Internal Memo

From	Caitlin O'Neill
Department	Land Survey and Management
To	Fiona Bell
Copies	
Reference	Revised troglofauna habitat removal impact assessment process for Mesa A Hub Proposal
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Revised troglofauna habitat removal impact assessment process for Mesa A Hub Proposal

Dear Fiona

The following memo documents the process taken to assess the environmental impact of troglofauna habitat removal as a part of the Mesa A Hub Proposal. The process was undertaken by a multi-disciplinary team of Rio Tinto staff with expertise in assessing 3-Dimensional habitats in the Pilbara, including geologists, geophysicists, hydrogeologists, ecologists and GIS personnel. Details on the methods utilised, locations of survey effort and key results are presented below.

Yours sincerely

Caitlin O'Neill

1. Background

For the purpose of this memo, the Mesa A Hub project area is divided into the Warramboo area and the Mesa B/C area. Between April 2015 and September 2016, Biota Environmental Sciences completed two and four rounds of troglofauna sampling in the Warramboo and Mesa B/C areas respectively. This recent sampling covered 146 unique locations using 557 traps and 106 scrape samples. Methodology for the sampling was consistent with the Environmental Protection Authority's 'Environmental Factor Guideline – Subterranean Fauna' (EPA2016a), 'Technical Guidance – Subterranean fauna survey' (EPA 2016b), and 'Technical Guidance – Sampling methods for subterranean fauna (EPA 2016c).

Biota then compiled these recent results with historical sampling results (Biota 2017a, 2017b). A total of 211 and 136 troglofauna specimens from 22 and 51 taxa were collected from the Warramboo and Mesa B/C areas respectively.

2. Habitat retention (Mining Exclusion Zone)

The design of the current mining operation at Mesa A includes a Mining Exclusion Zone (MEZ). The MEZ was established to ensure retention of a significant volume of troglofauna habitat at Mesa A (>50% by volume of the pre-mining troglofauna habitat) as well as to protect terrestrial fauna, heritage and visual amenity values. Multiple phases of targeted troglofauna sampling were conducted at Mesa A during 2005 and 2006 as part of the Environmental Impact Assessment for the Mesa A/Warramboo Iron Ore Project. Active mining commenced at Mesa A in February 2010 under Ministerial Statement 756. Monitoring has been conducted in accordance with the requirements of Ministerial Statement 756 and includes:

- Biennial troglofauna sampling in the MEZ
- Troglofauna sampling in disturbed habitats
- Subterranean habitat monitoring
- Downhole optical image surveys

The troglofauna sampling and habitat monitoring conducted as required by Ministerial Statement 756 indicate that the Mesa A MEZ is functioning as intended. Within the inherent limitations of troglofauna sampling, the results indicate that a troglofauna community with similar abundance and diversity to the pre-mining community continues to be present at Mesa A.

The design of the MEZ at Mesa A and the monitoring results from Mesa A have been used to guide the initial design of the MEZs at Mesas B and C. Similar to Mesa A, the MEZs at Mesas B and C have been designed to ensure retention of a significant volume of troglofauna habitat (at least 50% by volume of the pre-mining troglofauna habitat at each mesa).

The results of baseline troglofauna sampling at Mesas B and C and the habitat assessment were then used to refine the proposed MEZs at Mesas B and C to not only ensure retention of a significant volume of habitat but to also conservatively avoid as many troglofauna taxa potentially at risk as possible. The iterative process that led to the refinement of the proposed MEZs at Mesas B and C is the focus of this memorandum.

3. Habitat determination

Habitat was modelled separately for each area according to the information available. Information considered included coarse and fine scale 2D surface geological mapping, downhole drill hole geological and geophysical logs, 3D hydrogeological modelling providing depth to water surfaces and 3D models of the Robe Pisolite / Channel Iron Deposit (CID) lithologies. Biota Environmental Sciences (2017a, 2017b, 2017c) detail the methodology for each.

