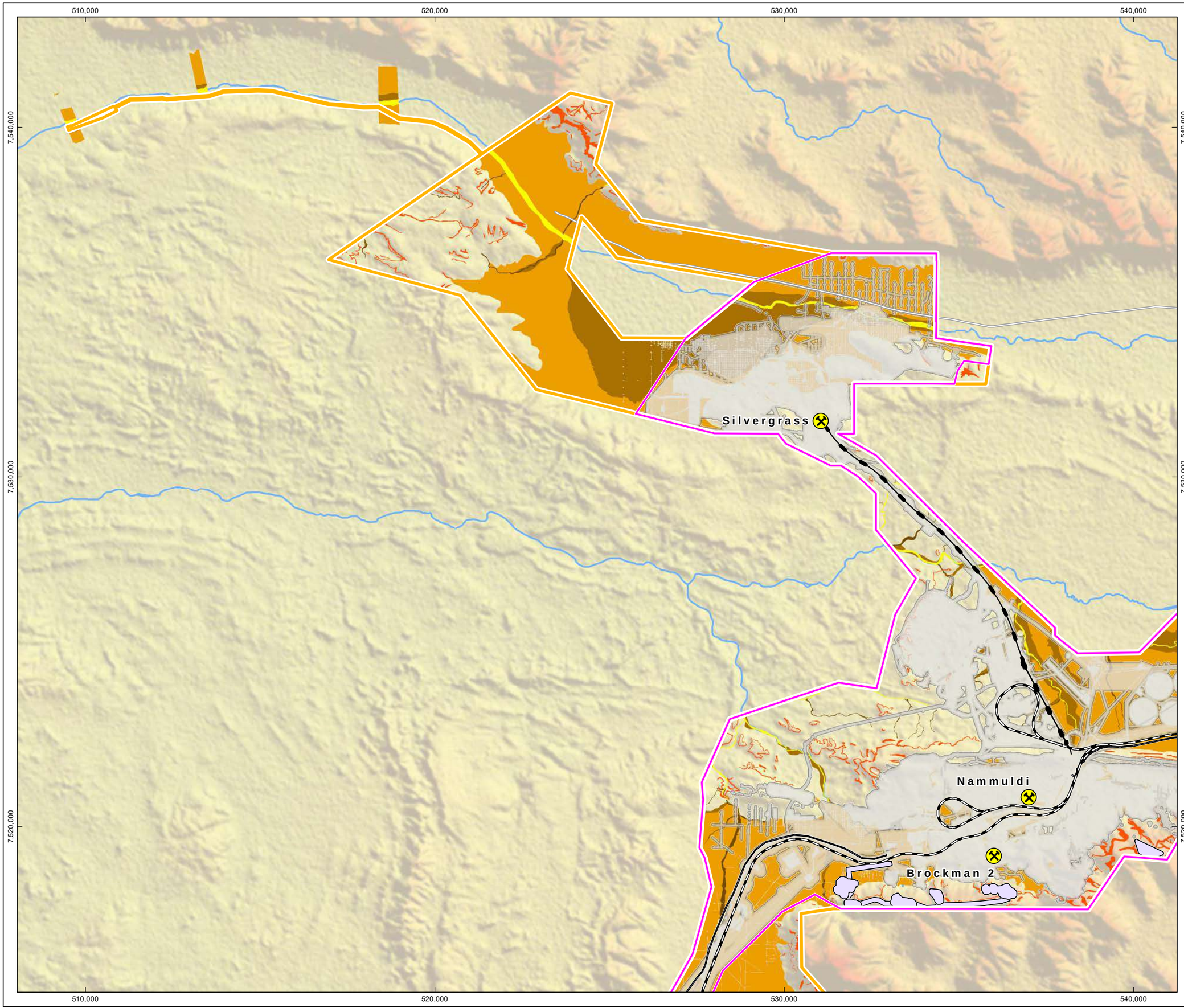
Critical (Breeding and Roosting) Habitat

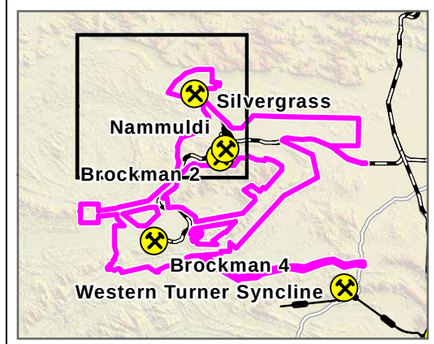
- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek





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0 2 4 6

Kilometres

Map units in metres

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Figure 14-7
Conceptual Footprint in the Context of Potential Significant Habitat
Map B

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

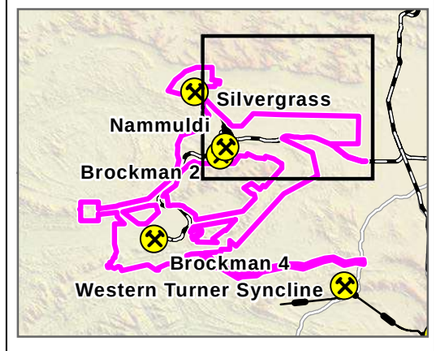
Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Hardpan Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



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0 2 4 6

Kilometres

Map units in metres

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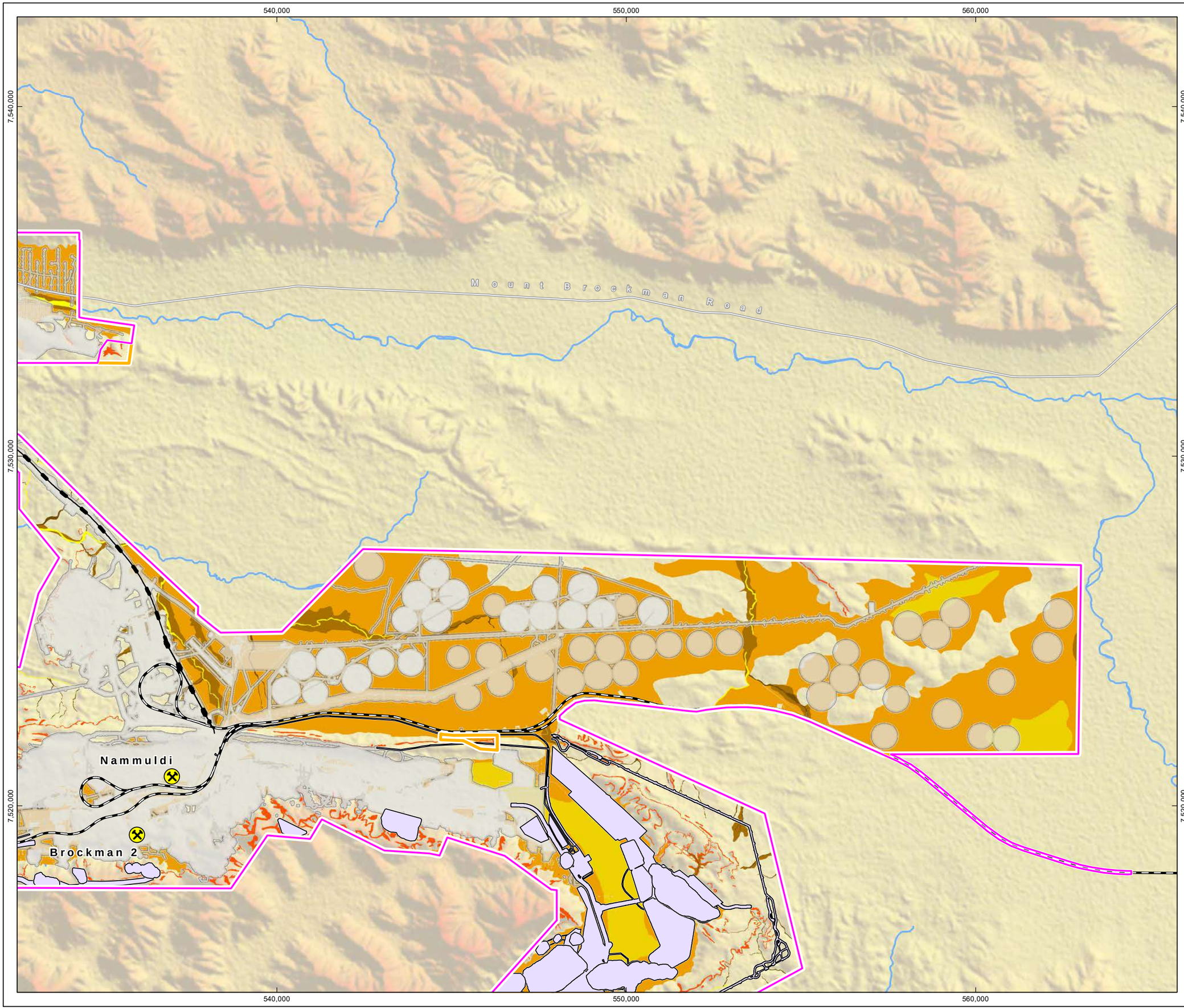


RioTinto

Figure 14-7
Conceptual Footprint in the Context of Potential Significant Habitat Map C

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

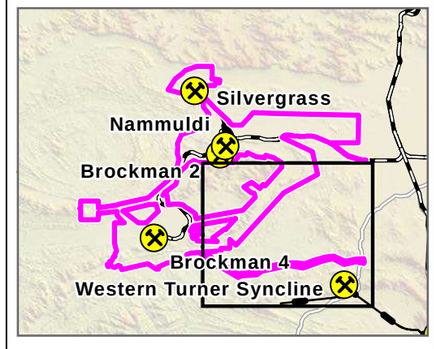
Critical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Hardpan Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Brockman 4

RioTinto

Figure 14-7
Conceptual Footprint in the Context of Potential Significant Habitat
Map D

Drawn: L.Fuentes
Plan: PDE0189739v3
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Conceptual Footprint
- Part IV Indicative Approved Footprint

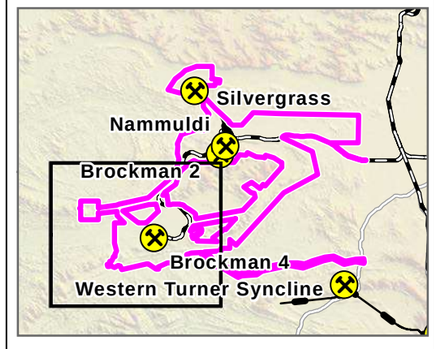
HCritical (Breeding and Roosting) Habitat

- Debris Slope/Rocky Outcrop
- Gorge/gully and free face

Supporting (Foraging and Dispersal) Habitat

- Alluvial Plain
- Colluvial Plain
- Major/Minor Creekline
- Minor Creekline

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 2 4 6
Kilometres

Map units in metres

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Table 14-12: Caves to be Impacted within the Development Envelope and their Significance to the Ghost and Pilbara Leaf-nosed Bat

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
B2BAT06	Category 3	-	Category 4	-
BS4MM-Aug16-13	Category 3	-	No Usage	-
BS4MMJul16-11	Category 3	-	No Usage	-
C1	Category 4	-	Category 4	
C2	Category 4	-	Category 4	
CBRK-053	Category 3	-	Category 4	
CBRK-084	Category 3	-	Category 4	
CBRK-086	Category 3	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-094	Category 4	-	Category 4	
CBRK-096	Category 4	-	Category 4	
CBRK-098	Category 4	-	Category 4	
CBRK-102	Category 4	-	Category 4	
CBRK-103	Category 3	-	Category 4	
CBRK-104	Category 3	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-107	Category 4	-	Category 4	
CBRK-108	Category 3	-	Category 4	
CBRK-124	Category 4	-	Category 4	
CBRK-138	Category 4	-	Category 4	
CBRK-144	Category 3	-	Category 4	
CBRK-145	Category 4	-	Category 4	

Cave Name	Ghost Bat Cave Category	Ghost Bat Caves within an Apartment Block	Pilbara Leaf-nosed Bat Cave Category	Image
CBRK-151	Category 3	-	Category 4	
GBS_CA_04	Category 4	-	Category 4	
GBS_CA_06	Category 3	-	No usage	-
GBS_CA_21	Category 3	-	No usage	
MAMCAM11-01	Category 3	-	Category 4	

Table 14-13: Water Features to be Impacted within the Development Envelope

Water Feature Name	Image	Water Feature Name	Image
B4		WBRK-01	
LGCAM04	-	No Name	-

RioTinto

Figure 14-8
Conceptual Footprint in the Context of Pilbara Leaf-nosed Bat Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189725v1
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Pilbara Leaf-nosed Bat Roost

- Category 2
- Category 3
- Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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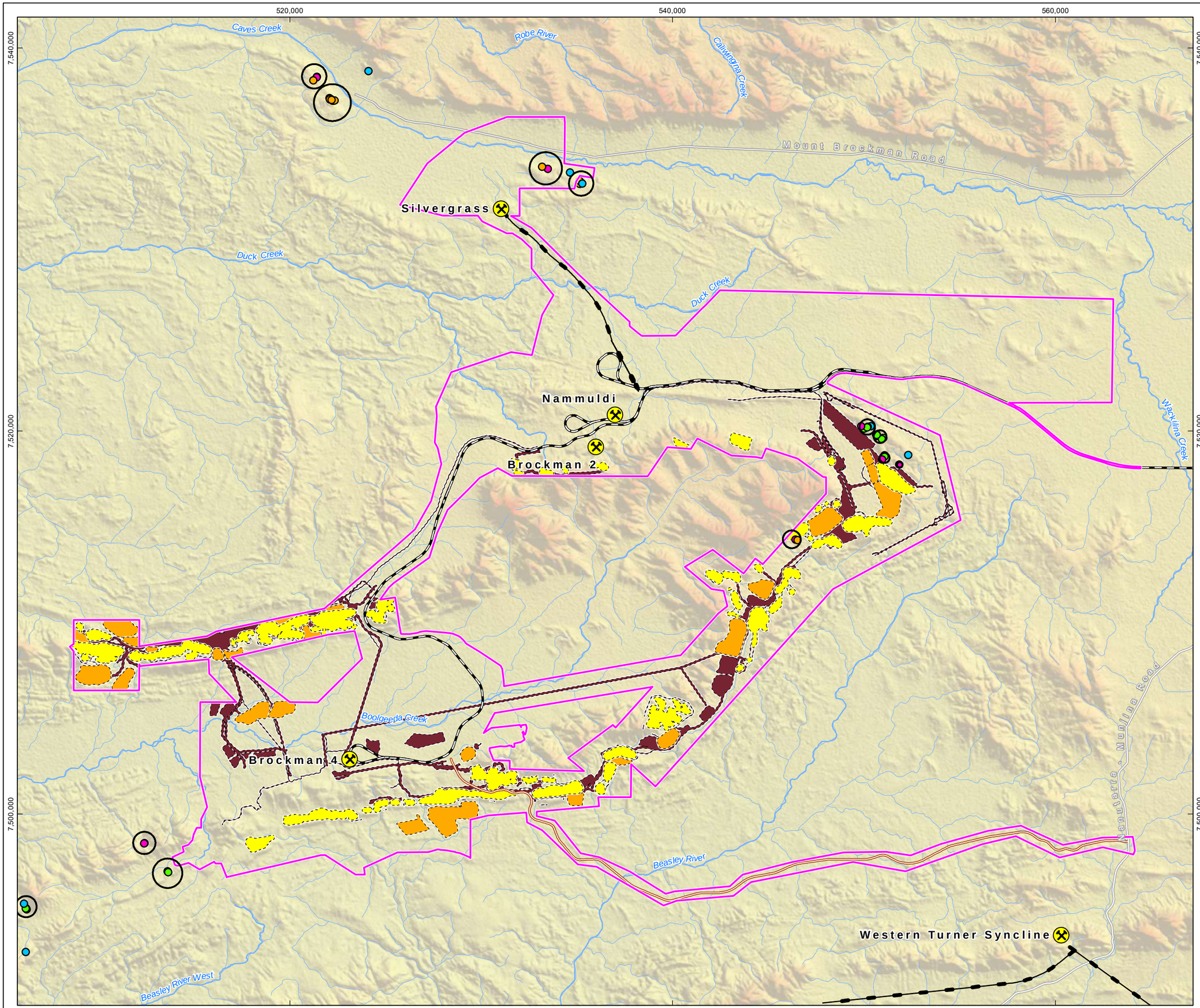
520,000 540,000 560,000

7,540,000 7,520,000 7,500,000

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Mount Brockman Road
Munjina Road

0 0.5 1 1.5 2 2.5
Kilometres



RioTinto

Figure 14-9
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Overview

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Apartment Block

Ghost Bat Roots

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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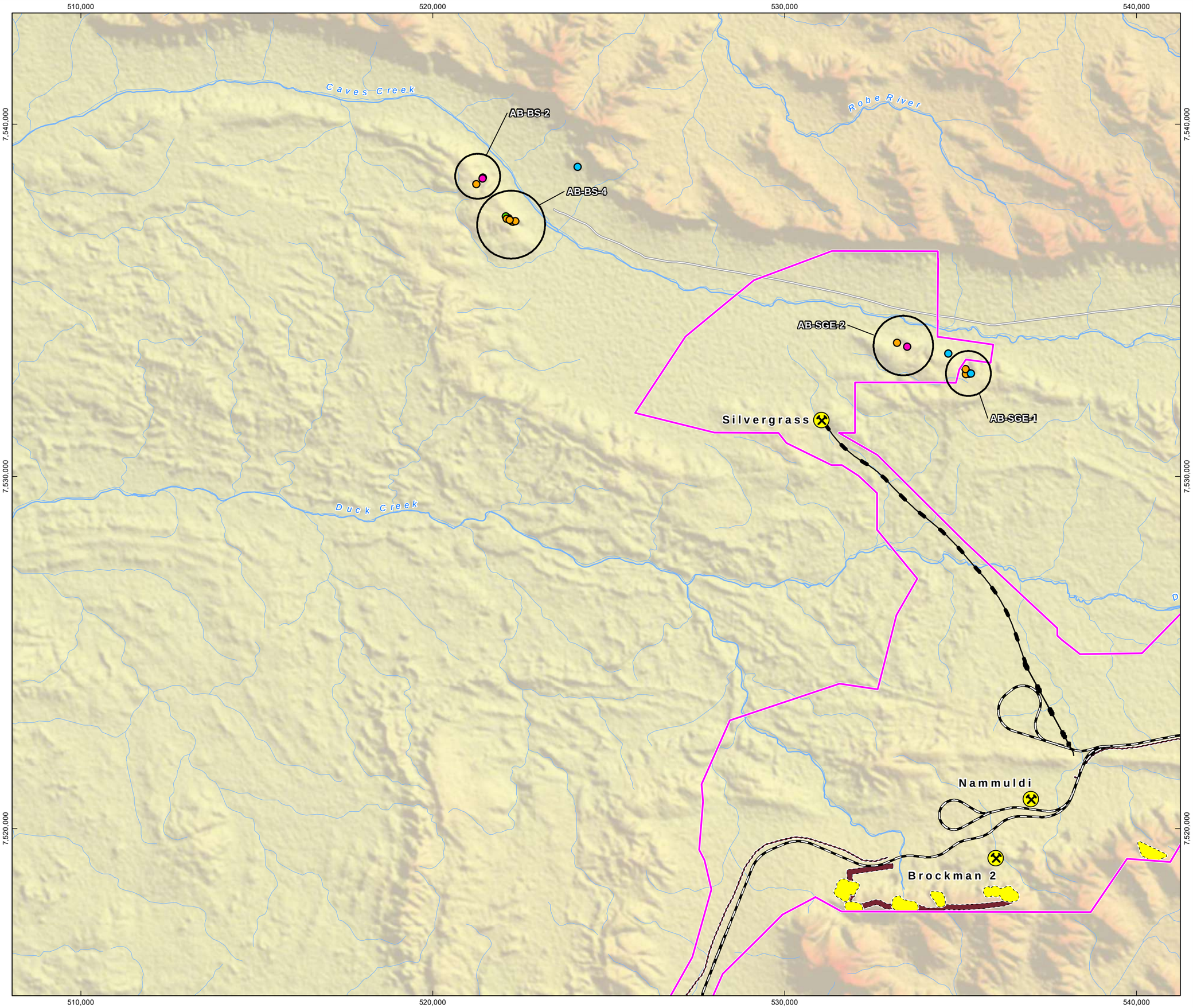
RioTinto

Figure 14-9
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



Legend

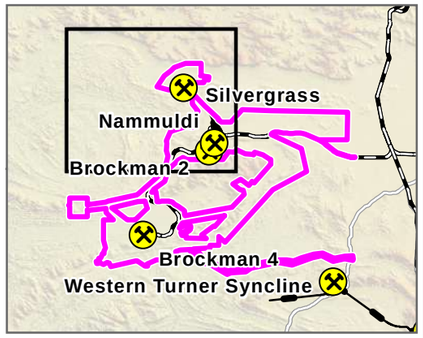
- Development Envelope
- Apartment Block

Ghost Bat Roosts

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



N

0 2 4 6

Kilometres

Map units in metres

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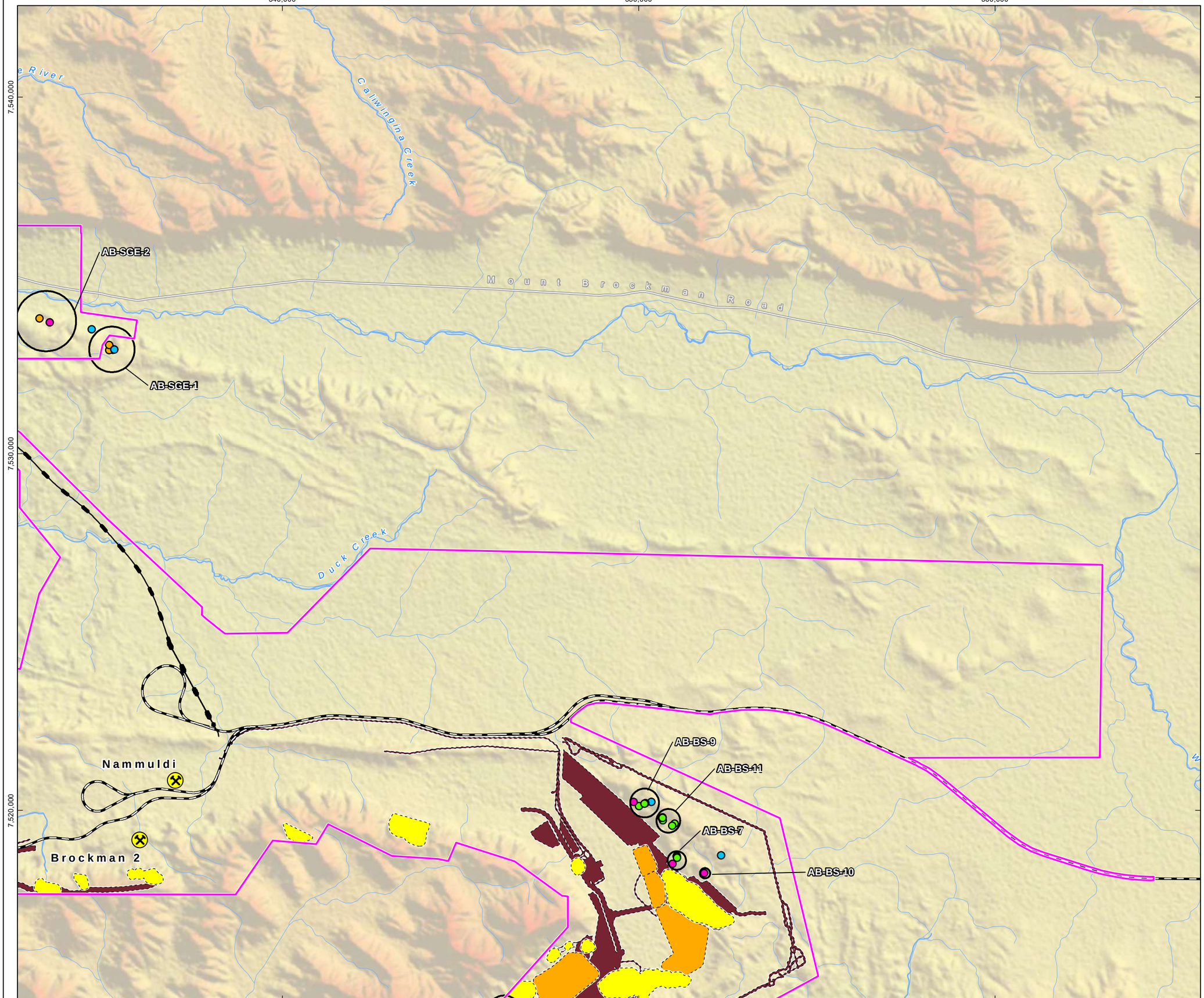
RioTinto

Figure 14-9
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



Legend

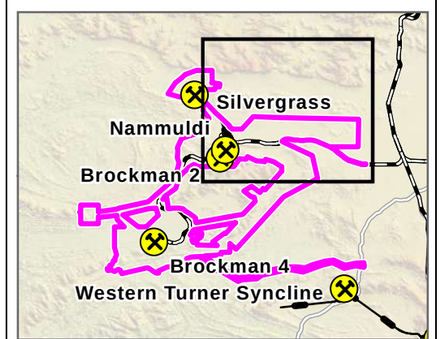
- Development Envelope
- Apartment Block

Ghost Bat Roots

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek



N

0 2 4 6

Kilometres

Map units in metres

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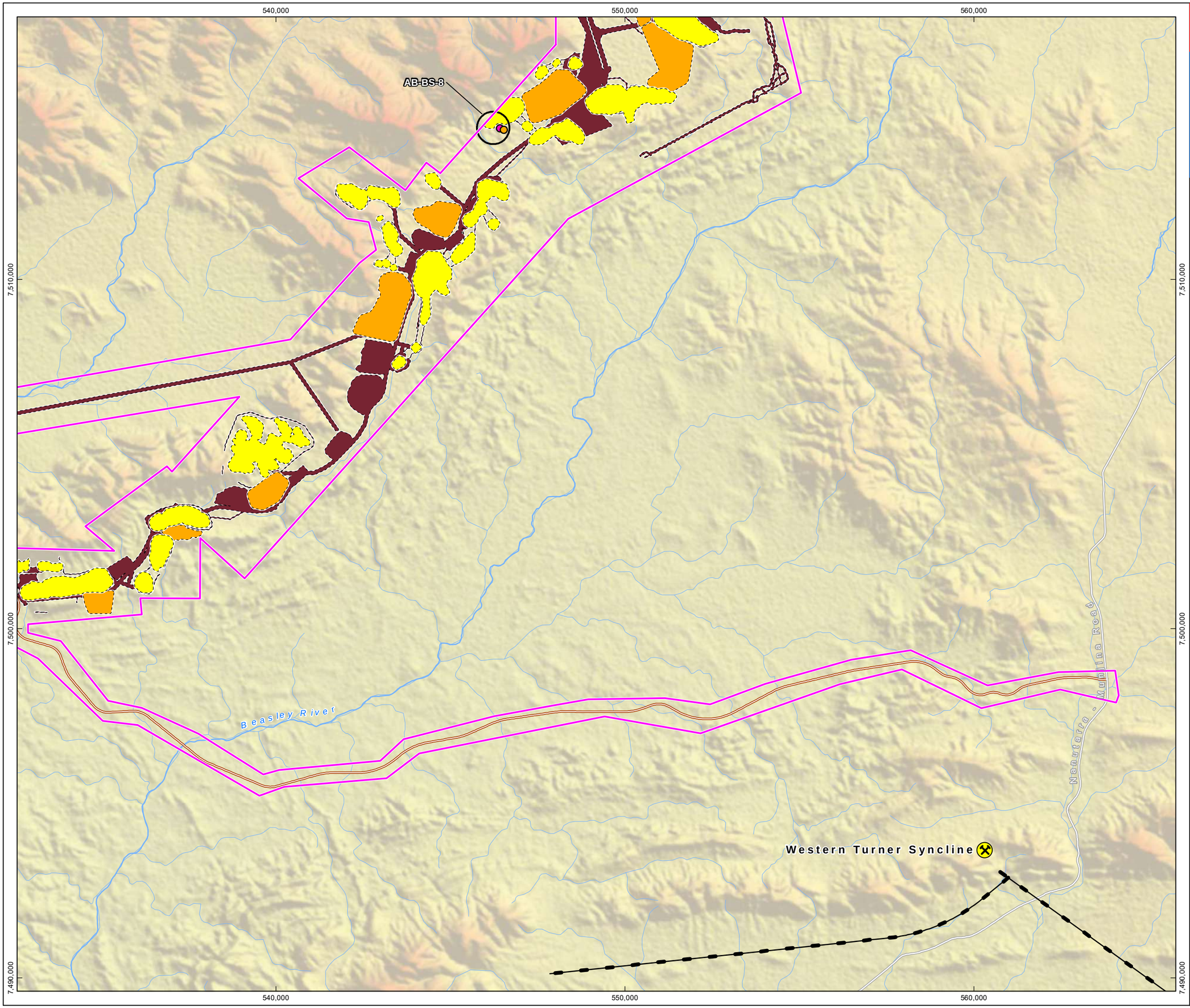
RioTinto

Figure 14-9
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



Legend

- Development Envelope
- Apartment Block

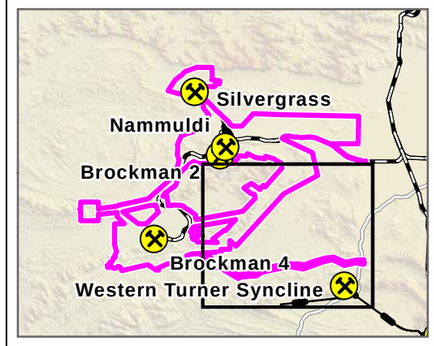
Ghost Bat Roots

- Apartment Block Category 2
- Apartment Block Category 4

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek
- Minor Creek



N

0 2 4 6

Kilometres

Map units in metres

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RioTinto

Figure 14-9
Conceptual Footprint in the Context of Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189740v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Apartment Block

Ghost Bat Roots

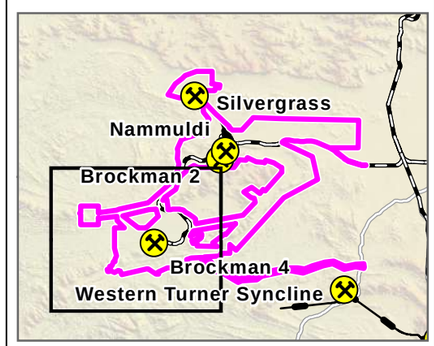
- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Site Access Road
- Major Creek
- Minor Creek

510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Boolgeeda Creek
Brockman 4
AB-BS-6
AB-BS-5
AB-BS-3
Beasley River West



N

0 2 4 6
Kilometres

Map units in metres

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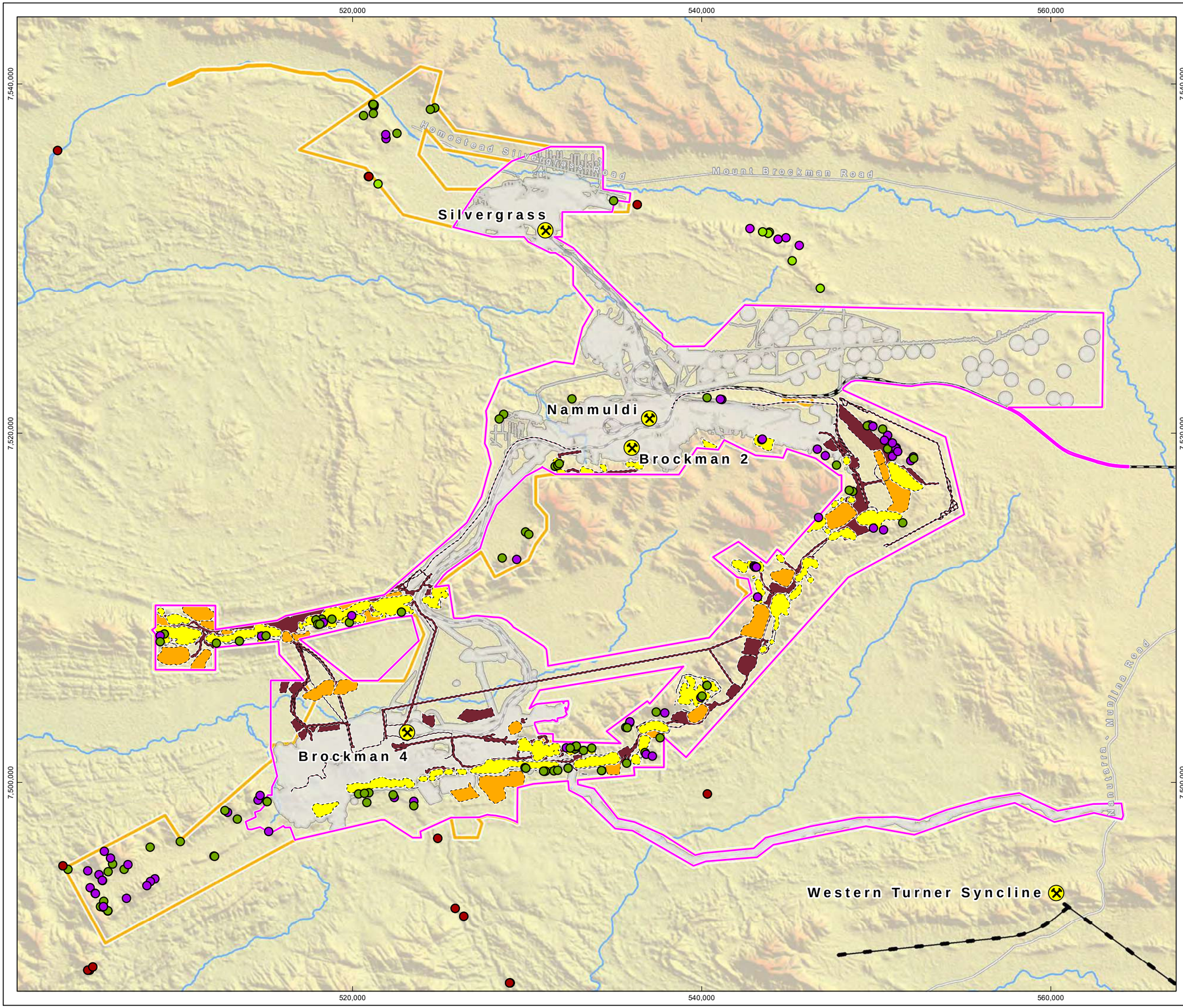

RioTinto

Figure 14-10
Conceptual Footprint in the Context of Category 3 and 4 Ghost Bat Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189730v1
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint

Ghost Bat Roosts

- Category 3
- Category 4
- Unclassified

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 14-11
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Homestead Silvergrass Road
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
White Quartz Road
Nanutarra - Munjina Road
Western Turner Syncline

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 14-11
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

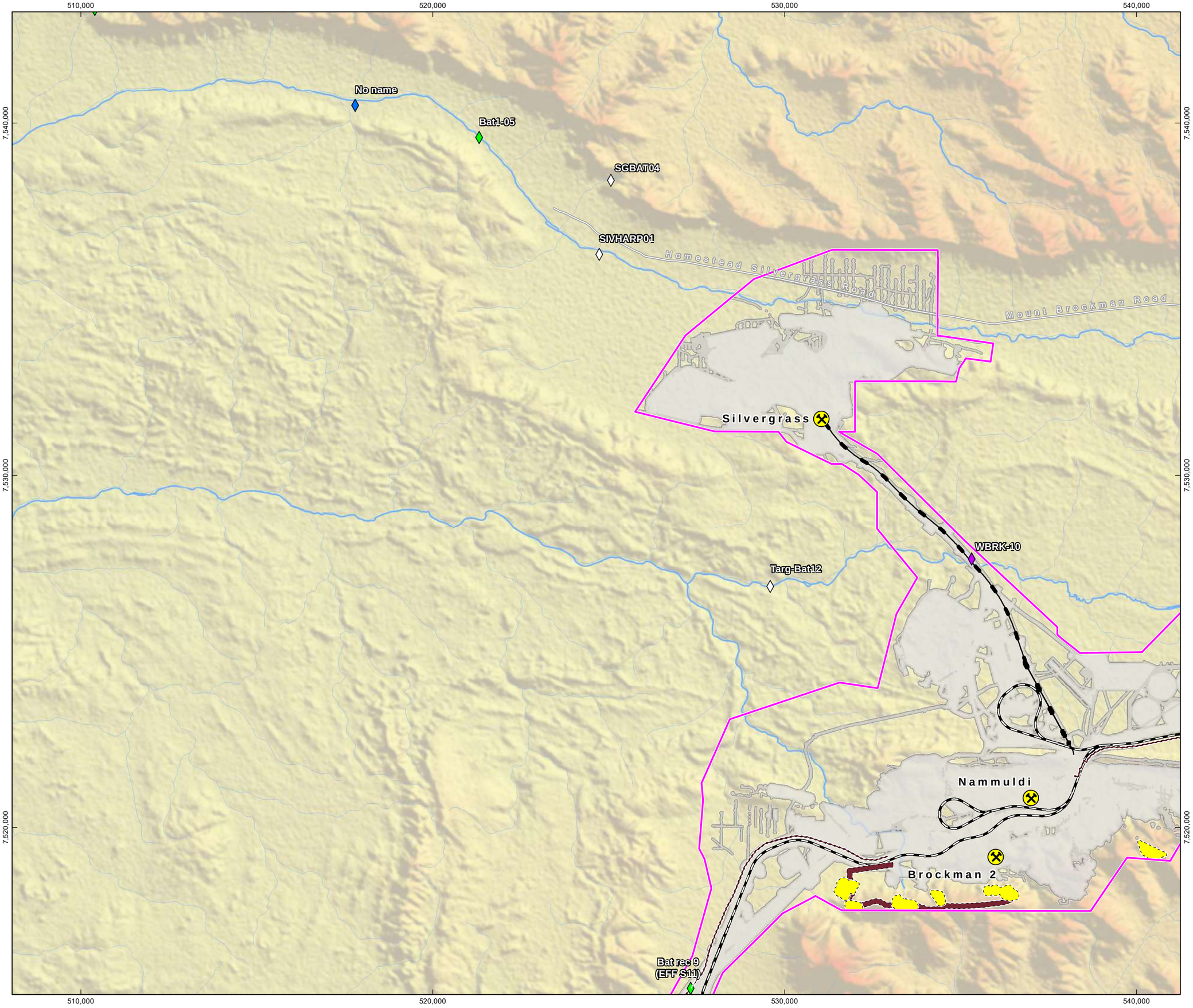
- Development Envelope
- Part IV Indicative Approved Footprint

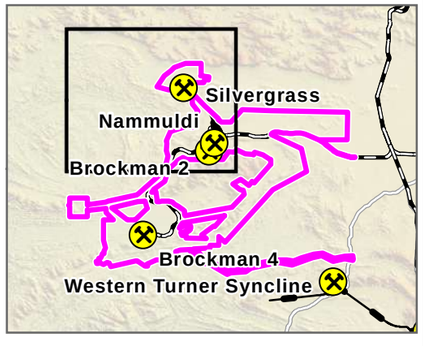
Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek





