Yangibana Rare Earths Project

Response to Submissions on Environmental Review Document

Assessment Number 2115
EPBC 2016/7845

18 April 2019

	Document Status			
Rev	Author	Reviewer	Approved	Date
A	Lara Jefferson	Kathy McDougall, Stuart Halse, Jim Hondras		
0	Lara Jefferson		Andrew Reid	13/12/18
1	Lara Jefferson	EPA Services	Lara Jefferson	22/12/18
2	Lara Jefferson	EPA Services	Andrew Reid	27/03/19
3	Lara Jefferson	EPA Services	Lara Jefferson	18/04/19

CONTENTS

APPENDICES

1. INTRODUCTION

Hastings Technology Metals Limited (Hastings) proposes to develop the Yangibana Rare Earths Project (the Proposal) in the Upper Gascoyne Region of Western Australia. The Proposal will produce a Mixed Rare Earth Carbonate (MREC) rich in Neodymium (Nd) and Praseodymium (Pr). Nd-Pr are critical materials of permanent magnets, which in turn are important components of many new technology products such as Electric Vehicles (EV), renewable energy, wind turbines and electrical consumer products.

The Proposal establishes Hastings as an important future supplier of critical rare earths to the high growth EV and renewable energy sectors. Following government agreements at the Paris Climate Conference in 2015, a great deal of emphasis has been placed on the reduction of fossil-fuels in transportation and energy generation. Several countries, most notably Norway, India, United Kingdom and France, have recently announced policy targets to transform the use of fossil-fuel vehicles to electric over the next one or two decades. At the same time, innovation in electric motors utilising permanent magnets has resulted in lighter and more efficient EV, which are increasingly in demand from consumers around the world. In 2016, it was estimated that two million EVs were on the road. The International Energy Agency estimates the number of EVs will increase to between 120 – 200 million by 2030. Hastings anticipates that these trends will underpin the solid demand for Nd-Pr.

Hastings referred the Proposal to the Commonwealth Department of the Environment and Energy (DoEE) under the Environment Protection Biodiversity Conservation Act 2000 and the Western Australian Environmental Protection Authority (EPA) under s38 of the *Environmental Protection Act 1986* in 15 December, 2016 and 30 January 2017, respectively. The Proposal was considered a significant proposal requiring a formal environmental impact assessment under Part IV, Section 38 of the EP Act. In addition, the proposal triggered a 'controlled action' under the EPBC Act.

The delegate of the Commonwealth Minister for Environment and Energy assigned the assessment approach under section 87 of the EPBC Act as an accredited process under the EP Act. The level of assessment was set as an Environmental Review with a four-week advertisement period.

The EPA Services then developed the Environmental Scoping Document (ESD) in consultation with Hastings and other relevant stakeholders. The purpose of the ESD is to define the form, content, timing and procedure of the environmental review as required by section 40(3) of the EP Act. The ESD was approved by the EPA Board on the 18th May 2017.

The Environmental Review Document (ERD) was then prepared to meet the requirements of the ESD and in accordance with the EPA's Procedures Manual (Part IV Divisions 1 and 2). The ERD was advertised between the 1-28th October 2018 and invited the public to make submissions.

1.1 SUBMISSIONS

The EPA Services submitted comments and a total of eight public submissions were received from government departments. No submissions were received from members of the public. The EPA Services considered the following issues to be addressed:

- Flora and Vegetation - detailed surveys have not been conducted in accordance with the standards of Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, December 2016);

- Subterranean Fauna - sufficient information is required to demonstrate troglofaunal species identification and distribution;
- Terrestrial Environmental Quality - clarification and further information is required in relation to radiation;
- Inland Waters - information should be provided on potential impacts to other sensitive receptors such as subterranean fauna and flora from mine waste seepage; and
- Inland Waters - address the potential for the mining and processing of low-level sulphide local basement rocks to increase the concentrations of chemical constituents in groundwater.

1.2 PURPOSE OF THIS DOCUMENT

The purpose of this document is to address comments received from EPA Services and the public during the public advertisement period of the ERD. This document has been prepared to meet the EPA Services request to provide a response to the issues summarised in the Attachments of the correspondence dated 12 December 2018 (Ref DWERA-000024). Hastings provided a response to submissions document in the form of a cover letter, Table providing a response to comments and associated appendices to EPA Services on the 13 December 2018 and then revised the structure as per 1.3 below. Additional comments were received from EPA Services on the 20 February 2019. This document is revised to further respond to those comments.

1.3 STRUCTURE

A request to structure the response to submissions document differently was received from the EPA Services on the 21 December 2018 (Ref DWERA-000024) and was required in order for the document to be sent to the relevant agencies, which included:

1. Provide item numbers (as provided in the summary of submissions).
2. Ensure all submissions are in the correct order and under the correct key environmental factor heading (as provided in the summary of submissions).
3. The title of the tables should be Response to EPA Services Comments rather than Response to Submissions and Response to Public Submissions rather than Comment from the Public.
4. Clarify the what appendices are being referred to in the Troglofaunal responses.
5. Ensure a list of references is provided for the documents referred to in the responses.
6. Ensure the correct documents are referred to for example the last paragraph of your response to the Radiological Council submission regarding radon and thoron concentrations (page 19) refers to the ESD rather than the ERD.

This document was re-structured to meet EPA Services requirements for distribution of the document to the relevant agencies and re-submitted on the 22 December 2018.

1.4 CONSULTATION

During the preparation of this document, the following consultation has taken place:

- Meeting with the Department of Water and Environmental Regulation (13 December 2018) to discuss a research framework to reduce the level of uncertainty associated with waste characterisation, defining adjacent hyporheic environments, and potential uptake of soluble metals by flora species used to rehabilitate waste landforms.
- A meeting with EPA Services (4 January 2019 and 27 February 2019) to further discuss the sampling methodology of the flora and vegetation surveys conducted for the Project.

2. RESPONSE TO COMMENTS

The following provides Hastings (Proponent) response to comments made during the public advertisement period of the Environmental Review Document:

- Table 1 – Response to EPA Services Comments
- Table 2 – Response to Public Submissions

Table 1 Response to EPA Services Comments

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	Flora and Vegetation			
1	The supporting flora and vegetation (including weeds) surveys and reporting were not conducted to the standard required by the EPA Guidance for example Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016) requires a minimum of three quadrats per vegetation unit survey effort. The surveys and	Hastings notes that the EPA guidance (EPA 2016) also states: "Botanists must demonstrate that adequate sampling effort has been undertaken to enable an assessment of the proposal's impacts on flora and vegetation. The survey effort should also consider the number of quadrats required for adequate replication in data analysis. Species accumulation curves will generally indicate if an area has been adequately sampled." Ecoscape (2015) assessed their adequacy of sampling and stated: "In order to demonstrate adequacy of sampling, a species accumulation curve was generated by the computer programme *Species Diversity and Richness*	As previously stated the technical survey reports were not conducted to the standard required by the EPA Guidance for example Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). Additional information provided on 9 January 2019 confirms that targeted sampling for significant flora was not conducted. Ongoing discussions are being conducted with the proponent regarding this issue.	Following consultation with the EPA and DWER TEB, an additional flora survey has been conducted. A supplementary flora report is provided in Appendix 12.

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	reporting do not contain sufficient information to determine impact on flora and vegetation.	(Pisces Conservation Ltd 2007) using five random selections of sample order, and using only quadrat data. Adequacy of sampling is also assessed in terms of representation of various attributes, including vegetation types and representation of land systems. A species accumulation curve was generated to display adequacy of sampling: If the curve has reached (or nearly reached) an asymptote, it is considered likely that most species have been recorded from the study area. The species accumulation curve for the study area (not including regional quadrats) suggests that additional survey would increase the number of species recorded within the study area. The bootstrap estimate of species richness generated from this data indicates that 428.4 species could be expected from the study area. However, the total species count richness of the study area is 468 flora taxa when opportunistic collections are included. Therefore, Ecoscape considers that this survey has documented the vast majority of flora that may occur within the study area."		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
		A table below shows a count of quadrats per vegetation type and other methods of assessment (also included Ecological's survey data of the access road to the south; Ecological 2018) of those vegetation types that occur within the development envelope. The data shows that in most cases (e.g. 21 quadrats for EpAc) there were more than enough sample locations available to determine the impacts on flora and fauna. One of the difficulties with field work is pre-empting the outcomes of the statistical analysis as is shown by the variable number of samples collected and large range in number of sampling locations. Often vegetation types are closely associated with other vegetation types, and their composition and abundance can change with season and over time. The Ecological (2018) survey was conducted as a Reconnaissance Survey (Level 1) in agreement with EPA Services. Since this time, the following approvals have been granted for minor or preliminary works (i.e., the access road) within this survey area, i.e., a Section 41A, Mining Proposal and a Native Vegetation Clearing Permit. For the purposes of this response, the consideration of vegetation from this survey is not considered due to the already approved disturbance, except where the vegetation		

<table>
<tr><th>No.</th><th>EPA Services comment</th><th>Proponent response</th><th>EPA services comment on response - Feb 2019</th><th>Proponent response</th></tr>
<tr><td></td><td></td><td>type complements that of the Ecoscape-determined vegetation type.

It is evident that Ecoscape (2015) have conducted a thorough sampling effort across the survey area, however due to the outputs of the statistical analysis the number of quadrats for a few vegetation types is less than 3. Hastings believes that despite this, the survey effort has been more than adequate to assess the impacts to flora and vegetation.