Based on consideration of the physical dimensions of troglofauna, sampling results and expert opinion, Robe Pisolite in the Mesa A Hub Project area that occurs above the water table and with a thickness of greater than 5 metres is considered to represent the habitat with the highest prospectivity for troglofauna. Colluvium, alluvium or Robe Pisolite with a thickness of less than 5 metres is considered to represent lower (medium) prospectivity

habitat; and all other geological units in the area are considered to represent low prospectivity habitat due to lack of key habitat features such as likelihood of containing void / cavity spaces suitable to support viable troglofauna populations.

4. Habitat removal impact assessment

Rio Tinto recognises that the development of the Mesa A Hub Proposal will remove a portion of subterranean fauna habitat and has the potential to impact individuals of the troglofauna communities at Warramboo and Mesas B and C. This impact assessment addresses potential impact from habitat removal through excavation only; other potential impacts are addressed separately.

The results of the subterranean fauna sampling and modelled available habitat were examined relative to the proposed mine plan and draft proposed MEZ. Many troglofauna species were recorded in the area delineated as the original draft MEZ (see complete species lists in Biota 2017a, 2017b). The mine plan was then adjusted wherever possible to avoid troglofauna species potentially at risk (i.e. currently only known from the proposed pit areas). The process for determining those taxa potentially at risk was:

1. The number and location of sites where each unique taxa was recorded were compiled. Taxa with multiple records from a single site were denoted as equivalent to those known only from one record from one site.
2. Taxa locations were then compared to those of the proposed disturbance areas. Taxa were grouped based on the number of recorded locations within the proposed disturbance areas:[1]
    a. Group A: Taxa known only from one location that is within the proposed disturbance area.
    b. Group B: Taxa know from multiple locations that are all within the proposed disturbance area.
    c. Group C: Taxa known from multiple locations within uncertain areas of development (this category was removed as the project plan progressed).
    d. Group D: Taxa known from multiple locations within the proposed disturbance area plus one location outside that is very close to the pit edge.
3. The two groups identified as most at risk were ‘Group A’ and ‘Group B’ taxa. The locations of all taxa in these groups were compiled and mine plans were re-run and optimised to avoid these taxa (where technically feasible). For Group B taxa, mine plans were re-run and optimised to avoid at least one of the multiple locations for each taxa.
4. The optimised mine plans reduced the mine pit shells in order to increase the MEZ to connect to and include a buffer of 30 metres around each additional location that could be avoided.
5. The final mine plan and proposed MEZ were produced.

All taxa were assigned the same intrinsic value. The grouping was used to demonstrate the optionality that was available to avoid taxa in each group; there are numerous mine pit shell / MEZ configurations to avoid taxa in Groups D and C, limited options to avoid Group B taxa and one option to avoid Group A taxa. This system of grouping allows a systematic and transparent approach for avoidance actions to be taken.

5. Results

Table 1 shows the iterative process applied to mine pit shell design and MEZ configuration in order to avoid as many troglofauna taxa as technically feasible. Table 2 summarises the results of the design process. As a result of the iterative mine design process, Rio Tinto has avoided 15 Group A and B taxa from seven locations (Note: This count does not include species that were recorded from the original draft MEZ). Records

[1] The groups are equivalent to the ‘Priority’ rankings used in the previous version of this document. The nomenclature for the groupings has been updated to clarify that these groupings are based on the location of records and are not ‘Priority’ rankings as provided under legislation.

of 16 Group A and B taxa from 14 locations remain well inside the proposed mining pit shells and, as such, are not able to be reasonably excluded from the proposed mine design while maintaining a feasible mine plan (Figures 1, 2 and 3; Table 1 and 2).