N

0 1 2 3
Kilometres

Map units in metres

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RioTinto

Figure 14-11
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

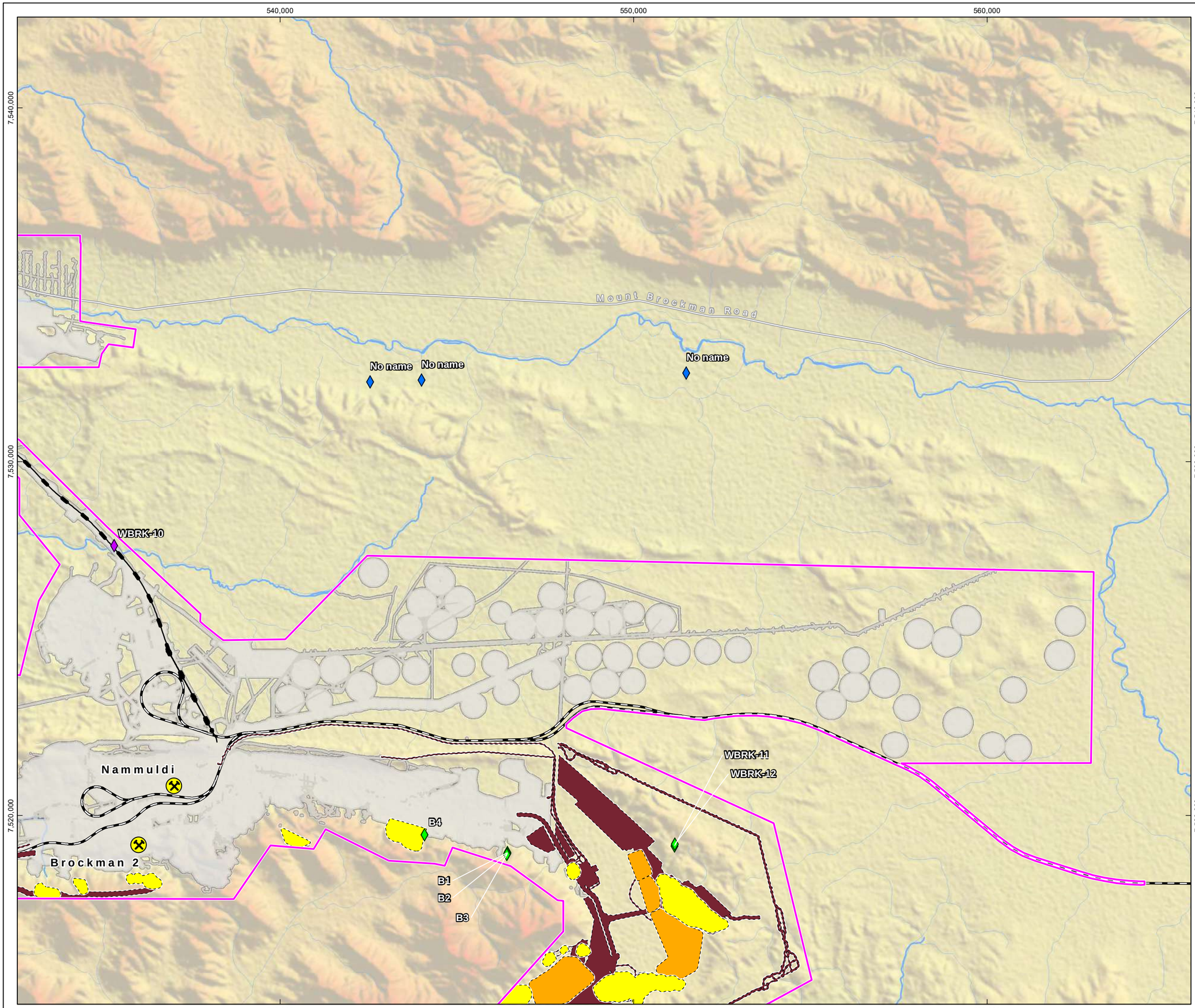
- Development Envelope
- Part IV Indicative Approved Footprint

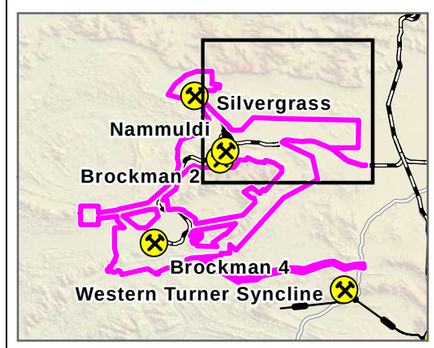
Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek
- Minor Creek





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0 1 2 3

Kilometres

Map units in metres

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RioTinto

Figure 14-11
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

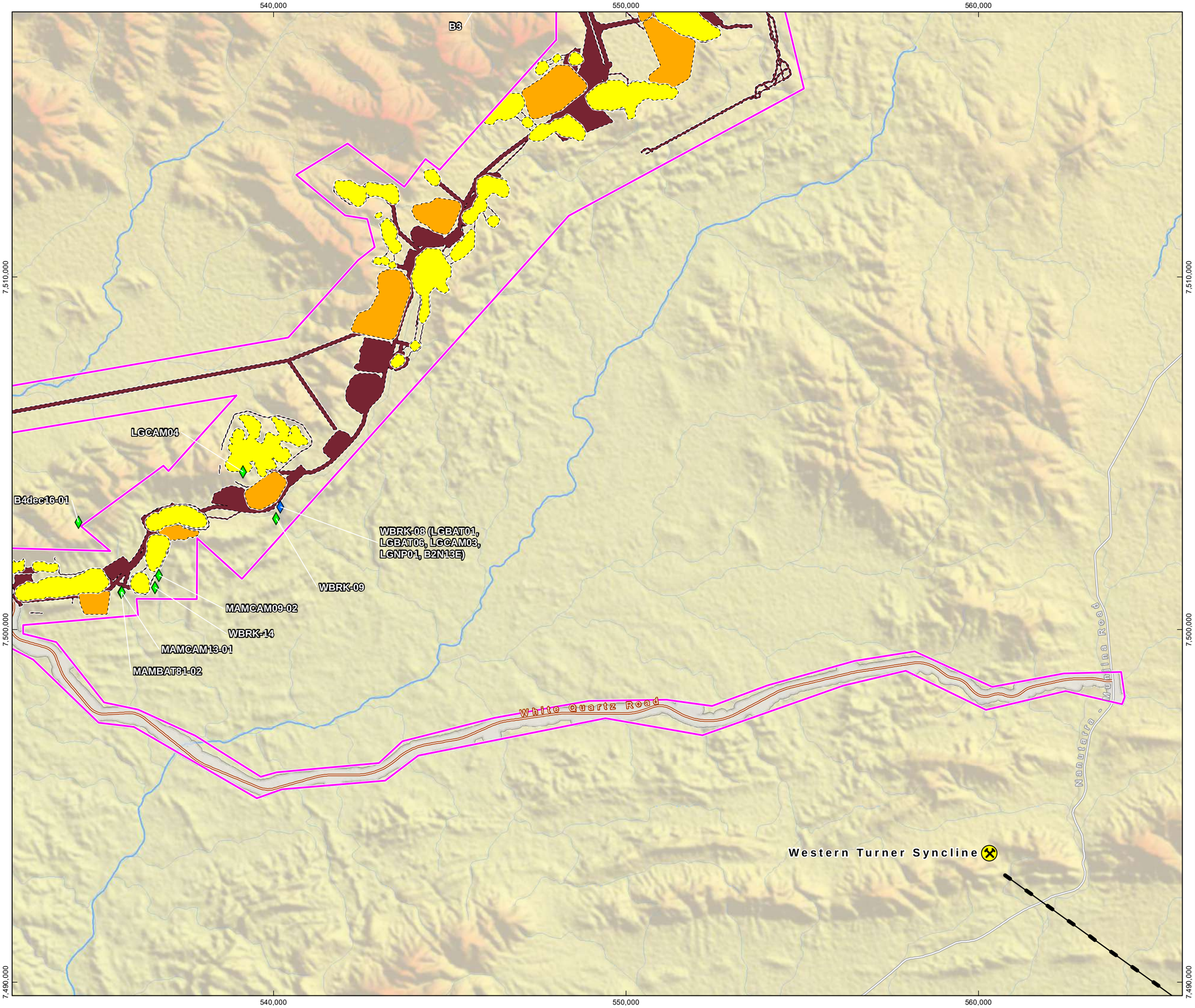
- Development Envelope
- Part IV Indicative Approved Footprint

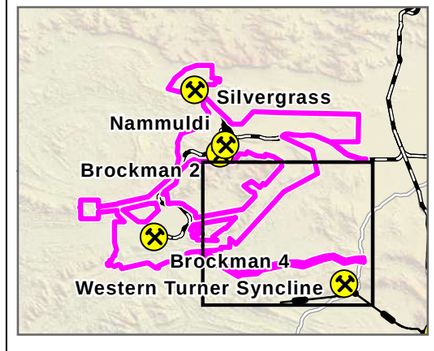
Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Conveyor
- Major Road
- Site Access Road
- Major Creek
- Minor Creek





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Kilometres

Map units in metres

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RioTinto

Figure 14-11
Conceptual Footprint in the Context of Water Features Recorded within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189722v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint

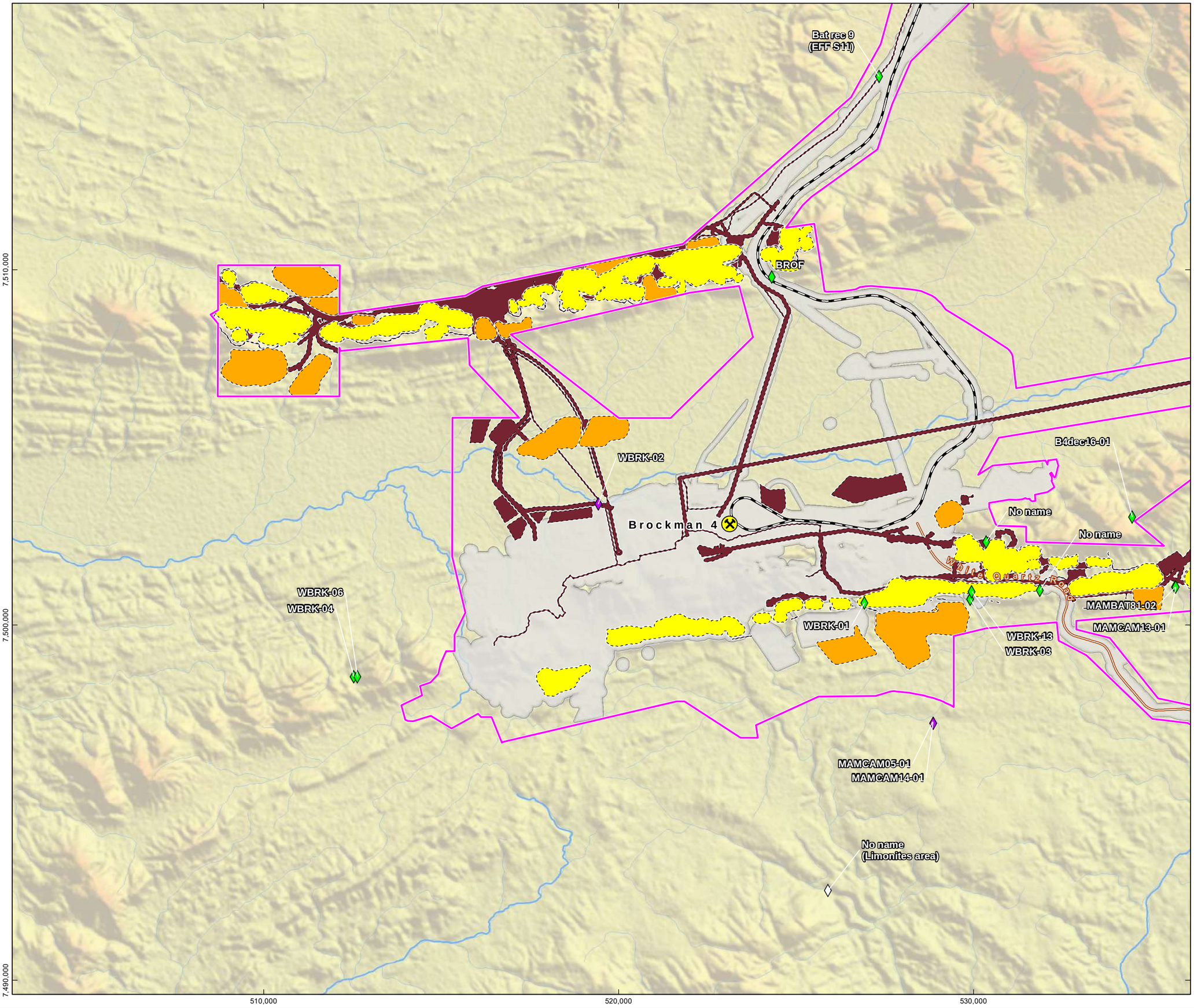
Water Features

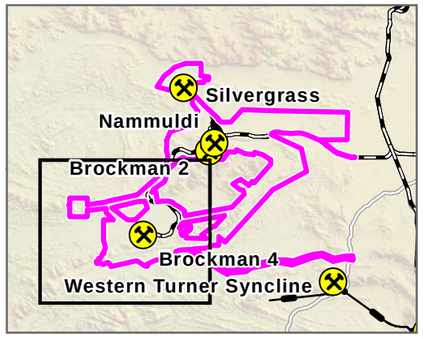
- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Site Access
- Major Creek
- Minor Creek





N

0 1 2 3
Kilometres

Map units in metres

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14.4.2. Indirect Impacts to MNES

Indirect impacts on MNES comprise:

- Degradation or alteration of habitat as a result of altered hydrological regimes
- Degradation or alteration of habitat features (caves) as a result of dewatering
- Habitat degradation associated with construction and operation activity, including dust and altered fire regimes
- Disturbance from light, noise and/or vibration, resulting in displacement of fauna associated with the construction activity and mining operations
- Disturbance resulting from an increase in abundance and diversity of pest species.

14.4.2.1. Degradation or Alteration of Habitat as a Result of Altered Hydrological Regimes

Surface water features within the survey area and Development Envelope provide important habitat for MNES fauna, such as the Pilbara Leaf-nosed Bat and Pilbara Olive Python. Many surface water features are surface water dependent, and the potential changes resulting from catchment loss and/or discharge have been assessed in Section 6. The hydrological assessment concludes that there will not be a significant change to the hydrological regimes of the pools (including Plunge Pool and Ridge Pool) and therefore, their habitat values will not be affected.

Discharge of surplus water to surface water systems is undertaken at many mining operations in the Pilbara. Vegetation may respond to prolonged discharge with increased growth and altered structure and provide additional temporary shelter and foraging habitat for fauna. Discharge of surplus water to creeks is expected to occur predominantly early in the mine life before mine pit storage is available. There will be no significant change to the existing hydrological regime at Boolgeeda Creek and Duck Creeks as a result of surface discharge. Riparian communities along these creeks are adapted to periodic inundation from surface water flows and any habitat changes are expected to be temporary, with a gradual adaptation of habitat to lower water availability upon cessation of dewatering. As a result, the effects of surplus water discharge are expected to be minor and temporary, and related impacts to foraging and dispersal habitat are not expected to be significant.

On this basis, the alteration of hydrological regimes as a result of the Proposal is not expected to degrade or alter fauna habitat to the extent that it significantly impacts the local fauna population. As such, this potential impact is not discussed further in this assessment.

14.4.2.2. Degradation or Alteration of Habitat Features (Caves) as a Result of Dewatering

Changes to groundwater levels due to dewatering have the potential to impact upon the suitability of caves as bat roosting habitat, particularly the Pilbara Leaf-nosed Bat which has specific temperature and humidity requirements for roosting.

Groundwater levels across the Brockman Syncline are generally deep and beyond the typical depth of vegetation root systems (>20 m bgl). Pre-mining groundwater levels within the Development Envelope range from 593 to 495 mRL. The range in depth is a reflection of both the variation in surface elevations combined with the local groundwater gradient.

Figure 6-4 presents pre-mining depth to water contours (metres below ground level – m bgl) for the Brockman Syncline aquifer. Depth to groundwater is variable due to significant topographic variation.

As such, habitat features such as Caves (which generally sit high up within the landscape) are unlikely to be connected to groundwater within the syncline and groundwater drawdown of the synclinal aquifers will not result in a change to the temperature and/or humidity of the caves.

On this basis, the degradation or alteration of habitat features (caves) as a result of dewatering is not expected to degrade or alter habitat features to the extent that it significantly impacts the MNES species. As such, this potential impact is not discussed further in this assessment.

14.4.2.3. Habitat Degradation Associated with Construction and Operation Activity

Dust

The Pilbara region is naturally dusty, and the Proposed Action is located in and near an existing operational mine. Mining may generate dust in high wind, reaching roosts or surface water pools. An air quality assessment was undertaken for the Proposed Action modelling against NEPM criteria, relevant for protecting human health but also useful in identifying potential effects on fauna (ETA 2021). The modelling found dust parameters may be elevated above criteria values in earlier stages of the Proposed Action and then decline.

The assessment shows Plunge Pool, a critical water source for the MNES species (Pilbara Leaf-nosed Bat and Pilbara Olive Python), may be subject to increased dust and could experience nine occasions within the year that are higher than the adopted health criteria. There are no environmental criteria regarding dust deposition on pools; therefore, the health criteria are expected to be conservative. Any potential dust generation is expected to be of short duration and will not permanently impact the MNES fauna that utilises this water source.

The assessment found high variability in predicted ground-level concentrations of dust parameters at the bat roosts included in the model, depending on proximity to mining operations; however, this does not constitute a prediction of concentrations inside these roosts, which may be significantly lower (ETA 2021). Although there will be elevated dust levels resulting from the Proposed Action, the Pilbara Leaf-nosed Bat and Ghost Bat populations are adapted to the dusty Pilbara climate. Dust generation will not result in permanent changes to fauna habitat. The Proponent will implement well-established dust management measures to minimise clearing and vehicle movement emissions. Associated risks are expected to be effectively reduced and not affect habitat values.

Continued implementation of existing dust suppression strategies to avoid prolonged dust emissions and dust cover on adjacent vegetation is expected to result in a low likelihood of MNES species being adversely affected by dust.

Fire

Changes to the fire regimes can result in habitat degradation, including critical breeding and supporting foraging and dispersal habitat for MNES species. The Proponent will implement standard fire management procedures (i.e., fire equipment in vehicles and training for site personnel). The Proposed Action is unlikely to change the fire regime of the Development Envelope.

The Proponent considers that by implementing mitigation measures addressing the risk of fire and dust (Section 8.5), indirect impacts can be appropriately managed; therefore, no significant impacts to MNES species are expected concerning habitat degradation associated with construction and operation activities.

Weeds

Weeds can reduce biodiversity, or adversely affect the integrity, conservation value and processes of ecosystems. They do this by, among other things, successfully out-competing native species for resources including available nutrients, water, space and sunlight. Exotic pasture grasses may disadvantage particularly the Norther Quoll because their unusually high density, biomass and rigidity may inhibit ground movements and hunting by Northern Quolls, and they may foster fire regimes that are more intense which are more likely to cause direct mortality, reduce availability of shelter and reduce habitat heterogeneity.

The Proponent considers that by implementing mitigation measures addressing the risk of weeds (Section 7.5), indirect impacts can be appropriately managed; therefore, no significant impacts to MNES species are expected concerning habitat degradation associated with construction and operation activities.

14.4.2.4. Disturbance from Light, Noise and/or Vibrations, Resulting in Displacement of Fauna

Light emissions from the Proposed Action are not expected to significantly alter nocturnal foraging activities as light emissions are already present in the current operational mining area at Greater Brockman. Additional light emissions from the Proposed Action are not expected to impact MNES species' breeding or foraging behaviour significantly as:

- Lighting will be designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020):
  - Permanent lighting will only be installed where required, mainly in pit and operational areas
  - 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 Debris Slope. Rocky Outcrop)
  - 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.

Species-specific potential disturbance from noise and/or vibrations is discussed in Sections 14.6 to 14.9.

14.4.2.5. Increase in Abundance and Diversity of Pest Species

The Cane Toad is an invasive species that threatens many MNES species but is not established in the Pilbara. The Proposed Action will not increase Cane Toads' potential to become established in the Development Envelope. Predation from feral Cats can have a severe effect on the MNES species. Feral Cats may also compete for food sources and den sites. To minimise the potential risk of feral Cats on MNES species, the Proponent will implement a feral Cat monitoring and control program as described in the EMP (Appendix B.3).

Fencing of attractant areas (waste disposal/landfill) would limit the increase of pest species within the Development Envelope by decreasing access and attraction. Borrow pits will also be designed and constructed to minimise surface water ponding after rehabilitation, limiting pest species' attraction. Additional management measures such as the regular covering of wastes and trapping of pest species would further reduce the impact to native fauna.

Whilst there is the possibility that the Proposed Action could result in an increased number of feral animals, it is more likely that the implementation of management measures (see Section 8.5) in an area that currently has limited feral animal control programs in place would result in a decrease in feral animal populations in the local area.

14.4.3. Cumulative Impacts to MNES

The Proposed Action will contribute to cumulative regional impacts on MNES fauna habitat and MNES species in the Development Envelope. This is discussed further in Section 8.

14.5. Summary of Proposed Mitigation Relevant to MNES

A summary of the Proposed management of MNES fauna, including avoidance and minimisation, is provided in Figure 14-19 and outlined in the EMP (attached in Appendix B.3).

Table 14-14: Summary of Residual Impacts to MNES Fauna Species Following Implementation of Management Mitigation Measures

Potential impact	Avoidance	Minimisation	Rehabilitation	Residual impact

Loss of habitat	The Proposed Action has been designed, where practicable, to avoid impacts to MNES habitat, including:
	• Critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning, roosting and breeding) habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python
	• Supporting Major and Minor Creekline, Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat within the home range of the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python.
	In addition, the Proposed Action has been designed to avoid impacts to the following significant habitat features:
	• A cluster of seven caves at the BS1 assessment area ensures east-west connectivity is maintained across the ridgeline
	• Apartment block caves within the Lens G assessment area through the removal of satellite deposits
	• Plunge Pool through the removal of BWT mining at BS3 deposit
	• Ghost Bat roosts, including:
	  ○ One confirmed maternity (category 2) roost
	  ○ Seven potential maternity (category 2) roost
	  ○ Sixty-four (64) day, potential day and unknown (category 3) roosts
	  ○ Thirty-four (34) night and potential night (category 4) roosts
	• The known Pilbara Leaf-nosed Bat Upper Beasley River Roost (UBRR) (Outside the Development Envelope).
	Other avoidance measures include:
	• Establishment of MEZs within MRZs around 106 significant Ghost Bat roosts, critical habitat and significant water features
	• MEZs within MRZs will be included in the Proponent's GIS system to ensure known locations are avoided
	• The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system
	• Pre-clearance surveys for significant fauna, including flushing all bats from known roosts and sheeting entrances to prevent return before ground disturbance occurs.
		The Proposed Action will minimise impacts on critical denning, roosting and shelter habitat through the following:
		• Implementation of upper clearing limits for Gorge/Gully and Debris Slope/Rocky Outcrop habitat types
		• Application of blasting (PPV) limits to apartment block, isolated category 2 and retained category 3 roosts to ensure structural integrity is maintained as detailed in Table 14-20 and the EMP (Appendix B.3)
		• Implementation of ongoing Geotechnical assessment and echolocation, temperature and humidity monitoring of significant caves within the Development Envelope to ensure continual usage, as detailed in the EMP (Appendix B.3).
			The MCP (Appendix B.4) 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:
			• Vegetation that is known to provide food or shelter
			• Retaining and replacing woody debris
			• Retention of leaf litter using small-scale topography
			• Introducing in-situ rock features.
			Rehabilitation will be conducted following the *Rio Tinto Iron Ore 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 331 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning, roosting and breeding) habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python
				• Clearing approximately 140 ha of supporting Major and Minor Creekline (foraging and dispersal) habitat within the home range of the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bats and Pilbara Olive Python
				• Clearing approximately 2,806 ha of supporting Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat for the Pilbara Leaf-nosed Bat and Ghost Bat

Fragmentation of fauna habitat	• The Development Envelope and Conceptual Footprint have been modified during the design phase to avoid, where possible fragmentation of significance vertebrate fauna habitat.	• The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system.	The MCP includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms are stable and consider ecological and hydrological factors including habitats previously fragmented.	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
	• Significant corridors in different landforms such as ridges, hillsides and creeklines will remain in place to allow movement around the mining area and through the landscape thus maintaining habitat connectivity, particularly between the three areas enclosed by the Development Envelope.	• Mining will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement. • Culverts, which are often used by fauna as corridors, will be installed along linear infrastructure allowing for continued dispersal. • On tracks that cross drainage lines, no windrows will be established within the drainage line in order to maintain natural free flow of water and minimise barriers to fauna which use drainage lines for dispersal. • Windrows on all roads and tracks will be kept as low as possible, where safety regulations allow, to allow fauna to cross the road as quickly as possible. • The Proponent will undertake feral animal management on site, in particular for cats which are known to occur within the area. • Progressive rehabilitation of disturbed areas will be prioritised in order to re-establish vegetation cover and connectivity. • Larger sized rocks will be stockpiles so as to recreate fauna habitat features during rehabilitation such as rocks and crevasse	Habitat elements considered part of the rehabilitation design includes: • Vegetation is known to provide preferred food or shelter preference, particularly for significant fauna. • Retaining and replacing woody debris • Managing feral predators and herbivores across both reference and rehabilitated areas • Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore 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.	
Loss of fauna individuals	The Proponent will avoid impacts to individual MNES species by: • Establishing MEZs within MRZs around retained Ghost Bat Caves in accordance with Table 14-20 • Barbed wire fences will be avoided in most instances. If barbed wire fencing is required (due to legislative, safety or pastoral requirements), the top strand will be replaced with plain wire, and reflectors will be placed on the top wire to help prevent the entanglement of bats.	The Proponent will minimise impacts to individual MNES species by: • Ensuring most light vehicle movements outside of the operating mine area occur during daylight hours to minimise interaction with nocturnal species • Undertaking progressive clearing to allow fauna to migrate away from clearing activities or machinery movements • Clearing will commence, where possible, from a disturbed vegetation edge to an undisturbed area (to encourage mobile fauna to relocate to adjacent areas naturally). • The implementation of speed limits on unsealed roads and tracks to reduce dust creation based upon a risk assessment that considers environmental values (in addition to safety/other required legislation). Speed limits on unsealed roads to not exceed 60 km/h. Roads and tracks signposted with speed limits and warnings of fauna in areas identified as having high value for MNES fauna. • Removing roadkill from trafficable areas • Undertake awareness training to identify conservation 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) • The top edges of artificial water source, trenches and borrow pits will be sloped to enable fauna egress.	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
Habitat degradation associated with construction and operation activity, including dust and altered fire regimes	Clearing activities will not be undertaken when fire danger ratings are severe or high.	The Proponent will: • Undertake dust suppression within the Development Envelope to minimise disturbance to fauna habitats. These measures will include but are not limited to, water carts with water sourced from dewatering activities and sprayers on crushers. • 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 restricted from accessing rehabilitated surfaces except for management purposes • 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.	No specific closure or rehabilitation actions are proposed.	The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.
Disturbance from light, noise or vibration and possible displacement of fauna associated with the construction and operation of the mine	The Proponent will ensure that vibration limits will apply to the apartment block and isolated category 2 and 3 roosts within the Development Envelope to manage vibration impacts and maintain significant roosts' structural integrity. These limits are outlined in Table 14-20 and will be managed through the EMP (Appendix B.3).	The Proposed Action has been designed to minimise noise impacts at caves through MRZ implementation as per Table 14-20 for six apartment blocks, two isolated category 2 and retained category 3 and 4 caves. The Proponent will: • Permanent lighting will be installed only where 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, MRZs, significant caves, critical habitat) • Temporary lighting (e.g., trailer mounted units) may be required to provide a safe working environment for short periods, where practicable, and while still providing a safe working environment; these will be positioned to minimise direct light spill into sensitive areas • Ensure equipment design is specified to be within Australian standard noise limits.	No specific closure or rehabilitation actions are proposed	The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.
Disturbance resulting from an increase in abundance and diversity of pest species	No specific avoidance measures are proposed.	The Proponent will: • Fence landfills and regularly cover putrescible wastes • Implement feral animal control as required, in co-operation with regional control programs and the Traditional Owners.	The Proponent will design, and construct borrow pits to minimise surface water ponding after rehabilitation.	The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.

14.6. Northern Quoll (*Dasyurus hallucatus*)

14.6.1. 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 – 1120g, with males being larger than the females (Dunlop et al. 2017).

14.6.2. Habitat Preference and Distribution

The Northern Quoll is currently restricted to five regional populations across Queensland, the Northern Territory and Western Australia on the mainland and offshore islands (DotEE 2019). Northern Quolls occupy a variety of habitats such as iron and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats, dissected rocky escarpments, open forest of lowland savannah and woodland (Braithwaite and Griffiths 1994, Oakwood 2002 and 2008, cited in Biologic 2020d). Areas of rocky habitat are preferred due to protection from predators and resource availability (Braithwaite and Griffiths 1994 and Oakwood 2002, cited in Biologic 2020d).

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 (DotEE 2019). In the Pilbara, the most recent records have come from the Rocklea, Macroy and Robe land systems (DotEE 2019). 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 (DotEE 2019).

DBCA has been conducting the Pilbara Northern Quoll Monitoring Project since 2012 to improve understanding of the distribution, ecology, abundance and demographics of the Northern Quoll in the region (Rangelands 2018; Dunlop et al. 2019). Northern Quoll records from this project are uploaded to the DBCA online government database NatureMap. Extensive evidence of this species in the form of scats and motion camera captures have been identified in Karijini National Park, approximately 90 km east of the Development Envelope (Dunlop et al. 2019). The Pilbara Northern Quoll Monitoring Project has confirmed an eastern range extension of over 200 km into Karlamilyi National Park (Rangelands 2018).

14.6.3. Key Threats and Recovery Actions

14.6.3.1. 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).

14.6.3.2. 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 (the Proponent) 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 8-23 provides mitigation that the Proponent will implement to reduce impacts on this species and habitat.

14.6.4. Important Populations and Critical Habitat

14.6.4.1. Important Population

Populations that constitute an 'important population' for the Northern Quoll include (DoE 2016a):

- 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.

14.6.4.2. 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 any clearing of these habitats is likely to be less significant.

DAWE 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.

14.6.5. Occurrence within and Surrounding the Development Envelope

The survey area and Development Envelope are located near the southern extent of the current mapped distribution of the Northern Quoll (Stantec 2020a), with DAWE records of the species spread only sporadically through this part of the Hamersley Ranges (Biologic 2020d; DoE 2016a).

Northern Quolls have been recorded on 62 occasions within the survey area between 2019 and 2021 via a variety of sampling methods, including trapping (24), camera traps (10) and secondary evidence (comprising scats (27) and tracks (1)). Of the 24 captures, 18 were considered unique individuals (seven females, eight males and three unidentified) (Biologic 2022a) (Figure 14-12).

Despite considerable sampling effort throughout the survey area to date, records of the species are relatively sparse with only 11 scats being recorded within the Development Envelope. The exception to this is the population occurring outside of the Development Envelope at Vivash (southwest of BS4 assessment area), which is considered a high-density population based on the number of individuals recorded over several sampling events and, therefore, an important population as defined by DoE (2016a).

14.6.6. Habitat within and Surrounding the Development Envelope

Critical (denning and shelter) habitat for the Northern Quoll occurs within the survey area within the Gorge/Gully and Debris Slope/Rocky Outcrop habitat types (Biologic 2022a). Major and Minor Creekline habitat types within 1 km of known Northern Quoll records provide supporting (foraging and dispersal) habitat. Other habitat types within the survey area provide limited foraging and dispersal habitat and are considered of low significance (Figure 14-13).

No instances of denning and/or breeding were recorded within the survey area or Development Envelope during surveys and/or opportunistically (Biologic 2020d, Biota 2019d, e, f and Stantec 2020a).

The proposed clearing of these habitats has been minimised, and clearing is considered a significant residual impact and will be offset

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Figure 14-12
Northern Quoll Records Within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189723v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

Legend

- Development Envelope
- Survey Area

***Dasiyurus hallucatus* (Northern Quoll)**

Sampling Method

- Cage trap
- Elliott trap
- Motion Camera (active)
- Motion Camera (passive)
- Opportunistic
- Secondary observation
- Other

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 14-13
Potential Northern Quoll Habitat within and Surrounding the Proposal
Overview

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
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Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Mount Brockman Road

Silvergrass

Nammuldi

Brockman 2

Brockman 4

Western Turner Syncline

Nanutarra - Munjina Road

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Figure 14-13
Potential Northern Quoll Habitat within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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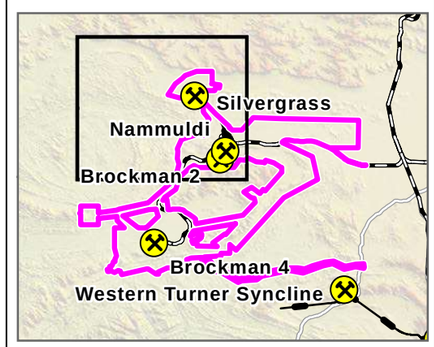
Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



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0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 14-13
Potential Northern Quoll Habitat within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

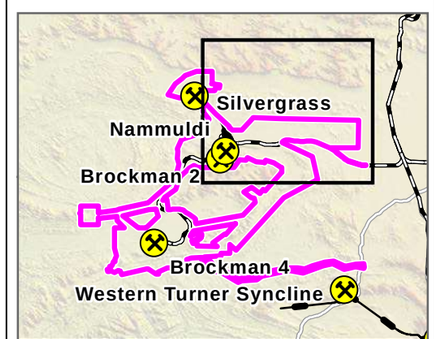
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



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Kilometres

Map units in metres

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Figure 14-13
Potential Northern Quoll Habitat within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



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0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 14-13
Potential Northern Quoll Habitat within and Surrounding the Proposal
Map D

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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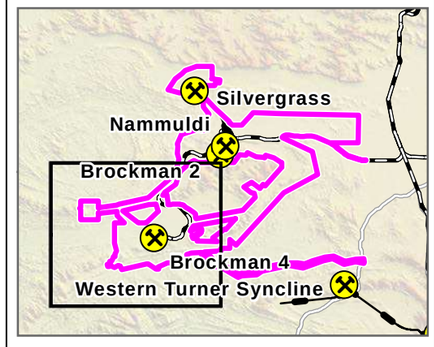
Legend

- Development Envelope
- Survey Area

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



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Kilometres

Map units in metres

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14.6.7. Assessment of Impacts

The Proposed Action may result in direct, indirect and cumulative impacts on 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 Section 14.4).

14.6.7.1. Loss of Fauna Habitat as a Result of Clearing

The Proposal will result in clearing up to a maximum of 331 ha (14% in the survey area and 23% of the Development Envelope) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitats.

Major and Minor Creekline within 1 km of known Northern Quoll records is considered supporting (dispersal and foraging) habitat within the species' home range.

The proposed clearing of Gorge/Gully and Debris Slope/Rocky Outcrop habitat within the Development Envelope and Major and Minor Creekline habitats within 1 km of a Northern Quoll record is considered a significant residual impact and is proposed to be offset (See Section 13). 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 high or moderate significance critical habitat for the species.

At least 1,128 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitat and 4,120 ha (76%) of supporting Major and Minor Creekline (foraging and dispersal) habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated survey area. 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 (Figure 14-15). Northern Quolls have been recorded within operational areas at Pilbara mine sites and so can disperse through these disturbed areas.

14.6.7.2. Fragmentation of Habitat

Habitat degradation and population isolation are identified in the National Recovery Plan for the Northern Quoll as key threats to the species (Hill and Ward, 2010). Vegetation clearing has the potential to result in fragmentation of fauna habitat, reducing the connectivity of fauna populations.

While Northern Quolls are present throughout the Hamersley Ranges, the Proposal area is regionally within low density areas of Northern Quoll populations, as modelled by Moore et al (2021) (Figure 14-14). In a regional context, higher density populations of Northern Quolls exist in places like the northern and western edges of the Hamersley Range, on Dolphin Island off Dampier, and in the large areas of granite outcropping south of Port Hedland.

Long-term work on the ecology of Northern Quolls in the Pilbara has shown that:

- Northern Quolls are highly mobile and are not currently constrained by major infrastructure in the Pilbara. Northern Quolls from all areas of the Pilbara are indistinguishable from each other by region, that is, there is enough movement across the region to maintain genetic mixing (Chan et al., 2020; Shaw et al., 2023).
- Northern Quolls will use artificial denning habitat if it has sufficient resources and protection from predators (Cowan et al., 2020).
- Northern Quolls use creeks and rivers as dispersal pathways (Shaw et al., 2023), meaning that retention of vegetation around creeks and rivers will be more important than across spinifex plains.

- Northern Quolls will use culverts under rail and roads as a protected pathway through these barriers (Creese, 2012).

The area containing Mt Brockman, which is likely to support Northern Quolls as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) so should provide sufficient habitat to maintain Northern Quolls living within it, taking into consideration that there will be sufficient opportunity for them to access the greater Pilbara population as shown in Figure 14-14.

To ensure environmental impacts are not greater than assessed, the Proponent suggest a maximum clearing extent for habitat types of high significance, as per Table 14-10. The Proponent proposes that these limits be conditioned within the MS. Habitat types of moderate and low significance are presented as approximate clearing extents. These limits will ensure that fragmentation of these habitats are minimised too as low as reasonably possible.

Habitat fragmentation is not expected to significantly affect Northern Quoll habitat connectivity or movement. Additionally, implementation of measures outlined in Table 14-14 will reduce the risk of direct impacts to individuals and/or critical habitat and ensure indirect impacts are minimised.