<table>
<tr><th>Vegetation type Ecoscape/ELA</th><th>Quadrats</th><th>Releves</th><th>Sample locations</th></tr>
<tr><td>AaSaEs/AaAcTSS</td><td>1</td><td>8</td><td>9</td></tr>
<tr><td>AcEt/AcApTSS</td><td>4</td><td>3</td><td>7</td></tr>
<tr><td>ApSgAc/ApGbTSS</td><td>2</td><td>8</td><td>10</td></tr>
<tr><td>ArPc</td><td>4</td><td>-</td><td>4</td></tr>
<tr><td>AtGc^</td><td>2</td><td>-</td><td>2</td></tr>
<tr><td>AxEcAc*/AxTSS</td><td>13</td><td>3</td><td>16</td></tr>
</table>
</td><td></td><td></td></tr>
</table>

No.	EPA Services comment	Proponent response				EPA services comment on response - Feb 2019	Proponent response
		VfSS/EcBp*	2	3	5		
		EcMgCc	5	-	5		
		EeAc	7	-	7		
		EfAc	6	-	6		
		EpAc	21	-	21		
		EvCc	3	-	3		
		Fs	1	-	1		
		Mp*	2	-	2		
		* Quadrats representing vegetation types **Mp** and **EcBp** together form a cluster that is floristically similar to the more widespread vegetation type **AxEcAc** (Ecoscape 2015). ^ Quadrats representing vegetation type **AtGc** form a distinctive cluster in the dendrogram associated with ironstone outcrops and crests. These quadrats are nested within a larger cluster of quadrats belonging mostly to vegetation type **AaEpDr** (4 quadrats) (Ecoscape 2015).					

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
2	Provide a figure/map showing the quadrats over vegetation mapping within the development envelope and proposed area of clearing.	Figure 1-1 (Appendix 1) shows the location of the quadrats within each vegetation type. Figure 1-2 shows those vegetation types with less than three quadrats.	Include Figure provided at meeting with EPA Services on 4 Jan 2019	This figure has been added to Appendix 1 as Figure 1-2
3	The current draft of the Flora and Vegetation Environmental Management Plan (FVEMP) has been updated to follow the EPA's Management Plan template. To be a robust auditable management plan the FVEMP should be updated to include sufficient content on objectives, threshold and targeted monitoring for flora, vegetation health (GDEs) and weeds,	The FVEMP has been updated (Appendix 2) to include additional content on: • Objectives • Thresholds • Targeted monitoring for flora, vegetation health (GDEs) and weeds • Baseline data	The FVEMP requires further amendments and should be resubmitted for consideration. Details of the required amendments are outlined below. It is noted that some changes have been made to the FVEMP as requested, however the plan still refers to other plans including the Vegetation Condition Monitoring Plan which has not yet been developed. The management-based (management targets) FVEMP refers to undeveloped objectives based trigger levels in a Water Management Plan that	Reference to a Vegetation Condition Monitoring Plan were remnants of information from the previous revision that have now been removed because vegetation condition monitoring was further detailed in section 2.4 of the FVEMP (Dec 2018). Trigger levels in Section 2.4 of the Water Management Plan are clearly defined: *Trigger levels for groundwater quality have been proposed for the Project, for all monitoring locations (including dewatering discharge, production bores, TSF monitoring bores and the regional*

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	including baseline data. The FVEMP may need to include species substantially impacted by the proposal, that have not currently been identified due to insufficient information. The FVEMP refers to the future development of a Vegetation Condition Monitoring Plan, however this content needs to be included in this overarching FVEMP. A management plan should not refer to other related and undeveloped management plans.		does not refer to the development of those trigger levels (ERD Appendix 4-4). Early response indicators, criterion and actions provided in Section 3.2 of the FVEMP provide only for the effects to flora from groundwater drawdown. The use of death of individuals as an indicator of an early response is not appropriate. A more objective and measurable early response indicator should be utilised that precedes plant death from groundwater drawdown.	*stock water bores). The proposed trigger values have been set as follows:* • *Exceedances of >25% beyond natural variability on 3 consecutive samples.* • *Exceedances of ANZECC guidelines for fresh and marine water quality (2000) for livestock and Australian NHMRC and ARMCANZ (1996) Australian Drinking Water Guidelines for drinking water quality for elements that are not exceeded naturally*. Early response indicators, criterion and actions have now been included for all identified risks. In addition, the FVEMP has been adjusted to include an early warning trigger using remote sensing data analysis. Changes in

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
				vegetation condition and canopy density (analogous to leaf area index) can be determined from remote sensing analysis and used to identify early changes in vegetation condition. The results of the analysis will be reviewed with climate and groundwater data to help to identify if and when changes in vegetation condition are potentially the result of changes in groundwater availability. Death of individuals has been replaced by: • Dead branches, and/or • Reduced canopy area. Botanists, Kellie Bauer-Simpson and Mike Baimbridge, have reviewed the FVEMP, and made the following improvements:

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
				• Incorporation of remote sensing into the monitoring of GDE condition; • Monitoring of Priority flora abundance and extent, in addition to the condition monitoring; • Additional information to be recorded at each monitoring plot; • Revised monitoring schedule to take account of different types of monitoring (i.e. vegetation, Priority flora and remote sensing).
	Subterranean Fauna			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
4	*Troglofauna* Provide sufficient evidence (genetic) to support the ERD's conclusions regarding the identifications and distributions of a number of troglofaunal taxa that may be restricted to mine pit areas. • The ERD states that the millipede *Lophoproctidae* sp., known from a single specimen obtained from a mine pit area, is "likely" to be *Lophoturus madecassus* – a widespread species that was found outside the impact areas (Hastings Technology Metals	Bennelongia (pers comm. Stuart Halse, 3 Dec 2018) provided the following response to each point raised regarding the identifications and distributions of troglofaunal taxa: • Lophoproctidae sp. was collected at Yangibana North pit area in drill hole number YGRC069 on 6/10/2016 in a scrape. The specimen was very damaged with its antenna missing. Antennae are one of the characters used to identify millipedes to species level. All the other characters on the specimen were consistent with *Lophoturus madecassus,* which is widespread across the Pilbara and the most frequently collected millipede species. It was left as a higher level identification because of the absence of antennae but the identifier (Jane McRae) had little doubt that it was *Lophoturus madecassus,* which was collected from both the vicinity of Yangibana and Frasers. Bennelongia has almost 60 records of the occurrence of Lophroctidae in the Pilbara (and other consultants have more) without a single record of any other species (this includes some genetic confirmation on other projects).	Confirm whether the location from which the only known specimen of *Scutigerella* sp. B09 was collected is protected, this location remains outside the pit boundary given current impact footprints, and that the subterranean habitat present will not be isolated or otherwise compromised due to pit construction. It is noted that this location – site BHRC006 – was mapped as just outside the boundary for the Bald Hill pit (Ecoscape 2016), but that it was unclear whether this location could still be considered non-impact based on current impact footprints.	Scutigerella sp B09 was collected from BHRC006, which occurs within the latest pit footprint and will be impacted. This symphylan was collected as by-catch in a stygofauna net sample and, as such, a collection depth cannot be attributed to the specimen. However, at the time of sampling the water table was encountered at a depth of 26 metres below ground level, and together will drill logs for the hole this indicates that the habitat from which *Scutigerella* sp. B09 was collected is granite. As with other granite geologies in the vicinity, this habitat is likely to be continuous outside the proposed pit boundary as shown in Figures 7-2 and 8-11 in the Environmental Review Document (Hastings 2018). EPA Services have since raised addition queries, which are

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	2018; Table 7-4). On this basis, *Lophoproctidae* sp. has been excluded from the assessment of direct impacts to troglofauna. It is unclear whether this is appropriate because no evidence – genetic or otherwise – has been provided to support the designation of *Lophoproctidae* sp. as *Lophoturus madecassus*. In addition, the ERD fails to specify the collection location of *Lophoproctidae* sp. (Table 1). • The ERD states that the symphylan	• The symphylan *Scutigerella* sp. was in very poor condition and was juvenile: Its head was missing as well as most legs and it was unlikely to yield DNA. There is no certainty it is the same species as *Scutigerella* sp. B09 that was recorded 12km away although the overall shape was the same. Bennelongia reported *Scutigerella* sp. and *Scutigerella* sp. B09 as "possibly the same species" and when calculating the total species richness of the area treated them as one species (noting this assumption). There is uncertainty about the species level identity of *Scutigerella* sp. • The two schendylid centipedes were damaged. One was only a front half, both had the telopodites missing, which are needed to identify them further. The animal from Yangibana North was sequenced for C01 but failed. The two animals were compared using the available characters, antennal segment number (14), body size, leg size and setation and the shape of the mandibles were consistent. The individuals were considered to probably represent the same species, as was reported. Given the low frequency of occurrence of schendylid centipedes in subterranean habitats		summarised and a response provided in Appendix 13.