The EPA acknowledges that habitat may be used as a surrogate for inferring distributional boundaries of potentially restricted taxa (EPA 2016b, 2016c). Where a habitat type that supports a species is continuous then the extent of that habitat may be used to infer the likely presence of that species in the same habitat. A risk-based habitat approach was undertaken to review the taxa remaining in the proposed mine pit shells to determine the risk of taxa being isolated to the pit shells. Robe Pisolite with thickness >5 m is considered to represent high prospectivity troglofauna habitat. Geological models developed from downhole geological and geophysical logs for Mesas B and C were used to examine the extent and continuity of Robe Pisolite within each mesa. The data and modelling show Robe Pisolite to be present across the entirety of each mesa formation and there are no known geological barriers or faults within Mesas B and C that may restrict troglofauna movement. The risk that the taxa remaining in the proposed pit shells are restricted to the pit shells is, therefore, considered to be low.

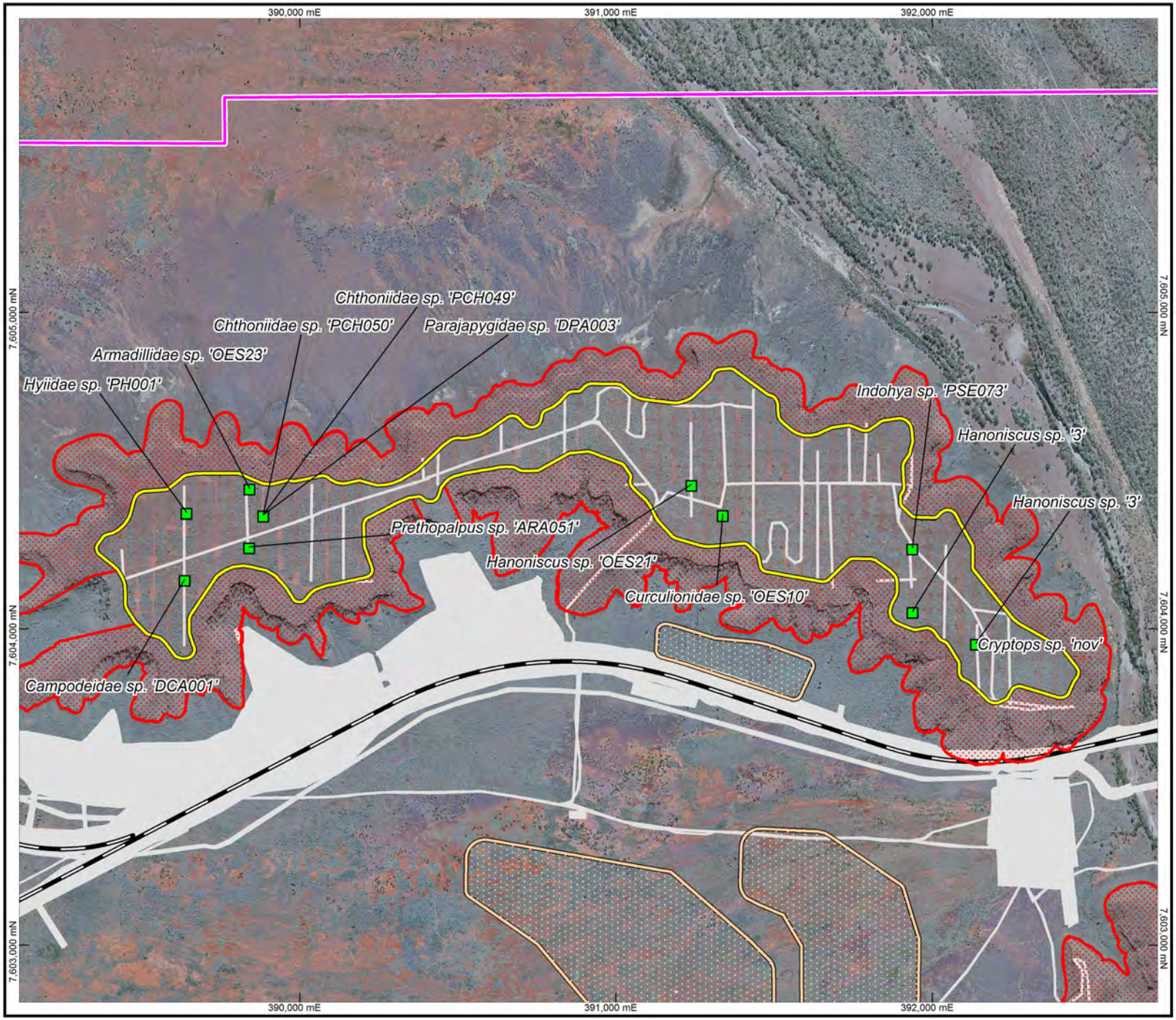
Table 1: Iterative process of avoiding Group A and B troglofauna taxa. Table shows the change between mine plan iteration 1 and 2. Taxa without the minimum of one location outside the proposed impact area are highlighted in pink.