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Figure 14-14
Potential Distribution of the Northern Quoll as Modelled by Moore et al. (2021)

Drawn: L.Fuentes
Plan: RTIO-1012684v1
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:2,100,000 @A3
GIS.Team@riotinto.com

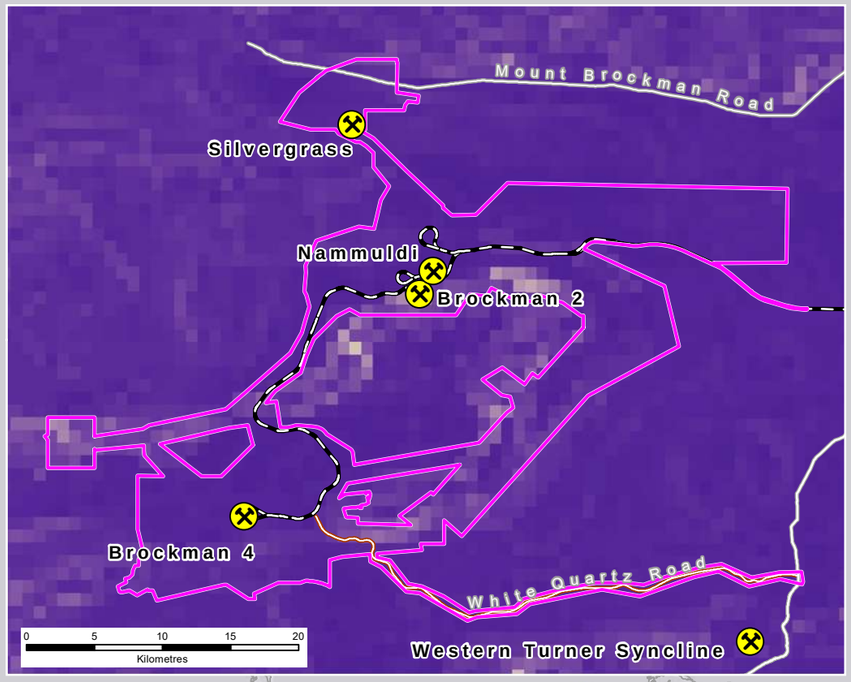
Legend

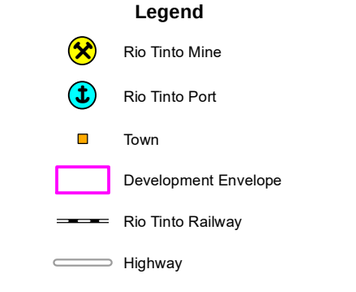
- Rio Tinto Mine
- Rio Tinto Port
- Town
- Development Envelope
- Rio Tinto Railway
- Highway
- Minor Road
- Site Access Road

Dasyurus hallucatus Distribution

High : 0.950361

Low : 0.000189836





N

0 15 30 45 60
Kilometres

Map units in metres

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Figure 14-15
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 14-15
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Map A

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

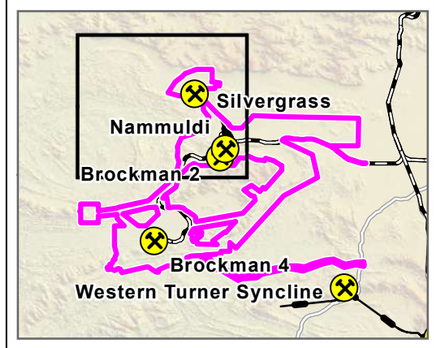
Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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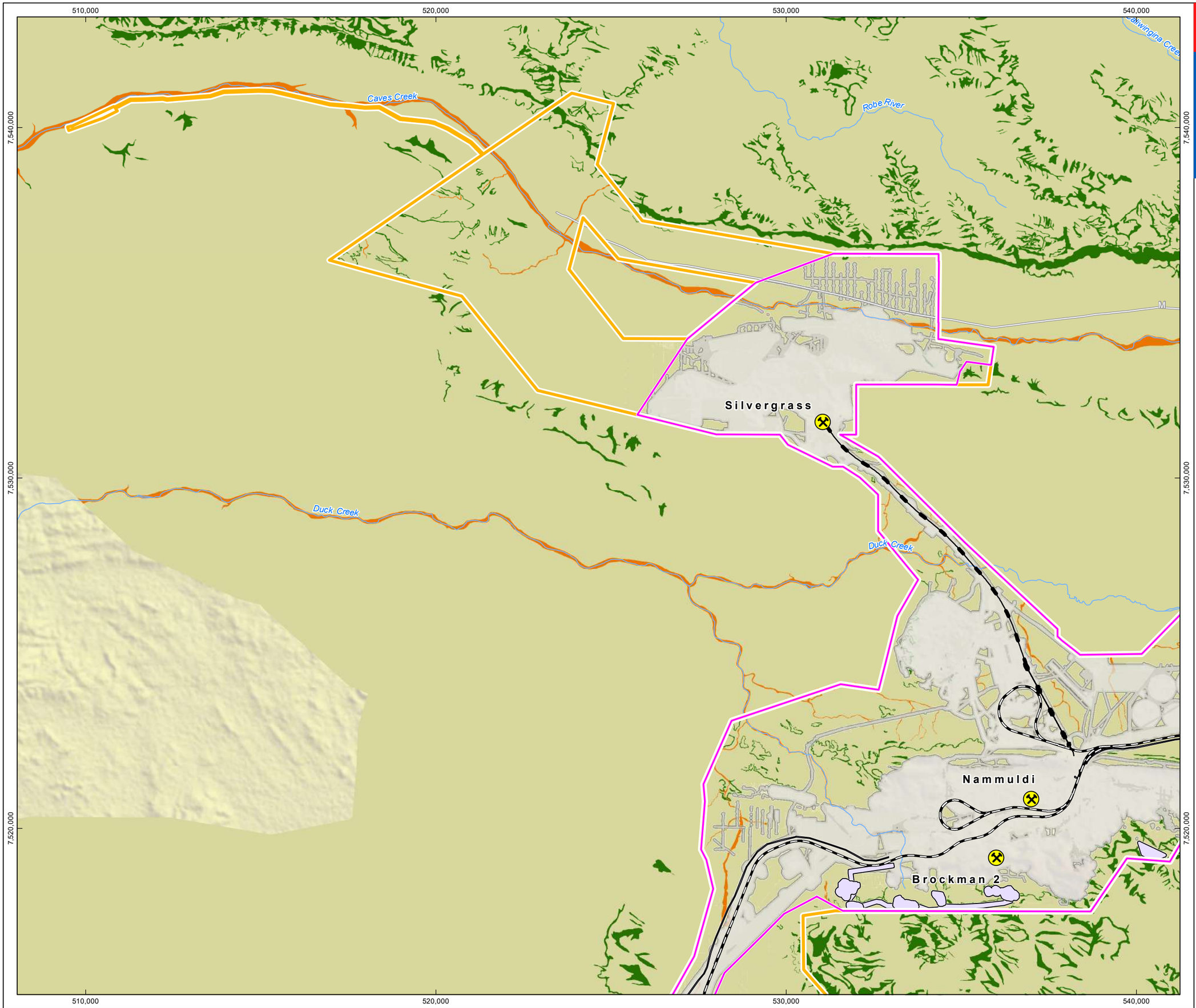

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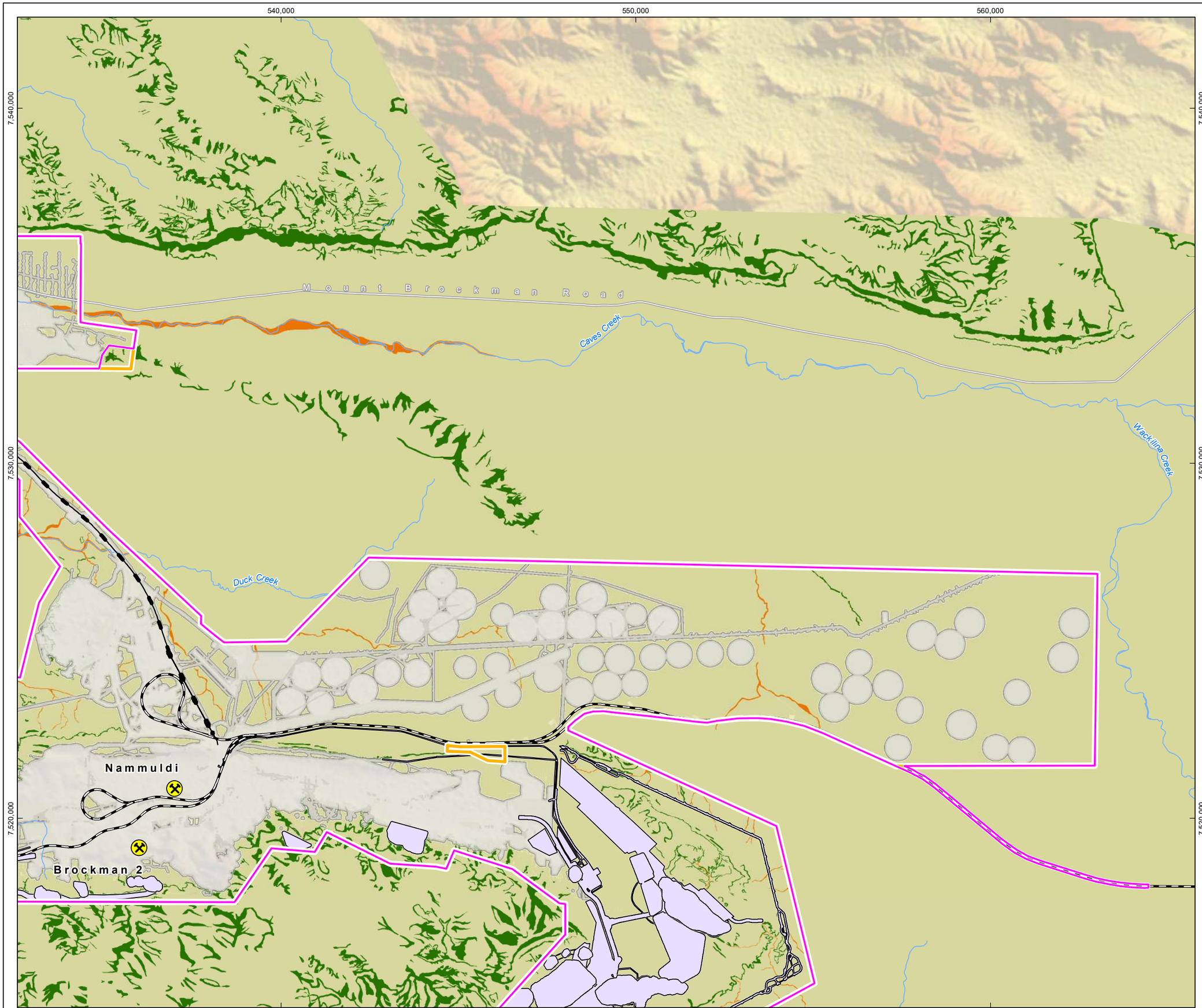
Figure 14-15
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com



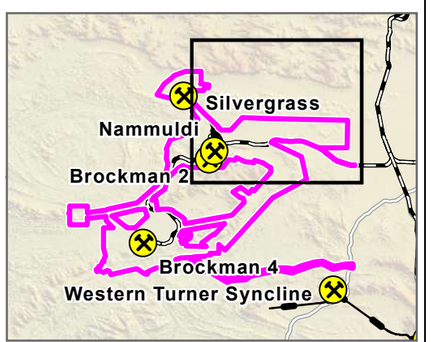
Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 14-15
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Map C

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 14-15
Habitat Remaining for Northern Quoll Dispersal During and Post Implementation of the Proposal Map D

Drawn: L.Fuentes
Plan: PDE0189724v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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Legend

- Development Envelope
- Survey Area
- Part IV Indicative Approved Footprint
- Conceptual Footprint

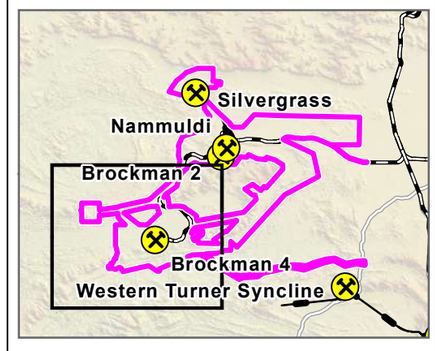
Northern Quoll Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek

510,000
520,000
530,000
7,510,000
7,500,000
7,490,000

Boolgeeda Creek
Brockman 4
Beasley River West



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0 1 2 3 4 5
Kilometres

Map units in metres

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14.6.7.3. 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 2017197]). Too-frequent fire can reduce the population size (DBCA 2019d). 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 2019b). The Proponent will implement safety procedures (i.e., fire equipment, training) to reduce fire risk within the Development Envelope.

After applying mitigation measures (see Section 8.5), no significant increase in the risk of habitat degradation from dust emissions or altered fire regimes is anticipated.

Weeds

Exotic pasture grasses such as gamba grass (*Andropogon gayanus*), Para grass (*Urochloa mutica*), Olive Hymenachne (*Hymenachne amplexicaulis*), perennial mission grass (*Cenchrus polystachios*) and annual mission grass (*Cenchrus pedicellatus*) may disadvantage the Northern Quoll because their unusually high density, biomass and rigidity may inhibit ground movements and hunting by Northern Quolls, and they may foster fire regimes that are more intense which are more likely to cause direct mortality, reduce availability of shelter and reduce habitat heterogeneity.

The Proponent considers that by implementing mitigation measures addressing the risk of weeds (Section 7.5), indirect impacts can be appropriately managed; therefore, no significant impacts to MNES species are expected concerning habitat degradation associated with construction and operation activities.

14.6.8. 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 14-15.

Table 14-15: Assessment of Significant Impacts to the Northern Quoll

Significant Impact and/or Referral Criteria	Assessment of the Significance of Impacts to Northern Quoll
Potential to lead to 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	Removing high significance Gorge/Gully and Debris Slope/Rocky Outcrop habitat will likely reduce the long-term carrying capacity within the Development Envelope for Northern Quoll. However, despite considerable sampling effort throughout the survey area, records of the Northern Quoll are sparse within the Development Envelope (Biologic 2022a). This suggests the species occurs at low densities and/or is only present intermittently or following optimal seasonal conditions (DoE 2016a). As such, the population within the Development Envelope is not considered an important population for the species' long-term survival (Biologic 2022a; DoE 2016a). Therefore, the Proposed Action is unlikely to lead to a decrease in the size of a population important to the species' long-term survival, thereby interfering with the recovery of the species.
Potential to reduce the area of occupancy of the species	'Area of occupancy' is defined as the area within a species extent of occurrence which is occupied by that species' (IUCN 2021). 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 Fragment a population important for the long-term survival 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 Development Envelope and the areas surrounding the Development Envelope, which will continue to support the overall Pilbara population of Northern Quoll. 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. 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 the species Result in the loss of habitat critical to the survival of the Northern Quoll	The Proposed Action will result in clearing up to 331 ha (22.7%) of high significance critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitat and 140 ha (11%) of moderate significance critical Major Creekline and Minor Creekline (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 1,128.6 ha (77%) of critical habitat and 1,083 supporting habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope/Rocky Outcrop habitats have been mapped within the

Significant Impact and/or Referral Criteria	Assessment of the Significance of Impacts to Northern Quoll
	extrapolated survey area. 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. The clearing of critical (high significance) habitat comprising Gorge/Gully and Debris Slope/Rocky Outcrop and supporting habitat comprising supporting Major and Minor Creekline habitats is considered a significant residual impact and is proposed to be offset (See Section 13).
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 331 ha (22.7%) of critical habitat within the Development Envelope and 140 ha (11%) of supporting habitat within the species home range; however, at least 1,128.6 ha (77%) of critical habitat and 1,083 supporting habitat will remain available in the Development Envelope and a further 11,491 ha in the surrounding area. The remaining habitat will continue to provide critical and supporting habitat for this species. Habitat removal will not 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 an annual plan or in response to significant increases in feral animal sightings. 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 survey area or 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 that affect the Northern Quoll. There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species to decline.

Significant Impact and/or Referral Criteria	Assessment of the Significance of Impacts to Northern Quoll
Potential interference with the recovery of the species	The proposed mitigation measures (Table 14-14) 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.

14.6.9. Consistency with Relevant Recovery Plan and Guidance

14.6.9.1. Recovery Plan

The National Recovery Plan for the Northern Quoll (Hill & Ward 2010) aims to minimise the rate of decline in Australia and ensure that viable populations remain in each of the major regions of distribution into the future. Table 14-16 discusses how the Proposed Action aligns with the objectives of this Recovery Plan.

Table 14-16: National Recovery Plan Actions 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	1.1 Maintain biosecurity of important offshore islands through quarantine measures on the mainland.	The Proposed Action does not involve transfers to offshore islands.
	1.2 Monitor offshore islands supporting Quoll populations to detect the presence of Cane Toads, Cats and any other potential invasive predator.	
	1.3 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	2.1 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 Hamersley region.
	2.2 Use information from Action 2.1 to assist surviving populations to recover in sympatry with Cane Toads.	
	2.3 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	3.1 Collect baseline data on population densities and monitor trends of Quolls at a series of key sites not currently occupied by Cane Toads	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).
	3.2 Investigate factors causing declines in Northern Quoll populations not yet affected by Cane Toads	
	3.3 Manage key Quoll populations in areas not currently affected by Cane Toads to halt population declines	
	3.4 Identify the effect of pastoral land management practices on Northern Quoll persistence	
	3.5 Interim fire management at potential key Quoll populations in areas not currently affected by Cane Toads	
	3.6 Refine models of the current and expected distribution of cane toads and Northern Quolls, incorporating predictions of climate change	
Halt Northern Quoll decline in areas recently colonised by Cane Toads	4.1 Continue research into the susceptibility of quolls to Cane Toad poisoning	The Cane Toad is not currently present in the Development Envelope.
	4.2 Test the efficacy of control measures for Cane Toads and whether they allow local persistence of Quoll populations	

Objective	Actions	Proposed Action Assessment
Maintain secure populations and source animals for future reintroductions/ introductions if they become appropriate	5.1 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 and Conservation Agreements.
	5.2 NT and WA to maintain captive breeding populations of Northern Quolls	
	5.3 Protection of key secure populations through protection of habitat in National Parks and Conservation Agreements	
	5.4 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	6.1 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	7.1 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.
	7.2 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	8.1 Develop new and promote existing materials for educating the public on the need for quarantine measures at important island habitats for quolls and along major routes westward into Western Australia	The Proponent will implement site inductions for all on-site personnel to raise environmental awareness and identify on-site threats to Northern Quoll populations.
	8.2 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	
	8.3 Implement a broader public education and awareness campaign on quolls and feral species (particularly Cane Toads and Cats)	
	8.4 Develop and implement public education and awareness campaign on land management threats to Quolls	

14.6.9.2. Conservation Advice

There is no approved Conservation Advice for Northern Quoll. The Commonwealth Listing Advice for the Northern Quoll (TSSC 2005) lists the following priority recovery and threat abatement actions required for the Northern Quoll:

- Minimise the impact of colonizing Cane Toads on the species
- Identify areas of critical habitat
- Investigate the need to establish a captive breeding program for the species
- Investigate the status of the species in Queensland, including the reasons for its survival following Cane Toad invasion.

The Cane Toad is currently not in the Pilbara, and the Proposed Action is unlikely to increase its chance of occurrence.

Critical habitat for the Northern Quoll has been identified within and surrounding the Development Envelope and impacts to those habitats have been minimised.

14.6.9.3. Threat Abatement Plans

Feral Cats have been recorded within the Development Envelope (Biota 2019d, Stantec 2020a). Mine sites can attract and 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 2015b).

A total of 36 weed species from multiple surveys have been recorded within the Development Envelope (Figure 7-13; Appendix D.7 Stantec 2021, Biota 2019a, Mattiske 2019 and Stantec 2019). All weed species are widespread throughout the bioregion. None represents a declared pest as listed under the *State Biosecurity and Agriculture Management Act 2007* (BAM Act), as a Weed of National Significance (WoNS) on the Western Australian Organism List database or as a weed listed under the TAP. The Proponent has well-established strategies for managing weeds at its Pilbara operations to minimise weed ingress and spread risks. Weed monitoring and management strategies have been and will continue to be implemented to minimise the risk of weed ingress. As such the Proposed Action will align with the TAP of reducing the impact on northern Australia's biodiversity by five listed grasses.

14.6.10. 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.

14.6.10.1. Significant Residual Impact

After application of mitigation measure the following significant residual impacts are predicted for the Northern Quoll:

- Clearing of up to 264 and 67 ha (27.9% and 13.0%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitats for the Northern Quoll. This clearing is proposed to be managed via upper limits of clearing as per Table 14-10 and will be offset as per Section 13
- Clearing of approximately 25 ha and 114 ha (4.4% and 14.9%) of supporting Major and Minor (foraging and dispersal) Creekline habitat for the Northern Quoll, when within the species home range. This clearing is proposed to be offset as per Section 13.

14.6.10.2. 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:
    - 264 ha of Gorge/Gully habitat within the Development Envelope
    - 67 ha of Debris Slope/Rocky Outcrop habitat with the Development Envelope.

- Minimise direct and indirect impacts from the Proposal on Northern Quoll habitat in accordance with the EMP.

The Proponent will implement the EMP as per Appendix B.3 to achieve these outcomes.

14.6.11. Conclusion

The significant residual impact, after implementation of the mitigation hierarchy, is clearing of up to 331 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitat and approximately 140 ha of supporting Major and Minor Creekline (foraging and dispersal) habitat for the Northern Quoll, when within its home range. Environmental offsets are proposed for this clearing and are discussed in Section 13. Subject to conditions and implementation of offsets (Section 13), 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.

14.7. Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

14.7.1. 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 11g 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).

14.7.2. Habitat Preference 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. 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 2016a). 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 category 1 and 2 roosts throughout the Pilbara region, including 17 known locations and 31 yet to be found. Thirty-eight are natural roosts in banded iron formations in the Hamersley Ranges and eastern Pilbara, and six are disused underground mines.

In the Pilbara, natural roosts are restricted to roosts formed in gorges where at least semi-permanent water is nearby (TSSC 2016a). Pilbara Leaf-nosed Bats typically roost in undisturbed roosts, deep fissures or abandoned mine shafts (Armstrong 2000, 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 2000, 2001; Bullen & 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 2000, 2001; Bullen & McKenzie 2011).

The Proponent commissioned Biologic to undertake a VHF tracking study on the Pilbara Leaf-nosed Bat at another of their mine sites (Greater Paraburdoo) (Biologic 2020e). The study's objective was to understand the bat species' movement better and determine significant habitat types regarding foraging habitat (Biologic 2020e). 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 occurred outside of the detection range. The bats were regularly detected in plains habitat located to the north and north-east of the Paraburdoo Ranges, as well as to the south of the Western Range. The data collected from the study suggested that the Pilbara Leaf-nosed Bats' preferred

foraging habitats were 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.

14.7.3. Key Threats and Recovery Actions

14.7.3.1. Key Threats

Known threats to the species 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 (TSSC 2016a).

14.7.3.2. Recovery Actions

There are currently no adopted or made recovery plans for the Pilbara Leaf-nosed Bat.

14.7.4. Important Populations and Critical Habitat

The Pilbara and upper Gascoyne population of Pilbara Leaf-nosed Bat are recognised as an important population composed of one isolated interbreeding population of national significance that shows genetic divergence (TSSC 2016a). A total of 526 records of the Pilbara Leaf-nosed Bat occurrence are spread throughout the region (DotEE 2019).

Habitat critical to the survival of the Pilbara Leaf-nosed Bat is ranked according to three priority levels applied to diurnal roosts, as follows (TSSC 2016a):

- Permanent diurnal roosts (Priority 1) – occupied year-round and likely the focus for some part of the 9-month breeding cycle
- Non-permanent breeding roosts (Priority 2) – evidence of usage during some part of the 9-month breeding cycle (July-March)
- Transitory diurnal roosts (Priority 3) – occupied for part of the year only, outside of the breeding season (April-June).

One other habitat is not considered critical habitat, but is considered important for the persistence of the species in the local area, accordingly and given a lower priority ranking (TSSC 2016a):

- Nocturnal refuge (Priority 4) – occupied or entered at night for resting, feeding or other purposes, with perching not required (excludes overhangs).

Observations also support an assumption that the condition of specific foraging habitats is particularly important for sustaining nearby colonies of the Pilbara Leaf-nosed Bat, with these habitats also ranked in order of priority (TSSC 2016a):

- Gorges with pools (Priority 1) – watercourses through upland areas bounded by sheer rock walls for parts of their length, often containing pools that remain for weeks or months, sites of relatively large biomass production sometimes containing caves
- Gullies (Priority 2) – primary drainage with limited riparian development in upland rocky habitats, sometimes containing small pools that may last for weeks, with less biomass production than Priority 1 gorge habitat
- Rocky outcrop (Priority 3) – areas of exposed rock at the top of rocky outcrop and mesa hills containing caves, overhands, and boulder piles in the granite terrains
- Major watercourses (Priority 4) – riparian vegetation on flat land plus the riverbed's main gravelly or sandy channel, sometimes containing pools that persist for weeks or months and generally supporting higher biomass productivity than the surrounding habitats

- Open grassland and woodland (Priority 5) – dominated by Triodia, on lowland plains, colluvial slopes and hilltops.

Robert Bullen, a Bat expert (from Bat Call WA), has undertaken a further assessment of the roosts within the Development Envelope (Bat Call WA 2021a). Bat Call WA (2021a) assessed each roost in the Development Envelope and assigned it a roost category (this differs from the guideline terms above). The full roost category definitions are in *A review of Pilbara Leaf-nosed Bat Ecology, Threats and Survey Requirements* (Bat Call WA 2021b), noting that these differ slightly from the definitions provided in the survey of the Development Envelope (Bat Call WA 2021a).

Roost classification:

- Category 1 – Permanent diurnal roosts which are maternity roosts where seasonal presence of young is proven
- Category 2 – Permanent diurnal roosts which are occupied year-round but without proven presence of young
- Category 3 – Semi-permanent diurnal roosts which are occupied during some part of the year, but not year-round
- Category 4 – Nocturnal refuges which are occupied or entered at night for resting, feeding or other purposes.

The Bat Call WA (2021a) categories have been used to prioritise the application of the mitigation hierarchy to roosts. The roost priorities assigned in the guidelines (TSSC 2016a) are still used throughout this ERD.

Based on the conservation advice and VFH tracking program at Brockman, this assessment has used the term critical habitat in relation to rocky habitats that support breeding and roosting and defined supporting habitat as foraging and dispersal habitat within 10 km radius of Upper Beasley River Roost and Plunge Pool.

14.7.5. Occurrence within and Surrounding the Development Envelope

Since sampling for the Pilbara Leaf-nosed Bat began in 2005 within the survey area, 70 records of the species within the survey area have been detected by ultrasonic recorder. Additionally, in the tracking program undertaken for the Proposal, ten individuals tagged by Biologic (2022c) were recorded from 1,972 detections within the survey area by VHF tracking (Biologic 2022a). The tracking program revealed that most of the bats foraged within 11 km of the Upper Beasley River Roost (located within an excised area approximately 670 m outside of the Development Envelope). Foraging occurred within various habitats, including Major and Minor Creeklines, Alluvial and Colluvial Plains and Gorge/Gully and Debris Slope/Rocky Outcrop surrounding the Upper Beasley River Roost both inside and outside of the Development Envelope. During the tracking program, one individual was recorded foraging at Plunge Pool. The individuals were recorded at 12 non-cave sites within Gorge/Gully, Debris Slope/Rocky Outcrop and Major Creekline habitats (Biologic 2022c). This program suggests that while bats can travel larger distances, they prefer to forage in habitat close to their associated diurnal roost, in this instance the Upper Beasley River Roost (UBRR) (Biologic 2022c).

There have been 97 records of the Pilbara Leaf-nosed Bat within the extrapolated habitat mapping area i.e., 10 km buffer of the survey area (comprising 11 individuals trapped and 86 records of calls) (Biologic 2022c).

Pilbara Leaf-nosed Bat records were primarily located within the vicinity or entrance of known roosts, particularly the Upper Beasley River Roost complex, a known permanent diurnal roost, located approximately 670 m outside the Development Envelope (Biologic 2022a), most of the records within the survey area are likely to represent individuals originating and roosting within the Upper Beasley River Roost (Figure 14-16) (Biologic 2022a).

14.7.6. Habitat within and Surrounding the Development Envelope

14.7.6.1. Roosting Habitat

Of the 208 caves known from the survey area, one is a potential transitory diurnal roost (category 3) roost according to Bat Call WA (2021a)), 22 are nocturnal refuges (category 4 roost), 150 are potential nocturnal refuges (category 4 roost), and 35 are not suitable (Figure 14-16) (Bat Call WA 2021a).

Of the 208 caves known from the survey area, 131 occur within the Development Envelope consisting of 12 nocturnal refuges (category 4 roosts), 90 potential nocturnal refuges (category 4 roost), and 29 that are not suitable (Table 14-17). All of the roosts within the Development Envelope have been categorised as category 4 roosts which are not considered critical habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021a). Gorge/Gully and Debris Slopes/Rocky Outcrop habitat types are regarded as priority foraging habitat for the species. Supporting foraging and dispersal habitat is represented by the Major and Minor Creekline habitats and Plains (combined Alluvial, Colluvial and Hardpan Plain habitats) (TSSC 2016a), when within 10 km of the Upper Beasley River Roost and Plunge Pool, based on the average distance observed from the VHF tracking program at Brockman (Biologic 2022a; 254]) (Figure 14-17).

The roosts within the Development Envelope can potentially be occupied by both Ghost Bat and Pilbara Leaf-nosed Bat species.

14.7.6.2. Foraging Habitat

Permanent water sources (such as pools) provide foraging habitat for this species as Pilbara Leaf-nosed Bat's forage on invertebrates that are attracted to water, and the species also requires regular drinking water (Biologic 2020d); Stantec 2020a).

Of the 25 known water features within the survey area, all may provide foraging and drinking resources for the species; however, those naturally more persistent and closer to the UBRR are likely to be more significant.

Ridge Pool, located 500 m southeast of the UBRR, is critical to the Pilbara Leaf-nosed Bat as a foraging resource; this is a semi-permanent pool situated outside of the Development Envelope, where up to 779 calls were recorded in 2016 (Biologic 2020d).

Plunge Pool, a permanent groundwater fed pool located within the BS3 assessment area (approximately 6 km from the UBRR), is another critical water source for the Pilbara Leaf-nosed Bat, as shown by records at this location (e.g., 50 calls in 2016, 20 calls in 2017) (Biologic 2020d).

The tracking program revealed that most bats foraged within 11 km of the UBRR. Foraging occurred within various habitats, including Major and Minor Creeklines, Alluvial and Colluvial Plains, Gorge/Gully and Debris Slope/Rocky Outcrop surrounding the UBRR. During the tracking program, one individual was recorded foraging at Plunge Pool. The individuals were recorded at 12 non-cave sites within Gorge/Gully, Debris Slope/Rocky Outcrop and Major Creekline habitats (Biologic 2022c). This program suggests that while bats can travel larger distances, they prefer to forage in habitat close to the diurnal roost (Biologic 2022c).

Therefore, supporting foraging and dispersal habitat is represented by the Major and Minor Creekline habitats and the Alluvial, Colluvial and Hardpan Plains within 10 km of UBRR and Plunge Pool.

Table 14-17: Pilbara Leaf-nose Bat Roosts Recorded within and Surrounding the Proposal

Cave Name	Pilbara Leaf-nosed Bat Cave Category		
	Category 3	Category 4	No Usage
Inside Development Envelope			
B2BAT06		X	
B4jul16-26-27			X
B4jun16-09			X
B4jun16-36		X	
B4June16-26			X
BS4MM-Aug16-03			X
BS4MM-Aug16-04			X
BS4MM-Aug16-13			X
BS4MM-Aug16-15		X	
BS4MM-Aug16-18			X
BS4MM-Aug16-19			X
BS4MMJul16-11			X
BS4MMJul16-13			X
BS4MMJul16-14			X
BS4MMJul16-15			X
BS4MMJul16-17			X
BS4MMJul16-30		X	
C1		X	
C2		X	
C8		X	
CBRK-000		X	
CBRK-006		X	
CBRK-045		X	
CBRK-052		X	
CBRK-053		X	
CBRK-055		X	
CBRK-057		X	
CBRK-059		X	
CBRK-061		X	
CBRK-063		X	
CBRK-065		X	

Cave Name	Pilbara Leaf-nosed Bat Cave Category		
	Category 3	Category 4	No Usage
CBRK-067		X	
CBRK-069		X	
CBRK-071		X	
CBRK-073		X	
CBRK-074		X	
CBRK-075		X	
CBRK-076		X	
CBRK-077		X	
CBRK-078		X	
CBRK-079		X	
CBRK-080		X	
CBRK-081		X	
CBRK-082		X	
CBRK-083		X	
CBRK-084		X	
CBRK-085		X	
CBRK-086		X	
CBRK-087		X	
CBRK-089		X	
CBRK-090		X	
CBRK-091		X	
CBRK-092		X	
CBRK-093		X	
CBRK-094		X	
CBRK-095		X	
CBRK-096		X	
CBRK-097		X	
CBRK-098		X	
CBRK-099		X	
CBRK-100		X	
CBRK-101		X	
CBRK-102		X	
CBRK-103		X	

Cave Name	Pilbara Leaf-nosed Bat Cave Category		
	Category 3	Category 4	No Usage
CBRK-104		X	
CBRK-105		X	
CBRK-106		X	
CBRK-107		X	
CBRK-108		X	
CBRK-109		X	
CBRK-110		X	
CBRK-111		X	
CBRK-113		X	
CBRK-116		X	
CBRK-119		X	
CBRK-120		X	
CBRK-121		X	
CBRK-122		X	
CBRK-123		X	
CBRK-124		X	
CBRK-125		X	
CBRK-126		X	
CBRK-136		X	
CBRK-137		X	
CBRK-138		X	
CBRK-139		X	
CBRK-140		X	
CBRK-141		X	
CBRK-142		X	
CBRK-143		X	
CBRK-144		X	
CBRK-145		X	
CBRK-147		X	
CBRK-148		X	
CBRK-149		X	
CBRK-150		X	
CBRK-151		X	

Cave Name	Pilbara Leaf-nosed Bat Cave Category		
	Category 3	Category 4	No Usage
CBRK-152		X	
CBRK-153		X	
CBRK-154		X	
CBRK-173		X	
CBRK-174			X
CBRK-199		X	
GBS_CA_03		X	
GBS_CA_04		X	
GBS_CA_05		X	
GBS_CA_06			X
GBS_CA_08			X
GBS_CA_09			X
GBS_CA_10			X
GBS_CA_11			X
GBS_CA_12			X
GBS_CA_14			X
GBS_CA_15			X
GBS_CA_16			X
GBS_CA_17			X
GBS_CA_18			X
GBS_CA_20			X
GBS_CA_21			X
GBS_CA_22			X
MAMBAT81-01		X	
MAMBAT93-01		X	
MAMCAM11-01		X	
MMBAT01		X	
MMBAT02		X	
MMBAT03		X	
MMBAT04		X	
MME05		X	
MME06			X
NWTBAT01		X	

Cave Name	Pilbara Leaf-nosed Bat Cave Category		
	Category 3	Category 4	No Usage
NWTBAT02		X	
Subtotal	**0**	**102**	**29**
Outside Development Envelope			
C3		X	
C4		X	
C5		X	
C6		X	
C7			X
CBKT-04		X	
CBRK-001		X	
CBRK-002		X	
CBRK-003		X	
CBRK-004		X	
CBRK-005		X	
CBRK-007		X	
CBRK-008		X	
CBRK-009		X	
CBRK-010		X	
CBRK-011	X		
CBRK-012		X	
CBRK-013		X	
CBRK-014		X	
CBRK-015		X	
CBRK-016		X	
CBRK-017		X	
CBRK-018		X	
CBRK-020		X	
CBRK-021		X	
CBRK-022		X	
CBRK-023		X	
CBRK-024		X	

Cave Name	Pilbara Leaf-nosed Bat Cave Category		
	Category 3	Category 4	No Usage
CBRK-025		X	
CBRK-026		X	
CBRK-028		X	
CBRK-030		X	
CBRK-031		X	
CBRK-032		X	
CBRK-033		X	
CBRK-034		X	
CBRK-035		X	
CBRK-036		X	
CBRK-037		X	
CBRK-038		X	
CBRK-039		X	
CBRK-040		X	
CBRK-041		X	
CBRK-042		X	
CBRK-043		X	
CBRK-044		X	
CBRK-046		X	
CBRK-047		X	
CBRK-048		X	
CBRK-049		X	
CBRK-050		X	
CBRK-051		X	
CBRK-054		X	
CBRK-056		X	
CBRK-058		X	
CBRK-060		X	
CBRK-062		X	
CBRK-064		X	
CBRK-066		X	

Cave Name	Pilbara Leaf-nosed Bat Cave Category		
	Category 3	Category 4	No Usage
CBRK-068		X	
CBRK-070		X	
CBRK-072		X	
CBRK-088		X	
CBRK-112			X
CBRK-114		X	
CBRK-115		X	
CBRK-146		X	
CBRK-175		X	
CBRK-176		X	
CBRK-177			X
CBRK-178		X	
GBS_CA_01		X	
GBS_CA_02		X	
GBS_CA_07			X
GBS_CA_13			X
GBS_CA_19			X
SIV15EH		X	
Subtotal	**1**	**70**	**6**
Total	**1**	**172**	**35**

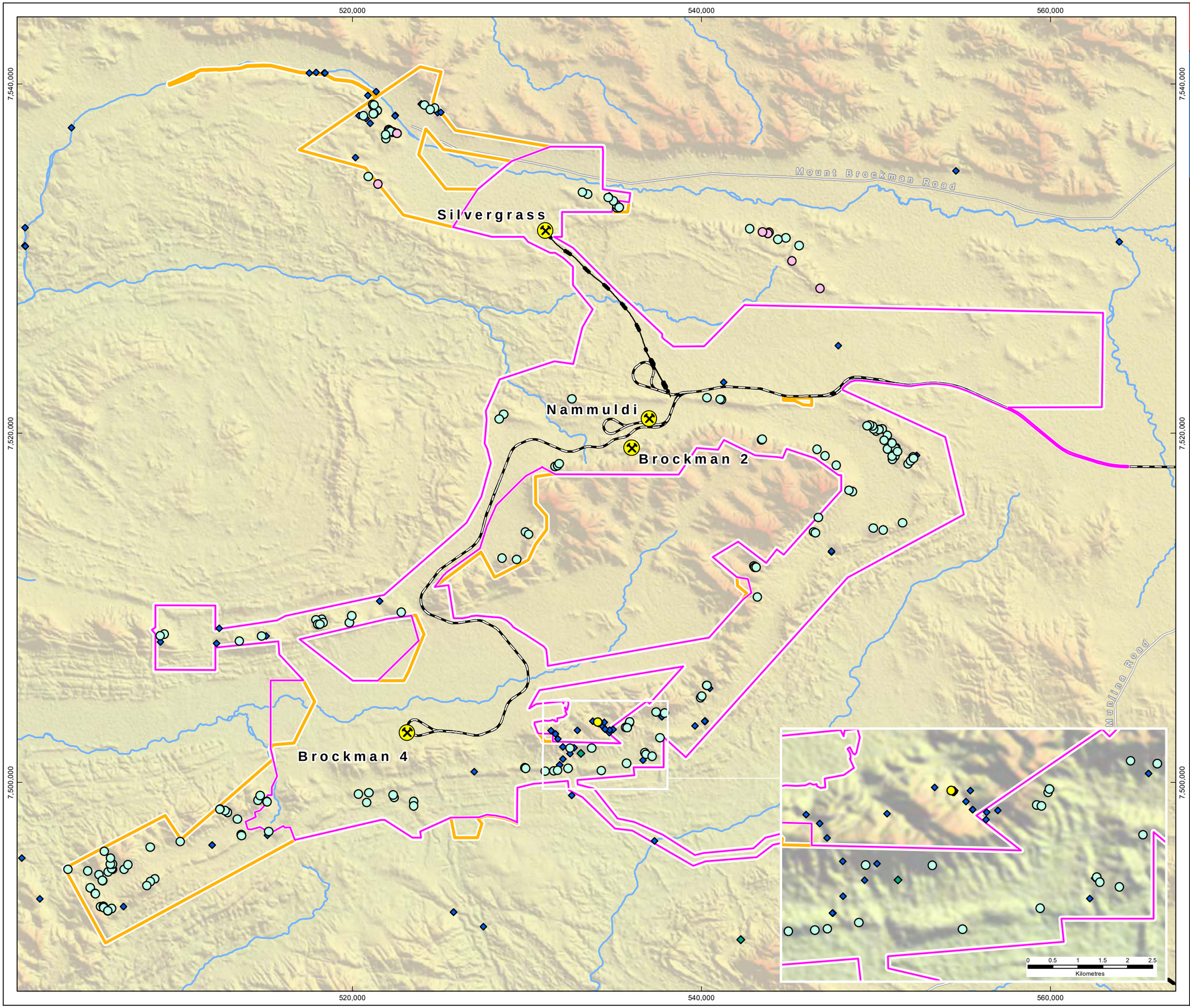

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Figure 14-16
Pilbara Leaf-nosed Bat Records and Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189725v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey

Pilbara Leaf-nosed Bat Roost

- Category 2 (Upper Beasley River Roost)
- Category 3
- Category 4

Rhinonicteris aurantia (VU)
(Pilbara Leaf-nosed Bat)

Sampling Method

- Audio Recording
- Echolocation Recording
- Other

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Nanutarra Munjina Road
Western Turner Syncline

RioTinto

Figure 14-17
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 14-17
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal
Map A

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Caves Creek
Robe River
Calamina Creek
Duck Creek
Duck Creek
Silvergrass
Nammuldi
Brockman 2

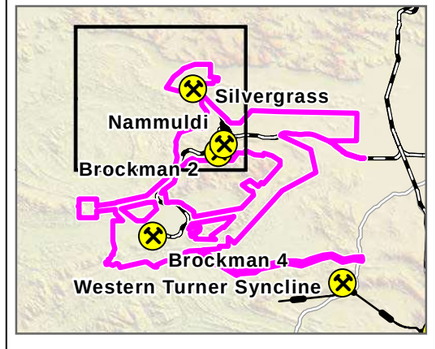
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 14-17
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal
Map B

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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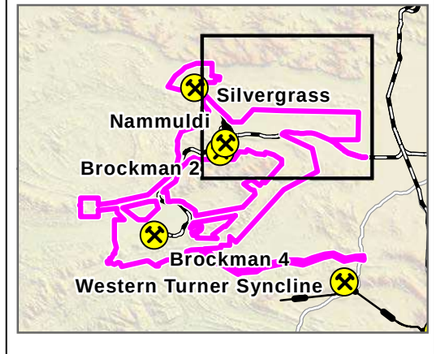
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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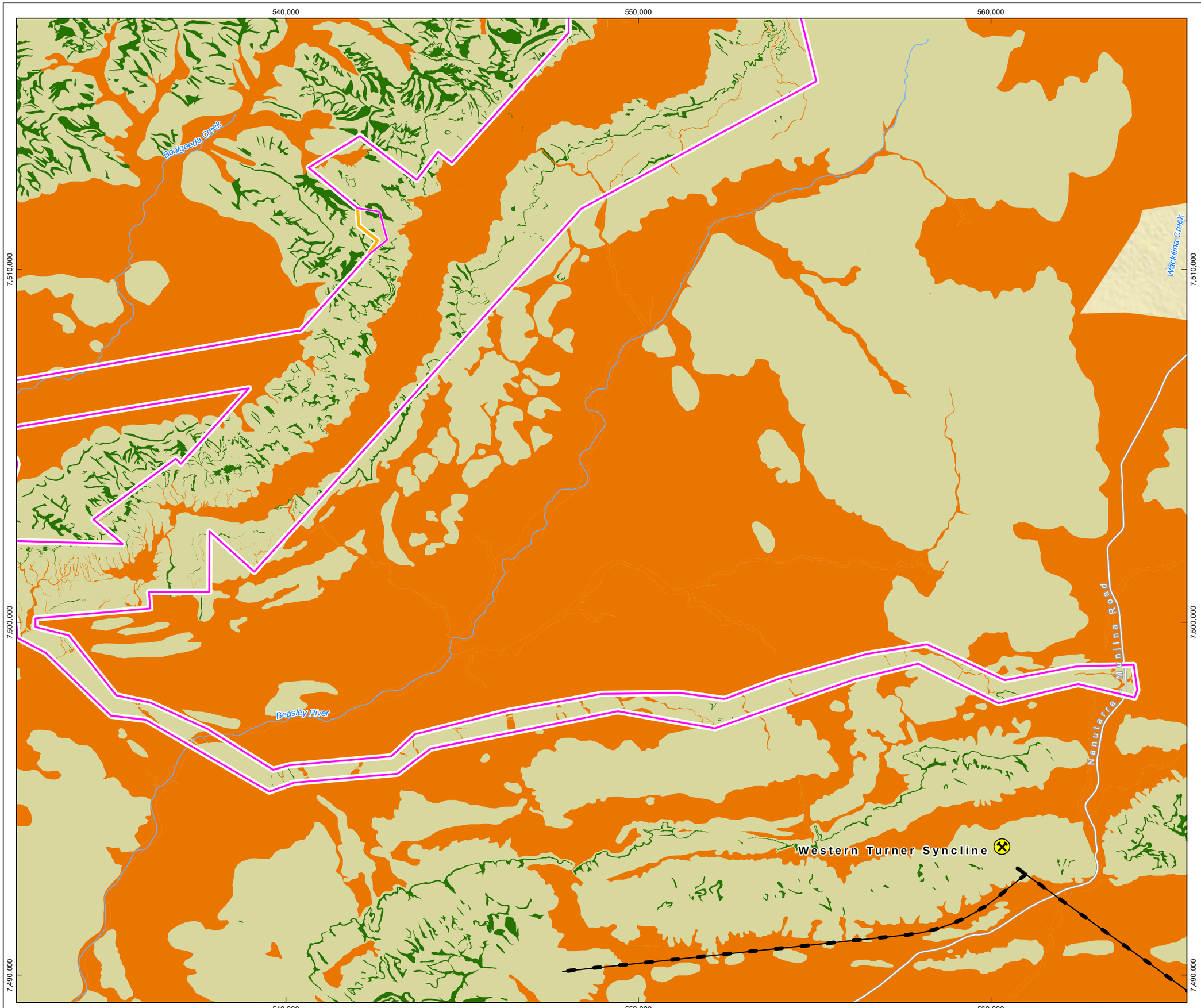

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Figure 14-17
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal
Map C

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
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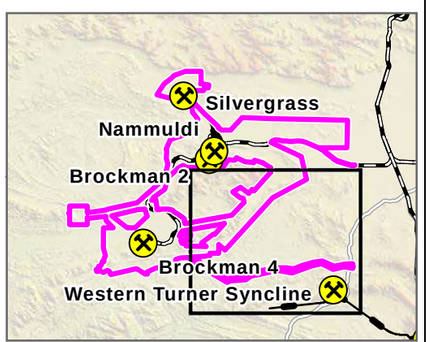
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



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0 1 2 3 4 5
Kilometres

Map units in metres

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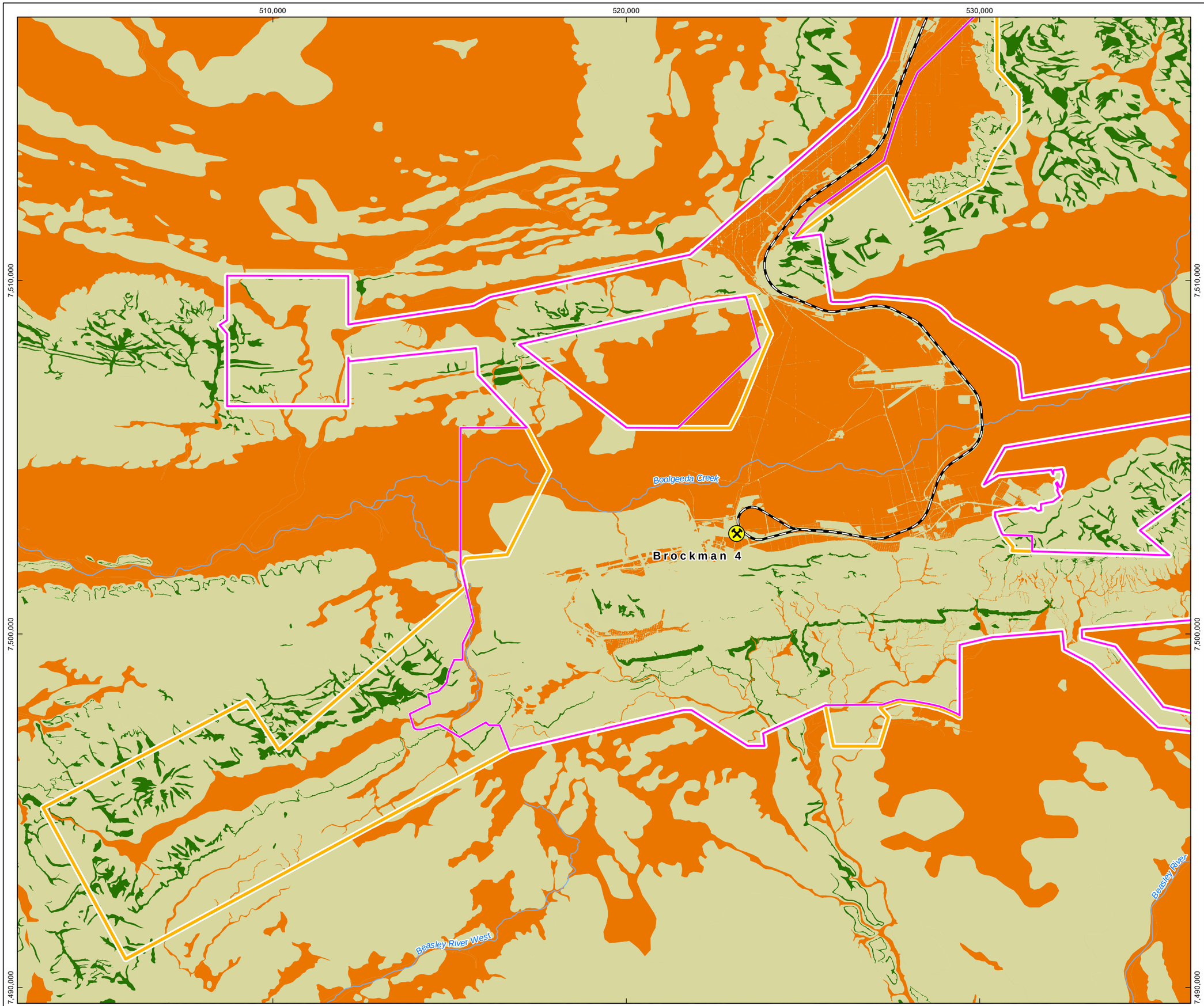

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Figure 14-17
Potential Pilbara Leaf-nosed Bat Habitat Within and Surrounding the Proposal Map D

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

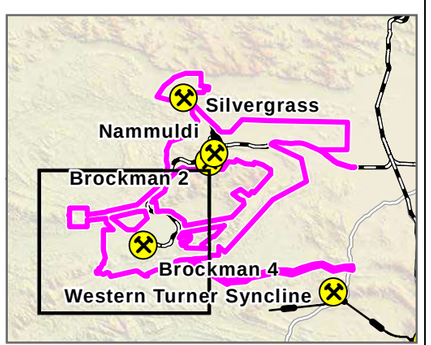
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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14.7.7. Assessment of Impacts

The Proposed Action may, directly and indirectly, impact Pilbara Leaf-nosed Bat. The following assessment of impacts has been identified specifically for Pilbara Leaf-nosed Bat. The impacts apply more broadly for all MNES species with the potential to occur within the Development Envelope as described in Section 14.4.

14.7.7.1. Loss of Fauna Habitat as a Result of Clearing

The Proposal will result in the clearing of up to a maximum of 331 ha (14% in the survey area and 23% of the Development Envelope) of critical Gorge/Gully (Priority 1 and 2 foraging) and Debris Slope/Rocky Outcrop (Priority 3 foraging) habitats (Figure 14-7).

Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain habitats within 10 km of the UBRR and 10 km from Plunge Pool (a significant water feature) are considered supporting habitats within the species' home range because of the foraging and dispersal opportunities that these habitats provide.

Clearing of critical Gorge/Gully and Debris Slope/Rocky Outcrop habitat within the Development Envelope and supporting Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plains habitats within the species home range are considered a significant residual impact and are proposed to be offset (See Section 13). The offset method and calculations for fauna habitat are detailed in Section 13.4.

The remaining habitats do not represent critical or supporting habitats for the species and are considered of low significance (limited habitat).

At least 1,459.6 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop habitat and 22,890 ha (85.9%) of supporting Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated survey area. Individuals can also disperse and forage more broadly in the surrounding low significance habitats.

14.7.7.2. Fragmentation of Habitat

Fragmentation is not expected to significantly impact Pilbara Leaf-nosed Bats, as a result of the Proposed Action, due to:

- The UBRR sits within an excised area, outside of the Development Envelope.
- The yet to be identified Lower Caves Creek Roost does not fall within the Development Envelope.
- VHF tracking of Pilbara Leaf-nosed Bats conducted by Biologic (2021e and 2022c) recorded the Pilbara Leaf-nosed Bat spending a significant time period outside of the VHF array, and likely the Development Envelope.
- VHF tracking of Pilbara Leaf-nosed Bats for the Greater Paraburdoo Iron Ore Hub project (EPBC 2018/8341), recorded a bat traveling approximately 40 km between two isolated ranges on two consecutive nights, demonstrating the long-range dispersal and foraging abilities of the species (Biologic 2020e). Hence this species will be able to easily clear the Development Envelope to forage.
- Critical habitat, in the form of Ridge and Plunge Pool are located either outside of the Development Envelope or situated within a MEZ.

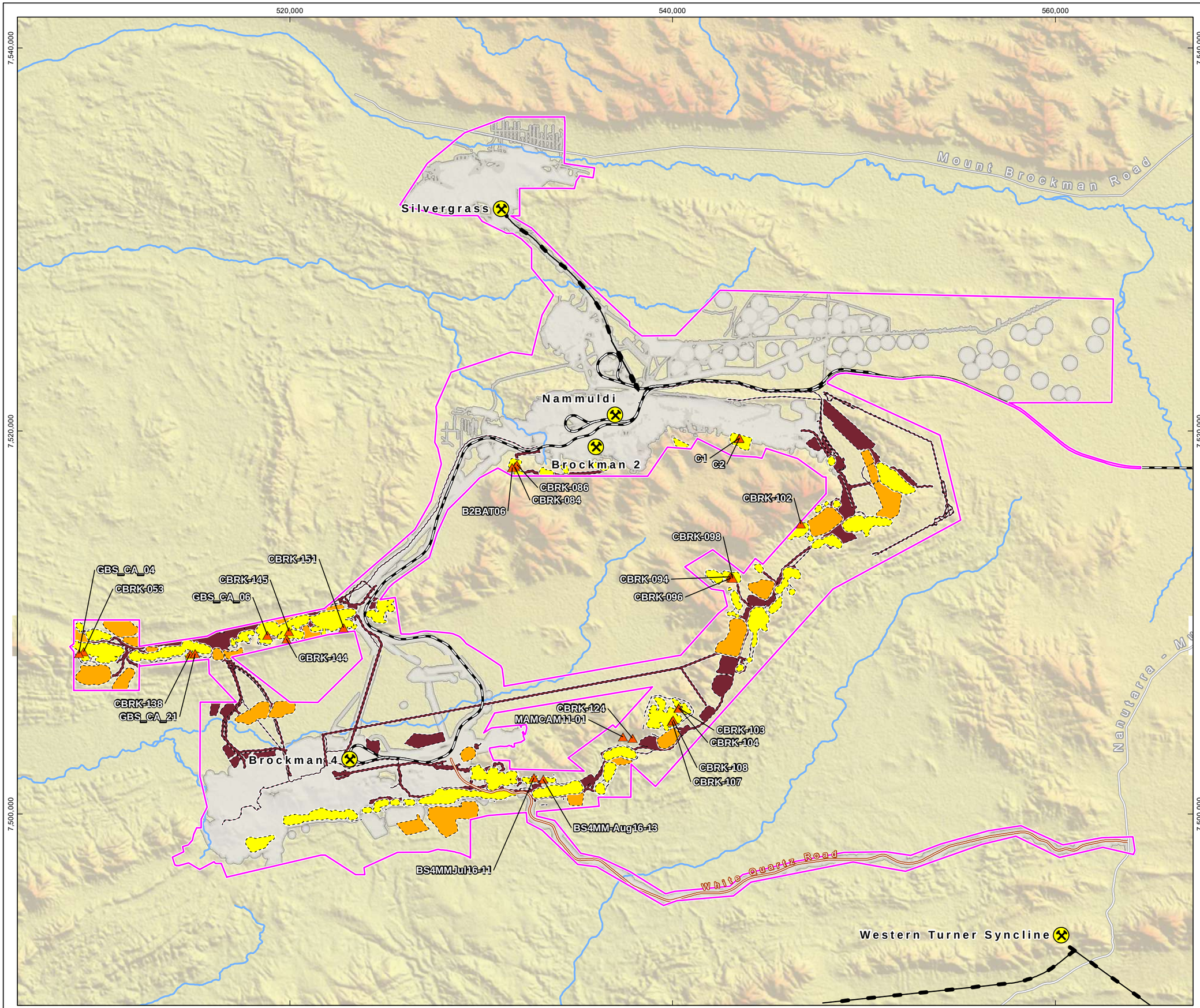
Of the 131 Pilbara Leaf-nosed Bat roosts with the potential to be used as a nocturnal roost within the Development Envelope, 25 will be impacted by the Proposed Action (these roosts overlap with the removal of Ghost Bat roosts). All 25 roosts are either nocturnal refuge (category 4 roosts) or of no usage and are not considered critical habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021a) (Table 14-12 and Figure 14-18). MEZs within MRZs will be established around the 106 remaining known category 4

roosts. The only known permanent roost (UBRR) is outside the Development Envelope and will not be impacted.

The Pilbara Leaf-nosed Bat relies on surface water availability for foraging and survival. The Proposed Action will not impact Plunge Pool, a groundwater-fed pool within the Development Envelope nor Ridge Pool, a surface water pool located outside the Development Envelope and near the UBRR (Section 6). These are the only two known critical water features in the survey area. Fifteen known ephemeral pools and two artificial water features throughout the Development Envelope will not be impacted as they will be included in MEZs.

The area containing Mt Brockman, which is likely to provide the greatest area of critical and supporting habitat for the Pilbara Leaf-nosed Bat, as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) with fragmentation of these habitats unlikely to occur as a result of the Proposed Action.

In addition to the above habitat connectivity will be maintained along the three Major Creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These Major Creeklines 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 Pilbara Leaf-nosed Bat and enable dispersal and connection between individuals and populations.



RioTinto

Figure 14-18
Pilbara Leaf-nosed Bat Roosts to be Impacted by the Proposed Action

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint
- Impacted Cave Location

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

Cave Name	Pilbara Leaf-nosed Bat Category
B2BAT06	Category 4
BS4MM-Aug16-13	No Usage
BS4MMJul16-11	No Usage
C1	Category 4
C2	Category 4
CBRK-053	Category 4
CBRK-084	Category 4
CBRK-086	Category 4
CBRK-094	Category 4
CBRK-096	Category 4
CBRK-098	Category 4
CBRK-102	Category 4
CBRK-103	Category 4
CBRK-104	Category 4
CBRK-107	Category 4
CBRK-108	Category 4
CBRK-124	Category 4
CBRK-138	Category 4
CBRK-144	Category 4
CBRK-145	Category 4
CBRK-151	Category 4
GBS_CA_04	Category 4
GBS_CA_06	No usage
GBS_CA_21	No usage
MAMCAM11-01	Category 4

N

0 2 4 6 8 10
Kilometres

Map units in metres

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14.7.7.3. Loss of Pilbara Leaf-nosed Bat Individuals

Pilbara Leaf-nosed 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 Pilbara Leaf-nosed Bat individuals associated with the Proposed Action is not expected to cause significant impacts to the species.

14.7.7.4. Disturbance from Light, Noise and/or Vibration Resulting in the Displacement of Fauna Associated with the Construction Activity and Mining Operations

The Proposed Action will generate light, noise and vibration emissions due to clearing, construction and mine operation.

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.

During the operational phase, active mining can cause noise and vibration disturbance 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 due to the establishment of vibration limits and MEZs within MRZs. The UBRR is approximately 700 m from the Development Envelope (near BS4 assessment area) and sufficiently far away that the risk of impacting this habitat or individuals present is considered to be low. Two other potential diurnal roosts near Silvergrass and west of BS4 assessment area are also located further outside the Development Envelope and no impacts area anticipated.

As all are nocturnal refuges or potential nocturnal refuges within the Development Envelope and thus not considered critical habitat, it is considered unlikely that noise or vibration will have a significant impact upon the species. In addition, the Pilbara Leaf-nosed Bat roosts within the survey area and Development Envelope correspond to roosts utilised by the Ghost Bat. Given the significance of these roosts for the Ghost Bat, MEZs within MRZs will be established around 106 of the retained roosts, including disturbance buffers and PPV levels (see Section 14.6.7). Therefore, noise and vibration are not expected to cause a significant impact on the Pilbara Leaf-nosed Bat.

14.7.7.5. Predation of Pilbara Leaf-nosed Bats by Feral Species

Five feral fauna species have been recorded in the Development Envelope, including the Cat, Dingo, European Cattle, Horse and House Mouse. These species are known from the region surrounding the Development Envelope. The development of new tracks, increased water points and production of domestic waste has the potential to attract and increase the abundance and diversity of introduced species. This may increase competition with and predation of native species.

Clearing may result in native fauna traversing cleared areas to reach suitable habitats. These altered movement patterns may result in increased predation of significant fauna by feral predators, causing injury or mortality of individuals. Where Red Foxes are scarce (as in the survey area and Development Envelope), Cats are the main cause of population declines in smaller mammals (CALM 1996).

The Proponent will undertake feral animal control as required, in co-operation with regional control programs and the Traditional Owners. By implementing control programs, the loss of Pilbara Leaf-nosed Bat individuals associated with the Proposed Action is not expected to cause significant impacts to the species.

14.7.8. Significance of Impacts

An assessment of the impacts the Proposed Action may have on the Pilbara Leaf-nosed Bat as per the Significant Impact Guidelines (DoE 2013) is detailed in Table 14-18.

Table 14-18: Assessment of Significant Impacts to the Pilbara Leaf-nosed Bat

Significant Impact Criteria	Assessment of Impacts to Pilbara Leaf-nosed Bat
Potential to cause a 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. A total of 131 roosts consisting of nocturnal refuges, potential nocturnal (category 4) roosts and not suitable for use have been recorded in the Development Envelope. There are no maternity roosts or diurnal roosts with regular use (category 1 and 2 roosts) within the Development Envelope. A total of 25 roosts will be impacted, all of which are nocturnal (category 4) refuges or unsuitable for use. The Proposed Action will not impact the UBRR (category 2) or previously unknown Lower Caves Creek Roost, located outside the Development Envelope. There is evidence of the persistence of the Pilbara Leaf-nosed Bat population in the Pilbara region alongside existing mining operations, including Brockman operations, so roosts and habitats retained in the Development Envelope are expected to continue to be utilised. Given the preservation of 106 out of 131 roosts within the Development Envelope, the retention of at least 995 ha (75%) of critical habitat and supporting habitat (of moderate significance), 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 an important population which may occur within the Development Envelope.
Potential to reduce the area of occupancy of an important population	The Proposed Action has the potential to reduce the area of occupancy of the Pilbara Leaf-nosed Bat through the loss of critical habitat; however, given the retention of at least 1,128.6 ha (77%) of critical habitat and 22,890 ha (85.9%) of supporting habitat, the species is expected to continue to exist within and surrounding the Development Envelope and wider Pilbara region.
Potential for fragmentation of an existing important population into two or more populations	Habitat connectivity will be maintained along the three Major Creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These Major Creeklines 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 Pilbara Leaf-nosed Bat and enable dispersal and connection between individuals and populations. Extensive foraging habitat will remain within the species' predicted nocturnal foraging range. In addition, the species is highly mobile and can travel greater than 10 km for foraging (Bat Call WA 2021b). On this basis, the Proposed Action is not expected to fragment the Pilbara Leaf-nosed Bat population into two or more populations.
Potential to adversely affect habitat critical to the survival of the species	The Proposed Action will result in clearing up to 331 ha (22.7%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (breeding and roosting) habitat and 2,946 ha (11.1%) of supporting Major and Minor Creekline, and Alluvial Colluvial and Hardpan Plain (foraging and dispersal) habitat The remaining habitats do not represent critical habitat for the species and are considered of low significance.

Significant Impact Criteria	Assessment of Impacts to Pilbara Leaf-nosed Bat
	Approximately 22,890 ha (85.9%) of supporting habitat will remain in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated survey area. Individuals can also disperse and forage more broadly in the surrounding low significance habitats. Of the 131 Pilbara Leaf-nosed Bat roosts with the potential to be used as a nocturnal roost within the Development Envelope, 25 will be impacted by the Proposed Action (these roosts overlap with the removal of Ghost Bat roosts). All 25 roosts are either nocturnal refuge (category 4 roosts) or not suitable and are not considered critical habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021a). Clearing critical Gorge/Gully and Debris Slope/Rocky Outcrop habitat and supporting Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plains habitats, when within the home range is considered a significant residual impact and is proposed to be offset (Section 13).
Potential to disrupt the breeding cycle of an important population	There will be no direct impact on the UBRR (category 2) roost or the previously unknown Lower Caves Creek Roost by the Proposed Action; therefore, the Proposed Action is not expected to impact the breeding cycle of the local 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 can potentially decrease the availability of the Pilbara Leaf-nosed Bat habitat due to clearing critical and supporting habitats. However, given that no breeding roosts will be affected and the retention of approximately 22,890 ha (82%) of high and moderate significance habitat within the Development Envelope, Pilbara Leaf-nosed Bats are expected to remain within 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	The approved conservation advice for the species suggests that invasive species are not expected to significantly impact the Pilbara Leaf-nosed Bat (TSSC 2016a). Cane Toads are identified as a threat to the species; however, the Cane Toad is not present in the Pilbara. The Proposed Action will not increase the potential for Cane Toad to become established in the Development Envelope.
Potential for the introduction of disease that may cause the species to decline	Currently, there are no known diseases harmful to Pilbara Leaf-nosed Bat. 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 2016a). There will be no direct disturbance to the confirmed UBRR and previously unknown Lower Caves Creek Roost, and mitigation measures will be implemented to minimise and manage any potential indirect impacts. The Proponent will avoid using barbed wire fencing as far as practicable. Where barbed wire fencing is required, the top strand will be replaced with plain wire, and 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

14.7.9. Consistency with Relevant Recovery Plans and Guidance

There are no recovery plans for Pilbara Leaf-nosed Bat.

14.7.9.1. Threat Abatement Plans

There are no TAPs identified as being relevant for the Pilbara Leaf-nosed Bat.

14.7.9.2. Conservation Advice

The primary conservation actions from the approved Conservation Advice for Pilbara Leaf-nosed Bat are outlined in 14.1. The Proposed Action has contributed to the following primary conservation actions:

- Discovery of new roosts and occurrences through field surveys across the Development Envelope and surrounding areas
- Protect known roosts with the implementation of 150 m MEZs around known roosts
- Monitor the population (Upper Beasley River Roost) outside of the Development Envelope is permanently monitored)
- Protection of foraging and dispersal habitat with the implementation of avoidance and minimization measures associated with land clearing activities.

14.7.10. 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.

14.7.10.1. Significant Residual Impact

After application of mitigation measures, the following significant residual impacts are predicted for the Pilbara Leaf-nosed Bat:

- Clearing up to 264 ha and 67 ha (27.9% and 13.0%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitats for the Pilbara Leaf-nosed Bat. This clearing is proposed to be managed via upper limits of clearing as per Table 14-10 and will be offset as per Section 13
- Clearing approximately 2,946 ha of supporting Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat for the Pilbara Leaf-nosed Bat, when within the species home range. This clearing is proposed to be offset as per Section 13.

14.7.10.2. 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 Pilbara Leaf-nosed Bat are set out below.

- The Proponent shall not clear more than:
  - 264 ha of Gorge/Gully habitat within the Development Envelope
  - 67 ha of Debris Slope/Rocky Outcrop habitat with the Development Envelope.
- No direct or indirect impacts from the Proposal to Pilbara Leaf-nosed Bat roosts retained within MRZs and MEZs shown in Figure 14-25.

The Proponent will implement the EMP as per Appendix B.3 to achieve these outcomes.

14.7.11. Conclusion

The significant residual impact, after implementation of the mitigation hierarchy, is clearing of up to 331 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitat and approximately 2,946 ha of supporting Major and Minor Creekline, Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat for the Pilbara Leaf-nosed Bat, when within its home range. Environmental offsets are proposed for this clearing and are discussed in Section 13. Subject to conditions and implementation of offsets (Section 13), 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.

14.8. Ghost Bat (*Macroderma gigas*)

14.8.1. 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 g. It is carnivorous, feeding on insects, reptiles, frogs, birds and small mammals (Bat Call WA 2021c).

14.8.2. Habitat Preference 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, typically within 2 km of day roosts (TSSC 2016b). 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 2016b). 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 2016b). 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 2016b).

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 (Biologic 2020d; TSSC 2016b). DAWE 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).

The species' current range is discontinuous, with geographically disjunct colonies occurring in the Pilbara, Kimberley, Northern Territory, Gulf of Carpentaria, coastal and near eastern coastal Queensland from Cape York to near Rockhampton and western Queensland (TSSC 2016b). The Ghost Bat has a patchy distribution in the Pilbara, with 903 records in Western Australia (DBCA 2007-2021). The regional Pilbara Ghost Bat population is estimated at 1,300 to 2,000 individuals, and in the Hamersley subregion, approximately 350 individuals (TSSC 2016b).

14.8.3. Key Threats and Recovery Actions

14.8.3.1. Key Threats

Ghost Bats' EPBC Act conservation advice identifies several known threats to the species (TSSC 2016b). Loss of and disturbance to roost sites due to mining are rated as having potentially severe consequences. Disturbance to maternity roosts from human visitation is rated as having moderate to severe consequences on the species. Modification to foraging habitat, poisoning by Cane Toads and collision with barbed wire fences is rated as a moderate consequence (TSSC 2016b).

Potential population decline associated with competition for prey with foxes and feral cats has been rated an ‘unknown’ consequence.

14.8.3.2. Recovery Actions

There are currently no adopted or made recovery plans for the Ghost Bat.

Table 14-14 provides mitigation that the Proponent will implement to reduce impacts on this species and habitat.

14.8.4. Important Populations and Critical Habitat

The Pilbara Ghost Bat population is genetically distinct and divergent. It has been assumed to be an important population based on the definition in the Significant Impact Guidelines “Key source population either for breeding or dispersal” (DoE 2013).

There are no species-specific policy guidelines on what constitutes habitat critical to the Ghost Bat's survival. For the purpose of this assessment, critical habitat for the Ghost Bat has been defined as habitat used for breeding, such as roosting habitat. Supporting habitat is any foraging habitat within the home range of the Ghost Bat (5 km radius from category 2 and category 3 in an apartment block).

The fauna surveys (Biota 2016b, Biota 2019d and Stantec 2020a) describe roost types using the classifications, maternity, day and night roosts. Robert Bullen, a Bat expert (from Bat Call WA), has assessed each roost in the Development Envelope and assigned it a roost category based on the following roost classification (Bat Call WA 2021a in Appendix E.4):

- Category 1 – Maternity/diurnal roost caves with large and permanent Ghost Bat occupancy
- Category 2 – Maternity/diurnal roost caves with regular occupancy
- Category 3 – Diurnal roost caves with occasional occupancy
- Category 4 – Nocturnal roost caves with opportunistic usage.

There are no category 1 roosts within the Hamersley Ranges and thus the Development Envelope (Bat Call WA 2021c). Bat Call WA (2021a) assessed all category 2 roosts as critical habitat. Groupings of category 3 and 4 roosts immediately surrounding higher category roosts are also considered critical habitat and described as “apartment blocks” that support the viability of the category 2 roosts (Bat Call WA 2021a). Bat Call WA 2021a) did not consider isolated category 3 and category 4 roosts as critical habitat as these isolated roosts are used opportunistically according to the methodology described in Appendix E.4.

The Bat Call WA (2021a) categories have been used to prioritise mitigation of impacts to significant roosts, and the terms used in the surveys are still used throughout this ERD. Examples of each bat roost category 2 to 4 are provided in Plate 14-1 to Plate 14-3.



Plate 14-1: Example of Category 2 Ghost Bat Roost



Plate 14-2: Example of Category 3 Ghost Bat Roost



Plate 14-3: Example of Category 4 Ghost Bat Roost

14.8.5. Occurrence within and Surrounding the Development Envelope

A total of 173 records of Ghost Bat have been observed within the survey area through several methods, including ultrasonic recordings (35), trapping using white sheets (9), scats (117) and direct observations (comprising both alive (11) and deceased individuals (1)) (Biologic 2022a). Within the extrapolated area, there have been seven records of the Ghost Bat comprising of scats (Figure 14-19). Additionally, nine individuals tagged by Biologic (2022c) were recorded from 5,910 detections within the survey area and from 29 detections within the extrapolated area by VHF tracking towers.

Genetic analysis of scats identified 75 unique individuals within the survey area, although Biologic (2022a) considers this an underestimation of the number of individuals. Out of the individuals identified, there was an even sex ratio for the samples collected (for available samples, the sex could be 100% confirmed), with 29 females and 29 males. Of the remaining individuals, seven samples were likely females, five were likely males, and five could not be determined (Biologic 2022c). Overall genetic diversity was comparable to East, Central and West Hammersley and lower than the Chichester populations (Biologic 2022c). The genetic effective population size for the Brockman area was estimated as 67.4 individuals (95% confidence interval) (Biologic 2022c).

Of the 75 individuals, the scat analysis showed most of the bats moved between caves within a 5 km radius.

The population of Ghost Bats occurring in the Development Envelope represents a permanent breeding population (Biologic 2020d) due to:

- The presence of confirmed category 2 and category 3 (maternity and day) roosts
- The range of suitable habitats for roosting and foraging within the Development Envelope.

The Ghost Bat population in the Development Envelope is expected to meet the definition of an important population as defined in the Significant Impact Guidelines (DoE 2013).

14.8.6. Habitat within and Surrounding the Development Envelope

14.8.6.1. Roosting Habitat

Of the 208 caves known from within the survey area, three are maternity (category 2) roosts, 16 are potential maternity roosts (category 2), seven represent diurnal (category 3) roosts, 86 represent potential diurnal (category 3) roosts, 42 represent night (category 4) roosts, 35 represent potential night (category 4) roosts, and 19 are unknown (however following the precautionary principal these have been classified as potential diurnal (category 3) roosts).

The presence of three category 2 and 16 potential category 2 caves within the survey area suggests that the species resides permanently within the survey area and Development Envelope. The population of Ghost Bats within the survey area forms part of a key source population for breeding and dispersal and is, therefore, an ‘important population’ as defined by DoE (2013) (Biologic 2022a}. The scat analysis further supports this; of the 525 scat samples analysed, 236 scats contained elevated progesterone indicating pregnant individuals are likely using the caves. Furthermore, the population of Ghost Bats within the survey area, forms part of a key source population for breeding and dispersal and is therefore an ‘important population’ as defined by DoE (2013).

Additional caves may be found throughout the survey area; however, it is very unlikely any further caves would provide critical habitat (i.e., category 2 caves) due to the extensive searching and ultrasonic recording results, which identify Ghost Bat activity.

Of the 208 caves known from the survey area, 131 occur within the Development Envelope consisting of one maternity roost (category 2 roost), seven potential maternity roosts (category 2 roost), six diurnal roosts (category 3 roosts), 54 potential diurnal roosts (category 3 roosts), 32-night roosts (category 4 roosts), 13 potential night roosts (category 4 roost) and 18 are unknown (precautionary classification as category 3 roosts) (Table 14-19).

Overall, 12 apartment block roost complexes (comprising a category 2 roost with several other caves, shelters and overhangs within a few hundred meters (totalling 47 roosts)) and four isolated category 2 (without a roost complex) roosts were identified within the survey area (Bat Call WA 2021a). Of these, six apartment block roost complexes (comprising a total of 20 roosts) and two isolated category 2 roost occur within the Development Envelope (Table 14-19).

Apartment Blocks and isolated category 2 caves are displayed on Figure 14-20. Isolated category 3 and category 4 caves are presented on Figure 14-21.

Because the majority of these roosts are located within Gorge/Gully and Debris Slope/Rocky Outcrop habitats, these habitat types are considered to provide critical breeding and roosting habitat for the species. Records 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 category 2 and category 3 roosting sites and most commonly moves small distances (approximately 6 km) between roosting sites (Biologic 2022c). For this reason, supporting foraging and dispersal habitat is represented by Alluvial Plain, Colluvial Plain, Hardpan Plain, Major Creekline and Minor Creekline habitats within 5 km of a category 2 or category 3 within an apartment block

14.8.6.2. Foraging Habitat

Records and tracking data obtained from Ghost Bats within the survey area supports the limited amount of published literature on the species' movements and habitat preferences. A total of nine Ghost Bat individuals (seven females and two males) were captured and tracked during the VHF tracking program. The species commonly forages upon plains, generally within proximity to category 3 roosting sites and most commonly moves small distances (~6 km) between roosting sites (Biologic 2022c). For these reasons, supporting foraging and dispersal habitat is represented by the Alluvial Plain, Colluvial Plain, Hardpan Plain, Major Creekline and Minor Creekline habitats of the survey area (Biologic 2022a) (Figure 14-22). These habitats are well represented within and surrounding the Development Envelope (Biologic 2022a). The cluster of roosts in the north of the BS2 assessment area (Apartment Block 8) opens up onto Colluvial Plain and Hardpan Plain habitat types (Figure 14-22).

Footslope, Gently Sloping Rise, Pediment and Plateau habitat types provide limited foraging habitat. Other than the more restricted Plateau habitat type, these habitats are not limited in extent within the Development Envelope and are widespread in the region (Biologic 2020d).