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	Scutigerella sp., known from a single specimen obtained from a mine pit area, "may" be *Scutigerella* sp. B09 – a taxon found outside the impact areas (Hastings Technology Metals 2018; Table 7-4). On this basis, *Scutigerella* sp. has been excluded from the assessment of direct impacts to troglofauna. It is unclear whether this is appropriate because no evidence – genetic or otherwise – has been provided to support the designation of	in the Pilbara, treating them as two similar but separate species is more likely to be an error. • The centipede *Chilenophilidae* sp. B09 from Frasers deposit was sequenced for C01 which was successful. And the partial/damaged specimen obtained at Yangibana North – *Chilenophilidae* sp. – was also sequenced for C01 but failed. The Yangibana North animal was slightly larger but antennal segment number, leg size and setation and the shape of the mandibles and maxilla were consistent. The individuals were considered to probably represent the same species. Further, as mentioned in the comments treating *Chilenophilidae* sp. as an additional species implies the occurrence of three species of Geophilidae centipedes in the Project area, which does not match the general pattern of survey results in the Pilbara.		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	Scutigerella sp. as *Scutigerella* sp. B09. • If *Scutigerella* sp. is demonstrated to be *Scutigerella* sp. B09, additional information regarding whether its location at Bald Hill is secure is required. In 2015 the site from which *Scutigerella* sp. B09 was collected was close to but outside the pit boundary for the Bald Hill deposit (Ecoscape 2016; Map 8); it is unclear whether this location can still be considered non-impact based on the current impact footprints. Geological mapping			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	also suggests that the establishment of the mine pit may result in habitat at this location becoming isolated (Ecoscape 2016; Map 8). • Two schendylid centipedes that could not be identified to species level were represented by partial/damaged specimens at the Frasers and Yangibana North deposits. The ERD states that these specimens are "likely" to represent the same species and proceeds to include *Schendylidae* sp. as			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	a single taxon in the assessment of direct impacts to troglofauna. It is unclear whether this approach is appropriate because no supporting evidence – genetic or otherwise – has been provided. • The centipede *Chilenophilidae* sp. B09 was represented by one intact specimen at the Frasers deposit. The ERD also states that a partial/damaged specimen obtained at Yangibana North – *Chilenophilidae* sp. – "probably" also represents this			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	taxon, and proceeds to include only *Chilenophilidae* sp. B09 in the assessment of direct impacts to troglofauna. It is unclear whether this approach is appropriate because no supporting genetic evidence has been provided (though the relevant technical report does speculate that the occurrence of a second chilenophilid centipede is "unlikely" based on the total number of centipede taxa collected; Bennelongia 2018).			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
5	*Troglofauna* Provide adequate physical surrogate evidence to support the conclusions drawn regarding habitat connectivity. The ERD argues that the taxa currently known only from mine pit areas at Yangibana are likely to also occur outside of potential impact areas, using a physical surrogate approach. Use of biological surrogates is not possible with the available data due to the very low yield rates for troglofauna sampling in the proposal area. However, the ERD uses only coarse geological	The taxa currently known to only occur within the mine pit areas are: • Parajapygidae sp. B41 • Troglarmadillo sp. B60 Single specimens of the dipluran Parajapygidae sp. B41 were recorded in two holes in the Yangibana North deposit in stygofauna net samples. The exact collection depths are therefore unknown other than that the specimens were both collected above the water table (15.65 m and 10.72 m in holes YGRC067 and YGRC069, respectively). Based on these depths and geological cross sections for the collection holes, it is considered likely that the primary habitat for Parajapygidae sp. B41 is Pimbyana Granite, which is extensive above the water table and outside the extent of the proposed pit (Yangibana North Sections A and B; Appendix 3 Figures 3A and 3B). Species of troglofaunal Diplura in the Pilbara have estimated median ranges of 16 km^2 (Halse and Pearson 2014), further supporting the notional wider range of Parajapygidae sp. B41. The Troglarmadillo sp. B60 specimens were collected from FRRC010 in a trap sample at the end of the	The supplied geological cross sections and descriptions should illustrate the locations and collection depths at which the two schendylid and two chilenophilid centipede specimens were obtained (site FRRC100 at Fraser's and site YGRC069 and an unspecified site at Yangibana North). Provide this site-specific information, in the same manner and to the same level of detail as was done for *Parajapygidae* sp. B41 and *Troglarmadillo* sp. B60 in the Response to Submissions document, to adequately demonstrate likely habitat connectivity between these locations and non-impact areas outside of the proposed pit boundaries.	All specimens of the taxa Chilenophilidae sp., Chilenophilidae sp. B09 and Schendylidae sp. were collected as by-catch in stygofauna net samples and, as such, precise collection depths cannot be assigned to each specimen, other than to say that each was collected above the water table. These depths were 16.6 metres below ground level (mbgl) for Chilenophilidae sp. from hole YGRC066 (Figure 3D); 35.73 mbgl for both Chilenophilidae sp. B09 and the schendylid specimen from FRRC100 (Figure 3E); and 10.72 mbgl for the schendylid specimen from YGRC069 (Figure 3F). The stratigraphies above the water table in all three holes predominantly comprise granite but some ironstone is also present. The lack of known collection depths means that the geological unit from which each animal was collected is uncertain.

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	information to illustrate habitat connectivity and does not adequately link the information it provides on known ranges of similar taxa outside the proposal area to those taxa and habitats found at Yangibana. It therefore does not meet the requirements of EPA *Technical Guidance: Subterranean Fauna Survey*, which specifies that "a physical surrogate can be used only where continuity of the presumed habitat can be clearly demonstrated with site-specific data".	hole, equating to a collection depth of approximately 24 m, in granite geology comprising either weathered granite or Yangibana granite. Support for Troglarmadillo sp. B60 primarily occupying granite, rather than the ironstone vein that also occurs in the profile, is provided by the non-collection of the species in a shallower trap at around 14 m in the vicinity of the ironstone stratum. Based on geological cross sections provided to Bennelongia by Hastings, the Yangibana granite is very widespread and extends beyond the proposed pit (although the connectivity of weathered and fractured zones is unknown). While the overlying weathered granite appears to be less common, it occurs in three channels within the mine pit area that run out of pit at 90 degrees to the axis of the cross-section in Appendix 3, Figure 3C. These channels form a network of deeper weathered granite habitat that extends outside the proposed mine pit. In addition, the channel habitat is also likely to be connected for troglofauna by the shallower surficial deposits found throughout and beyond the pit, providing extensive habitat connectivity outside proposed excavations.		Collections of other troglofauna species (e.g. Parajapygidae sp. B41 and *Troglarmadillo* sp. B60) from granite demonstrate the suitability of this habitat, which extends outside the proposed pit boundaries. It is reiterated that the two chilenophilid specimens are considered likely to be conspecific and the same is true for the two schendylid specimens. In both cases, conspecificity was unable to be confirmed with molecular techniques due to one of the two specimens from each family failing to yield a COI sequence. However, morphological similarities point to the likelihood of single species of both Chilenophilidae and Schendylidae being present. It is therefore inferred that both species have moderately extensive linear ranges and are likely to occur in areas outside proposed pits.

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
				See Appendix 13 for additional information.
	Gifford Creek Calcrete PEC Provide additional detail regarding the extent to which water abstraction and pit dewatering associated with the proposal may affect groundwater levels in the PEC. Although the proposal will not directly draw water from the Gifford Creek Calcrete PEC aquifers, the possibility of indirect drawdown impacts to the PEC remains. The proponent states that "no significant groundwater abstraction from an aquifer with direct hydraulic connection to	Groundwater modelling was undertaken as part of the pit dewatering assessment to understand potential impacts to the surrounding environment, including potential impacts to calcrete outcrops within the PEC. The dewatering model did not include recharge and is therefore considered conservative with respect to drawdown impacts. The model simulated drawdown at the end of mining (Appendix 4, Figure 4A) indicates that the 5 m drawdown remain within about 1 km of the calcrete outcrops at Fraser's and Bald Hill pits. However, at Yangibana West pit, the 5 m drawdown contour touches on the edge of the calcrete to the north of the pit. It is important to understand that the pit dewatering modelling does not allow for rainfall recharge, and as shown in the palaeochannel modelling (Appendix 4, Figure 4B), which does include rainfall recharge, the creek systems and associated calcrete units are expected to recharge readily and negate the mining induced drawdown in the immediate area of the calcrete. It is this reason that the study assessment concluded that impacts to the PEC calcretes as a result of pit dewatering is not expected to significantly impact the calcrete		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	the Gifford Creek Calcrete PEC" will occur (Hastings Technology Metals 2018; p. xix). Define 'significant' and explain in more detail – in a subterranean fauna context – the hydraulic connections between aquifers to be used for water abstraction and the aquifers of the PEC.	outcrops within the PEC (with 'significant' defined as drawdown greater than 5 m over an area greater than 50% of the identified local outcrop). It should also be noted that the calcrete outcrops identified in Appendix 4, Figures 4A and 4B have been assumed to extend below the water table for the purpose of the study (noting that this has not been confirmed by drilling), to maintain a conservative approach to assessing impacts. In terms of the conceptual understanding of hydraulic connection between the various aquifers, there are three identified aquifer types in the area: • The shallow alluvium and calcrete, which typically occupies the current drainage systems. These units do not always extend below the water table, but when they do, they can form subterranean fauna habitat. These aquifers are expected to be readily recharged following rainfall events. • The fractured rock aquifers, which are the target of mine dewatering and the fractured rock bores. This aquifer is discontinuous and follows the larger structural features of the bedrock, including the orebody. Away from the structural features the intact bedrock has very low		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
		permeability. For this reason, drawdown associated with mining activities will propagate along the highly permeable features, whilst will be limited in the intact bedrock. There is only expected to be hydraulic connection between the fractured bedrock aquifer and the overlying alluvium and calcrete aquifer where the two units are in direct contact. Given that calcrete aquifers are readily recharged by rainfall events and isotopic analysis of the fractured rock aquifers' water shows that the water is greater than 50 years old and thus not recently recharged, it is unlikely that there is direct connectivity between the calcrete aquifers and the fractured rock aquifers of the pit dewatering areas. • The palaeochannel aquifer is a deep sand aquifer, overlain by a thick sequence of low permeability clay. This unit is the target of the SipHon Well Borefield and the aquifer has limited connection to the overlying shallow alluvium and calcrete, due to the thick clay unit. However, the palaeochannel will have connection to fractured rock aquifers in locations where the palaeochannel sands are in direct contact with the fractured bedrock.		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
		The hydraulic connectivity within the entire system is complex, and whilst groundwater investigations and modelling have been undertaken to further understand the system, ongoing monitoring will be crucial to verify the current interpretation during the operational phase of the project.		
	Inland Waters			
7	Discuss the risk that mining and mineral processing in the area could increase the concentrations of arsenic, boron, copper, molybdenum, vanadium, selenium and uranium (and potentially some other) chemical constituents in groundwater, despite the apparent absence of significant levels of sulfide minerals in local basement rocks.	Hastings have conducted waste rock characterisation studies (Trajectory and Graeme Campbell and Associates, 2016) to determine if there is a risk of increased concentrations of harmful chemicals being released from the waste material. The studies found the waste rock to be benign. There is not 'treatment' of waste rock with reagent during mining, and although nitrates locally occur as residues from explosive charges, the groundwaters are naturally enriched in nitrate, due to leaching below the root zone of leguminous species (e.g. acacias). Hastings has conducted tailings characterisation studies generated from bench-scale metallurgical testings (Trajectory and Graeme Campbell and Associates, 2016) as well that generated from pilot plant studies (Trajectory and Graeme Campbell and	The proponents for the Yangibana have used geochemical testing methodologies that are commonly used to assess the risks of chemical constituents leaching from mine-wastes at hard-rock mine sites. However, these tests are not considered to adequately assess the risks of chemical constituents being mobilised from wastes at the Yangibana deposits due to the unusual mineralogy of the deposits and because of a lack of consideration of the soil pathway for the migration of	Hastings commits to a program of further kinetic testing of mine waste to determine whether or not there is a potential risk that mining and mineral could increase the concentrations of chemical constituents in groundwater.