			Iteration 1 (layers created 14th Feb-30th May 2017)	**Iteration 2** (updated Mesa B/C layers 31st Jul-14th Aug 2017)
Group A taxa	**Location**	**Known locations**	**Impact locations**	**Impact locations**
Armadillidae sp. 'OES23'	Mesa B	MEBRC005A	MEBRC005A	MEBRC005A
Campodeidae sp. 'DCA001'	Mesa B	DD11MEB0001	DD11MEB0001	DD11MEB0001
Chthoniidae sp. 'PCH047'	Mesa B	GR15MEB0022	GR15MEB0022	-
Chthoniidae sp. 'PCH049'	Mesa B	RC15MEB0171	RC15MEB0171	RC15MEB0171
Chthoniidae sp. 'PCH050'	Mesa B	RC15MEB0171	RC15MEB0171	RC15MEB0171
Chthoniidae sp. 'PCH054'	Mesa B	GR15MEB0022	GR15MEB0022	-
Chthoniidae sp. 'PCH058'	Mesa C	RC16MEC0177	RC16MEC0177	-
Cryptopidae sp. 'CHI026'	Mesa C	RC15MEC0168	RC15MEC0168	RC15MEC0168
Cryptops sp. 'nov'	Mesa B	MEBRC0015	MEBRC0015	MEBRC0015
Gnaphosidae sp. 'AG001'	Mesa C	RC16MEC0177	RC16MEC0177	-
Hanoniscus sp. 'OES21'	Mesa B	MEBCR0029	MEBCR0029	MEBCR0029
Haplodesmidae sp. 'new genus'	Mesa C	MECRC0026	MECRC0026	-
Hyiidae sp. 'PH001'	Mesa B	DD14MEB0002	DD14MEB0002	DD14MEB0002
Indohya sp. 'PSE073'	Mesa B	MEBRC0022	MEBRC0022	MEBRC0022
Parajapygidae sp. 'DPA003'	Mesa B	RC15MEB0171	RC15MEB0171	RC15MEB0171
Parajapygidae sp. 'DPA008'	Mesa C	RC16MEC0118	RC16MEC0118	RC16MEC0118
Parajapygidae sp.'DPA004'	Mesa C	DD11MEC0005	DD11MEC0005	DD11MEC0005
Prethopalpus sp. 'ARA051'	Mesa B	MEBRC0073	MEBRC0073	MEBRC0073
Cryptopidae sp. 'CHI023'	Mesa B	RC14MEB0115	RC14MEB0115	-
Haplodesmidae sp. 'DIHAP005'	Mesa B	RC14MEB0115	RC14MEB0115	-
Hyiidae sp. 'PH020'	Mesa B	RC14MEB0115	RC14MEB0115	-
Armadillidae sp. 'ISA006'	Warramboo	TOBRC0020	TOBRC0020	-
Armadillidae sp. 'ISA007'	Warramboo	TOBRC0020	TOBRC0020	-
Tyrannaochthonius sp. 'Warramboo'	Warramboo	MEADC2380	MEADC2380	MEADC2380
Cryptops sp. 'CHI002'	Warramboo	MEARC4383	MEARC4383	MEARC4383
Trinemura sp. 'T1'	Warramboo	TOBRC0011	TOBRC0011	-
Group B taxa				
Hanoniscus sp. '3'	Mesa B	MEBRC0015, MEBRC0023	MEBRC0015, MEBRC0023	MEBRC0015, MEBRC0023
Hyiidae sp. 'PH002'	Mesa B	RC14MEB0029, GR15MEB0022	RC14MEB0029, GR15MEB0022	RC14MEB0029
Hyiidae sp. 'PH008/022/023'	Mesa B	RC14MEB0101, RC14MEB0123, DD15MEB0018	RC14MEB0101, RC14MEB0123, DD15MEB0018	RC14MEB0123, DD15MEB0018
Nicoletiinae sp. 'TN012'	Mesa C	GR15MEC0001, RC15MEC0197	GR15MEC0001, RC15MEC0197	RC15MEC0197
Armadillidae sp.' ISA055'	Mesa B	RC15MEB0216, GR15MEB0004	RC15MEB0216, GR15MEB0004	RC15MEB0216