Table 14-19: Ghost Bat Roosts Recorded within and Surrounding the Proposal

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block
	Category 2	Category 3	Category 4	
Inside Development Envelope				
B2BAT06				No
B4jul16-26-27			X	No
B4jun16-09				No
B4jun16-36		X		No
B4June16-26			X	No
BS4MM-Aug16-03			X	No
BS4MM-Aug16-04		X		No
BS4MM-Aug16-13		X		No
BS4MM-Aug16-15		X		No
BS4MM-Aug16-18		X		No
BS4MM-Aug16-19		X		No
BS4MMJul16-11		X		No
BS4MMJul16-13		X		No
BS4MMJul16-14		X		No
BS4MMJul16-15		X		No
BS4MMJul16-17		X		No
BS4MMJul16-30		X		No
C1			X	No
C2			X	No
C8		X		No
CBRK-000		X		No
CBRK-006			X	No
CBRK-045		X		No
CBRK-052		X		No
CBRK-053		X		No
CBRK-055			X	No
CBRK-057			X	No
CBRK-059		X		No
CBRK-061		X		AB-BS-7
CBRK-063		X		AB-BS-7
CBRK-065		X		AB-BS-7

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block
	Category 2	Category 3	Category 4	
CBRK-067	X			AB-BS-7
CBRK-069	X			AB-BS-8
CBRK-071			X	AB-BS-8
CBRK-073		X		No
CBRK-074		X		No
CBRK-075			X	No
CBRK-076	X			AB-BS-9
CBRK-077			X	No
CBRK-078	X			AB-SGE-2
CBRK-079		X		AB-BS-9
CBRK-080			X	AB-SGE-2
CBRK-081			X	AB-BS-9
CBRK-082	X			No
CBRK-083		X		AB-BS-9
CBRK-084		X		No
CBRK-085	X			AB-BS-9
CBRK-086		X		No
CBRK-087			X	No
CBRK-089		X		No
CBRK-090			X	No
CBRK-091			X	No
CBRK-092			X	No
CBRK-093	X			AB-BS-10
CBRK-094			X	No
CBRK-095			X	No
CBRK-096			X	No
CBRK-097			X	No
CBRK-098			X	No
CBRK-099		X		No
CBRK-100		X		No
CBRK-101			X	No
CBRK-102			X	No
CBRK-103		X		No

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block
	Category 2	Category 3	Category 4	
CBRK-104		X		No
CBRK-105			X	No
CBRK-106		X		No
CBRK-107			X	No
CBRK-108		X		No
CBRK-109		X		No
CBRK-110		X		No
CBRK-111		X		No
CBRK-113			X	No
CBRK-116		X		No
CBRK-119		X		No
CBRK-120			X	No
CBRK-121		X		No
CBRK-122			X	No
CBRK-123			X	No
CBRK-124			X	No
CBRK-125		X		No
CBRK-126			X	No
CBRK-136			X	No
CBRK-137		X		No
CBRK-138			X	No
CBRK-139		X		No
CBRK-140		X		No
CBRK-141		X		No
CBRK-142			X	No
CBRK-143			X	No
CBRK-144		X		No
CBRK-145			X	No
CBRK-147			X	No
CBRK-148			X	No
CBRK-149			X	No
CBRK-150		X		No
CBRK-151		X		No

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block
	Category 2	Category 3	Category 4	
CBRK-152			X	No
CBRK-153		X		No
CBRK-154		X		No
CBRK-173		X		No
CBRK-174		X		No
CBRK-199			X	No
GBS_CA_03		X		No
GBS_CA_04			X	No
GBS_CA_05		X		No
GBS_CA_06		X		No
GBS_CA_08		X		AB-BS-11
GBS_CA_09		X		AB-BS-11
GBS_CA_10		X		AB-BS-11
GBS_CA_11		X		AB-BS-11
GBS_CA_12		X		AB-BS-11
GBS_CA_14		X		AB-BS-11
GBS_CA_15		X		No
GBS_CA_16			X	No
GBS_CA_17	X			No
GBS_CA_18		X		No
GBS_CA_20		X		No
GBS_CA_21		X		No
GBS_CA_22		X		No
MAMBAT81-01		X		No
MAMBAT93-01		X		No
MAMCAM11-01		X		No
MMBAT01		X		No
MMBAT02		X		No
MMBAT03		X		No
MMBAT04		X		No
MME05		X		No
MME06		X		No
NWTBAT01		X		No

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block
	Category 2	Category 3	Category 4	
NWTBAT02		X		No
Subtotal	**8**	**78**	**45**	**N/A**
Outside Development Envelope				
C3	X			AB-SGE-1
C4	X			AB-SGE-1
C5		X		AB-SGE-1
C6			X	AB-SGE-1
C7			X	AB-SGE-1
CBKT-04			X	No
CBRK-001			X	No
CBRK-002			X	No
CBRK-003			X	No
CBRK-004			X	No
CBRK-005	X			AB-BS-2
CBRK-007	X			AB-BS-2
CBRK-008		X		AB-BS-3
CBRK-009			X	AB-BS-4
CBRK-010		X		AB-BS-3
CBRK-011			X	AB-BS-2
CBRK-012		X		No
CBRK-013			X	No
CBRK-014	X			AB-BS-5
CBRK-015	X			No
CBRK-016		X		AB-BS-5
CBRK-017		X		No
CBRK-018		X		No
CBRK-020			X	No
CBRK-021	X			AB-BS-4
CBRK-022		X		No
CBRK-023			X	AB-BS-4
CBRK-024			X	No

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block
	Category 2	Category 3	Category 4	
CBRK-025			X	AB-BS-4
CBRK-026		X		No
CBRK-028		X		No
CBRK-030			X	No
CBRK-031		X		No
CBRK-032			X	No
CBRK-033		X		Ab-BS-4
CBRK-034		X		No
CBRK-035		X		AB-BS-4
CBRK-036		X		No
CBRK-037			X	AB-BS-4
CBRK-038	X			No
CBRK-039			X	AB-BS-4
CBRK-040			X	No
CBRK-041			X	No
CBRK-042		X		AB-BS-5
CBRK-043		X		No
CBRK-044		X		No
CBRK-046	X			No
CBRK-047		X		No
CBRK-048			X	No
CBRK-049			X	No
CBRK-050			X	No
CBRK-051		X		No
CBRK-054			X	No
CBRK-056		X		No
CBRK-058		X		AB-BS-6
CBRK-060	X			AB-BS-6
CBRK-062			X	No
CBRK-064			X	No
CBRK-066		X		No

Cave Name	Ghost Bat Cave Category			Ghost Bat within an Apartment Block
	Category 2	Category 3	Category 4	
CBRK-068			X	No
CBRK-070			X	No
CBRK-072			X	No
CBRK-088		X		No
CBRK-112		X		No
CBRK-114		X		No
CBRK-115			X	No
CBRK-146		X		No
CBRK-175		X		No
CBRK-176		X		No
CBRK-177		X		No
CBRK-178	X			No
GBS_CA_01			X	No
GBS_CA_02		X		No
GBS_CA_07		X		No
GBS_CA_13		X		No
GBS_CA_19			X	No
SIV15EH		X		No
Subtotal	**11**	**34**	**32**	**N/A**
Total	**19**	**112**	**77**	

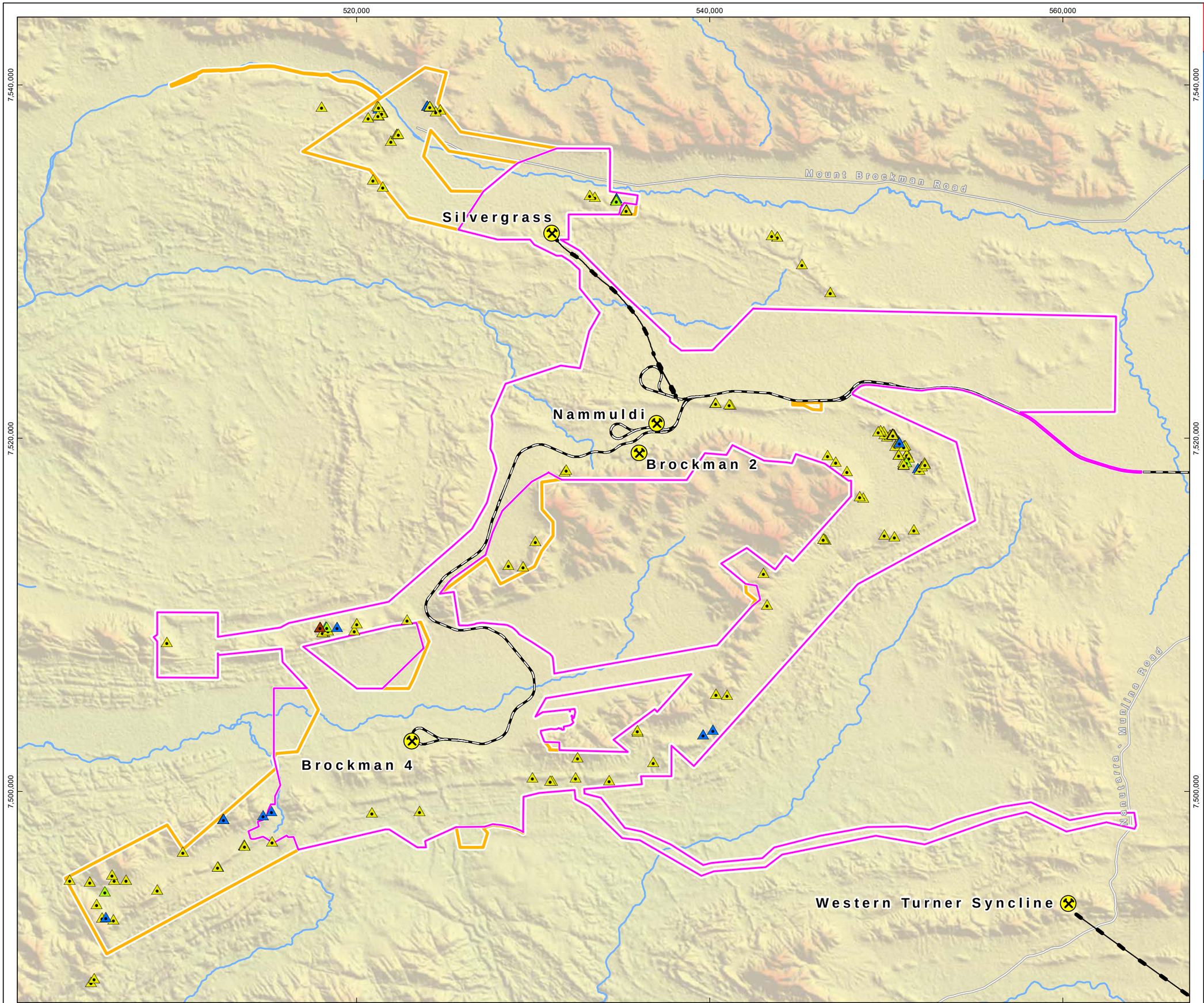

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Figure 14-19
Ghost Bat Records within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189728v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Macroderma gigas (VU) (Ghost

Sampling Method

- Audio recording
- Echolocation Recording
- Opportunistic
- Secondary Observation
- Targeted Searches
- Trapping

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 14-20
Apartment Block and Isolated Category 2 Ghost Bat Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189729v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area
- Apartment Block

Ghost Bat Roosts

- Isolated Category 2
- Apartment Block Category 2
- Apartment Block Category 3
- Apartment Block Category 4
- Unclassified

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek
- Minor Creek

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

AB-BS-2
AB-BS-4
AB-SGE-2
AB-SGE-1
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
AB-BS-6
AB-BS-5
AB-BS-3
Western Turner Syncline

AB-BS-9
AB-BS-11
AB-BS-7
AB-BS-10
0 0.25 0.5 0.75 1
Kilometres

AB-BS-8
0 0.25 0.5 0.75 1
Kilometres

RioTinto

Figure 14-21
Category 3 and 4 Ghost Bat Roosts within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189730v1
Date: August 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development
- Survey Area

Ghost Bat Roots

- Category 3
- Category 4
- Unclassified

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,540,000
7,520,000
7,500,000
Homestead Silvergrass Road
Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Nanutarra - Munjina Road
Western Turner Syncline

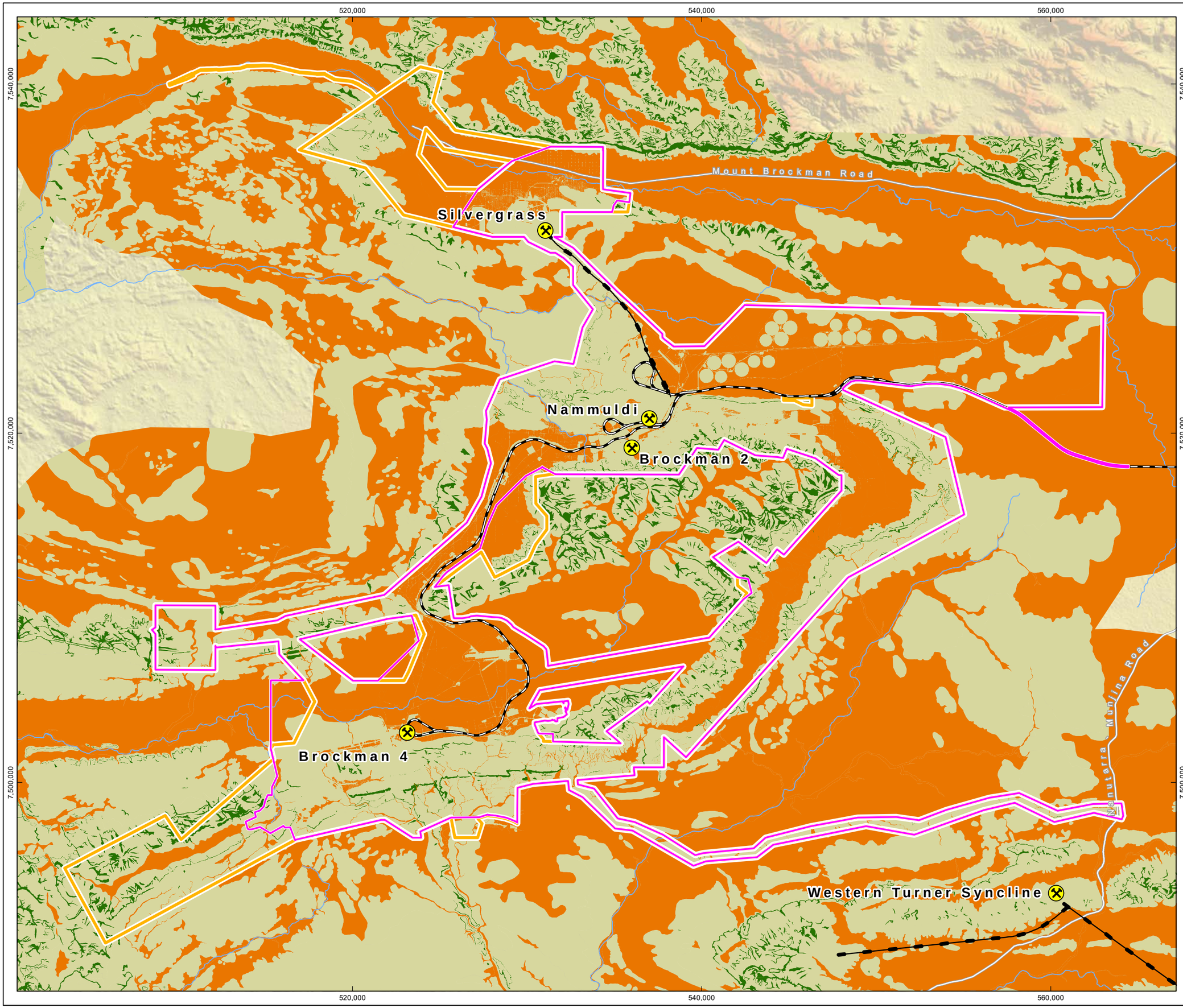

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Figure 14-22
Potential Ghost Bat Habitat within and Surrounding the Proposal Overview

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres
Map units in metres

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Figure 14-22
Potential Ghost Bat Habitat within and Surrounding the Proposal Map A

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

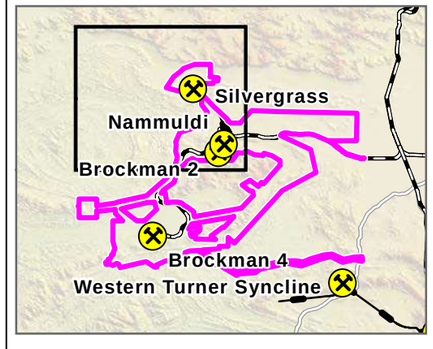
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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510,000 520,000 530,000 540,000

7,540,000 7,530,000 7,520,000

Caves Creek
Robe River
Calamina Creek
Duck Creek
Duck Creek
Silvergrass
Nammuldi
Brockman 2

RioTinto

Figure 14-22
Potential Ghost Bat Habitat within and Surrounding the Proposal Map B

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

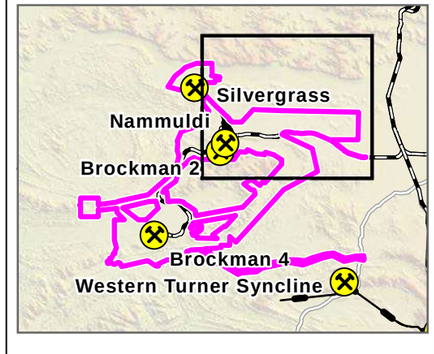
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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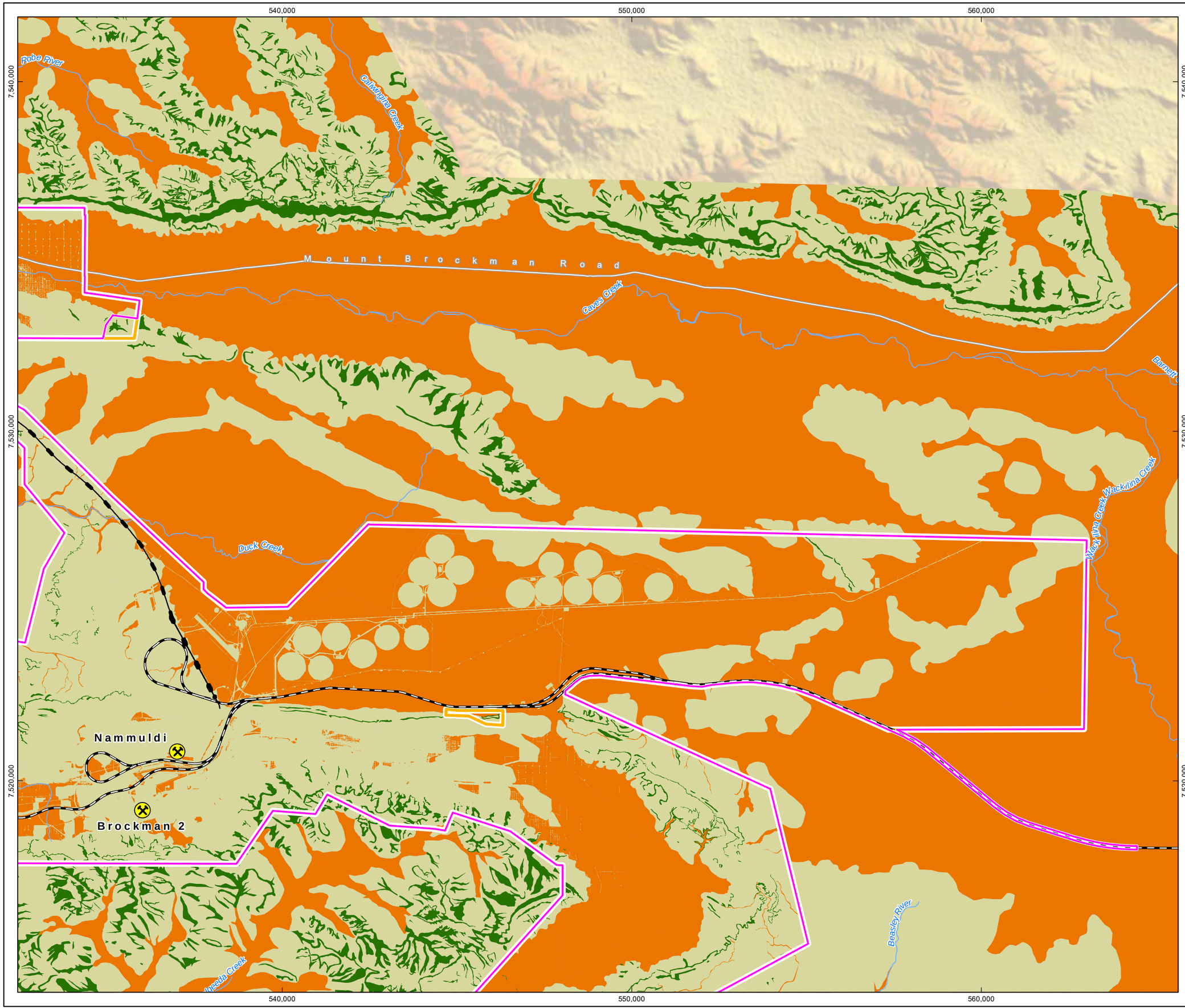


RioTinto

Figure 14-22
Potential Ghost Bat Habitat within and Surrounding the Proposal Map C

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

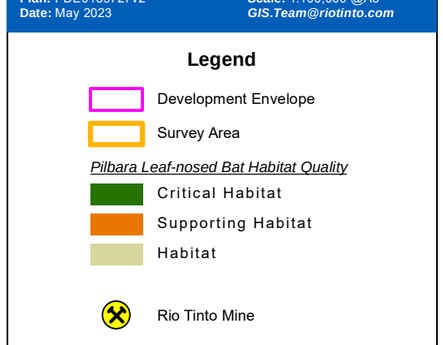
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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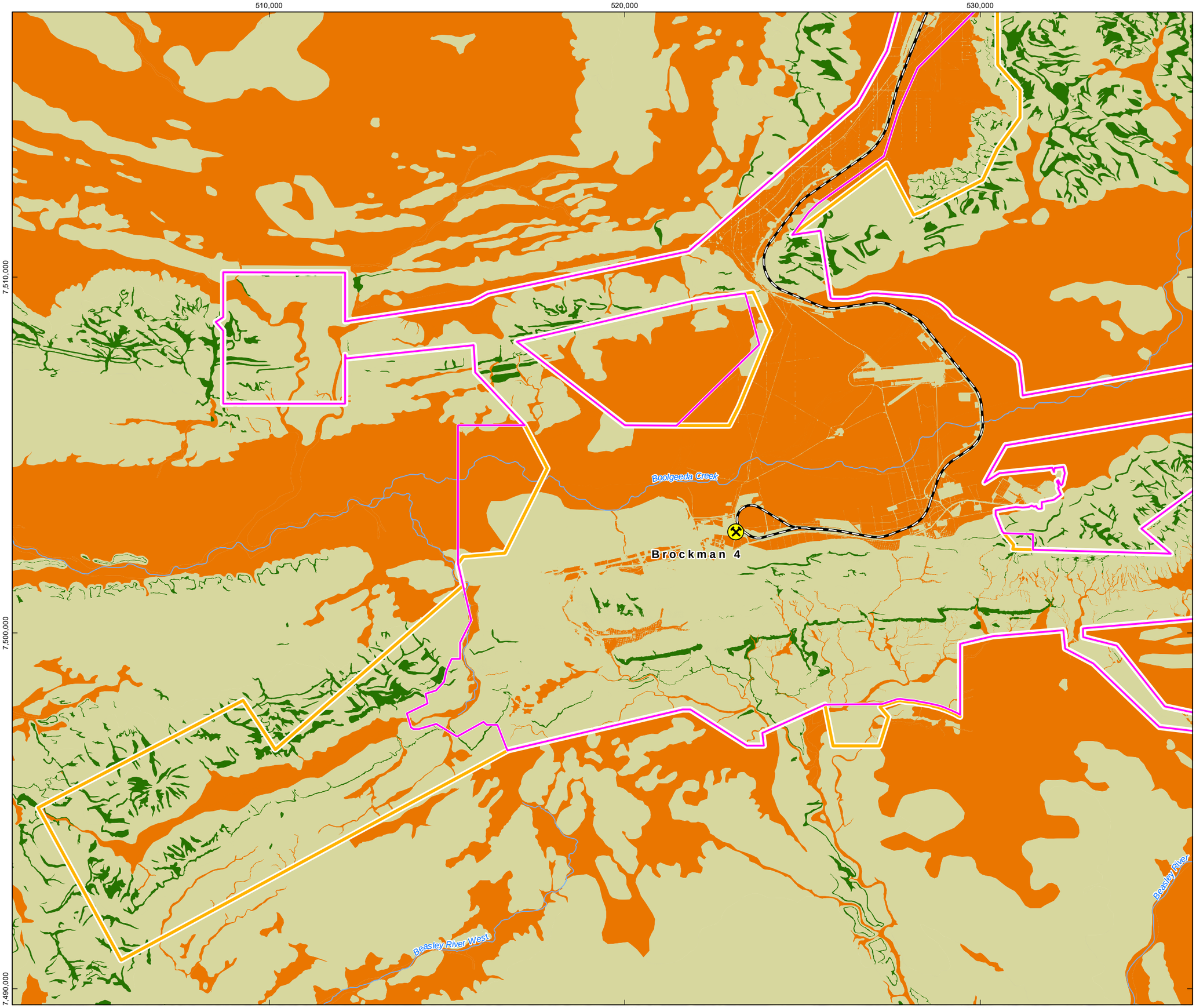


RioTinto

Figure 14-22
Potential Ghost Bat Habitat within and Surrounding the Proposal Map D

Drawn: L.Fuentes
Plan: PDE0189727v2
Date: May 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

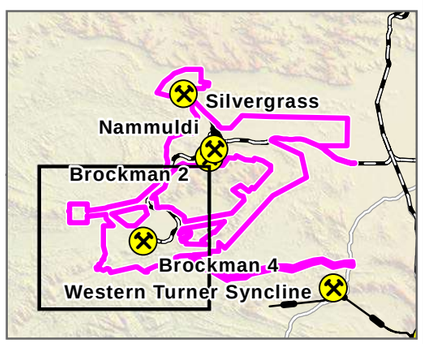
Legend

- Development Envelope
- Survey Area

Pilbara Leaf-nosed Bat Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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14.8.7. Assessment of Impacts

The Proposed Action may result in direct and indirect impacts on Ghost Bat. The following assessment of impacts has been identified specifically for Ghost Bat. The impacts applied more broadly for all MNES species with the potential to occur within the Development Envelope are described in Section 14.4.

14.8.7.1. Loss of Fauna Habitat as a Result of Clearing

The Proposal will result in clearing up to a maximum of 331 ha (14% in the survey area and 25% of the Development Envelope) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitats.

Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain habitats within 5 km from a category 2 cave or category 3 cave associated with an apartment block are considered supporting (foraging and dispersal) habitats within the species' home range.

The clearing of critical Gorge/Gully, Debris Slope/Rocky Outcrop and supporting Major Creekline, Minor Creekline and Alluvial, Colluvial and Hardpan Plains habitats is considered a significant residual impact and is proposed to be offset (Section 13).

The remaining habitats do not represent critical habitat for the species and are considered of low significance.

At least 1,128.6 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop habitat and 22,890.0 ha (85.9%) of supporting Major and Minor Creekline, and Alluvial, Colluvial and Hardpan Plain habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated area. Individuals can also disperse and forage more broadly in the surrounding low significance habitats.

14.8.7.2. Fragmentation of Habitat

Fragmentation is not expected to significantly impact Ghost Bats, as a result of the Proposed Action due to the following:

- All Apartment Blocks and Isolated Category 2 caves are being retained, which will allow Ghost Bats to continue to move throughout the landscape during and post implementation of the Proposed Action
- All Apartment Blocks and Isolated Category 2 caves have been included in appropriately sized MRZ and MEZs.
- Category 2 and 3 caves are not permanently occupied, therefore Ghost Bats can easily relocate away if disturbed by the pre-mining or pit development operations.
- High quality breakaways and ridgelines have been covered under MEZ's, which will aid with dispersal.
- Ghost Bats have been recorded foraging 40km in a night (return flight distance) by Bullen et al. (2023), allowing the species to easily clear the Development Envelope.
- Bullen (2023) commented that current field work involving numerous personal observation sessions at Ghost Bat roost entrances has shown that the species does not begin to forage from the ground immediately upon exiting the roost but departs the local area and begins to forage from the ground some distance away. This is supplemented by satellite tracking GPS tagged Ghost Bats (Bullen et al. 2023) and VHF and GPS data from Augusteyn et al. (2018)

Of the 131 Ghost Bat roosts within the Development Envelope, 25 will be impacted by the Proposed Action. Of these, 14 represent category 3 roosts and 11 represent category 4 roosts. Category 3 and 4 roosts are not considered critical habitat for the Ghost Bat (Bat Call WA 2021c) (Figure 14-23). All

significant roosts (including category 2 roosts and apartment block roosts) will be retained within MEZs and MRZs (Table 14-20 and Figure 14-25).

The area containing Mt Brockman, which is likely to provide the greatest area of critical and supporting habitat for the Ghost Bat, as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) with fragmentation of these habitats unlikely to occur as a result of the Proposed Action.

In addition to the above habitat connectivity will be maintained along the three Major Creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These Major Creeklines 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 range within the BS1 assessment area by protecting a cluster of seven roosts removed from the mine plan and placed within MEZs and MRZs.

Ghost Bat Roosts within BS1 Assessment Area

The range within the BS1 assessment area likely acts as an east-west corridor for the movement of Ghost Bats in the region as there is no suitable roosting habitat to the north or south (flats extend to the north and south). Surveys have shown there are 15 roost sites within the survey area along the range comprising ten category 3 and five category 4 roosts.

Removal of all 15 roost sites within the BS1 assessment area could potentially prevent Ghost Bat use of the corridor to move to and between other roosts within surrounding areas. As such the Proponent has amended the Proposed Action to avoid and protect a cluster of seven roosts, including five category 3 and two category 4 roosts, to maintain the east-west corridor connection.

To ensure operations do not accidentally impact these roosts, the Proponent has established MEZs within MRZs around these roosts. An MRZ refers to a demarcated zone where no mining excavation will occur, and only low-impact activities (such as access tracks) may be implemented. A MEZ refers to an area where no direct disturbance is permitted. A central MEZ will surround each significant roost within an MRZ (Table 8-22 and Figure 14-24). Management and monitoring in relation to these roosts is also included within the EMP attached as Appendix B.3.

Ghost Bat Apartment Block and Isolated Category 2 Roosts

The Proponent has designed the Proposed Action to avoid all six known apartment block roost complexes (comprising 20 roosts in total) and the two isolated category 2 roosts within the Development Envelope. To ensure these roosts are protected the Proponent will establish MEZs within MRZs around each roost/roost complex in line with Table 14-20 and as shown on Figure 14-24 and Figure 14-25 a to d.

Due to the significance that apartment block roosts provide to the Ghost Bat, buffers associated with category 3 and 4 roosts in an apartment block have been elevated in significance to provide additional protection.

To further avoid impacts to apartment blocks and isolated category 2 roosts, the Proponent has established minimum vibration limits for each roost category as per Table 8-22 which deposit scale blast management plans will support. These minimum vibration limits have been informed by technical advice from Chiropterologist Bob Bullen (Bat Call WA) and will be monitored via the EMP.

Isolated Category 3 and 4 Roosts

Whilst isolated category 3 and 4 roosts are not considered critical habitat the Proponent recognises the value they provide in the landscape to the Pilbara Leaf-nosed Bat and Ghost Bat. Up to 25 category 3 and 4 roosts will be directly impacted by the Proposal. As such the Proponent will establish MEZs within MRZs for all remaining known category 3 and 4 roosts within the Development Envelope. Vibration limits

will also apply to retained category 3 roosts (Table 14-20 and as shown on Figure 14-24 and Figure 14-25 a to d). The Proponent has specifically chosen to protect these roosts across the Development Envelope in order to provide for ongoing dispersal and genetic viability across the Development Envelope and wider area.

Table 14-20: Mine Restriction and Exclusion Zones and Peak Particle Velocity Limits for Roosts

Roost Category	Mine Exclusion Zone and Mining Restriction Zone (m)	Peak Particle Velocity (PPV)
Apartment Block – Primary Roosts	• MRZ: Mining activities permitted up to 150 m of primary category 2 roosts • MEZ: Ground disturbance is restricted to within 100 m of primary category 2 roosts.	• 10 mm/s peak particle velocity (PPV) during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months.
Apartment Block – Category 3 and 4 Roosts	• MRZ: Mining activities permitted up to 150 m of secondary category 3 roost • MEZ: Ground disturbance is restricted to within 100 m of secondary category 3 roost • MRZ: Mining activities permitted up to 75 m of secondary category 4 roost • MEZ: Ground disturbance is restricted to within 65 m of secondary category 4 roosts.	• 10 mm/s peak particle velocity (PPV) during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months • Category 3 roosts - 50 mm/s PPV • Category 4 roosts – N/A.
Isolated Category 2 Roosts	• MRZ: Mining activities permitted up to 150 m of isolated category 2 roosts • MEZ: Ground disturbance is restricted to within 100 m of isolated category roosts.	• 10 mm/s peak particle velocity (PPV) during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months.
Retained Category 3 Roosts	• MRZ: Mining activities permitted up to 75 m of retained category 3 roosts • MEZ: Ground disturbance is restricted to within 65 m of retained category 3 roosts.	• 50 mm/s PPV
Retained Category 4 Roosts	• MRZ: Mining activities permitted up to 20 m of retained category 4 roosts.	• N/A

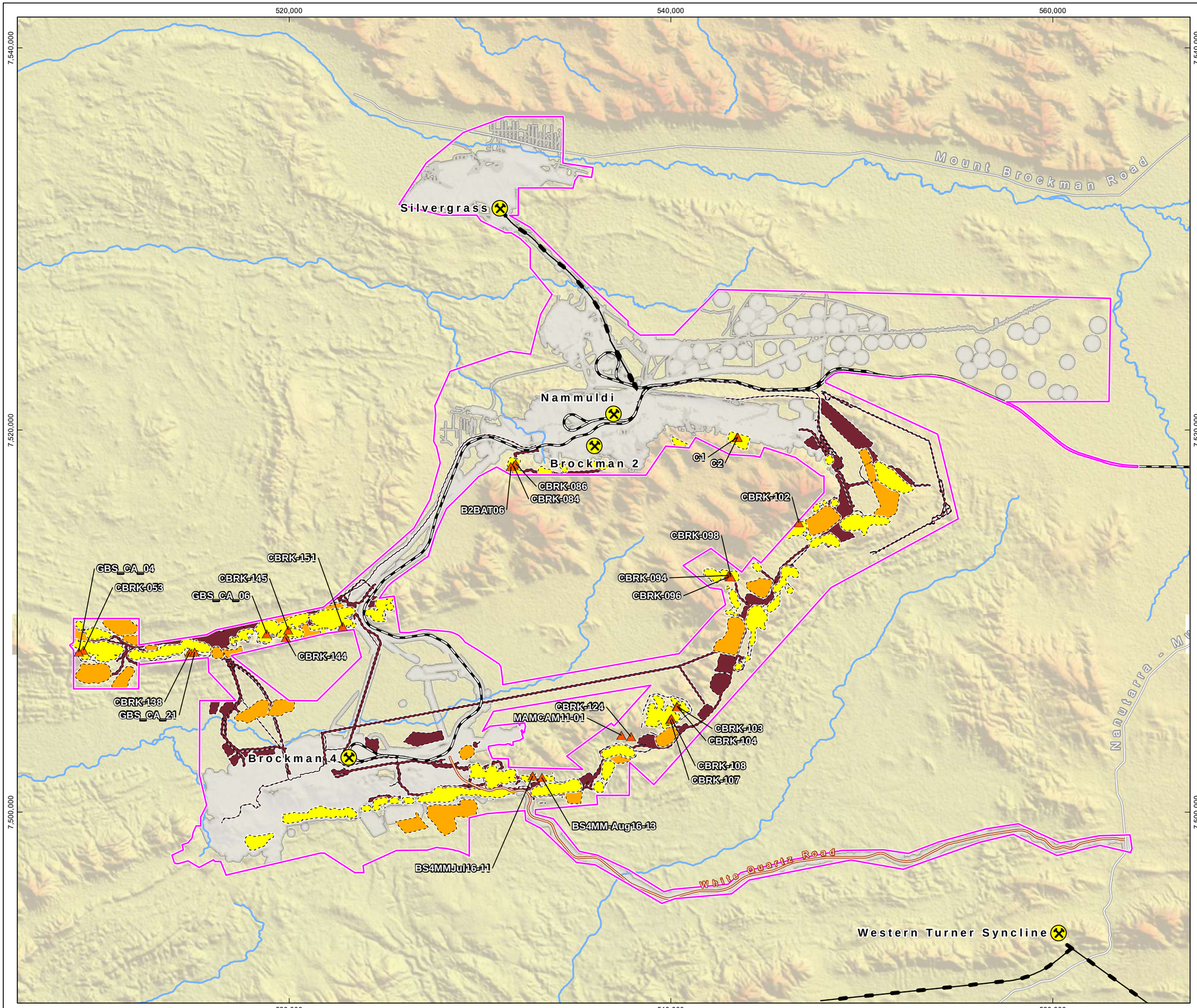

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Figure 14-23
Ghost Bat Roosts to be Impacted by the Proposed Action

Drawn: L.Fuentes
Plan: PDE0189721v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Part IV Indicative Approved Footprint
- Impacted Cave Location

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure
- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Site Access Road
- Major Creek

Cave name	Ghost Bat Cave Category
B2BAT06	Category 3
BS4MM-Aug16-13	Category 3
BS4MMJul16-11	Category 3
C1	Category 4
C2	Category 4
CBRK-053	Category 3
CBRK-084	Category 3
CBRK-086	Category 3
CBRK-094	Category 4
CBRK-096	Category 4
CBRK-098	Category 4
CBRK-102	Category 4
CBRK-103	Category 3
CBRK-104	Category 3
CBRK-107	Category 4
CBRK-108	Category 3
CBRK-124	Category 4
CBRK-138	Category 4
CBRK-144	Category 3
CBRK-145	Category 4
CBRK-151	Category 3
GBS_CA_04	Category 4
GBS_CA_06	Category 3
GBS_CA_21	Category 3
MAMCAM11-01	Category 3

N

0 2 4 6 8 10
Kilometres

Map units in metres

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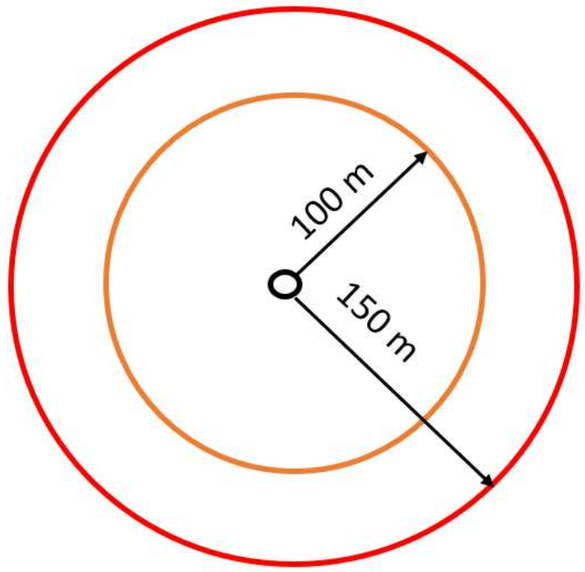
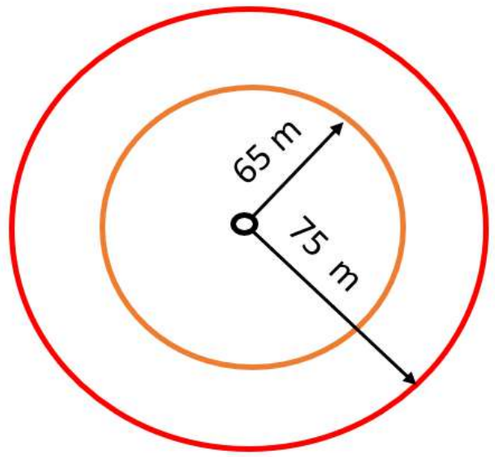
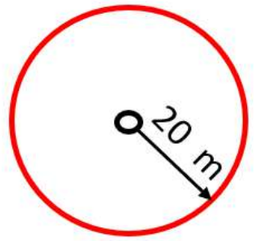
- Isolated Category 2 Roosts
- Category 2 Roosts when in an Apartment Block
- Category 3 Roosts when in an Apartment Block