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	The extent to which potentially harmful chemical constituents will be leached from rock that has been excavated, crushed, processed and disposed of at a mine site will depend on: • The constituent rock-forming, ore and accessory minerals in the host rocks; • The texture and fabric of the rock matrix; • The degree of heterogeneity of rock-types and their mineralogy, textures and fabrics throughout the	Associates, 2017). Where elevated chemicals were found, leach testing was conducted to determine their risk of persisting beyond the closure phase. These studies showed the risk to be low (i.e. a run-down elution behaviour with monotonically decreasing concentrations)(Trajectory and Graeme Campbell and Associates, 2018). The US EPA (2012) literature review stated "Waste rock from REE deposits could potentially present a problem with neutral mine drainage (NMD), with pH in the range of 6 to 10. Mine drainage in the NMD pH range can have various elevated metal (e.g., zinc, cadmium, manganese, antimony, arsenic, selenium) concentrations (INAP, 2010). In the case of REE deposits, there is generally a lack of a mineralogical source for metals that are mobile under such conditions; however, elements like uranium and vanadium could be mobile under NMD conditions, and these elements are constituents of some REE ores." Hastings waste characterisation studies to-date show this to be the case, as well as having low levels of uranium and vanadium associated with the waste rock and the ore body. A key feature of mineralisation at the Project is enrichment in iron, especially within the ironstones, with consequent high capacity for retention of sorbed elements –	metals into the ecosystem in the project area. There is a risk that mining and mineral processing in the area could increase the concentrations of chemical constituents in groundwater, despite the absence of significant levels of sulfide minerals in local basement rocks. Although the risk is considered to be low because of the generally low rainfall and high evaporation rates in the area, it is not negligible and would require further waste rock testing to assess its likelihood. The most effective way of assessing this risk would be to subject a range of mine waste materials to kinetic testing to assess their potential to release chemical constituents of environmental concern after a prolonged period of	

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	deposit and the degree to which they have been weathered; • The degree to which rocks are crushed and treated with chemical reagents during the mining operation; and • On how tailings and other waste rock materials are managed after mineral processing. The most significant cause of the release of harmful chemical constituents from waste rock materials is generally the oxidation of sulfide minerals, and consequently much of	including those occurring as oxyanionic forms under the prevailing redox conditions – via sorption reactions of the high-affinity / poorly-reversible type. Isotopic analysis (i.e. tritium) of fractured rock aquifer water associated with the resource shows this water to be greater than 50 years old (GRM, 2018). Elevated levels of certain elements, as highlighted in the submission, will have slowly been released from the surrounding geology over long periods of time (i.e. >50 years) with no flushing of the aquifer via recharge or other throughput mechanisms during that period. Such chemistry of groundwater simply reflects slow trending to attainment of aquifer equilibrium along the flowpath by the slowly migrating groundwater. Given there was no immediate release of these elements in the waste rock, bench-scale tailings and pilot plant tailings characterisation testing or leach testing, it is not expected that they will be released beyond that of natural levels. Molybdenum and fluoride solubility levels were shown to fall within natural background levels post-closure.	weathering. Such testing could be carried out during the mining operation to provide information to help develop closure strategies for the mine wastes at the site. The proponent should undertake additional geochemical testing during the life of the mining operation to ensure that these issues are adequately addressed in the closure strategy for the project.	

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	the geochemical test-work that is undertaken for conventional hard-rock mineral deposits is focussed on assessing risks associated with sulfide oxidation. However, some mine rock materials that have low sulfide contents have the potential to leach significant amounts of harmful chemical constituents to the environment, particularly of metals and metalloids that form stable oxyanions in water (MEND, 2004). There is a risk that this could occur at the Yangibana deposits because of the unusual characteristics host-rocks in these deposits. A review of carbonatite-	Further testing and verification of the studies conducted to-date will be performed on tailings during operations (Objective 1 in Appendix 5).		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	hosted rare-earth deposits undertaken by the US EPA (US EPA, 2012) indicated that a range of metals and metalloids have the potential to be released under neutral to alkaline conditions from waste rocks (neutral mine drainage) including zinc, cadmium, antimony, arsenic, selenium, uranium and vanadium. The rare-earth minerals at the Yangibana deposits occur within the Gifford Creek Ferrocarbonatite Complex (Pirajno et al., 2014), a suite of intrusive rocks that has been derived from a magma with a high carbonate content. The			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	ore in these deposits occurs in iron-rich veins (Pirajno and Gonzalez-Alvarez, 2013) that have intruded into granitic rocks which have been highly altered by high temperature fluids containing very high concentrations of potassium and sodium through the process of "fenitisation" (Elliott et al., 2018). Although carbonatite-hosted rare-earth deposits have a limited capacity to produce acid drainage because of their low sulfide and high carbonate mineral contents (Verplanck et al., 2014) these deposits contain readily soluble minerals that have the potential to release			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	toxic chemical constituents on disposal to waste rock dumps (for example, the rare-earth and uranium containing carbonate mineral batnäsite), particularly if acidic residues from mineral processing are co-disposed with tailings. Additionally, the fenitsed host-rocks contain a range of silicate minerals that contain toxic chemical constituents such as fluorine, lithium and thallium which can weather at a much faster rate than standard rock-forming minerals in granitic rocks, providing another potential source of harmful chemical constituents in tailings			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	storage facilities (TSFs) and waste rock dumps. Groundwater sampling in fractured rock aquifers in the vicinity of the proposed mine sites indicates that groundwater in the area contains elevated concentrations of arsenic, boron, copper, molybdenum, vanadium, selenium and uranium through natural water-rock reactions in the aquifers. Consequently, there is a risk that mining and mineral processing in the area could increase the concentrations of these (and potentially some other) chemical constituents in groundwater, despite			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	the apparent absence of significant levels of sulfide minerals in local basement rocks.			
8	Provide information on the potential impact to sensitive environmental receptors such as stygofauna and flora form mine waste seepage. Geochemical testing of potential mine wastes carried out for the ERD has not considered impacts on environmental receptors other than groundwater used for stock water supply. Other more sensitive receptors of potential concern at the site are: impacts on fauna in hyporheic zones	There is no potential impact to sensitive receptors such as stygofauna and flora from mine waste seepage. A seepage analysis showed that vertical seepage did not extend to the groundwater table and lateral seepage did not extent beyond the disturbance footprint of the Tailings Storage Facilities (ATC Williams, 2018). Thus there is no pathway to the sensitive receptors such as the hyporheic zone of the creeks. Hastings appreciates the scientific work provided by Gad, 2007 and Corbett et al., 2017; and will apply the outcomes of their research to mine closure planning. It should be noted that the Tailings Storage Facilities will have a cover of inert waste rock. However, there may still be potential for plant roots to penetrate into tailings material. Further consideration of species for rehabilitation of these areas and depth of inert waste rock will need to assess the potential for release organic acids via a research program that determines whether or not soil fungi, bacteria or plant roots are able to release	A more significant exposure pathway for chemical constituents of environmental concern in mine-waste disposal areas is likely to be through their uptake by vegetation and soil-fauna in soils that are developed on mine-waste landforms after mine closure. This process could then lead to metals entering local food webs by animals eating vegetation or soil fauna. Molybdenum and tungsten in particular can be readily bioaccumulated by vegetation at mine sites (Pyatt and Pyatt, 2004). This risk of the mobilisation of some metals is considered to be particularly high in soils that are likely to develop on mine	Initial discussions, with researchers in Canada and WA, involved development of a research program to further understand the release of metals from mine waste associated with rare earth mining and processing. In WA initial research has been completed using sequential leaching methods under circum-neutral and alkaline conditions to determine the likely order of element mobilisation and dissolution of metal ions and metalloids. In WA this program has been tested on iron ore waste rock from the Pilbara Region. In Canada, studies have focussed on rare earth mine waste and the release of elements using long term weathering cells amongst other methodologies. Both