Table 2: Potential SRE trolgofauna species known only from the proposed impact areas at Mesas B and C and Warramboo following the iterative mine design process

Mesa B	Mesa C	Warramboo
Armadillidae sp. 'OES23'	Cryptopidae sp. 'CHI026'	Cryptops sp. 'CHI002'
Campodeidae sp. 'DCA001	Parajapygidae sp. 'DPA004'	Tyrannaochthonius sp. 'Warramboo' *
Chthoniidae sp. 'PCH049'	Parajapygidae sp. 'DPA008'	
Chthoniidae sp. 'PCH050'		
Cormcephalus sp. `blind`		
Hanoniscus sp. '3'		
Hanoniscus sp. 'OES21'		
Indohya sp.'PH001'		
Indohya sp. 'PSE073'		
Parajapygidae sp. 'DPA003'		
Prethopalpus sp. 'ARA051'		

* Specimen collected in 2005 in an area proposed as a mine pit as part of the Mesa A/ Warramboo Iron Ore Project. This area was assessed and approved for mining under Ministerial Statement 756.



LEGEND

- Group A & B Troglofauna
- Development Envelope
- Current Mining Operations
- Mining Exclusion Zone (MEZ)

Conceptual Mine Layout

- Pit
- Waste Dump / Stockpile

Current Infrastructure

- Rio Tinto Railway
- Highway

N

SCALE

0 0.25 0.5 0.75km

1:17 500 @ A4

Rio Tinto

Iron Ore (WA)