- Retained Category 3 Roosts
- Category 4 Roosts when in an Apartment Block

- Retained Category 4 Roosts







- **Mining Restriction Zone (MRZ)**: Refers to a demarcated zone where no mining excavation will occur, and only low impact activities associated with environmental monitoring and management may be implemented. No more than 5% of the MRZ can be cleared for low impact activities
- **Mining Exclusion Zone (MEZ)**: Refers to an area within the Development Envelope where no direct disturbance is permitted unless in response to a contingency action associated with monitoring and management

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Figure 14-24
Ghost Bat Mine Restriction and Exclusion Zones According to Roost Category

Drawn: L.Fuentes
Plan: PDE0189741v1
Date: May 2023
Scale: Not to Scale @A3
GIS.Team@riotinto.com

Legend

- Cave
- Mine Restriction Zone
- Mine Exclusion Zone

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Figure 14-25
Mine Restriction and Exclusion Zones Roosts, Connecting Habitat and Water Features

Drawn: L.Fuentes
Plan: PDE0189741v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:185,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Roost
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Water Features

- Ephemeral
- Permanent
- Year-round (artificial)
- Unknown

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Major Creek
- Minor Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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520,000
540,000
560,000
7,520,000
7,500,000

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Plunge Pool
Duck Creek
Wackiina Creek
Boolgeeda Creek
Beasley River West

0 0.25 0.5 0.75 1
Kilometres

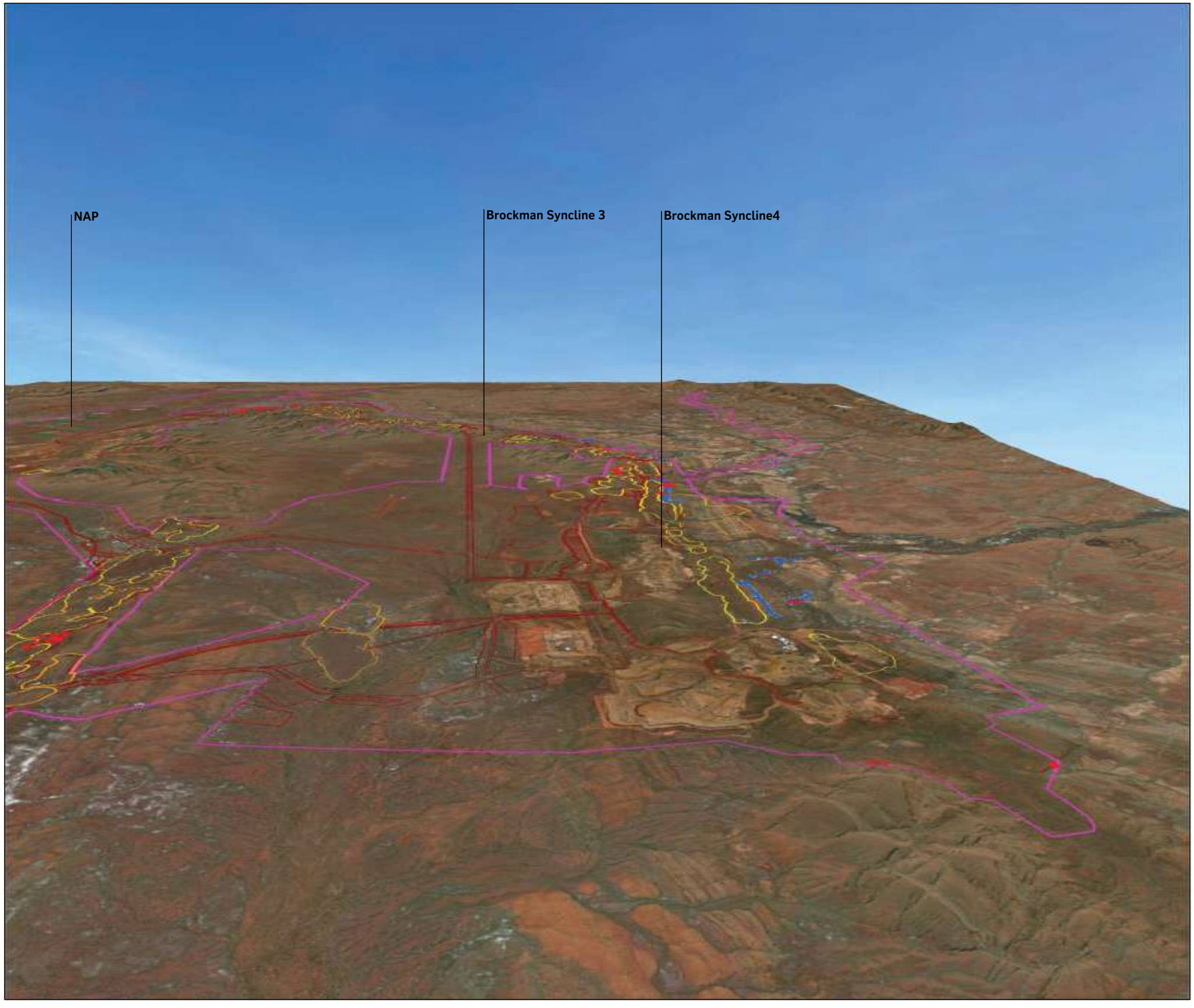

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Figure 14-25
Mine Exclusion Zones
Roosts and Critical Habitat
Looking East

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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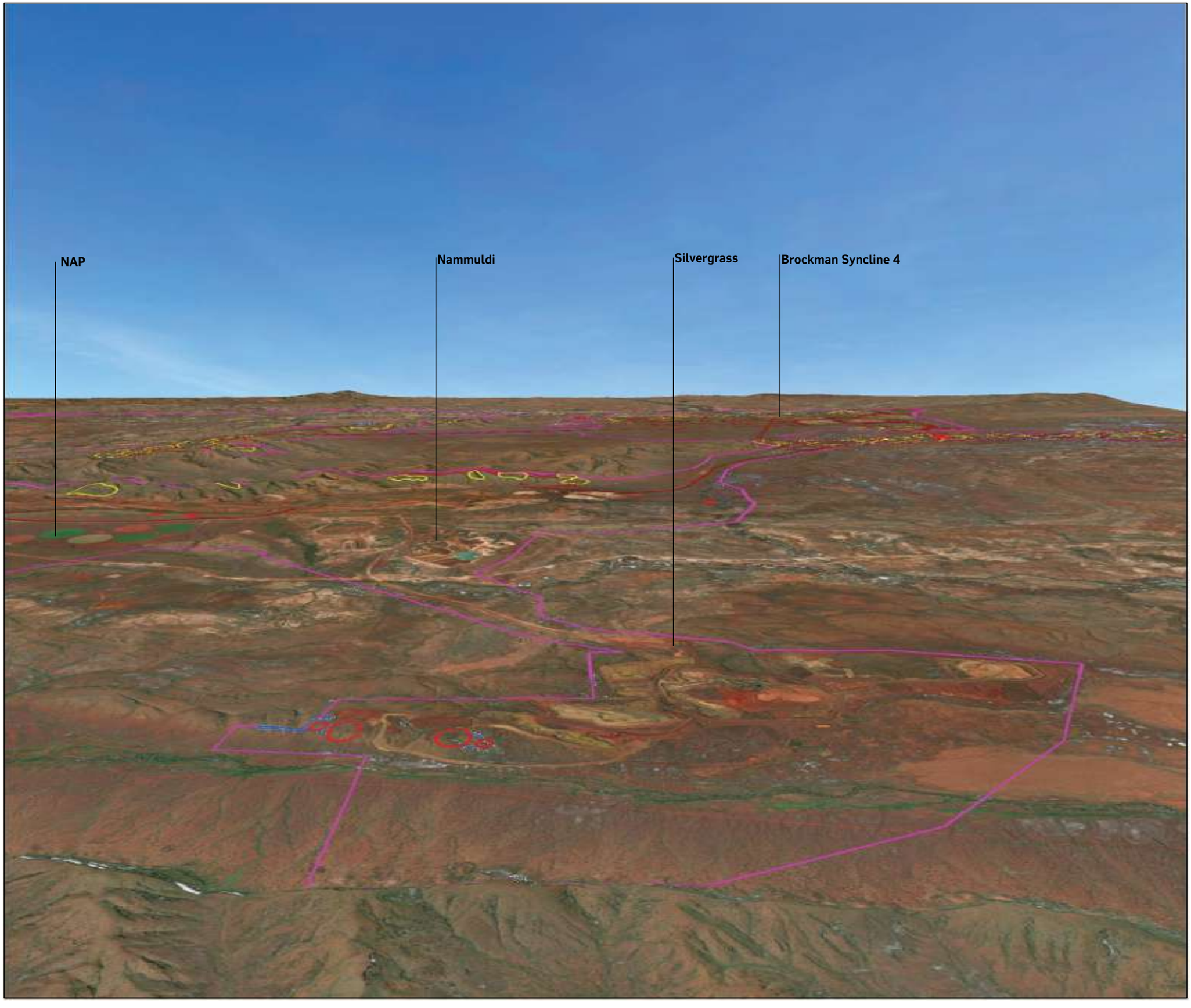

RioTinto

Figure 14-25
Mine Exclusion Zones
Roosts and Critical Habitat
Looking South

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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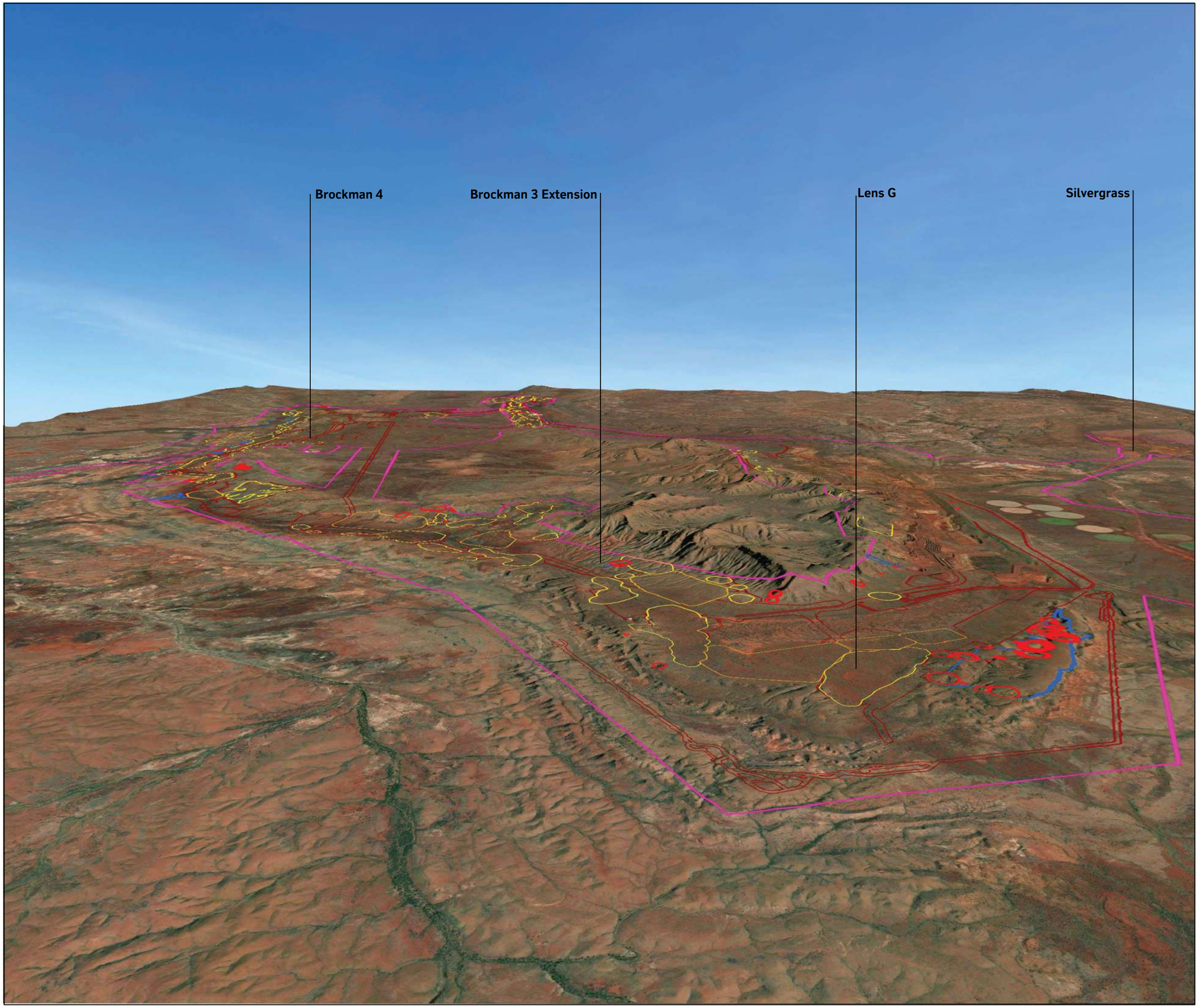

RioTinto

Figure 14-25
Mine Exclusion Zones Roosts and Critical Habitat Looking West

Drawn: L.Fuentes
Plan: PDE0191287v1.2
Date: May 2023

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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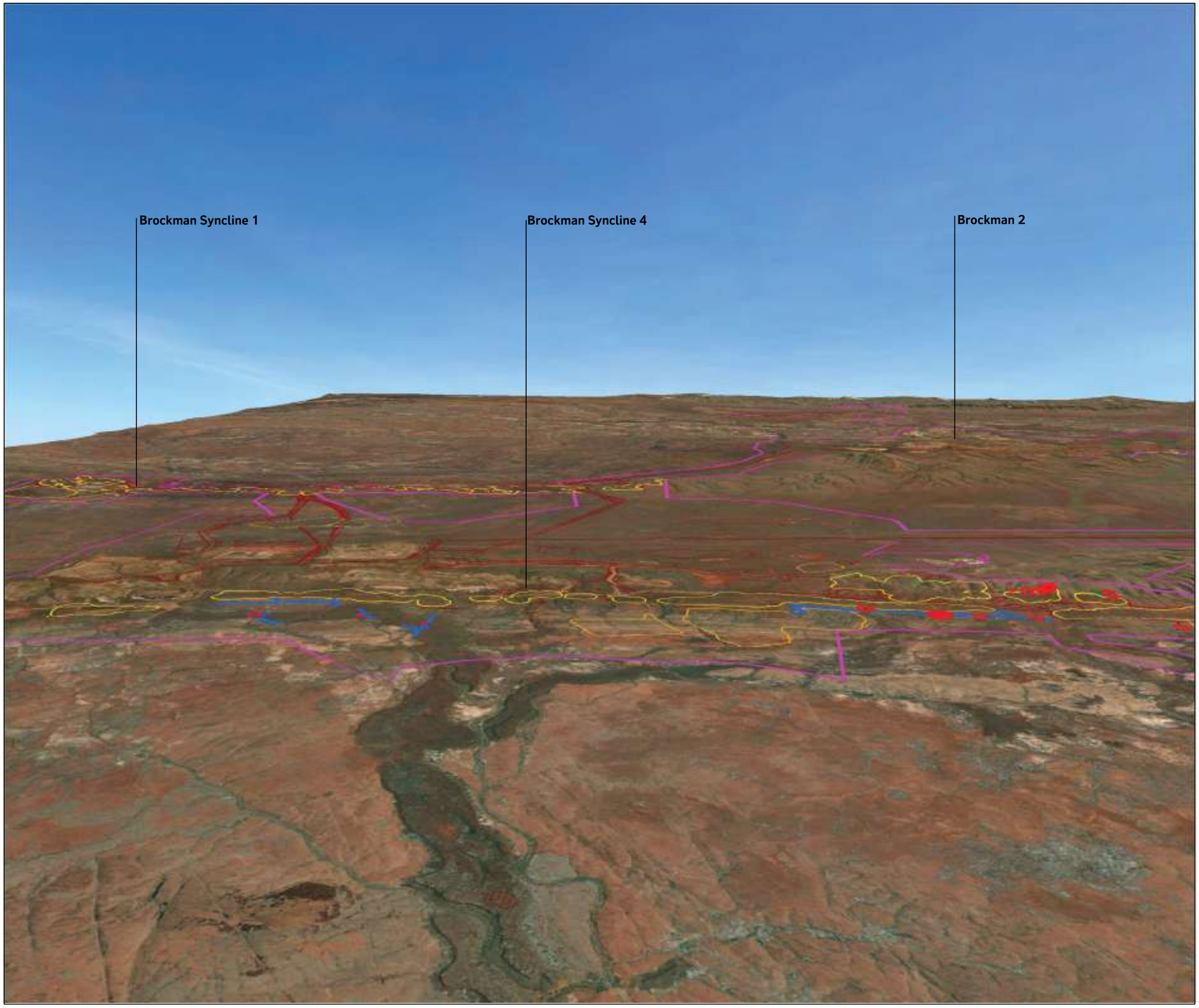

RioTinto

Figure 14-25
Mine Exclusion Zones
Roosts and Critical Habitat
Looking North

Drawn: L.Fuentes
Plan: PDE0191287v1
Date: July 2022

NTS @ A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Ghost Bat Restriction and Exclusion Zone
- MNES Critical Habitat Exclusion Zone

Conceptual Footprint

- Pit
- Waste Rock Landform
- Infrastructure

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14.8.7.3. 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.

14.8.7.4. Disturbance from Light, Noise and/or Vibration Resulting in the Displacement of Fauna Associated with Construction Activity and Mining Operations

Light emissions from the Proposed Action are not expected to significantly alter nocturnal foraging activities as light emissions are already present in the current operational mining area at Greater Brockman. Additional light emissions from the Proposed Action are not expected to impact Ghost Bat roosting or foraging behaviour significantly due to the lighting being designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020), including:

- Permanent lighting will be installed only where 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, MRZs, significant caves, critical habitat)
- Temporary lighting (e.g., trailer mounted units) may be required to provide a safe working environment for short periods, where practicable, and while still providing a safe working environment; these will be positioned to minimise direct light spill into sensitive areas.

There are no regulations in Western Australia that specify noise and vibration limits for the habitat of MNES fauna species (Wood 2021). However, DAWE (2013) specifies that activities should not “disrupt the breeding cycle of an important population”. Ghost Bat behaviour may be disrupted if bat roosts are exposed to noise or vibration (Wood 2021). Mining activities undertaken within 1,000 m of a roost may result in a noise level that exceeds the 70 dB(A) threshold (Wood 2021). Seven roosts were identified by Wood (2021) as exceeding the 70 dB(A) threshold. However, all but one are within the Conceptual Footprint and will be directly impacted.

The one roost identified that could be indirectly impacted by noise based on its location from mining is a category 4 isolated roost and is not considered critical habitat. This roost will be managed and has a PPV limit of 75, which is anticipated to minimise indirect impacts from noise and vibration at this roost.

Wood (2021) modelled vibration from blasting and concluded that 980 m was the distance from blast where vibration falls below the 10 mm/s peak particle velocity (PPV) limit (Appendix E.6). Blasting activities undertaken within 980 m of roosts may result in vibrations that exceed the threshold (10 mm/s PPV). The Proponent will implement an EMP (Appendix B.3) to set out PPV levels of significant roosts.

The Proponent will implement a Blast Management Plan for all significant roosts (including isolated category 2 roosts and apartment block roosts). A Blast Management Plan is expected to effectively minimise impacts from vibration and noise on significant Ghost Bat roosts. The Proponent will implement a 150 m MEZ around category 2 roosts and those roosts described as category 3 within an apartment block. For less significant roosts such as isolated category 3 roosts, a MEZ with a buffer of 75 m around the roost will be implemented (Table 8-22).

If PPV levels from blasting cannot be achieved, then bats will be flushed from caves and caves temporarily sheeted to allow blasting to occur. Once blasting is completed sheeting will be removed to allow Ghost Bat access again.

14.8.7.5. Predation of Ghost Bats by Feral Species

Five feral fauna species have been recorded in the Development Envelope, including the Cat, Dingo, European Cattle, Horse and House Mouse. These species are known from the region surrounding the Development Envelope. The development of new tracks, increased water points and production of domestic waste has the potential to attract and increase the abundance and diversity of introduced species. This may increase competition with and predation of native species.

Clearing may result in native fauna traversing cleared areas to reach suitable habitats. These altered movement patterns may result in increased predation of significant fauna by feral predators, causing injury or mortality of individuals. Where Red Foxes are scarce (as in the survey area and Development Envelope), Cats are the main cause of population declines in smaller mammals (CALM 1996).

The Proponent will undertake feral animal control as required, in co-operation with regional control programs and the Traditional Owners. By implementing control programs, the loss of Ghost Bat individuals associated with the Proposed Action is not expected to cause significant impacts to the species.

14.8.8. Significance of Impacts

An assessment of the impacts the Proposed Action may have on the Ghost Bat as per the Significant Impact Guidelines (DoE 2013) is detailed in Table 14-21.

Table 14-21: Assessment of Significant Impacts to the Ghost Bat

Significant Impact Criteria	Assessment of Impacts to Ghost Bat
Potential to cause a long-term decrease in the size of an important population of the species	The population of Ghost Bats within the survey area and Development Envelope forms part of a key source population for breeding and dispersal and is, therefore, an important population as defined by DoE (2013). A total of 131 Ghost Bat roosts have been identified within the Development Envelope, including one maternity roost (category 2) and seven potential maternity roost (category 2). A total of 25 roosts will be directly impacted, comprising 14 category 3 roosts and 11 category 4 roosts. No roosts identified as critical habitat for the Ghost Bat (category 2 and apartment block roosts) will be impacted by the Proposed Action. MEZs within MRZs will be established around these retained significant roosts. There is evidence of the persistence of the Ghost Bat population in the Pilbara region alongside existing mining operations, including Brockman operations, so roosts and habitats retained in the Development Envelope are expected to continue to be utilised. Given the avoidance of 106 out of 131 roosts within the Development Envelope, the retention of at least 1,128.6 ha (77%) of critical 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 an important population that may occur within the Development Envelope.
Potential to reduce the area of occupancy of an important population	Ghost Bat foraging range is an average of 1.9 km (61 ha) (Bat Call WA 2021) from a category 1 or 2 roost (diurnal). Eight category 2 roosts have been recorded in Development Envelope. All category 2 roosts have been avoided and placed into MEZs for protection. Up to 331 ha (22.7%) of critical (roosting and breeding) habitat and 2,946 ha (11.1%) supporting (foraging and dispersal) habitat occurs will be cleared within the Development Envelope. But at least 1,128.6 ha (77%) of critical habitat and approximately 22,890 ha (85.9%) of supporting habitat will remain. 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 important population into two or more populations	Habitat connectivity will be maintained along the three Major Creeklines (Boolgeeda Creek, Duck Creek and Caves Creek) within and surrounding the Development Envelope. These Major Creeklines 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 range within the BS1 assessment area through the protection of a cluster of seven roosts that have been removed from the mine plan and placed within MEZs. The Ghost Bat is a highly mobile species and known to disperse up to 5 km from known roosts for nocturnal foraging activities. Given the extensive foraging range and retention of 106 roosts and approximately 18,488 ha (82%) of high and moderate significance habitats, 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 clearing up to 331 ha (22.7%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (breeding and roosting) habitat and 2,946 ha (11.1%) of supporting Major and Minor Creekline, and Alluvial Colluvial and Hardpan Plain (foraging and dispersal) habitat The remaining habitats do not represent critical habitat for the species and are considered of low significance.

Significant Impact Criteria	Assessment of Impacts to Ghost Bat
	Approximately 1,128.6 ha (77%) of critical habitat and approximately 22,890 ha (85.9%) of supporting habitat will remain in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated survey area. Individuals can also disperse and forage more broadly in the surrounding low significance habitats. Of the 131 Ghost Bat roosts within the Development Envelope, 25 will be impacted by the Proposed Action. Of these, 14 represent category 3 roosts and 11 represent category 4 roosts. Category 3 and 4 roosts are not considered critical habitat for the Ghost Bat (Bat Call WA 2021a). Clearing critical Gorge/Gully and Debris Slope/Rocky Outcrop and supporting Major Creekline, Minor Creekline and Alluvial, Colluvial and Hardpan Plains habitats (within the species home range) is considered a significant residual impact and is proposed to be offset (Section 13).
Potential to disrupt the breeding cycle of an important population	There will be no direct impact on category 1 or 2 roosts (maternity and diurnal roosts) by the Proposed Action. A total of 106 roosts, including six apartment block roost complexes, have been placed into MEZs/MRZs for protection. The Proposed Action will retain 1,128.6 ha (77%) of critical habitat and approximately 22,890 ha (85.9%) of supporting habitat. There is Gorge/Gully and Debris Slope/Rocky Outcrop that will persist in the survey area and extrapolated 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 extent that the species is likely to decline	The Proposed Action has the potential to modify, destroy, remove, isolate and decrease the availability of Ghost Bat habitat due to the clearing of roosting, foraging and dispersal habitat. However, no maternity roosts will be affected and given the retention of 106 roosts and approximately 1,128.6ha (77%) of critical habitat and approximately 22,890 ha (85.9%) of supporting habitat will remain in the Development Envelope., 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 2016b). 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 Bat at Mt Etna in Queensland; however, this has not been identified in the vicinity of the Development Envelope or in Western Australia, and 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 protecting land with significant colonies, replacing and avoiding barbed wire fencing, protecting roost sites and surrounding foraging areas and preventing the collapse of roost sites. The Proponent commits to avoiding barbed wire fencing as far as practicable. Where barbed wire is required by legislation, the top strand will be replaced with plain wire, and reflectors will be installed to prevent Ghost Bat interaction.

Significant Impact Criteria	Assessment of Impacts to Ghost Bat
	The Proposed Action has also been modified to minimise disturbance within Gorge/Gully and Debris Slope/Rocky Outcrop habitats, representing the critical roosting habitat for the species. On this basis, the Proposed Action is not expected to interfere with the recovery of the Ghost Bat.

14.8.9. Consistency with Relevant Recovery Plans and Guidance

There are no recovery plans for the Ghost Bat.

14.8.9.1. Threat Abatement Plans

Feral Cats have been recorded within the Development Envelope (Biota 2019d, Stantec 2020a). 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 2015b). 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.

14.8.9.2. Conservation Advice

The primary conservation actions from the approved Conservation Advice for Ghost Bat are outlined in Table 14-1. The Proponent has avoided and implemented the following:

- Auditing of retained Ghost Bat roost sites following the cessation of mining activities
- Protection of Ghost Bat roost sites from mining activities within the Development Envelope due to the implementation of:
    - 150 m MRZ/MEZs around 22 Ghost Bat (category 2 and apartment block category 3) roosts
    - 75 m MRZ/MEZs around 43 Ghost Bat (retained category 3) roosts
    - 20 m MEZs around 28 low significance Ghost Bat (category 4) roosts
- Avoidance of barbed wire fencing as far as practicable. Where barbed wire is required by legislation or other requirement, 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.

14.8.10. 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.

14.8.10.1. Significant Residual Impact

After application of mitigation measures, the following significant residual impacts are predicted for the Ghost Bat:

- Clearing up to 264 ha and 67 ha (27.9 and 13.0%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitats for the Ghost Bat. This clearing is proposed to be managed via upper limits of clearing as per Table 14-10 and will be offset as per Section 13
- Clearing of approximately 2,946 ha of supporting Major and Minor Creekline and Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat for the Ghost Bat, when within the species home range. This clearing is proposed to be offset as per Section 13.

14.8.10.2. 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 Terrestrial Fauna are set out below.

- The Proponent shall not clear more than:
  - 264 ha of Gorge/Gully habitat within the Development Envelope
  - 67 ha of Debris Slope/Rocky Outcrop habitat with the Development Envelope.
- No direct or indirect impacts from the Proposal to Ghost Bat roosts retained within MRZs and MEZs shown in Figure 14-25.

The Proponent will implement the EMP as per Appendix B.3 to achieve these outcomes.

14.8.11. Conclusion

The significant residual impact, after implementation of the mitigation hierarchy, is clearing of up to 331 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and breeding) habitat and approximately 2,946 ha of supporting Major and Minor Creekline, Alluvial, Colluvial and Hardpan Plain (foraging and dispersal) habitat for the Ghost Bat, when within its home range. Environmental offsets are proposed for this clearing and are discussed in Section 13. Subject to conditions and implementation of offsets (Section 13), 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.

14.9. Pilbara Olive Python (*Liasis olivaceous barroni*)

14.9.1. Species Profile

The Pilbara Olive Python (L*iasis 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).

14.9.2. Habitat Preference 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; 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).

14.9.3. Key Threats and Recovery Actions

14.9.3.1. Key Threats

Key threats to the Pilbara Olive Python population include predation by feral cats and foxes particularly juveniles, competition for food sources with feral predators, and destruction of habitat due to gas and mining developments (DEWHA 2008a).

14.9.3.2. 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).

14.9.4. Important Populations and Critical Habitat

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 2007-2021), 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 90 km east of the Development Envelope.

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 Debris Slope/Rocky Outcrop habitat types. Supporting foraging and dispersal habitat comprises Major and Minor Creeklines within 1 km of known records of the Pilbara Olive Python (Biologic 2022a).

14.9.5. Occurrence within and Surrounding the Development Envelope

Pilbara Olive Pythons have been recorded on 12 occasions within the survey area from 2009 to 2021 (Biologic 2022a). Of the 12 records of the species, seven were direct observations (comprising six live individuals and one dead individual), and five were records of secondary evidence, comprising sloughs (3) and scats (2). One additional scat was found 300 m northwest of the survey area. Of the live individuals recorded, one was a juvenile, one was an adult, while the other four individuals' age was not specified (Figure 14-26). Five Pilbara Olive Python sightings have been at Plunge Pool (a significant water feature).

Despite the low number of records, it is expected that the species occurs throughout the survey area and that the survey area supports a healthy breeding population, as evident by the demographic recorded (including juveniles and breeding-sized adults) (Biologic 2022a). For this reason, the Pilbara Olive Python population at Brockman is likely to represent a key source population for breeding and dispersal. Therefore, it could be regarded as an ‘important population’ as defined by DoE (2013) (Biologic 2022a).

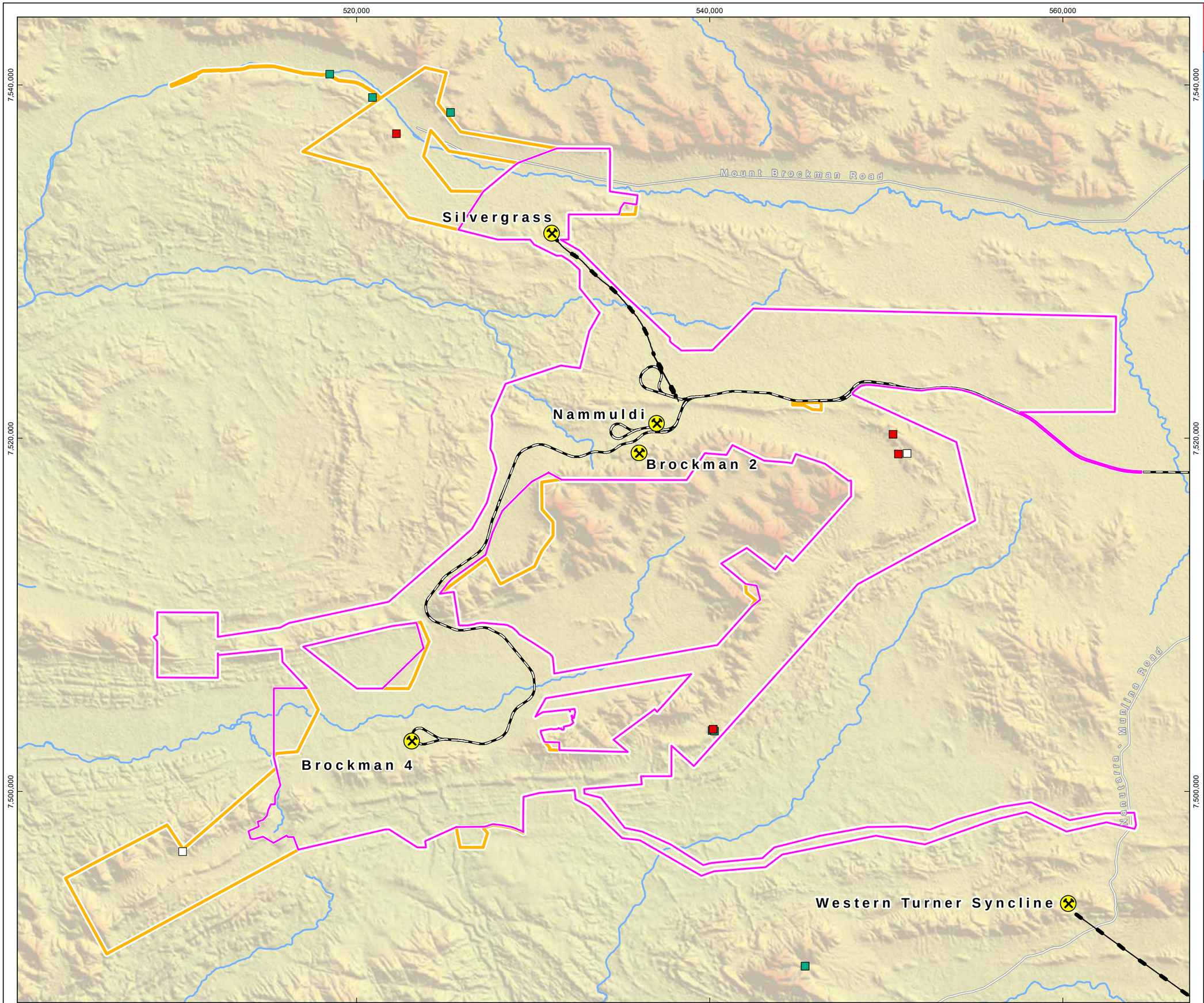

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Figure 14-26
Pilbara Olive Python Records within and Surrounding the Proposal

Drawn: L.Fuentes
Plan: PDE0189732v1
Date: July 2022

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Liasis olivaceus barroni (VU) (Pilbara Olive Python)

Sampling Method

- Secondary observation
- Opportunistic
- Systematic
- Targeted

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10

Kilometres

Map units in metres

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Figure 14-27
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings Overview

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A3
GIS.Team@riotinto.com

520,000
540,000
560,000
7,540,000
7,520,000
7,500,000

Mount Brockman Road
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Nanutarra - Munjina Road

Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Major Road
- Minor Road
- Major Creek

N

0 2 4 6 8 10
Kilometres

Map units in metres

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Figure 14-27
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map A

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

510,000
520,000
530,000
540,000
7,540,000
7,530,000
7,520,000

Cajwingina Creek
Robe River
Caves Creek
Duck Creek

Silvergrass
Nammuldi
Brockman 2

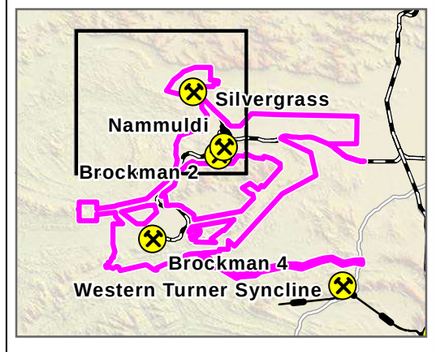
Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 14-27
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map B

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

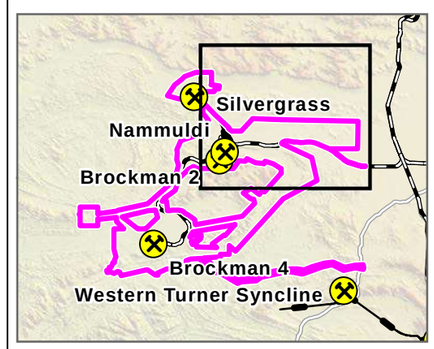
Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Conveyor
- Minor Road
- Major Creek



N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 14-27
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map C

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

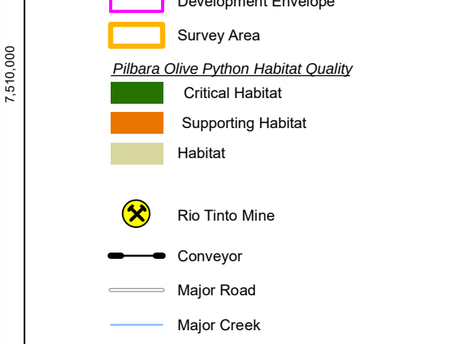
Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Conveyor
- Major Road
- Major Creek



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0 1 2 3 4 5

Kilometres

Map units in metres

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Figure 14-27
Potential Pilbara Olive Python Habitat within the Survey Area and Surroundings
Map D

Drawn: L.Fuentes
Plan: PDE0189733v2
Date: May 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:100,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Survey Area

Pilbara Olive Python Habitat Quality

- Critical Habitat
- Supporting Habitat
- Habitat

- Rio Tinto Mine
- Rio Tinto Railway
- Major Creek



N

0 1 2 3 4 5

Kilometres

Map units in metres

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510,000 520,000 530,000

7,510,000 7,500,000 7,490,000

Boolgeeda Creek

Brockman 4

Beasley River West

Beasley River

14.9.6. Habitat within and Surrounding the Development Envelope

Gorge/Gully and Debris Slope/Rocky Outcrop habitats provide critical shelter and breeding habitats. Additionally, Major Creekline and Minor Creekline habitats mapped within the survey area provide supporting foraging and dispersal habitat for the species, particularly in areas adjacent to or provide connectivity between Gorge/Gully and Debris Slope/Rocky Outcrop habitats (Figure 14-17).

Key surface water features associated with gullies and gorges include (Figure 6 2; Rio Tinto 2019c):

- Plunge Pool is a permanent groundwater-fed water feature in BS4 assessment area
- Ridge Pool is a surface water driven pool (outside the Development Envelope) with reduced evaporation from shading from a nearby overhanging rock shelf

Other water features have been recorded within the survey area; however, these are small, ephemeral pools only present after rainfall when water is widely available and therefore not considered critical habitat.

14.9.7. Assessment of Impacts

The Proposed Action may, directly and indirectly, impact Pilbara Olive Python. Key impact pathways are described in Section 14.4

14.9.7.1. Loss of Fauna Habitat as a Result of Clearing

The Proposal will result in the clearing of up to 331 ha (14% in the survey area and 22.7% of the Development Envelope) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (shelter and breeding) habitats.

Major and Minor Creekline habitats within 1 km of known Pilbara Olive Python records is considered supporting (foraging and dispersal) habitat within the species' home range.