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	beneath nearby ephemeral creeks; and the uptake of contaminants by vegetation and soil fauna on waste landforms after mine closure. The ERD assumes that the most sensitive environmental receptor that could be affected by seepage from mine waste materials is groundwater that is used for stock water supply. On this basis and the geochemical test-work that has been carried out on rocks from the Yangibana deposits, it has been concluded that seepage from mine sites will have negligible environmental impacts.	organic acids of any significant quantity to influence the release of metals (also in any significant quantity) in a semi-arid, highly disturbed environments such as that of rehabilitated mine waste rock landforms and tailings storage facilities. The referenced research in the literature review of Gad 2007 was based on laboratory-based tests and did not specifically consider the ecology of the natural environment. It is proposed to address the uncertainty associated with the release of organic acids by fungi, bacteria and plant roots and thus increasing availability of soluble metals on rehabilitated areas (refer to Objective 3 in Appendix 5).	wastes at the Yangibana mine sites after closure because of the likely presence of large amounts of phosphate minerals such as monazite in the mine-wastes. As phosphate is an essential nutrient for soil ecosystems, soil fungi are able to exude organic acids to extract phosphate directly from a variety of minerals (Gadd, 2007) a process that also leads to metals being released from these minerals. This ability has led to certain soil-fungi being used for the industrial- scale leaching of rare-earth elements from monazite in bioreactors (Brisson *et al*., 2016). As rare-earth elements released by this process can be bioaccumulated in vegetation and could potentially cause adverse impacts on grazing animals (Gwenzi *et al*., 2018), additional geochemical work	researchers in Canada and WA are keen to work with Hastings to further develop a research program during operations.

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	However, there are potential for impacts of groundwater contaminated by leachate from mine wastes on the hyporheic zone in the network of creeks that surround the mine site. Although these water courses are ephemeral in nature, it is likely that sands and gravels beneath creek beds contain a hyporheic fauna (stygofauna) that has the potential to be affected by mine discharges. Although this fauna is likely to be fairly depauperate by comparison with the fauna in calcrete bodies lower in the catchment, measures should be taken to limit the potential impacts of		including sequential-extraction leaching tests should be undertaken during the life of the mine to develop closure strategies that will ensure that rare-earth phosphate minerals in mine wastes do not cause environmental harm through the soil pathway after closure.	

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	mine discharges on the hyporheic zone of local creeks which are potentially located very near the proposed mine-waste landforms. A second potential group of environmental receptors are vegetation and soil fauna that will be established on mine-waste landforms after mining ceases at the Yangibana deposits. The ore and host rocks at the Yangibana site contain elevated concentrations of phosphorus in a region which is otherwise often deficient in this nutrient, and it is likely that soil fungi, bacteria and plant roots in soils on waste landforms			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	after mine-closure will access this phosphorus by exuding organic acids to attack phosphate-containing minerals in the wastes (Gad, 2007). This organic acid attack can also release metals into soil pore-water where they can be taken up by soil fauna and vegetation. Even the highly resistant mineral monazite can be attacked by soil fungi to cause the leaching of rare earth elements (Corbett et al., 2017). Metals that are released into soil pore-water through leaching by organic acids in soils can then enter local food-webs.			
9	The leaching tests that have been undertaken	Hastings commits to doing the additional geochemical testwork during the life of the Project		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	for the ERD assess the leaching potential of materials that are placed near the surface of mine-waste landforms that are exposed to rainfall. Additional test procedures such as the US EPA LEAF suite of tests and geochemical modelling would be required to assess the leaching potential of mine wastes covered with a soil profile after mine closure. It is recommended that additional testing is undertaken during the life of the Yangibana mines to determine the leaching behaviour of mine wastes under a range of geochemical scenarios to ensure that the wastes are	that includes the use of test procedures in the US EPA Leaching Environmental Assessment Framework (LEAF) suite of tests coupled with geochemical modelling using the ORCHESTRA model (US EPA, 2017) (Objective 1 in Appendix 5). Hastings appreciates the assessment of the potential lanthanum and uranium ecotoxicity to potential sensitive receptors. However, they are unlikely to be a risk to the surrounding environment because there is no pathway between the potential contaminant and the sensitive receptor. Surface water within the process plant area will be contained. Seepage modelling has shown that vertical seepage below the Tailings Storage Facilities does not reach groundwater levels and lateral seepage does not extend beyond the disturbance footprint (ATC Williams, 2018). At closure the TSFs will be covered with unprocessed waste rock and have been designed to be water shedding as per the Landform Evolution Report (Trajectory, 2017) and thus the risk is further reduced. However, given the lack of knowledge of toxicity of rare-earth elements and determination of whether or not there are hyporheic aquatic receptors within the immediate drainage channels, Hastings commits to supporting a research program to further extend our knowledge		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	adequately managed on mine closure. The geochemical test-work that was undertaken on materials from the Yangibana deposits included: a chemical analysis of a suite of metals and metalloids and a comparison of their degree of enrichment with respect to their crustal abundances; acid-base accounts using standard static test methods; and short-term leaching tests with deionised water. The testing has been undertaken in an appropriate manner using standard test procedures that are usually carried out for waste-rock materials	and that of the broader industry in this area (Objective 2 in Appendix 5). In terms of the cited German lanthanum criterion of 4 µg/L, it is noted that the shandy of site groundwater employed in the comprehensive column leaching study (Trajectory and Graham Campbell and Associates, 2018) had a lanthanum concentration of 14 µg/L. In terms of uranium solubility, the leachate concentrations from the column leaching study (Trajectory and Graham Campbell and Associates, 2018) exhibited a decreasing trend with progressive flushing. Uranium concentrations above 150 µg/L were transients restricted to the initial stages of leaching.		

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	from hard-rock mine sites, but may not be sufficient to fully assess the environmental risks associated with the disposal of mine wastes at the Yangibana deposits for the following reasons: i. Limited assessment of the toxicity of key rare-earth elements in leachate – There are currently no ANZECC water quality criteria for rare-earth elements, but there is increasing evidence that many of these elements are toxic to fauna and vegetation (US EPA, 2012). As it is likely that concentrations of			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	many of the rare-earth elements in fluids in TSFs will be higher than natural background levels due to the processing that will be undertaken to release them from the monazite ore, it is important that they are considered as a risk-factor in leachate and surface discharges from these facilities. Although water quality criteria are currently not available for many of the rare-earth elements, recent research in Germany has established an interim water			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	quality criterion for lanthanum of 4 µg/L to protect aquatic receptors (Herrmann et al., 2016). If it is assumed that a dilution-attenuation factor (DAF) of 10 would be required to protect nearby aquatic receptors in the hyporheic zone, a leachate concentration limit of 40 µg/L for lanthanum could be set to protect these receptors. Two samples of synthetic tailings materials that were tested for the ERD produced lanthanum concentrations that exceeded 40 µg/L, suggesting that this			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	rare-earth element is of potential environmental concern in leachate from TSFs at this site. i. Limited assessment of the chemical toxicity of uranium in leachate- There are currently no ANZECC water quality criteria for uranium for the protection of aquatic receptors, but Canada has set a concentration limit of 15 µg/L for this element to protect aquatic receptors from chemical (as distinct from radiological) impacts (Canadian Council of Ministers			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	of the Environment, 2011). If it is assumed that a DAF of 10 will be required to protect aquatic receptors in hyporheic zones, concentrations of uranium in leachate from TSFs should not exceed 150 µg/L to protect nearby hyporheic zones. Many of the samples subjected to leachate testing for the ERD exceeded this concentration, suggesting that uranium is an element of potential environmental concern in discharges from			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	TSFs at the Yangibana deposits. This is especially the case as uranium is highly mobile in groundwater with neutral to alkaline pH conditions and a high alkalinity due to the formation of highly stable and soluble ternary calcium-uranium-carbonate complexes (Vercouter et al., 2015). i. No assessment of leaching under a range of geochemical conditions – The leaching tests that have been undertaken to-date on rocks from the			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	Yangibana deposits are designed to assess the leaching potential of partially weathered wastes near the surface of a waste-rock or tailings landform that are exposed to rainfall. They are "single scenario" tests that do not consider the potential for chemical constituents to become mobilised if wastes are exposed to different geochemical conditions such as being covered by a soil profile after mine closure. Additional test procedures would			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	be required to assess the leaching potential of mine-wastes in other exposure scenarios such as the use of test procedures in the US EPA Leaching Environmental Assessment Framework (LEAF) suite of tests coupled with geochemical modelling using the ORCHESTRA model (US EPA, 2017). Additional testing that could also be considered are incubation tests for wastes with soil microorganisms from the area (e.g. Corbett et al., 2017).			