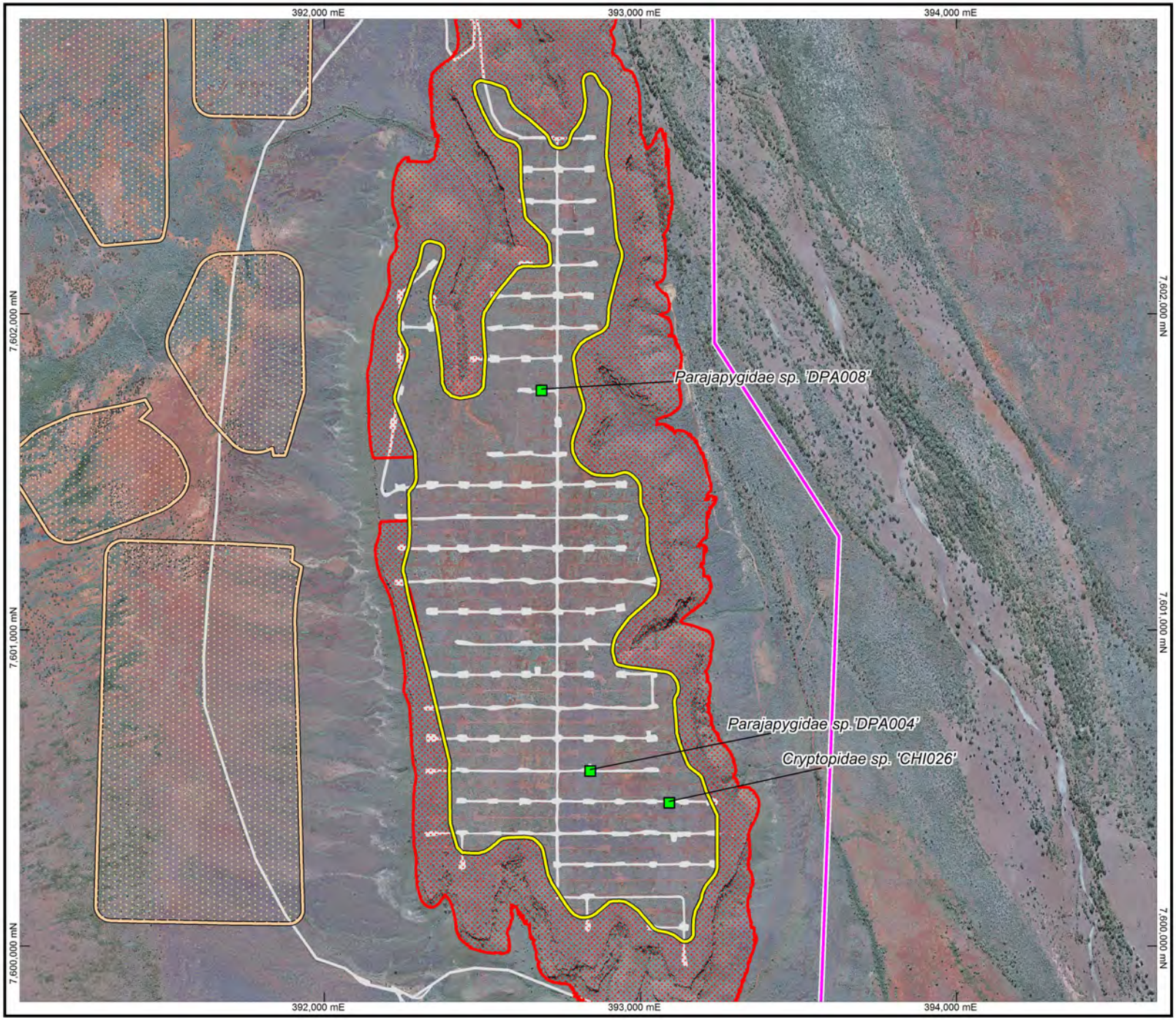
Mesa B

Group A and B Troglofauna

Drawn: GIS Team Plan No: PDE0164222v1

Date: November, 2018 Proj: MGA 94 (Zone 50)