The clearing of high significance critical Gorge/Gully and Debris Slope/Rocky Outcrop and moderate significance critical Major Creekline and Minor Creekline habitats is considered a significant residual impact and is proposed to be offset (Section 13).

The remaining habitats do not represent critical habitat for the species and are considered of low significance.

At least 1,128 ha (77%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (shelter and breeding) habitat and 4,120 ha (76%) of supporting Major and Minor Creekline (foraging and dispersal) habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope habitats have been mapped within the extrapolated survey area. Individuals can also disperse and forage more broadly in the surrounding low significance habitats.

14.9.7.2. Fragmentation of Habitats

The Pilbara Olive Python occurs in rocky habitats near surface water, which it relies upon for hunting. Prey is often captured by striking from a submerged position in the water. A reduction in surface water availability could potentially reduce the hunting opportunities for Pilbara Olive Python. Eighteen of the 22 water features (fifteen ephemeral, two artificial and Plunge Pool) within the Development Envelope will be retained within MEZs and MRZs and remain available for use by the Pilbara Olive Python.

The area containing Mt Brockman, which is likely to provide the greatest area of critical and supporting habitat for the Pilbara Olive Python, as opposed to the area north of BS4 and the surrounding area near Ridge Pool, is large (in excess of 15,000 ha) with fragmentation of these habitats unlikely to occur as a result of the Proposal.

Intact Pilbara Olive Python habitat will remain within and surrounding the Development Envelope. Significant corridors in Gorge/Gully, Debris Scope/Rocky Outcrop and Major Creekline habitats will allow

movement around the mining area and through the landscape. 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.

14.9.7.3. 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, such as:

- Implementation of MEZ/MRZs around 18 of the 22 water features within the Development Envelope, including Plunge Pool
- Progressive clearing to allow fauna to migrate away from clearing activities or machinery movements
- Clearing will commence, where possible, from a disturbed vegetation edge to an undisturbed area (to encourage mobile fauna to relocate to adjacent areas naturally).
- 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.
- Implement feral animal control as required, in co-operation with regional control programs and the Traditional Owners.

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.

14.9.7.4. 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.

14.9.8. Significance of Impacts

An assessment of the impacts the Proposed Action may have on the Pilbara Olive Python as per the Significant Impact Guidelines (DoE 2013) is detailed in Table 14-22.

Table 14-22: Assessment of Significant Impacts to the Pilbara Olive Python

Significant Impact Criteria	Assessment of Impacts to Pilbara Olive Python
Potential to cause a long-term decrease in the size of an important population	Despite the low number of records, the species are expected to occur throughout the survey area, supporting a healthy breeding population. For this reason, the Pilbara Olive Python population is likely to represent a key source population for breeding and dispersal and therefore, it could be regarded as an 'important population' (DoE 2013). The Proposed Action will not affect Plunge Pool, the only permanent pool in the Development Envelope and the location of five out of 12 Pilbara Olive Python records. The Proposed Action will remove up to 331 ha (22.7%) of critical Gorge/Gully and Debris Slope/Rocky/Outcrop (shelter and breeding) and 140 ha (10.5%) of supporting Major and Minor Creekline (foraging and dispersal) habitat types from the Development Envelope. At least 1,128.6 ha (77%) of high significance critical habitat and 1,083 supporting habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope/Rocky Outcrop habitats have been mapped within the extrapolated survey area. 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 protection of Plunge Pool and 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	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.
Potential for fragmentation of an existing important 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 1,128.6 ha (77%) of critical habitat and 1,083 supporting habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope/Rocky Outcrop habitats have been mapped within the extrapolated survey area. 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. Consequently, the Proposed Action is not expected to impede the movement of individuals and is not expected to fragment an important existing population into two or more populations.
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 331 ha (22.7%) of critical and approximately 140 ha (12%) of supporting habitat for the Pilbara Olive Python within the Development Envelope comprising Gorge/Gully, Debris Slope/Rocky Outcrop (critical) and Major and Minor Creekline (supporting) habitat types. The remaining habitats do not represent critical or supporting habitat for the species and are considered of low significance. At least 1,128.6 ha (77%) of critical habitat and 1,083 supporting habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope/Rocky Outcrop habitats have been mapped within the extrapolated survey area.

Significant Impact Criteria	Assessment of Impacts to Pilbara Olive Python
	The clearing of high significance Gorge/Gully and Debris Slope/Rocky Outcrop and moderate significance Major and Minor Creekline habitats is considered a significant residual impact and is proposed to be offset (See Section 13).
Potential to disrupt the breeding cycle of a population	Males of the species can move up to 4 km in search of females during the breeding season and often move into a shelter (i.e., caves) (DEWHA 2008a). At least 1,128.6 ha (77%) of critical habitat and 1,083 supporting habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope/Rocky Outcrop habitats have been mapped within the extrapolated survey. Given this and the small numbers of records of this species in the Development Envelope and no impact to Plunge Pool (a critical water feature), 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 331 ha (22.7%) of critical habitat for the species. However, due to the retention of 1,128.6 ha (77%) of hi critical habitat and 1,083 supporting habitat (including ephemeral and permanent pools) within the Development Envelope, 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 are 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 331 ha (22.7%) of critical and approximately 140 ha (12%) of supporting habitat for the Pilbara Olive Python within the Development Envelope comprising Gorge/Gully, Debris Slope/Rocky Outcrop (critical) and Major and Minor Creekline (supporting) habitat types. The remaining habitats do not represent critical or supporting habitat for the species and are considered of low significance. At least 1,128.6 ha (77%) of critical habitat and 1,083 supporting habitat will remain available in the Development Envelope. An additional 11,491 ha of Gorge/Gully and Debris Slope/Rocky Outcrop 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.

14.9.9. Consistency with Relevant Recovery Plans and Guidance

There are no recovery plans for the Pilbara Olive Python.

14.9.9.1. Threat Abatement Plans

Feral Cats have been recorded within the Development Envelope (Biota 2019d, Stantec 2020a). 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 2015b).

14.9.9.2. Conservation Advice

The primary conservation actions from the approved Conservation Advice for the Pilbara Olive Python are outlined in Table 14-1. The Proposed Action has contributed 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.

14.9.10. 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.

14.9.10.1. Predicted Residual Impact

After application of mitigation measures, the following significant residual impacts are predicted for the Pilbara Olive Python:

- Clearing up to 264 ha and 67 ha (27.9 and 13.0%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitats for the Pilbara Olive Python. This clearing is proposed to be managed via upper limits of clearing as per Table 14-10 and will be offset as per Section 13
- Clearing of approximately 25 and 114 ha (4.4 and 14.9%) supporting Major and Minor (foraging and dispersal) habitat for the Pilbara Olive Python when within its home range. This clearing is proposed to be offset as per Section 13.

14.9.10.2. 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 Terrestrial Fauna are set out below.

- The Proponent shall not clear more than:
    - 264 ha of Gorge/Gully habitat within the Development Envelope
    - 67 ha of Debris Slope/Rocky Outcrop habitat with the Development Envelope.

- Minimise direct and indirect impacts from the Proposal to Pilbara Olive Python habitat in accordance with the EMP.

The Proponent will implement the EMP as per Appendix B.3 to achieve these outcomes.

14.9.11. Conclusion

The significant residual impact, after implementation of the mitigation hierarchy, is clearing of up to 331 ha of critical Gorge/Gully and Debris Slope/Rocky Outcrop (denning and breeding) habitat and approximately 140 ha of supporting Major and Minor Creekline (foraging and dispersal) habitat for the Pilbara Olive Python, when within its home range. Environmental offsets are proposed for this clearing and are discussed in Section 13. Subject to conditions and implementation of offsets (Section 13), 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.

14.10. Summary of Significant Residual Impacts and Offset Requirements for MNES

14.10.1. Significant Residual Impacts

Significant residual impacts which remain post mitigation are presented in Table 14-23 and include:

- Clearing up to 264 ha and 67 ha (27.9% and 13.0%) of critical Gorge/Gully and Debris Slope/Rocky Outcrop (roosting and denning) habitats for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python within the Development Envelope. This clearing is proposed to be managed via upper limits of clearing as per Table 14-23 and will be offset as per Section 13
- Clearing approximately 25 ha and 114 ha (4.4% and 14.9%) supporting Major and Minor (foraging and dispersal) habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python when within the species home range. This clearing is proposed to be offset as per Section 13
- Clearing approximately 65 ha, 2,638 ha and 104 ha (2.5%, 12.3% and 8.8%) supporting Alluvial, Colluvial and Hardpan Plain habitat for the Pilbara Leaf-nosed and Ghost Bat, when within the species home range. This clearing is proposed to be offset as per Section 13.

Table 14-23: Significant Residual Impacts Resulting from the Clearing of Critical and Supporting (When in the Home Range of the Species) MNES Habitats within the Development Envelope

Habitat Type	Clearing within Development Envelope (ha)
Critical Habitat – upper clearing limit	
Gorge/Gully	264
Debris Slope/Rocky Outcrop	67
Supporting Habitat - approximate clearing	
Alluvial Plain	65
Colluvial Plain	2,638
Hardpan Plain	104
Major Creekline	25
Minor Creekline	114
Total	**3,276**

The MNES fauna species home range is defined as:

- Northern Quoll – 1 km from known records, within the Development Envelope
- Pilbara Leaf-nosed Bat – 10 km from Upper Beasley River Roost and Plunge Pool
- Ghost Bat – 5 km from category 2 or category 3 (associated within an apartment block)
- Pilbara Olive Python – 1 km from known records, within the Development Envelope.

14.10.2. Offset Requirements

Offsets are proposed to counterbalance the significant residual impact of clearing of habitat types that are considered critical to the survival of the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python. The appropriateness of offsets to achieve the objective of counterbalancing the significant residual impacts is discussed in Section 13.

15. HOLISTIC IMPACT ASSESSMENT

This ERD provides a detailed assessment of the potential environmental impacts associated with the Proposal and application of the mitigation hierarchy in relation to each environmental factor. The Proponent has also sought to understand the environment as a whole, informed by a detailed understanding of environmental values and processes and the holistic views and concerns raised through consultation with the Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma People. The assessment of the Social Surroundings factor is inherently holistic in nature, given the Traditional Owners have a holistic view and connection to country.

15.1. Connections and Interactions between Environmental Factors

The high level of connectivity between the environmental factors of Inland Waters, Flora and Vegetation, Terrestrial Fauna and Social Surroundings is illustrated in Figure 15-1.

The key impacts that have little interaction across factors are greenhouse gas emissions and loss of subterranean fauna habitat. These impacts are assessed in detail in the factor assessments and require no further holistic consideration.

15.2. Combined Environmental Effects

This section provides information on the environmental effects on the environment as a whole to determine whether this raises any additional considerations for assessment. For the purposes of this holistic assessment, the following has been considered:

- Where an impact(s) has been completely avoided, it will not contribute to holistic impacts and does not require consideration
- Where an impact is already considered potentially significant and the mitigation hierarchy applied in relation to one or more factors, additional mitigation measures to address combined environmental effects are unlikely to be required
- Where there are multiple overlapping minor impacts, or a minor impact affects multiple values and has been assessed as not significant in the context of an individual factor; these may require further consideration holistically.

The key environmental values that have been the focus of mitigation across multiple factors (points 1 and 2 above) in this assessment are Plunge Pool, Boolgeeda and Duck Creeks, rocky habitats and caves.

The minor impact that has been assessed as a negligible or minor potential impact in relation to Terrestrial Fauna, Vegetation and Flora, Social Surroundings and Inland Waters but may require additional consideration holistically, is dust.

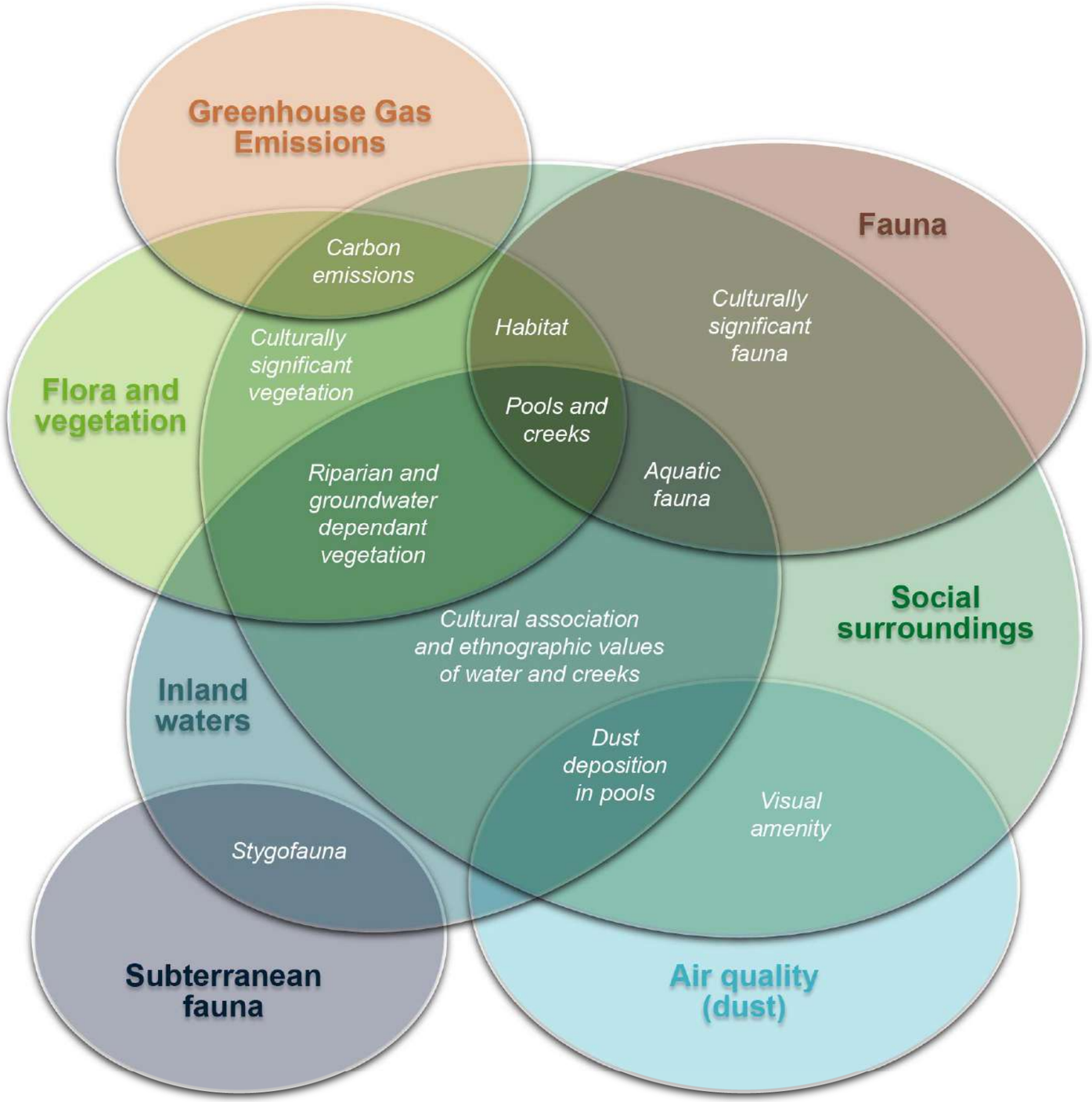

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Figure 15-1
Holistic View of Links between Environmental Factors Relevant to the Proposal

Drawn: L.Fuentes
Plan: PDE0191371v1 NTS @A3
Date: July 2022 *GIS.Team@riotinto.com*

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15.2.1. Summary of Combined Environmental Effects Already Addressed

Particular landscape features: rocky landforms, caves, creek lines and pools, are known to support higher biodiversity and are culturally important. The tendency for these key values to co-occur in landscape features in the Pilbara means that mitigation measures are often relevant for multiple factors. The Proposal has been developed with the protection of pools, particularly Plunge Pool and the minimisation of impacts to major creeklines, caves and gorge gully habitats as the priorities for application of the mitigation hierarchy, as shown in Figure 15-2. Therefore, the assessment of the potential environmental effect of the Proposal as a whole does not require different or additional mitigation to those applied when the factors were assessed in isolation. The synergies between landscape features and the location of various environmental values and the mitigation already applied are shown in Figure 15-2 and summarised below.

There are no additional significant residual impacts or additional mitigation required in relation to these landscape features.

15.2.1.1. Plunge Pool

Plunge Pool is culturally important, supports a range of aquatic and terrestrial fauna including MNES and supports groundwater dependent vegetation. Therefore, the avoidance of both direct disturbance and hydrological impacts on Plunge Pool as described previously in this ERD will avoid impacts to these environmental values and their relevant factors, both individually and holistically. As such no additional mitigation measures are required.

With the proposed mitigation (limit mining in the BS3 deposit to AWT and backfilling of the BS3 Extension deposits (MM-J and Creekside) to above post mining recovered water levels) groundwater levels at Plunge Pool are expected to be unaffected by mining. Whilst the frequency of surface water flushing will be reduced, the pool is expected to continue to fill and flush multiple times per year and therefore no significant change to the associated environmental values is anticipated.

15.2.1.2. Creeks

Surplus water discharge to Boolgeeda Creek and Duck Creek will continue early in mine life and then be phased out as mine pit voids become available for discharge. The water management strategy has been designed to maximise the retention of water within the Development Envelope. Therefore, the approved wetting front within Boolgeeda Creek will not be increased, and discharge to Duck Creek will be limited to within 67 km of the discharge outlet. Water quality and fauna assemblages will continue to be affected within the wetting fronts, but no significant environmental impacts have been identified. No aquatic fauna are limited to the wetting fronts and impacts are short-term, returning to baseline conditions on cessation of discharge.

The water management strategy will minimise the impacts on both environmental and cultural values that are associated with water in the Development Envelope and downstream.

15.2.2. Other Environmental Effects – Dust

Dust emissions will increase slightly due to the Proposal, but the overall impact will be minor. Dust emissions from mining, processing and vehicle movements have been assessed in relation to Vegetation and Flora, Terrestrial Fauna, Air Quality, Inland Waters and Social Surroundings. Negligible and minor impacts may occur in relation to habitat value, water quality (if dust washes into or settles in pools) and air quality. Studies have shown that vegetation health in the Pilbara is not affected by dust from mining. Visual amenity, in terms of airborne dust and settled dust on vegetation, will be affected close to mining activities.

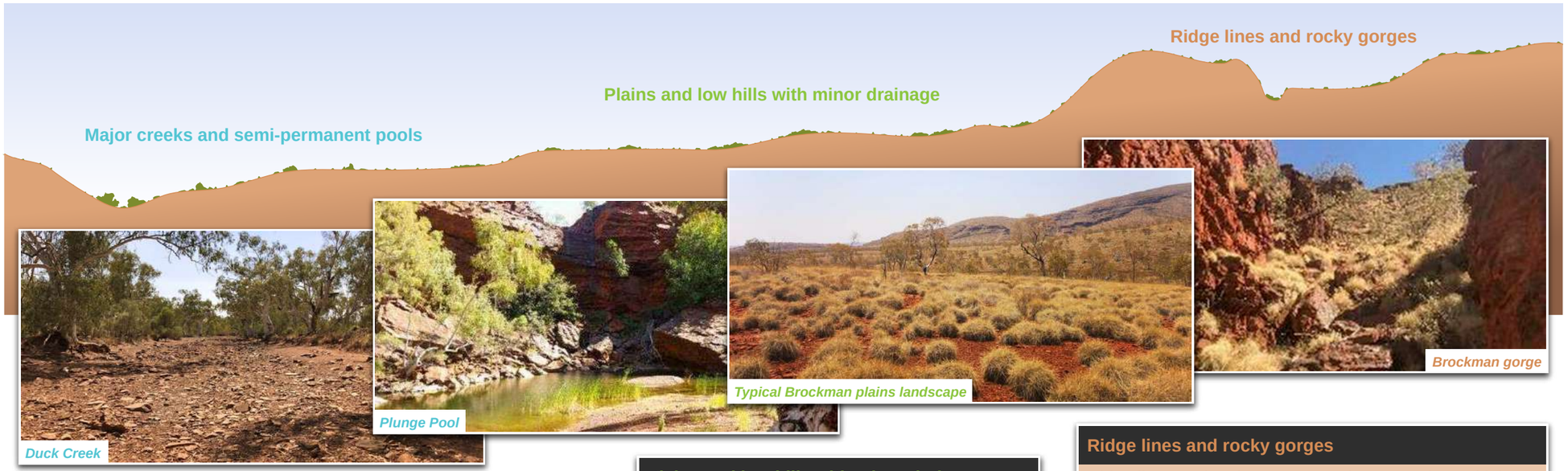
No significant impacts, holistically or by factor, associated with dust emissions have been identified given the management approaches that will be applied by the Proponent. However, given the potential for cumulative dust emissions in the Pilbara and concerns raised by Traditional Owners about amenity,

cultural values and potential avoidance behaviours by culturally significant fauna (e.g., kangaroos), the Proponent recognises the importance of reducing and maintaining low levels of dust across their operations in the Pilbara when considered holistically. Dust has the potential to affect the environment, neighbouring communities and the RTIO workforce. Therefore, the Proponent has a dust management improvement project underway that aims to reduce dust emissions from their Pilbara operations, including the establishment of a Dust Mitigation Working Group responsible for localised improvement initiatives, the Iron Ore Dust Management Awareness training package, governance processes and alternative dust suppression/capture trials for haul roads. These measures have already commenced and are not linked to a specific project.

15.2.3. Holistic Conclusion

The Proposal has been developed with the protection of pools, particularly Plunge Pool and the minimisation of impacts to major creeklines, caves and gorge gully habitats as the priorities for application of the mitigation hierarchy, including placing most of the above environmental values in MRZs/MEZs. Therefore, the assessment of the environmental effect of the Proposal as a whole does not require different or additional mitigation to the individual factor assessments.

The holistic impact assessment identified that dust is not expected to have a significant impact on the environment as a whole but in the context of the potential for cumulative emissions in the Pilbara, the Proponent is committed to investigating ways to improve dust emissions.



Major creeks and semi-permanent pools

Major creeks and semi-permanent pools are important for multiple factors and can support the following values:

- Cultural and heritage significance
- Groundwater dependent ecosystems
- Higher density vegetation provides increased shelter and foraging habitat
- Aquatic fauna and water resource for fauna including Pilbara Olive Python
- Visual amenity
- Hydrological processes

To minimise impact to these overlapping values, the Proposal includes:

- Footprint minimised (only 5 ha or 0.5 % of the footprint is within riparian vegetation areas)
- No increase to creek discharge
- Diversion proposed so that pools continue to fill at similar rate to pre-mining
- Mine plan modified to protect groundwater levels at Plunge Pool
- Clearing reduced to as low as reasonably possible in Creekline Habitat

Plains and low hills with minor drainage

Plains and low hills with minor drainage still support values but are widespread and less unique. Infrastructure is preferentially located in these areas to minimise impacts on key landscape features.

Holistic conclusion:

Proposal design has avoided or minimised disturbance to important environmental values.

The combined effects on the environment as a whole are not greater or different than effects on individual factors and have been minimised through application of the mitigation hierarchy.

Ridge lines and rocky gorges

Ridge lines and rocky gorges are important for multiple factors and can support the following values:

- Cultural and heritage significance and visual amenity
- Niche habitats for flora including *Tetratheca butcheriana* in the BS3 assessment area
- Caves that have heritage and/or habitat value as bat significant roosts
- Support ephemeral pools
- High significance Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python habitat

To minimise impact to these overlapping values, the Proposal includes:

- Clearing limits in Gorge/Gully and Debris Slope/Rocky Outcrop habitats
- Mining and disturbance exclusion zones established around important heritage areas, roosts and *Tetratheca butcheriana* populations.

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Figure 15-2
Holistic Impact Assessment
Landscape Perspective

Drawn: L.Fuentes
Plan: PDE0191372v1
Date: July 2022

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16. CUMULATIVE ENVIRONMENTAL 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 2021f). The EPA (2021f) 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".*

16.1.1. Reasonably Foreseeable Projects

There are several existing and reasonably foreseeable projects within 100 km of the Proposal and, more broadly within the Hamersley subregion of the Pilbara bioregion. These are listed in Table 16-1.

Table 16-1: Reasonably Foreseeable Projects within the Hamersley Subregion

Project*	Status	Location
Rio Tinto Existing Brockman Operations (BS2, BS4 and Nammuldi-Silvergrass) (MS 131, 867, 925 and 1000)	Operational	The approved footprint is within the Proposal Development Envelope
Fortescue Metals Group (FMG) Eliwana Iron Ore Project (MS 1109)	Commenced	Adjacent to the north of the Development Envelope
FMG Eliwana Railway (MS 1108)	Commenced	Adjacent to the north of the Development Envelope
Flinders Mine Pilbara Iron Ore Project (MS 1014)	Approved	15 km to the North of the Development Envelope
Rio Tinto Western Turner Syncline (MS 1031)	Operational	15 km to the south-east of the Development Envelope
FMG Solomon Expansion (MS 1062)	Operational	70 km to the north-east of the Development Envelope
Rio Tinto Greater Paraburdoo Iron Ore Hub (MS 1195)	Approved	85 km to the south-east of the Development Envelope

**Includes projects that have been approved but are yet to be implemented*

Further details of these projects are provided in Section 2.

16.2. Summary of Cumulative Assessment of Key Environmental Factors

Cumulative environmental impacts have been assessed for each factor. A summary of the cumulative impacts is provided below.

16.2.1. Inland Waters

Cumulative impacts associated with the Proposal (including approved and proposed operations) have been considered in assessing direct and indirect impacts (Section 6). The FMG Eliwana Iron Ore Mine (Eliwana Mine) is the only other project within the same surface and groundwater catchments as the

Proposal and, therefore, the cumulative impacts of the Proposal, existing Brockman operations, and the Eliwana Mine have been assessed.

A groundwater supply borefield at the FMG Flying Fish deposit (Eliwana Mine) is located directly north of the BS1 assessment area, and therefore the Proponent's groundwater modelling has included this abstraction in the cumulative assessment of groundwater drawdown. The modelling showed that the combined drawdowns increased the depth but not the extent of the predicted drawdown due to aquifer compartmentalisation. As no GDEs have been identified in this area or are likely to occur, given the topography, no significant environmental values are expected to be impacted by this potential cumulative impact.

The cumulative surface water catchment loss in Boolgeeda Creek due to the Proposal and Eliwana Mine is 11.4%, with 8.1% loss estimated from the Eliwana Mine and 3.3% loss from the Proposal. The proportion of catchment loss to Boolgeeda Creek is the greatest in the vicinity of the BS1 assessment area, where the upper catchment is expected to be lost due to FMG's Flying Fish deposit. Catchment loss in this area is anticipated to result in a runoff reduction of 18.5% in Boolgeeda Creek at this location (Rio Tinto 2021b). These changes will affect the depth and velocity of flood flows; however, catchment runoff is generally high in these rocky, arid environments, so the frequency of flooding is unlikely to be affected. No pools or surface water dependent ecosystems are identified in the upper reaches of Boolgeeda Creek. Therefore, no environmental values are expected to be impacted due to this reduction.

16.2.2. Flora and Vegetation

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

- Loss of native vegetation due to clearing
- Loss of significant flora due to clearing.

16.2.2.1. Native Vegetation

The Proposal will clear up to 7,896 ha of native vegetation, of which approximately 7,715 ha is in good to excellent condition. Vegetation to be cleared within the Development Envelope comprises five vegetation associations mapped by Beard (Hamersley 18, 29, 82, 175 and 567). Each vegetation association within the Development Envelope represents approximately 1.3%, 4.9%, 0.6%, 5.6% and 1.3% of the current pre-European extent within the Hamersley subregion. The cumulative impact is expected to contribute approximately 0.04% and 0.14% to vegetation clearing in the Pilbara region and Hamersley subregion, respectively (Section 7).

The approved clearing footprint proposed under the Eliwana Mine project is 7,900 ha and covers three vegetation associations as mapped by Beard (1975). Two of these are also present within the Development Envelope; Hamersley 18 and Hamersley 82 (FMG 2018a). The relative disturbance to each vegetation association is not presented in the Eliwana Mine ERD; therefore, a conservative approach was undertaken for this assessment by assuming the entire disturbance is equally divided between associations 18 and 82. The Eliwana Railway Project quantifies the clearing of all five vegetation associations present within the Proposal's Development Envelope (FMG 2018b).

The conceptual footprint of the Rio Tinto Greater Paraburdoo Iron Hub proposal intercepts two vegetation associations shared with the Proposal (Rio Tinto 2020b). The potential cumulative impacts on vegetation associations within the Hamersley subregion are presented in Table 7-18 as preliminary estimates only.

The assessment shows that the Proposal will have negligible cumulative effects at these scales, with 96.2% or more of pre-European extents remaining within the Hamersley subregion following the implementation of the Proposal and reasonably foreseeable projects. The maximum impact of clearing will be associated with Hamersley 175 at 3.5%, with the Proposal contributing 1.9% (Table 7-18). There are no significant impacts to any vegetation associations from the cumulative disturbance of reasonably

foreseeable projects. This is because less than 4.0% of each vegetation association in the Hamersley subregion is contained within the Conceptual Footprint of the Proposal and the relevant project development envelopes.

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 approved projects, at least 96% of pre-European extent for each vegetation association will remain in the State (Table 7-18).

Clearing of vegetation in good to excellent condition is considered a significant impact even though the remaining extent of vegetation associations potentially impacted by the Proposal and their representation in areas managed for conservation indicates no significant residual impacts on vegetation at the regional scale as per the EPAs cumulative environmental impacts of development in the Pilbara region (EPA 2014). This clearing is proposed to be offset as per Section 13.

16.2.2.2. Cumulative Impacts on Significant Flora

Thirteen species of priority flora are estimated to have the potential to be impacted cumulatively by the Proposal with other projects nearby. The estimated numbers potentially impacted by other reasonably foreseeable projects include all individuals within their Development Envelopes, not the disturbance footprints indicated by publicly available information and are considered conservative.

Implementation of the Proposal will remove from the region approximately:

- 11.5% of known *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354; P1)
- 20.5% of known *Ipomoea racemigera* (P2)
- 10.7% of *Pentalepis trichodesmoides* subsp. *hispida* (P2).

The known extent of these species has been calculated based on Rio Tinto's Database, which includes records of Priority flora species across the Pilbara region. Given over 90% of *Pentalepis trichodesmoides* subsp. *hispida* (P2) and 65% of *Hibiscus* sp. Mt Brockman (E. Thoma ET 1354; P1) and *Ipomoea racemigera* (P2) records will remain intact in the region; these cumulative impacts are not considered significant.

Cumulative impacts to known records of *Aristida jerichoensis var. subspinulifera* (P3), *Eremophila magnifica* subsp. *velutina* (P3), *Grevillea saxicola* (P3), *Indigofera rivularis* (P3), *Ptilotus subspinescens* (P3), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Rostellularia adscendens var. latifolia* (P3), *Sida* sp. Barlee Range (S. van Leeuwen 1642) (P3), *Sida* sp. Hamersley Range (K. Newbey 10692) (P3), *Themeda sp*. Hamersley Station (M.E. Trudgen 11431) (P3), *Acacia bromilowiana* (P4), *Eremophila magnifica* subsp. *magnifica* (P4) and *Goodenia nuda* (P4) will be less than 30% across regional records following the Proposal. Since over 70% of the species records will remain intact in the region these cumulative impacts are not considered significant.

Approximately 42.3% of known *Triodia basitricha* (P3) and 40.4% of known *Astrebla lappacea* (P3) have the potential to be removed from the region following the implementation of the Proposal and other reasonably foreseeable projects. Most of the records which have the potential to be removed occur within the Development Envelopes of other proposals. Only 4% and 1% of the total known *Triodia basitricha* and *Astrebla lappacea* populations, respectively, have the potential to be impacted by the Proposal. The majority of *Triodia basitricha* occur within the Eliwana Mine development envelope (34% of known individuals), and the majority of *Astrebla lappacea* occur within the FMG Eliwana Railway Project Development Envelope (39% of known individuals). However, the Proponents of these projects have committed to avoiding or minimising the impacts on these species. The FMG Eliwana Railway Project (MS 1109) includes a condition requiring the Proponent to avoid, where possible, or minimise impacts, to this species. Thus, it can be anticipated that disturbance will be kept to a minimum such that the status of the species will not be affected.

Cumulative impacts of significant flora species within the Development Envelope that occur across multiple nearby projects are not likely to alter the status of any Priority flora species within the Development Envelope. Therefore, cumulative impacts are not expected to be significant.

16.2.3. Terrestrial Fauna

The Proposal will contribute to cumulative regional impacts on fauna habitats and species in the Development Envelope. 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. Table 8-20 identifies the occurrence of significant species within other project areas within 100 km of the Proposal. Existing and reasonably foreseeable projects within the region that may contribute to cumulative impacts along with the Proposal are described in Table 16-1.

However, these species occur widely in the Hamersley sub-region and can move through the local landscape. The retention of high significance habitat will help maintain the significant fauna species in the area. 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.

Clearing for the Proposal has the potential to result in habitat fragmentation. The impact of fragmentation has the potential to be most apparent within the BS1 assessment area as a cumulative effect given the proximity to the adjacent Eliwana Mine project, creating a potential barrier to fauna dispersal to the north. However, the connected habitat extends throughout the Development Envelope and into the areas surrounding the Proposal and adjacent project. The presence of connected habitat outside the Development Envelope is expected to reduce the significance of the fragmentation on fauna in the area.

The estimated cumulative impacts from this Proposal and reasonably foreseeable projects on the land systems within the Hamersley subregion are anticipated to total 122,796 ha (3%; Table 8-16). This Proposals contribution is 7,896 ha (0.2%). The cumulative impacts on land systems are small (the highest loss is 6% within the Rocklea Land System with 41,044 ha). Therefore, the full range of habitat types associated with these land systems will remain in the Hamersley subregion.

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 addressed through the PEOF.

16.2.4. Subterranean Fauna

The Brockman Syncline aquifer system is primarily a closed system with little connection with the surrounding lithologies; therefore, only Proposals within the confines of the aquifer system (stygofauna) or Proposals situated close to the Proposal (troglofauna) will result in cumulative impacts.

16.2.4.1. Stygofauna

Considering cumulative impacts (combined direct impacts of historical mining and future mining operations, evaporative losses from proposed pits at 2350 and impacts from other 3rd Party projects), approximately 55% of BWT habitat will be impacted within the syncline. Broken down per area, this represents:

- Approximately 65% of suitable habitat BWT within the BS1 assessment area
- Approximately 64% of suitable habitat BWT within the BS2 assessment area
- Approximately 48% of suitable habitat BWT within the BS3 assessment area
- Approximately 42% of suitable habitat BWT within the BS4 assessment area.

Despite the reduction to the extent and thickness of saturated BWT habitats throughout most sections of the syncline, 3D modelling revealed significant areas of habitat will remain intact and suitable for stygofauna species.

As discussed in Section 9 twenty-one stygofauna taxa were considered ‘at risk’ of direct or cumulative impacts throughout the Development Envelope. The direct and cumulative impacts to these taxa are expected to be medium too low for the majority of these taxa, while only three taxa (Paramelitidae `sp. Biologic-AMPH012` within the BS2 assessment area and Brevisomabathynella `sp. B03` and Parabathynellidae `sp. Biologic-PBAT003`within the BS1 assessment area) was considered at high risk under the cumulative impact scenario. Analysis has, however shown that sufficient habitat remains in and around these species.

Neither the proposal's direct nor cumulative impacts are likely to completely remove suitable habitats 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.

16.2.4.2. Troglofauna

Following consideration of cumulative impacts (combined direct impacts of historical mining and future mining operations and 3rd party impacts), 3D modelling shows only minor changes in habitat thickness, extent, or connectivity throughout the syncline under the cumulative scenario, with extensive areas of prospective AWT habitat that remain unaffected. Furthermore, vast prospective AWT habitats are likely to exist outside of the 3D modelling boundary.

The impact rankings of troglofauna taxa are the same under the proposed and cumulative scenarios. Impacts to 11 troglofauna taxa were ranked as ‘medium’, while impacts to 38 troglofauna taxa were ranked as ‘low’. None of the impacts on troglofauna species values were considered ‘high’. Therefore, the troglofauna species recorded from the Development Envelope are expected to persist following the Proposal's implementation.

16.2.5. Air Quality

16.2.5.1. Dust

Modelling predicted dust contributions from the Proposal addressed scenarios with and without background concentrations. Therefore, the scenarios incorporating background data are considered to provide the basis for assessing the cumulative impact from past and present emissions sources (ETA 2021).

Additional future emissions from other nearby reasonably foreseeable sources include yet-to-be-developed parts of the Eliwana Mine, located along the northern border of the Development Envelope adjacent to the BS1 assessment area. The Proponent considers no other reasonably existing or foreseeable project to be near enough to contribute to cumulative dust emissions. Cumulatively, the Proposal, the existing Brockman operations and the Eliwana Mine will emit approximately 45 kt of PM10 particulates per annum. As discussed in Section 10.6.1 dust concentrations are not expected to impact sensitive receptors in the vicinity of the Proposal significantly.

16.2.6. GHG Emissions

Mine production included in the Proposal will sustain rather than increase annual ore throughput associated with existing operations within the Development Envelope. The Proposal will increase the total mine life as the existing approved mines reach the end of their productive life and are eventually replaced by the new mine pits associated with the Proposal. Therefore, the Proposal represents a continuation of iron ore mining. As a result, the Amended Proposal is expected to contribute approximately 231,661 t CO_2-e per annum (average), as follows:

- Scope 1 emissions: 199,122 t CO_2-e per annum (including land clearing)
- Scope 2 emissions: 32,539 t CO_2-e per annum.

Through the LOM, the Amended Proposal is expected to contribute 5,330,943 t CO_2-e Scope 1 and 2 emissions.

Intensity benchmarking shows the emissions intensity of the Proposal is lower than many of the domestic iron ore mines due to design decisions and continued commitment to the mitigation measures in place relating to GHG emission management. The total GHG emissions from the Proposal is expected to be reduced by approximately 2,100,000 t CO_2-e through incorporations and adoptions of the best practice designs and best practice measures throughout the LOM.

16.2.7. Social Surroundings

The Proposed Amendment has the potential to contribute to cumulative impacts to Social Surroundings values at a regional scale through:

- Alteration of visual amenity of the local area
- Increase of dust in the local area
- Increase noise and vibration in the local area
- Alteration of surface water regimes in the local area
- Loss of culturally significant native vegetation and fauna habitat
- Potential disturbance to sites of cultural significance or to Aboriginal heritage places

The Proponent aims to avoid impacting Heritage Places and places of cultural significance (where practical) and develop appropriate mitigation strategies through ongoing consultation with the Puutu Kunti Kurrama, and Pinikura People, and the Muntulgura Guruma People. Where the Proponent cannot avoid direct impact on Heritage Places, the Proponent will seek the relevant Heritage Approvals under the AH Act and ACH Act.