No.	EPA Services comment	Proponent response	EPA services comment on response - Feb 2019	Proponent response
	Such testing would not be required before mining took place at the Yangibana deposits but should occur during the life of the mines to provide information to ensure the wastes are properly managed on mine closure.			

Table 2 Response to Public Submissions

<table>
<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response to comment</th><th>EPA Services/Agency comment on response (Feb 2019)</th><th>Proponent Response</th></tr>
<tr><td colspan="4">Terrestrial Environmental Quality</td><td></td><td></td></tr>
<tr><td>1</td><td>Radiological Council</td><td>Address the discrepancy between the typical radon and thoron concentrations discussed in Section 9.3.1.3 and the data published by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

Section 9.3.1.3 states, “The existing radon and thoron concentration levels are consistent with levels from other regions of Australia. Typically, concentrations are</td><td>The observation regarding the reported ARPANSA levels is correct. However, it is noted that more recent published information by various mining companies indicates that radon concentrations in certain areas may be elevated compared to the reported ARPANSA concentrations.

The unpublished Baseline Radiation Report, prepared by Radiation Professionals (RadPro, 2016) for Hastings Technology Metals Limited in November 2016, provides details of radon concentration measurements from other mining operations in Australia (reproduced below; Table 2 in ERD Appendix 5-4).
<table>
<tr><td>Company – Operation, Reference (year published)</td><td>Radon Concentration (Bq.m^{-3})</td><td>Thoron Concentration (Bq.m^{-3})</td></tr>
<tr><td>Toro – Lake Way (on deposit), PER (2011)</td><td>38</td><td>n/a</td></tr>
<tr><td>Toro – Lake Way (regional), PER (2011)</td><td>21</td><td>n/a</td></tr>
</table></td><td></td><td></td></tr>
</table>

<table>
<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response to comment</th><th>EPA Services/Agency comment on response (Feb 2019)</th><th>Proponent Response</th></tr>
<tr><td></td><td></td><td>between 20 and 40 Bq/m3 for radon.”

This does not correlate with data published by the ARPANSA for radon concentrations in Australia. The data in that study reports a range of 3 - 24 Bq/m3, with an average of only 8 Bq/m3 for radon.”</td><td>
<table>
<tr><td>Vimy Resources – Mulga Rock , PER (2015)</td><td>25</td><td>n/a</td></tr>
<tr><td>Arafura Resources – Nolans Bore (on deposit), EIS (2015)</td><td>28.9</td><td>120.3</td></tr>
<tr><td>Arafura Resources – Nolans Bore (regional), EIS (2015)</td><td>43.7</td><td>470.2</td></tr>
</table>
It is noted that section 9.3.1.3 of the ERD should more correctly say, “The existing radon and thoron concentration levels are consistent with levels from other rare earth mining regions of Australia. Typically, concentrations are between 20 and 40 Bq/m^3 for radon.”</td><td></td><td></td></tr>
<tr><td>2</td><td>Radiological Council</td><td>Reporting has been provided for uranium and thorium in groundwater. Although this is useful, the minimum requirement is gross alpha, gross, beta (minus K-40), Ra-226 and Ra-228. Table 10 on page</td><td>Gross alpha, gross beta, Ra-226 and Ra-228 have been sampled from water collected at a number of bores.

The results are summarised in Tables below.

Initially Ra-226 and Ra-228 were collected at bores (FRW03, RC082, BHW05, YWRC075) associated with the fractured rocks in the resource:</td><td></td><td></td></tr>
</table>

<table>
<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response to comment</th><th>EPA Services/Agency comment on response (Feb 2019)</th><th>Proponent Response</th></tr>
<tr><td></td><td></td><td>43 of the Radiation Baseline Report (Appendix 5-4 to the ERD) does indicate that further analysis was conducted but this appears to be only for one sample for Ra-226, Ra-228 and Pb-210 and the laboratory analysis is not included in that report or in the monitoring and analysis results in Appendix 1 to that report.</td><td>
<table>
<tr><td>Sample descriptor</td><td></td><td></td><td>FRW03</td><td>RC082</td><td>BHW05</td><td>YWRC075</td></tr>
<tr><td>Sample date</td><td>LOR</td><td>UNITS</td><td>09/08/17</td><td>09/08/17</td><td>09/08/17</td><td>09/08/17</td></tr>
<tr><td>Radium 226</td><td>0.05</td><td>Bq/L</td><td><0.05</td><td><0.05</td><td><0.05</td><td><0.05</td></tr>
<tr><td>Radium 228</td><td>0.08</td><td>Bq/L</td><td><0.08</td><td><0.08</td><td><0.08</td><td><0.08</td></tr>
</table>
The following water samples from 2 bores within fractured rock aquifers (BHW05 and FRW03) in the resource and one from a palaeochannel tributary (SIPHON) were collected on the 25/02/18:</td><td></td><td></td></tr>
</table>

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response

Sample descriptor			SIPHON	BHW05	FRW03
Sample date	LOR	UNITS	25/02/18	25/02/18	25/02/18
Radium 226	0.2	Bq/L	<0.2	<0.2	<0.2
Radium 228	0.2	Bq/L	<0.2	<0.2	<0.2
U-238	0.001	Bq/L	<0.001	0.424	0.175
Th-232	0.001	Bq/L	<0.001	<0.001	<0.001
K-40	2	Bq/L	<2	<2	<2
Gross alpha	0.05	Bq/L	0.10	2.11	0.74

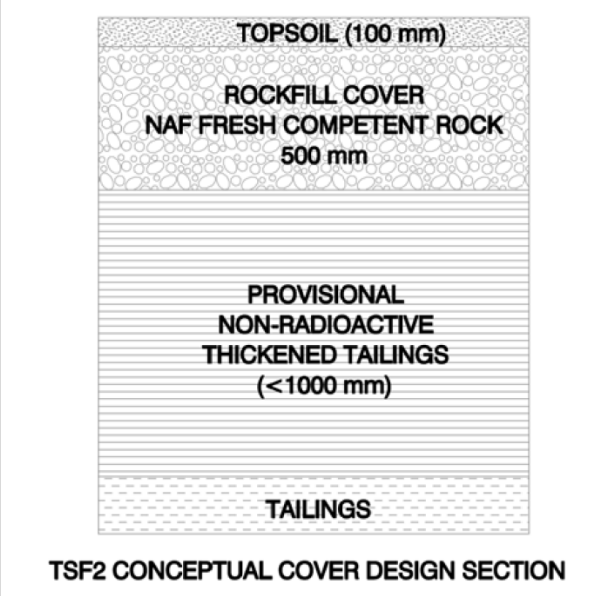
<table>
<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response to comment</th><th>EPA Services/Agency comment on response (Feb 2019)</th><th>Proponent Response</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Gross Beta</td><td>0.1</td><td>Bq/L</td><td>0.25</td><td>0.88</td><td><0.5</td></tr>
</table>
Regional pastoral bores (FR Well, Yangibana Bore) and a surface water pool at Fraser Creek (FR-POOL) have been tested for Ra-226 and Ra-228 on 4/4/18:
<table>
<tr><td>Sample descriptor</td><td></td><td></td><td>FR-POOL</td><td>Yangibana Bore</td><td>Frasers Well</td></tr>
<tr><td>Sample date</td><td>LOR</td><td>UNITS</td><td>04/04/18</td><td>04/04/18</td><td>04/04/18</td></tr>
<tr><td>Radium 226</td><td>0.05</td><td>Bq/L</td><td><0.05</td><td><0.05</td><td><0.05</td></tr>
<tr><td>Radium 228</td><td>0.08</td><td>Bq/L</td><td><0.08</td><td><0.08</td><td><0.08</td></tr>
</table>
And on 22/10/17 at regional pastoral bores (Edmund, Contessis and Redhill) and a surface water pool at Lyons River:
</td><td></td><td></td></tr>
</table>