Geospatial Information and Mapping



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SCALE

0 0.25 0.5 0.75km

1:17 500 @ A4

Rio Tinto

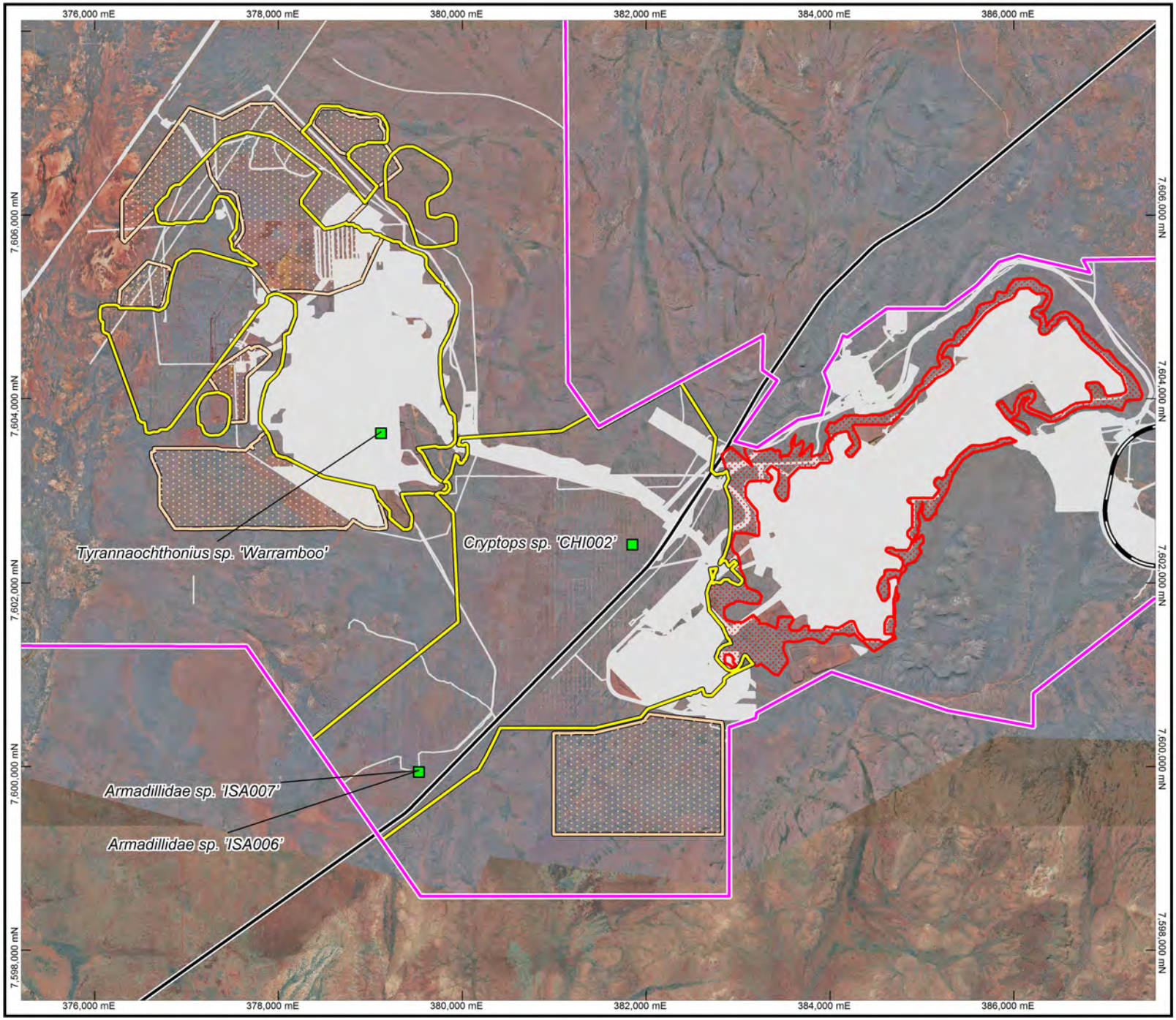
Iron Ore (WA)

Mesa C

Group A and B Troglofauna

Drawn: GIS Team Plan No: PDE0164222v1
Date: November, 2018 Proj: MGA 94 (Zone 50)

Geospatial Information and Mapping



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SCALE

0 0.5 1 1.5 2 2km

1:60 000 @ A4

Rio Tinto

Iron Ore (WA)

Warramboo

Group A and B Troglofauna

Drawn: GIS Team Plan No: PDE0164222v1
Date: November, 2018 Proj: MGA 94 (Zone 50)

Geospatial Information and Mapping

References

Biota 2017a Mesa A Hub: Warramboo Troglobitic Fauna Assessment. Unpublished report prepared for Rio Tinto, May 2017

Biota 2017b Mesa A Hub: Mesa B and C Troglobitic Fauna Assessment. Unpublished report prepared for Rio Tinto, July, 2017.

EPA (2016a). Environmental Factor Guideline: Subterranean Fauna. Environmental Protection Authority, Western Australia.

EPA (2016b). Technical Guidance: Subterranean Fauna Survey. Environmental Protection Authority, Western Australia.

EPA (2016c). Technical Guidance - Sampling methods for subterranean fauna. Environmental Protection Authority, Western Australia.