Consultation to date with the Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma People (and guided by best practice and Social Surroundings guidelines) has informed the development of SCHMPs for the Proposal that aims to:

- Establish frameworks and processes to identify social, cultural, and heritage values in consultation with the Puutu Kunti Kurrama and Pinikura and the Muntulgura Guruma Traditional Owners
- Avoid where possible and minimise disturbance to culturally significant places, including Heritage Places
- Proactively manage and minimise potential indirect impacts, including visual, noise, dust and vibration impacts to places of cultural significance
- Where possible, maintain access to Country (including places of cultural significance)
- Minimise unauthorised access to places of cultural significance and Heritage Places by employees and contractors
- Avoid where possible and minimise impacts to culturally significant flora and fauna
- Avoid where possible and minimise changes to hydrological regimes, including impacts to water level/quantity, water quality, or modification of flow paths, at culturally significant water sources
- Establish a framework for ongoing consultation with the Puutu Kunti Kurrama and Pinikura and the Muntulgura Guruma Traditional Owners through the life cycle of the Proposal regarding implementation and compliance of the SCHMP.

Engagement and consultation with the Puutu Kunti Kurrama and Pinikura People and the Muntulgura Guruma People is ongoing to further inform the Proponent's understanding of the potential impacts to social surroundings values within and surrounding the Proposal.

16.3. Predicted Cumulative Outcomes

Based on 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.

17. REFERENCES

AECOM 2019. Baseline Geomorphological Assessment: For Greater Brockman Expansion Project. Report prepared for Rio Tinto Limited.

AQ2 2021. *Duck Creek Ecohydrology Study*. Prepared for Rio Tinto.

AQEG (2012) Fine Particulate Matter (PM2.5) in the United Kingdom, Air Quality Expert Group, Department for Environment, Food and Rural Affairs, London 2012

Armstrong, K. 2000. Roost microclimates of the bat *Rhinonicteris aurantius* in a limestone cave in Geike Gorge, Western Australia. *Australian Mammalogy*. 22:69–70.

Armstrong, K. 2001. The roost habitat and distribution of the orange leaf-nosed bat, *Rhinoicteris aurantius,* in the Pilbara region of Western Australia. *Wildlife Research*. 28: 95-104.

Augusteyn, J., Hughes, J., Armstrong, G., Real, K., and Pacioni, C. 2018. Tracking and Tracing Central Queensland's Macroderma – determining the Size of the Mount Etna Ghost Bat Population and Potential threats. Australian Mammology, 40 (2), 243 – 253.

Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) 1994. *Policies and Principles — A Reference Document. National Water Quality Management Strategy Paper no. 2*.

Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

Australian and New Zealand Government (ANZG) 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Australian Geographic 2020. *Night Parrot found in Martu Country*, WA. Accessed online: https://www.australiangeographic.com.au/news/2020/08/night-parrot-found-in-salt-lake-country-ofwa/.

Bat Call WA 2021a. *Brockman Syncline Stage 1 cave sound and vibration review*. Report prepared for Rio Tinto, Perth, Western Australia.

Bat Call WA 2021b. *A review of Pilbara leaf-nosed bat ecology, threats and survey requirements*. Prepared for Department of Agriculture, Water and Environment, May 2021.

Bat Call WA 2021c. *A review of ghost bat ecology, threats and survey requirements*. Prepared for Department of Agriculture, Water and Environment, May 2021.

Baudinette, R.V., Churchill, S.K., Christian, K.A., Nelson, J.E. and Hudson, P.J. 2000. Energy, water balance and the roost microenvironment in three Australian cave-dwelling bats (Microchiroptera). *Journal of Comparative Physiology*. 170:439–446.

Beard, J.S. 1975. Vegetation Survey of Western Australia, Pilbara: 1,000,000 Vegetation Series: Explanatory Notes to Sheet 5. University of Western Australia Press, Western Australia.

Biologic Environmental Survey (Biologic) 2020a. *Brockman Syncline Riparian Vegetation Survey Interim Report*. Prepared for Rio Tinto Iron Ore, March 2020.

Biologic Environmental Survey (Biologic) 2020b. Riparian Vegetation and associated Groundwater Dependent Ecosystems: Targeted Survey of Caves Creek and Palm Springs. Prepared for Rio Tinto, June 2020.

Biologic Environmental Survey (Biologic) 2020c. Brockman Syncline: Riparian Vegetation Survey - Boolgeeda Creek.

Biologic Environmental Survey (Biologic) 2020d. *Brockman Syncline Targeted Vertebrate Fauna Survey*. Prepared for Rio Tinto Iron Ore, March 2020.

Biologic Environmental Survey (Biologic) 2020e. Western Range: Pilbara Leaf-nosed Bat VHF Study. Prepared for Rio Tinto, Perth, Western Australia.

Biologic Environmental Survey (Biologic) 2021a. Brockman Syncline Proposal (Revised Operations) Baseline Groundwater Dependent Ecosystem Exposure Assessment for the Greater Brockman Operations. Prepared for Rio Tinto.

Biologic Environmental Survey (Biologic) 2021b. *Brockman Syncline: Riparian Vegetation Survey - Duck Creek*. Prepared for Rio Tinto.

Biologic Environmental Survey (Biologic) 2021c. *Brockman Syncline Fauna Habitat Extrapolation Mapping*. Prepared for Rio Tinto, Perth, Western Australia.

Biologic Environmental Survey (Biologic) 2021d. *Targeted Conservation Significant Fauna Survey Memo*. Perth Western Australia.

Biologic Environmental Survey (Biologic) 2021e. Brockman Syncline Matters of National Environmental Significance and VHF Fauna Study. Unpublished report by Biologic Environmental Sciences to Rio Tinto Rev 1.

Biologic Environmental Survey (Biologic) 2022a. *Matters of National Environmental Significance Consolidated Report Brockman*. Prepared for Rio Tinto, June 2022, Perth, Western Australia.

Biologic Environmental Survey (Biologic) 2022b. *Greater Brockman Habitat Assessment and Modelling*. Unpublished Report for Rio Tinto.

Biologic Environmental Survey (Biologic) 2022c. *Brockman Syncline 2020-2021 Fauna Matters of National Environmental Significance Study*. Prepared for Rio Tinto, February 2022, Perth, Western Australia.

Biologic Environmental Survey (Biologic) 2022d. *Greater Brockman Subterranean Fauna Survey*. Unpublished Report for Rio Tinto.

Biota Environmental Sciences (Biota) 2005. Brockman Syncline 4 Project – Baseline Stygofauna Assessment.

Biota Environmental Sciences (Biota) 2007. Brockman Syncline 4 Boolgeeda Creek Stygofauna Survey.

Biota Environmental Sciences (Biota) 2010. Nammuldi – Silvergrass Subterranean Fauna Assessment.

Biota Environmental Sciences (Biota) 2011. Nammuldi – Silvergrass Troglobitic Fauna Assessment.

Biota Environmental Sciences (Biota) 2016a. *Brockman Syncline 4 - Marra Mambas Project Level 2 Vegetation and Flora Survey.* Prepared for Rio Tinto, January 2016.

Biota Environmental Sciences (Biota) 2016b. *Brockman Syncline 4 Marra Mambas: Level 2 Fauna Survey*. Prepared for Rio Tinto Iron Ore, January 2016.

Biota Environmental Sciences (Biota) 2016c. Brockman Syncline 4 Marra Mambas Subterranean Fauna Assessment.

Biota Environmental Sciences (Biota) 2016d. BS4 Marra Mambas Troglobitic Fauna Addendum Report.

Biota Environmental Sciences (Biota) 2019a. *Brockman 2 Deposits Detailed Flora and Vegetation Survey: Phase 1 and 2*. Prepared for Rio Tinto Iron Ore, September 2019.

Biota Environmental Sciences (Biota) 2019b. *Caves Creek Detailed Flora and Vegetation Survey: Phase 1 and 2*. Prepared for Rio Tinto Iron Ore, September 2019.

Biota Environmental Sciences (Biota) 2019c. *Silvergrass West Detailed Flora and Vegetation Survey: Phase 1 and 2*. Prepared for Rio Tinto Iron Ore, September 2019.

Biota Environmental Sciences (Biota) 2019d. *Brockman 2 Deposits Detailed Fauna Survey: Phase 1 and 2*. Prepared for Rio Tinto Iron Ore, October 2019.

Biota Environmental Sciences (Biota) 2019e. *Silvergrass West Detailed Fauna Survey: Phase 1 and 2.* Prepared for Rio Tinto Iron Ore, October 2019.

Biota Environmental Sciences (Biota) 2019f. *Caves Creek Detailed Fauna Survey: Phase 1 and 2*. Prepared for Rio Tinto Iron Ore, October 2019.

BirdLife Australia 2021. *Peregrine Falcon: Falco pregrinus*. Accessed online: https://www.birdlife.org.au/bird-profile/peregrine-falcon.

Bullen, R.D. and McKenzie N.L. 2011. Recent developments in studies of the community structure, foraging ecology and conservation of Western Australian bats. In *The Biology and Conservation of Australasian Bats*, Royal Zoological Society of New South Wales, Mosman. 35:31–43.

Burbidge, A.A. 2004. *Threatened Animals of Western Australia*. Kensington, Western Australia: Department of Conservation and Land Management.

Bush, B., & Maryan, B. 2011. *Field Guide to Snakes of the Pilbara, Western Australia*. Perth, Western Australia: Western Australian Museum.

Bullen, R.D., Reiffer, S. and Trainer, J. 2023. Satellite tracking Ghost bats (Macroderma gigas) in the Pilbara, Western Australia. Records of the Western Australian Museum doi: 10.18195/issn.0312-38 3162.38.2023.001-010

Chan, R., Dunlop, J., Spencer, P.B.S., 2020. Highly promiscuous paternity in mainland and island populations of the endangered Northern Quoll. Journal of Zoology. 310, 210–220.

Churchill, S.K. 1991. Distribution, abundance and roost selection of the Orange Horseshoe-bat, *Rhinonycteris aurantius*, a tropical cave dweller. *Wildlife Research*. 18:343–353.

Cogger, H.G. 2014. *Reptiles and Amphibians of Australia (Seventh ed.)*. Collingwood, Victoria: CSIRO Publishing.

Collins, B. 2021. New recordings of critically endangered nigh parrots music to ears of Kimberley rangers, scientists. ABC News. Accessed online: https://www.abc.net.au/news/2021-05-26/biggest-night-parrot-population-discovered-great-sandy-desert/100159378.

Commonwealth of Australia 2001. *National Objectives and Targets for Biodiversity Conservation 2001–2005, Commonwealth of Australia 2001*. Department of the Environment and Heritage, Commonwealth of Australia, Canberra.

Cowan, M.A., Dunlop, J.A., Turner, J.M., Moore, H.A., Nimmo, D.G., 2020. Artificial refuges to combat habitat loss for an endangered marsupial predator: How do they measure up? Conservation. Science. Pract. 2.

Creese, S., 2012. The use of rail culverts to facilitate the movement of fauna (Masters). University of Queensland, Brisbane.

Department of Agriculture, Water and the Environment (DAWE) 2021a. *Species Profile and Threats Database: Apus pacificus - Fork-tailed Swift*. Department of Agriculture, Water and the Environment, Australia Government, Canberra, Australia.

Department of Agriculture, Water and the Environment (DAWE) 2021b. *EPBC Act Protected Matters Report*. Department of Agriculture, Water and the Environment, Australian Government, Canberra.

Department of Biodiversity, Conservation and Attractions (DBCA) 2007-2021. *NatureMap*. Department of Parks and Wildlife and WA Museum. Available at: https://naturemap.dpaw.wa.gov.au/.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017. *Priority Ecological Communities for Western Australia Version 27*. Available online: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/priority_ecological_communities_list.pdf.

Department of Biodiversity, Conservation and Attractions (DBCA) 2019a. *Night Parro*t. Available from: Night parrot - Parks and Wildlife Service (dpaw.wa.gov.au).

Department of Biodiversity, Conservation and Attractions (DBCA) 2019b. *The ecology of the northern quoll (Dasyurus hallucatus) in the Pilbara bioregion, Western Australia*. Government of Western Australia, Perth, WA.

Department of Biodiversity, Conservation and Attractions (DBCA) 2022. Threatened and Priority Flora Database Search for Western Australia. Accessed on 10 January 2022. Prepared by the Species and Communities program for Rio Tinto for the Brockman Syncline Proposal.

Department of Conservation and Land Management (CLAM) 1996. A review of the conservation status of the Ngadji (Western Pebble-mound Mouse) Pseudomys chapmani Kitchener, 1980 (Rodentia muridae). Department of Conservation and Land Management, Science and Information Division. Wanneroo, Western Australia.

Department of Conservation and Land Management (CLAM) 1997. *Landscope: Mound builders of the Pilbara*. Vol 12. No.3, Perth Western Australia.

Department of Environment and Conservation (DEC) 2009. *Establishing Vegetation Transects*. Kensington, WA.

Department of Industry, Science, Energy and Resources (DISER) 2007. *National Greenhouse and Energy Reporting Act 2007*. Available online: https://www.legislation.gov.au/Series/C2007A00175.

Department of Industry, Science, Energy and Resources (DISER) 2008. *National Greenhouse and Energy Reporting Regulations 2008*. Australian Government.

Department of Industry, Science, Energy and Resources (DISER) 2021a. *Australian Greenhouse Emission Information System*. Assessed 25 November 2021. Available from: https://ageis.climatechange.gov.au.

Department of Industry, Science, Energy and Resources (DISER) 2021b. *National Greenhouse Accounts 2019 - National Inventory by Economic Sector: 2019 Emissions*. Assessed 25 November 2021. Available from: https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019/national-inventory-by-economic-sector-2019-emissions.

Department of Mines and Petroleum (DMP) 2013. Managing fibrous minerals during exploration. PowerPoint presentation based on content presented at the Exploration Safety Roadshow. July 2013.

Department of Mines and Petroleum (DMP) 2015. Management of fibrous minerals in Western Australian mining operations – guideline (2nd edition).

Department of Mines, Industry Regulation and Safety (DMIRS) 2020a. Mine Closure Plan Guidance - How to Prepare in Accordance with Part 1 of the Statutory Guidelines. DMIRS, Western Australia.

Department of Mines, Industry Regulation and Safety (DMIRS) 2020b. *Statutory Guidelines for Mine Closure Plans*. DMIRS, Western Australia.

Department of Parks and Wildlife (DPaW) 2017. Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia. Government of Western Australia, Perth, Australia.

Department of Planning, Industry and Environment (DPIE) 2021. *How fire affects plants and animals*. NSW Government, https://www.environment.nsw.gov.au/topics/fire/plants-animals-fire.

Department of State Development (DSD) 2017. *Port Hedland Dust Management Taskforce Report to Government*. Government of Western Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011a. *Survey Guidelines for Australia's Threatened Mammals*. Department of Sustainability,

Environment, Water, Population and Communities, Canberra. Retrieved from http://www.environment.gov.au/epbc/publications/threatened-mammals.html.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011b. *Survey Guidelines for Australia's Threatened Reptiles*. Canberra, Australian Capital Territory.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011c. Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads, Commonwealth of Australia 2011. Department of Sustainability, Environment, Water, Population and Communities, Australian Government, Canberra. Available from: http://www.environment.gov.au/resource/threat-abatement-plan-biological-effects-including-lethal-toxic-ingestion-caused-cane-toads.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a. *EPBC Act Environmental Offsets Policy*. Department of the Environment and Energy, Australian Government, Canberra.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012b. *Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses*. Department of Sustainability, Environment, Water, Population and Communities, Australian Government, Canberra. Available from: http://www.environment.gov.au/resource/threat-abatement-plan-reduce-impacts-northern-australias-biodiversity-five-listed-grasses.

Department of the Environment (DoE) 2013. Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Australian Government, Canberra. Available from: http://www environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance.

Department of the Environment (DoE) 2015a. *Referral guideline for 14 birds listed as migratory species under the EPBC Act*. Australia Government, Canberra, Australia.

Department of the Environment (DoE) 2015b. *Threat abatement plan for predation by feral cats, Commonwealth of Australia 2015*. Department of the Environment, Australian Government, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats.

Department of the Environment (DoE) 2015c. *Consultation Document on Listing Eligibility and Conservation Actions: Macroderma gigas (Ghost Bat)*. Commonwealth of Australia 2015. Department of the Environment, Australian Government, Canberra.

Department of the Environment (DoE) 2016a. Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for the endangered northern quoll, Dasyurus hallucatus. EPBC Act Policy Statement, Commonwealth of Australia 2016. Department of the Environment, Australian Government, Canberra.

Department of the Environment (DoE) 2016b. Engage Early: Guidance for Propoents on best practice Indigenous engagement for Environmental Assessments under the *Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth Australia.

Department of Environment and Energy (DotEE) 2018. *Guidelines for biological survey and mapped data*, *Commonwealth of Australia.* Department of Environment and Energy, Australian Government, Canberra.

Department of Environment and Energy (DotEE) 2019*. Species Profile and Threats Database, Commonwealth of Australia*. Department of Environment and Energy, Australian Government, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Department of the Environment and Energy (DotEE) 2020. National Light Pollution Guidelines for Wildlife: including marine turtles, seabirds and migratory shorebirds. Commonwealth of Australia January 2020.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008a. *Approved Conservation Advice for Liasis olivaceus barroni (Olive python - Pilbara subspecies)*. Canberra. Available from: http: www.environment.gov.au/biodiversity/threatened/species/pubs/66699-conservation-advice.pdf.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008b. *Threat abatement plan for predation by the European red fox.* Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/predation-european-red-fox.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010a. *Survey guidelines for Australia's threatened bats*. Canberra, Australia.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010b. *Survey guidelines for Australia's threatened birds*. Canberra, Australia.

Department of Water (DoW) 2009a. *Pilbara water in mining guideline*. Department of Water, Water resource allocation planning series Report No. 34. Perth, Western Australia.

Department of Water (DoW) 2009b. Operational policy no. 5.12 - Hydrogeological reporting associated with a groundwater well licence. Department of Water, Government of Western Australia.

Department of Water (DoW) 2012. Supplementary information for permit applications to interfere with bed or banks of watercourses. Fact Sheet. Government of Western Australia. March 2012.

Department of Water (DoW) 2013. Western Australian Water in Mining Guideline.

Department of Water and Environmental Regulation (DWER) 2016. *Groundwater assessment of the north-west Hamersley Range*. Hydrogeological record series, Report no. HG62, August 2016, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) 2019. *Pilbara Environmental Offsets Fund Governance Framework 2019*.

Department of Water and Environmental Regulation (DWER) 2020a. *Use of mine dewatering surplus*. Department of Water and Environmental Regulation, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) 2020b. *Use of operating strategies in the water licensing process*. Formerly operational policy 5.08. Government of Western Australia. October 2020.

Department of Water and Environmental Regulation (DWER) 2021. *The Pilbara Environmental Offsets Fund*. Available from: https://www.dwer.wa.gov.au/peof. Department of Water and Environmental Regulation, Joondalup, WA.

Doley, D. 2006. Airborne Particulates and Vegetation. Review of Physical Interactions, Clean Air and Environmental Quality Volume 40 No.2 pp 36–42, 2006.

Dunlop, J. 2017. *Pilbara Northern Quoll Research Program, Annual Report 2016*. Department of Parks and Wildlife, Perth, Western Australia. April 2017.

Dunlop, J., Birch, N., and Moore, H. 2019. *Pilbara Northern Quoll research program, Annual Report 2018*. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia.

Emerge Associates 2020. Preliminary Advice Report: Brockman Syncline Cultural Values Consultation - Eastern Guruma. Wintawari Guruma Aboriginal Corporation.

EMM Consulting (EMM) 2021. Greater Brockman Operations - Detailed water balance assessment.

Environmental Protection Authority (EPA) 1988. *Inland Waters of the Pilbara Western Australia (Part 1)*. Technical Series. No. 10. EPA, Western Australia.

Environmental Protection Authority (EPA) 1989. *Inland Waters of the Pilbara Western Australia (Part 2)*. Technical Series. No. 24. EPA, Western Australia.

Environmental Protection Authority (EPA) 2004. Guidance for the Assessment of Environmental Factors: Assessment of Aboriginal Heritage. EPA, Perth, Western Australia.

Environmental Protection Authority (EPA) 2012. *Discussion paper: A review of subterranean fauna assessment in Western Australia*. Perth, Environmental Protection Authority.

Environmental Protection Authority (EPA) 2014. *Cumulative environmental impacts of development in the Pilbara region*. Advice of the Environmental Protection Authority to the Minister for environment under Section 16e of the Environmental Protection Act 1986. EPA, Western Australia.

Environmental Protection Authority (EPA) 2016a. *Environmental Factor Guideline: Flora and Vegetation*. Perth, Western Australia. Published December 2016.

Environmental Protection Authority (EPA) 2016b. *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Perth, Western Australia. Published December 2016.

Environmental Protection Authority (EPA) 2016c. *Environmental Factor Guideline: Terrestrial Fauna*. EPA, Western Australia. December 2016.

Environmental Protection Authority (EPA) 2016d. *Technical Guidance: Sampling of Short Range Endemic Invertebrate Fauna*. EPA, Western Australia. December 2016.

Environmental Protection Authority (EPA) 2016e. *Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna.* EPA, Western Australia. December 2016.

Environmental Protection Authority (EPA) 2016f. *Environmental Factor Guideline: Subterranean Fauna*. EPA, Western Australia. December 2016.

Environmental Protection Authority (EPA) 2016g. *Environmental Factor Guideline: Social Surroundings*. EPA, Western Australia.

Environmental Protection Authority (EPA) 2018. *Environmental Factor Guideline: Inland Waters*. EPA, Western Australia. June 2018.

Environmental Protection Authority (EPA) 2020a. Environmental Factor Guideline: Greenhouse Gas Emissions.

Environmental Protection Authority (EPA) 2020b. Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment. EPA, Western Australia. June 2020.

Environmental Protection Authority (EPA) 2021a. *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual*. EPA, Western Australia, March.

Environmental Protection Authority (EPA) 2021b. *Statement of Environmental Principles, Factors, Objectives and Aims of EIA*. October, Perth, Western Australia.

Environmental Protection Authority (EPA) 2021c. *Instructions – How to identify the content of a Proposal*. EPA, Western Australia.

Environmental Protection Authority (EPA) 2021d. *Instructions – How to prepare an Environmental Review Document*. EPA, Western Australia.

Environmental Protection Authority (EPA) 2021e. *Interim Guidance - Environmental outcomes and outcomes-based conditions*. EPA, Western Australia.

Environmental Protection Authority (EPA) 2021f. Instructions - How to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EMPs). EPA, Western Australia.

Environmental Protection Authority (EPA) 2021g. *Interim Guidance – Taking decision making processes into account in EIA*. EPA, Western Australia.

Environmental Protection Authority (EPA) 2021h. Instructions on how to prepare Environmental Protection Act 1986 Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports. EPA, Western Australia.

Environmental Protection Authority (EPA) 2021i. Template for Environmental Protection Act 1986 Part IV Reconciliation Procedures. EPA, Western Australia.

Environmental Protection Authority (EPA) 2021j.Technical Guidance – Subterranean Fauna Surveys for Environmental Impact Assessment. EPA, Western Australia. December 2021.

Environmental Protection Authority (EPA) 2021k. *Environmental Factor Guideline: Air Quality*, EPA, Western Australia.

Environmental Protection Authority (EPA) 2023a. Statement of Environmental Principles, Factors and Objectives and aims of EIA. EPA, Western Australia. April 2023

Environmental Protection Authority (EPA) 2023b. Environmental Factor Guideline: Greenhouse Gas Emissions. EPA, Western Australia. April 2023.

Environmental Technologies and Analytics (ETA) 2021. *Brockman Syncline Dust Assessment/Study*. Report prepared for Rio Tinto. April 2021.

Farmer A.M. 1993, The Effects of Dust on Vegetation – A Review, Environmental Pollution 79, pp 63-75,1993

Fortescue Metals Group (FMG) 2015. Solomon Iron Ore Mine Project - Sustaining Production: Environmental Review Document. EPA Assessment no. 2019. EPBC reference no. 2014/7275.

Fortescue Metals Group (FMG) 2018a. *Eliwana Iron Ore Mine Project: Environmental Review Document*. EPA Assessment no. 2125. EPBC reference no. 2017/8024.

Fortescue Metals Group (FMG) 2018b. *Eliwana Iron Ore Mine Project: Environmental Review Document*. EPA Assessment no. 2129. EPBC reference no. 2017/8025.

Gilbert, J. and Deharveng, L. 2002. Subterranean ecosystems: a truncated functional biodiversity. *BioScience*. 52(6): 473-481.

Government of Western Australia (GoWA) 2011. *WA Environmental Offsets Policy*. Environmental Protection Authority, Western Australia. September 2011.

Government of Western Australia (GoWA) 2014. *WA Environmental Offsets Guidelines*. Environmental Protection Authority, Western Australia. August 2014.

Government of Western Australia (GoWA) 2019. Greenhouse Gas Emissions Policy for Major Projects (State GHG Policy).

Government of Western Australia (GoWA) 2020a. *2018 State-wide Vegetation Statistics (formerly the CAR Reserve Analysis) Full Report*. Department of Biodiversity, Conservation and Attractions, Western Australia. Current as of March 2019.

Government of Western Australia (GoWA) 2020b. *Western Australian Climate-Policy*. Perth, Western Australia.

Government of Western Australia (GoWA) 2021. Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures. Perth, WA.

Griffiths, A. and Brook, B. 2014. *Effect of fire on small mammals: A systematic review*. International Journal of Wildland Fire 2014, 23, 1034-1043 http://dx.doi.org/10.1071/WF14026.

Guzik, M., Austin, A., Copper, S., Harvey, M., Humphreys, W., Bradford, T. Eberhard, S., King, R., Leys, R., Muirhead, K. and Tomlinson, M. 2010. Is the Australian subterranean fauna uniquely diverse. *Invertebrate Systematics*. 24(5): 407-418.

Guzik, M.T., Abrams, K.M., Cooper, S.J.B., Humphreys, W.F., and Cho, J.L. 2008. Phylogeography of the ancient Parabathynellidae (Crustacea: Bathynellacea) from the Yilgarn region of Western Australia. *Invertebrate Systematics*. 22: 205–216.

Halse, S. 2018. Subterranean fauna of the arid zone. *On the Ecology of Australia's Arid Zone*. 235: 215-241.

Harvey, M.S. 2002. Short-range endemism among the Australian fauna: some examples from non-marine environments. Invertebrate Systematics, 16: 555-570.

Hernandez Santin, L., Fisher, D., and Goldizen, A. 2018. *Ecology and predator associations of the northern quoll in the Pilbara*. Report of the National Environmental Science Program Threatened Species Recovery Hub. April 2018.

Hill B.M and Ward S.J. 2010. *National Recovery Plan for the Northern Quoll Dasyurus hallucatus*. Department of Natural Resources, Environment, the Arts and Sport, Darwin Northern Territory.

Hydrology and Risk Consulting (HARC) 2019. *Caves Creek Hydrology: Mining Operations Impact Assessment.* Prepared for Rio Tinto.

International Union for Conservation of Nature (IUCN) 2021*. IUCN Definitions*. Available from: https://www.iucn.org/sites/dev/files/iucn-glossary-of-definitions_en_2021.05.pdf.

Jhariya, M. and Raj, A. 2014. Effects of wildfires on flora, fauna and physico-chemical properties of soil-An overview. Journal of Applied and Natural Science. 6. 887-897.

Kendrick, P. 2001. *Pilbara 3 (PIL3 - Hamersley subregion).* Department of Conservation and Land Management, Western Australia. pp 568-580.

Klohn Crippen Berger (KCB) 2021. Nammuldi Operation - Assessment of In-Pit LOM Waste Fines Disposal.

Matsuki M, Gardener M, Smith A, Howard R and Gove A. 2016. *Impacts of dust on plant health, survivorship and plant communities in semi-arid environments,* in Austral Ecology A Journal of ecology in the Southern Hemisphere, Ecological Society of Australia.

Matthews, E.F., Abrams, K.M., Cooper, S.J., Huey, J.A., Hillyer, M.J., Humphreys, W.F., Austin, A.D. and Guzik, M.T. 2020. Scratching the surface of subterranean biodiversity: Molecular analysis reveals a diverse and previously unknown fauna of Parabathynellidae (Crustacea: Bathynellacea) from the Pilbara, Western Australia. *Molecular Phylogenetics and Evolution*. 142: [106643].

Mattiske Consulting Pty Ltd (Mattiske) 2019. *Flora and Vegetation Assessment Boolgeeda Valley, Pilbara, WA*. Prepared for Rio Tinto Iron Ore, October 2019.

Nature 2018. *Ecologists try to speed up evolution to save Australian marsupial from toxic toads*. Accessed September 2022, https://www.nature.com/articles/d41586-018-05757-y.

Newport, J. Shorthouse, D., and Manning, A. 2014. *The effects of light and noise from urban development on biodiversity: Implications for protected areas in Australia*. Ecological Management And Restoration. 15(3): 204 - 214. doi:10.1111/emr.12120.

Pearson, D. J. 1993. *Distribution, status and conservation of pythons in Western Australia*. In D. Lunney & D. Ayers (Eds.), Herpetology in Australia: a Diverse Discipline (pp. 383-395). Sydney, New South Wales: Royal Zoological Society of NSW.

Pearson, D., Spencer, P., Hillyer, M., and How, Ric. 2013. *Genetic survey of the Pilbara Olive Python (Liasis olivaceaus barroni).* Department of Parks and Wildlife (DPaW), Government of Western Australia, Perth, Western Australia.

Perina, G., Camacho, A.I., Huey, J., Horwitz, P. and Koenders, A. 2018. Understanding subterranean variability: The first genus of Bathynellidae (Bathynellacea, Crustacea) from Western Australia described through a morphological and multigene approach. *Invertebrate Systematics*. 32: 423-447.

Perina, G., Camacho, A.I., Huey, J., Horwitz, P. and Koenders, A. 2019a. New Bathynellidae (Crustacea) taxa and their relationships in the Fortescue catchment aquifers of the Pilbara region, Western Australia. *Systematics and Biodiversity*. 17(2): 1-17.

Perina, G., Camacho, A.I., Huey, J., Horwitz, P. and Koenders, A. 2019b. The role of allopatric speciation and ancient origins of Bathynellidae (Crustacea) in the Pilbara (Western Australia): two new genera from the De Grey River catchment. *Invertebrate Systematics*. 88(4): 1-46.

Perth Zoo 2022. Ghost Bat: Blind as a bat. Accessed September 2022. https://perthzoo.wa.gov.au/animal/ghost-bat

Prajapati, S.K. 2012, Ecological Effects of Airborne Particulate Matter on Plants, Environmental Skeptics and Critics 1(1), pp12-22, 2012.

Preston Consulting 2015. Pilbara Iron Ore Project - Revised Proposal. Assessment on Proponent Information - Environmental Review Document. Report prepared for Flinders Mines Ltd. March 2015.

Rangelands NRM Western Australia (Rangelands) 2018*. Five years of quoll monitoring in the Pilbara*. Available from: https://rangelandswa.com.au/five-years-of-quoll-monitoring-in-the-pilbara/.

RGS 2021. Greater Brockman Geochemical Assessment. Prepared for Rio Tinto.

Rio Tinto 2015. Western Turner Syncline Iron Ore Project - Environmental Review Document. November.

Rio Tinto 2017. Greater Brockman AMD Assessment.

Rio Tinto 2019a. Surplus Water Discharge Extent Assessment: Duck Creek.

Rio Tinto 2019b. Surplus Water Discharge Extent Assessment: Boolgeeda Creek.

Rio Tinto 2019c. Iron Ore (WA) Fibrous Minerals Management Plan.

Rio Tinto 2020a. Greater Brockman Syncline Mine Closure Plan.

Rio Tinto 2020b. Greater Paraburdoo Iron Ore Hub Proposal - Environmental Review Document. Assessment No. 2189. EPBC 2018/8341. Report prepared by Hamersley Iron Pty Limited. May 2020.

Rio Tinto 2020c. Caves Creek Groundwater Modelling.

Rio Tinto 2020d. Brockman Syncline Proposal Greenhouse Gas Management Plan.

Rio Tinto 2021a. *Greater Brockman Tetratheca butcheriana Survey Effort Summary*. Prepared for Hamersley Iron Pty Limited, November 2021.

Rio Tinto 2021b. Brockman Syncline Proposal Hydrology and Hydraulics Study. February 2021.

Rio Tinto 2021c. Internal Memo: *Plunge Pool – Hydrological Impact Assessment.* February 2021.

Rio Tinto 2021d. Greater Brockman AMD Risk Assessment; March 2021.

Rio Tinto 2021e. Water Quality Assessment for the in-pit TSF pond at Pit 8. June 2021.

Rio Tinto 2021f. Brockman Syncline Proposal AMD Risk Assessment.

Rio Tinto 2021g. Priority Flora Database.

Rio Tinto 2022a. Internal Memo: *Plunge Pool – Sedimentation Assessment*. February 2022.

Rio Tinto 2022b. Internal Memo: *Plunge Pool: The Mode of Occurrence*. January 2022.

Rio Tinto 2022c. Brockman Syncline: Hydrogeological Assessment.

Rio Tinto 2022d. Greater Brockman Life of Mine Water Management Guiding Principles.

RPS 2021a. Brockman Syncline Regional Groundwater Model Cumulative Impact Assessment. Report prepared for Rio Tinto.

RPS 2021b. *Brockman Syncline Pit Lake Modelling.* Report prepared for Rio Tinto.

Schoenjahn, J., Paveym C.R. and Walter, G.H. 2019. Ecology of the Grey Falcon Falco hypoleucos – current and required knowledge. In the *Emu - Austral Ornithology*. 120:74-82.

Shaw, R.E., Spencer, P.B., Gibson, L.A., Dunlop, J.A., Kinloch, J.E., Mokany, K., Byrne, M., Moritz, C., Davie, H., Travouillon, K.J., Ottewell, K.M., 2023. Linking life history to landscape for threatened species conservation in a multiuse region. Conserv. Biol. 37.

Shepherd, D., Beeston, G., & Hopkins, A. 2002. Native Vegetation in Western Australia, Extent, Type and Status: Resource Management Technical Report 249. Perth, Western Australia: Department of Agriculture.

SRK Consulting (SRK) 2013. Geochemical Characterisation of Nammuldi / BS2 Low Sulfur Material.

SRK Consulting (SRK) 2015. Brockman Syncline 4 – Geochemical Characterisation of Samples from the Marra Mamba Deposit.

SRK Consulting (SRK) 2016. Brockman Syncline 4 – Geochemical Characterisation of Mount McRae Shale Samples.

Stantec Australia Pty Ltd (Stantec) 2019. *Greater Brockman 4 Sustaining Tonnes Project: Detailed Flora and Vegetation Survey 2019*. Prepared for Rio Tinto Iron Ore, December 2019.

Stantec Australia Pty Ltd (Stantec) 2020a. *Brockman Syncline Proposal Detailed Fauna Survey 2019*. Prepared for Rio Tinto Iron Ore, January 2020.

Stantec Australia Pty Ltd (Stantec) 2021a. *Greater Brockman Syncline: Consolidated Vegetation Type and Condition Mapping*. Prepared for Rio Tinto. April 2021.

Stantec Australia Pty Ltd (Stantec) 2021b. *Greater Brockman Syncline: Consolidated Fauna habitat Mapping*. Prepared for Rio Tinto. April 2021.

Threatened Species Scientific Committee (TSSC) 2005. *Commonwealth Listing Advice for Northern Quoll (Dasyurus hallucatus)*. Department of the Environment and Energy, Australian Government, Canberra. Available from: http://www.environment.gov.au/node16356.

Threatened Species Scientific Committee (TSSC) 2016a. *Conservation Advice Rhinonicteris aurantia Pilbara Leaf-nosed Bat*. Department of the Environment and Energy, Australian Government, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/82790-conservation-advice-10032016.pdf.

Threatened Species Scientific Committee (TSSC) 2016b. *Conservation Advice Macroderma gigas Ghost Bat*. Department of the Environment and Energy, Australian Government, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/174-conservation-advice-05052016.pdf.

Threatened Species Scientific Committee (TSSC) 2020. *Conservation Advice: Falco hypoleucos - Grey Falcon*. Department of Agriculture, Water and the Environment, Australian Government, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/929-conservation-advice-09072020.pdf.

Thompson J.R., Mueller P.W., Fluckiger W., and Rutter A.J. 1984, The Effects of Dust on Photosynthesis and its Significance for Roadside Plants, Environmental Pollution (Series A) 34, pp 171-190, 1984.

Upekala C.W., Sara J.S, and Lesley A. D, 2009. Dust Deposition Effects on Growth and Physiology of the Endangered *Astagalus jaegerianus* (Fabacea). Madrono 56, pp 81-88

Western Australian Herbarium (WAH) 1998–2021. *FloraBase—the Western Australian Flora*. Department of Biodiversity, Conservation and Attractions. Available online: https://florabase.dpaw.wa.gov.au/.

Woinarski, J.C., Burbidge, A and Harrison, P. 2014. *Northern Quoll*. In: Action Plan for Australian Mammals 2012, pp76-81. CSIRO Publishing: Collingwood.

Wood 2021. *Greater Brockman Proposal Noise and Vibration Impact Assessment*. Report prepared for Rio Tinto, Perth, Western Australia.

WRM Water & Environment (WRM) 2019a. Brockman Syncline Proposal Aquatic Ecological Values Desktop Review.

WRM Water & Environment (WRM) 2019b. Brockman Syncline Expansion Baseline Aquatic Fauna and Water Quality Survey of Caves, Duck and Boolgeeda Creeks Dry Season 2019.

WRM Water & Environment (WRM) 2019c. Greater Brockman 'Plunge Pool' Aquatic Biota Values Assessment Wet Season Sampling 2019.

WRM Water & Environment (WRM). 2020. *Hazard Analysis and Risk Assessment for Dewatering.* Discharge to Duck Creek and Boolgeeda Creek.

Appendices

APPENDIX A: EXECUTIVE SUMMARY

A.1: Other Matters Required by Schedule 4 of the EPBC Regulations

APPENDIX B: CHAPTERS 1 TO 5

B.1: Environmental Scoping Document

B.2: Proposal Content Document

B.3: Environmental Management Plan

B.4: Mine Closure Plan

B.5: Stakeholder Consultation Register

B.6: Traditional Owners Consultation Register - Commercial in Confidence

APPENDIX C: CHAPTER 6 - INLAND WATERS

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C.2: Hazard Analysis and Risk Assessment for Dewatering Discharge to Duck Creek and Boolgeeda Creek

C.3: The mode of occurrence for Plunge Pool

C.4: Brockman Syncline Regional Groundwater Model - Cumulative Impact Assessment

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C.6: Brockman Syncline Pit Lake Modelling

C.7: Brockman Syncline: Hydrogeological Assessment

C.8: Greater Brockman AMD Risk Assessment

C.9: Spontaneous Combustion and Acid Rock Drainage Management Plan

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D.4: Brockman Syncline Riparian Vegetation Survey Boolgeeda Creek

D.5: Brockman 2 Deposits Detailed Flora and Vegetation: Phase 1 and 2

D.6: Greater Brockman 4 Sustaining Tonnes Project: Detailed Flora and Vegetation Survey 2019

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E.4: Brockman Syncline 4 Marra Mambas Level 2 Fauna Survey

E.5: Brockman Syncline Stage 1 Cave Sound and Vibration Review

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