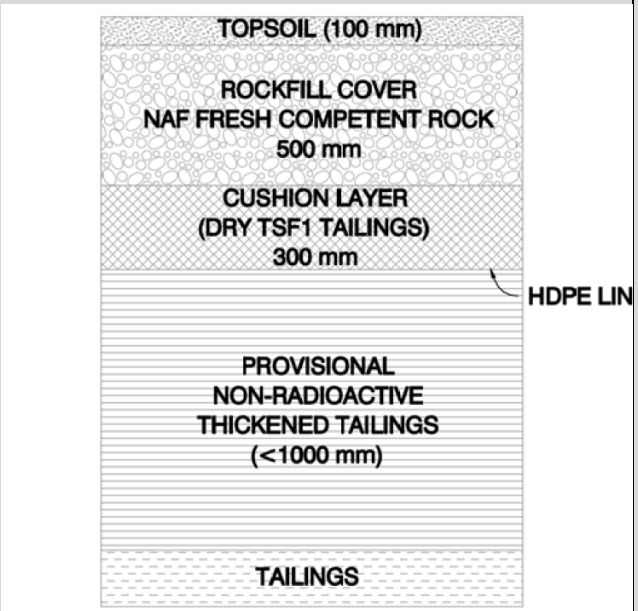
<table>
<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response to comment</th><th>EPA Services/Agency comment on response (Feb 2019)</th><th>Proponent Response</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Sample descriptor</td><td></td><td></td><td>Edmund Homestead</td><td>Contessis Bore</td><td>Redhill Bore</td><td>Lyons River Pool</td></tr>
<tr><td>Sample date</td><td>LOR</td><td>UNITS</td><td>22/10/17</td><td>22/10/17</td><td>22/10/17</td><td>22/10/17</td></tr>
<tr><td>Radium 226</td><td>0.05</td><td>Bq/L</td><td><0.05</td><td><0.05</td><td><0.05</td><td><0.05</td></tr>
<tr><td>Radium 228</td><td>0.08</td><td>Bq/L</td><td><0.08</td><td><0.08</td><td><0.08</td><td><0.08</td></tr>
</table>
The laboratory analysis reports are attached in Appendix 6.
</td><td></td><td></td></tr>
<tr><td>3</td><td>Radiological Council</td><td>Although process materials have been estimated to be in secular equilibrium, certain streams may need to be analysed on a once-off basis to establish that this is</td><td>Noted. As the company finalises the details of the flowsheet, additional information on the radionuclide deportment will become available and updated in future revisions of the Radiation Management Plan.</td><td></td><td></td></tr>
</table>

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		accurate, in particular, the total rare earth oxides (TREO) concentrate and flotation tailings.			
4	Radiological Council	Provide further information on dose rates. The conversion factors for the projected gamma dose rates used for Table 9-12 has been referenced in this section but the title has not been provided in the references to the document. The results appear to underestimate the gamma dose rates when using the conversion factors provided in the	There are a number of reported gamma dose factors for naturally occurring thorium in the literature. The reference in the ERD section is incorrect and should read "IAEA 2006a" which appears in the ERD references as "*Assessing the need for radiation protection measures in work involving minerals and raw materials. Safety Reports Series No. 49. International Atomic Energy Agency (IAEA), Vienna, November 2006*". In Appendix 3 of this document (IAEA 2006), a range of inferred gamma conversion factors for "small" quantities of materials and "large" quantities of materials range from approximately 4 to 20 µSv/Bq per %Th. The UNSCEAR gamma conversion factor for Th translates to approximately 17µSv/h per percent Th.		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000 Report, Annex B: Exposures from natural radiation sources.	Sonter and Carter (2015) report a gamma conversion factor of approximately 18µSv/hr per %Th. The figure used in the document was considered to be a reasonable estimate. Impacts of underestimation of thorium gamma conversion factor are not considered to be significant and are described as follows. If it is assumed that the gamma conversion factors are twice that reported in the ERD (Hastings, 2018), then the following changes may be expected: • Miner gamma doses increase from 0.9 to 1.8 mSv/y • Processing plant (beneficiation) 0.3 to 0.6 mSv/y • Processing plant (hydrometallurgy) 0.8 to 1.6 mSv/y		
5	Radiological Council	Address the following: • decontaminating surface contamination	Decontamination assumes that any removable radioactive surface contamination will be removed to a level less than 3,700Bq/m^2. In addition, that activity concentration is less than 1Bq/g. It is noted that this statement should have been explicitly made and will be incorporated in the next		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		in terms of Bq/cm^2 • Tailings Storage Facility (TSF) cover recommendations The subsection on rehabilitation (Section 9.6) states, *"where recycling or reuse of plant or equipment is feasible, items will be decontaminated to radiation levels less than 1 Bq/g before leaving site."* This is also repeated in the draft Radiation Management Plan (Appendix 5-8 to the ERD), but does not take surface contamination in	revision of the Radiation Management Plan (ERD Appendix 5-8; RSHS and Hastings, 2016). Note that section 9.6 of the ERD (Hastings, 2018) provides recommended cover layers, whereas the TSF design report (Figure 112391.12_012 in ERD Appendix 6-3; ATC Williams, 2018) includes:  TSF1 CONCEPTUAL COVER DESIGN SECTION		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		terms of Bq/cm^2 into account. The same subsection on rehabilitation discusses cover recommendations for TSF 1, TSF 2 and TSF 3 which references the document Tailings storage facilities closure: Radiological design considerations (Appendix 6-2 to the ERD). However, that document also states that *"it is prudent to build in a level of additional protection, rather than designing exactly to the requirement."* It is usual to include a minimum of 2 m	 TSF2 CONCEPTUAL COVER DESIGN SECTION		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		cover to also minimise the potential for intrusion.	 TSF3 CONCEPTUAL COVER DESIGN SECTION The tailings cover materials have been designed for the purpose of control of radiation emission and closure. The final cover sequence will be optimised taking account comments made by the Radiological Council.		
Inland Waters (was Hydrological Processes and Inland Waters Environmental Quality					

6	Department of Environment and Energy	The proponent should further explore whether there will be sufficient water available for mining operations and conduct a groundwater resource study. The primary impact of the project will be on groundwater resources, particularly the fractured rock aquifer. Depending on the amount of water available from this aquifer, additional impacts may occur to the Lyons River palaeochannel over and above those impacts currently predicted.	There are two types of aquifer from which water will be sourced: 1. Fractured rock aquifers associated with the ore body 2. Deep palaeochannel tributary aquifer i.e. SipHon Well borefield. Hastings largely agrees with the DoEEs comments regarding the fractured rock aquifers. Originally, 100% of Hastings water supply was intended to come from the fractured rock aquifers associated with the ore body. However, as the DoEE highlights, these aquifers are not a sustainable source of water (as per items i-vi of the DoEEs comments). Hastings reliance on the SipHon Well borefield aquifer will decrease with time because expected dewatering rates within each pit will increase with time to the point where most of Hastings water can be obtained from the pits. The pits will also collect rainfall runoff, which will provide a further water supply source for the project. Please note that water drawdown contours derived from modelling water abstraction from the fractured rock aquifers and the pit dewatering show that no impacts will occur to the Lyons River palaeochannel.	The proponent's response seems a little contradictory. Firstly, the response acknowledges that the fractured rock aquifers "are not a sustainable source of water" and so the reliance on the SipHon well borefield will decrease over time as "dewatering rates within each pit will increase" (noting this water is also from a fractured rock aquifer). a) From Appendix 4-2 Hydrogeological Assessment 11: Fractured Rock Aquifers (pg. 29), the maximum amount of water available from dewatering is 54.8L1s (Quarter 24) with an average across all quarters of 30ALls noting that 79.3L1s is stated to be required volume in the ERD. There is a another 11 quarters where dewatering rates	The comment relating to 'dewatering rates increasing with time' relates to each individual pit. In a general sense, for each pit the initial sump pumping rate is zero until the pit develops below the water table, and then if the pit progresses to depth in a linear manner, the sump pumping rate increases. In the case of the project, the pit developments are staggered, with pits coming online, pits finishing, pits developing at different rates with time etc. As a result, the total combined dewatering rates are not linear over the life of the project. Even though the individual sump pumping rate from each individual pit does increase with time. When the fractured rock bores are added to the total yield, this is even more apparent, as the bores are only operational during the

		The ERD states that up to 2.5GL/a of water (79.3L/sec) may be required - 2.1GL/a shown in water balance (page 2-14). The proponent states that "pit dewatering, including the two existing production bores, is expected to satisfy approximately 20% of this demand in the initial stage of the project, increasing to 90% towards the end of the mine life" (Environmental Review Document Pg. 2-14). The proponent has conducted dewatering assessments in the	As noted on page 6-15 of the ERD (Hastings 2018), the drawdown contours were derived from: *Modelling of groundwater drawdown of each deposit was undertaken using the MODFLOW 3D finite difference code PMWIN pre-processor. Sensitivity analyses were run to further understand the implications of varying hydraulic conductivities (K; GRM 2018a).* *Groundwater recharge was not included in the model given the low hydraulic conductivity of the fresh bedrock and the short project life. This is a conservative approach with respect to drawdown impacts, which will be reduced under recharge conditions (GRM 2018a).* Further information on the modelling is provided in the Stage I assessment of the fractured rock aquifers (GRM, 2017). This report was appended to the referral document, however Stage II was the updated report (Appendix 4-2 of the ERD, GRM 2018a). The modelling methodology had not been detailed in the Stage II report. Hastings has appended the Stage I assessment to this document (Appendix 8) and further detail on the modelling is provided in Section 6 of the report.	will decrease after the peak of 54.8L1s so the dewatering rates are not increasing per se. To express this another way, there is a shortfall of O.8GL (assuming annual water requirements) at the modelled peak dewatering rate noting that this likely to be an over-estimate - see point 2 - and the deficit will be greater across all the other quarters. b) It is unlikely that "rainfall runoff ... will provide a further water supply source for the project". Using the Bald Hill Pit as an example: Approximate area 1100m x 550m. Average rainfall O.24m/yr; average evaporation 3A75m/yr. This gives volumes respectively of 145MLlyr and 21 02MLlyr resulting in a deficit of 1957MLlyr. Given that the rainfall	initial stages of the project. Consequently, while the inflow rates to each pit increase with the depth of the pit, the overall abstraction rate from the fractured rock resource over the life of the project is not a linear increase. The site wide water balance captures the sequencing of these dynamic water supply sources, to determine the requirement from the SipHon Well Borefield over the life of the project. The limitation of fractured rock aquifers (in terms of sustainability as a water supply) is a risk that has been considered. The dewatering estimates and bore yield estimates are based on test data and an assortment of analytical techniques. A greater understanding of the sustainability of the supply will develop as the project

		area of the three proposed pits. This involved 3 stages: air lift of exploration bores; hydraulic testing of the exploration bores and pump testing of production bores. The Department agrees with the proponent that airlift associated with RC drilling underestimates likely production rates. However, the results from the other two methods also indicate highly variable results and this raises questions as to whether water demands can be met.		will be collected in sumps, and hence subject to evaporation, it is difficult to envisage that the collected rainfall will provide any meaningful additional water supply.	progresses. Until such time, the estimates are based on available data, known regional conditions and assumptions based on experience with other similar projects. Regarding the comment 'it is difficult to envisage that the collected rainfall will provide meaningful additional water supply', the values provided above are annual averages. It is agreed that surplus surface water will not provide an additional water source all year round within the pits as evaporation exceeds rainfall by more than an order of magnitude. However, there may be excess water collecting in the pits, which can be used as a water supply, immediately following short term high rainfall events. In addition, the catchment to the pit may be higher than the pit footprint (i.e. if

		i. Using the Bald Hill hydraulic testing data as an example, final airlift rates vary between 0.14 - 3.9L/sec (Appendix 4-2 Page 13) – significantly less than the 79.3L/sec required. ii. Across the mining area 12 bores were hydraulically tested. The cumulative final airlift rate was approximately 28L/sec (Appendix 4-2 Page 13) – again, less than the 79.3L/sec required. iii. The three production bores FRW03,			rainfall runoff from surrounding waste dumps and roads is diverted to the pits), which will increase the volume of water reporting to the pits following high rainfall events. Collected rainfall will not form a reliable water source, but may provide a small opportunistic short term supplementary supply.

		BHW05 (48-hour constant rate and recovery test and YWWB01 (96 hour) produced 8, 16 and 2.2L/sec respectively – noted in Table 8 (Appendix 4-2 Page 19) as 48 hour pumping rates. Another bore – YGWB03 is also listed in this table but no details are provided. iv. Table 8 indicates the maximum drawdown after 48 hours presumably at the nearby monitoring bores. The water column in these bores		Appendix 8 DFS Study - Stage 1 Hydrogeological Assessment Yangibana Rare Earths Project (Section 6.3 Pg. 26) states that "all lateral boundaries were designated as constant head boundaries". The location of these model boundaries are not presented in this report, however, figures 8-10 do show the model simulated drawdown contours. The 'straight contour lines' shown in these figures (e.g. Figure 8 NE and SE sides) were originally interpreted by OWS (see figure 7) as the edge (surface expression) of the ironstone dykes (fractured rock aquifer), however, it would appear that these actually represent a constant head boundary. This means that the groundwater drawdown in these areas cannot go below the set constant head. Given the proximity of these	The lateral boundaries in the models were set to about 5 km from the proposed pits (as described in Section 6.1 of the report), not immediately adjacent the pits as suggested in the above comment. The 'straight contour lines' are not representing constant head boundaries; they represent the interpreted geological and hydrogeological conditions. The ironstone dykes (which have higher permeability) are steeply dipping, whilst the intact bedrock has very low permeability. The modelled drawdown propagates along the dyke, and to a lesser extent out into the hanging wall of the intact bedrock (i.e. on the down dip side). The 'straight contour lines' occur on the footwall side of the dyke, because drawdown is

		(distance from static water level to the base of the bores is 76.2m, 79.5m and 112.86m respectively. The distance from the production to the monitoring bores is 6.0, 7.4m and 7.72m respectively and the v. observed drawdowns in these bores are 4.5, 10.8 and 34.15m respectively. This represents a loss of approximately 5%, 13% and 30% respectively of the water		boundaries to the pits, they are likely to be influencing the modelling results, potentially maintaining more groundwater in the system that what is actually available within the aquifer. If so, then the modelled dewatering rates are overestimating the amount of groundwater that is actually available and as such increases the deficit between water supply and water requirements.	thwarted by the low permeability intact bedrock. To use Figure 9 of the report (Bald Hill) as an example: • The model boundaries (constant head boundaries) are 5 km from the pit. • The ironstone dyke extends essentially north south and dips to the west. • The modelled drawdown propagates north and south, along the dyke. • It also propagates to the west, into the hanging wall of the intact country rock, due to the underlying dipping ironstone. • Yet there is very little drawdown in the low permeability intact country rock to the east, as the

		column, noting it would be greater in the production bores themselves, in a 48 hour time period. This calls into question the long-term ability of the fractured rock aquifer (via dewatering) to produce the volumes of water required. vi. v. A 48 hour pump test is also too short to assess the long term yield of a fractured rock aquifer. The Department's concern is further evidenced by the comments in Table			ironstone dips away in the other direction.

		9 (Appendix 4-2, page 20) which states that for FRW03 and BHW05 a boundary condition was met at 1000 minutes and for YWWB01 drawdown was “semi stabilised”. For the first two bores this means that the area from which water can be drawn from is reduced and for the third bore groundwater levels were still going down at the end of the test. These barriers are clearly indicated in Figures 5-8 (Page 5-34) and Figure 6-5 (Page 6-15) in the ERD. The flat edge indicates the barrier and as		The proponent notes "groundwater recharge was not included in the model" and that this is "a conservative approach" and that "with respect to drawdown impacts .... will be reduced under recharge conditions". However, from Appendix 4-2 Hydrogeological Assessment 11: Fractured Rock Aquifers (section 3.4 Pgs. 24-25) the Tritium results indicate that modern recharge (less than 60 years) is not occurring. It is stated that the "only sample to record measurable Tritium .... was the sample collected from FRW03 at the commencement of test pumping". The late sample from FRW03 "did not report measurable Tritium, nor did any of the samples collected from BHW05 and YGW03". As a result not incorporating recharge into the model is	The tritium results suggest that the groundwater in the vicinity of the bores is older than 60 years. However that doesn’t indicate there is no recharge to the entire groundwater system, just that the fractured rock aquifer isn’t readily recharged in close proximity to the bores. There will be some degree of rainfall recharge within the wider groundwater environment. Rainfall runoff will likely percolate through alluvial gravels, and gradually make its way into the underlying fractured bedrock. The tritium results suggest that this process takes longer than 60 years to reach the aquifers intercepted by the bores. Once groundwater abstraction from the bores commences, and a drawdown cone develops,

		noted on Page 6-18 "the pump testing data indicated barrier boundary conditions at both the Fraser's and Bald Hill bores indicative of limited storage". i. It is not clear from the documentation how these drawdown contours were developed. ii. Further on Page 26 (Appendix 4-2) "… and low yields at Yangibana North and Yangibana West,		actually a realistic rather than a conservative approach and as a consequence, during the life of the mine, no recharge will occur to reduce the impacts of groundwater drawdown.	gradients will steepen and groundwater will be drawn to the bores at a greater rate than would otherwise occur under natural circumstances. It is likely that younger groundwater is drawn into the bores with time. The recharge rates are not rapid, but the tritium results do not indicate that there is no recharge. The modelling was run without recharge to maintain a level of conservatism. However whether the modelling is conservative or realistic, in terms of recharge, will only be known by assessing ongoing monitoring data (bore yields and surrounding groundwater levels) once the project is operational.

		indicate limited storage. The limited recharge to the fractured rock aquifer and possible storage limitations indicate that bore yields and dewatering bores may diminish during the life of the project". iii. As noted above dewatering is to provide 90% [of water requirements] towards			

		the end of the mine life. The above discussion is important as it will place greater demands on the SipHon Well Borefield (located in a palaeochannel) and may require additional requests for water from the Gifford Creek Calcrete Aquifer "which provide habitat to a stygofauna community of the Gifford Creek Priority Ecological Community)(ERD Page 6-2).			

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
7	Department of Environment and Energy	Provide a map showing all the bore locations.	Refer to Figure 6-9 in the ERD (Hastings, 2018).		
8	Department of Environment and Energy	Impacts on surface water are likely to be small and primarily related to placement of mine infrastructure. The proponent should indicate how this will be minimised through correct placement and appropriate construction. Figure 6-3 (ERD, page 6-10) shows the results for flood mapping for a 100 year annual return interval rainfall	Hastings agrees that impacts on surface water will be minimal. Specifically, linear infrastructure is designed to ensure water flow is not obstructed and all significant drainage crossings will require a Bed and Banks Permit from DWER. The Permit application takes account of water flow and ensuring the bed and banks of the river are not compromised by road crossings. Please refer to Appendix 9 for the Draft Surface Water Management Plan.		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		event which indicates flood waters are restricted to the drainage lines. The majority of the infrastructure will be placed outside these drainage lines and appropriate construction of road crossings should result in minimal disruption to water flow in these drainage lines. i. It is noted however in Figure 3 Hydrology Assessment that some mining infrastructure is			

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		located in the Fraser creek catchment directly across one of the modelled tributaries. From Figure 6-3 it appears that flood levels will reach 1-2m in this tributary which would likely impact on this infrastructure and result in changes to flow characterist			

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		ics. This may impact on any riparian vegetation downstream of this infrastructure. ii. The Surface Water Management Plan is yet to be developed. (ERD Page 6-40). It would be useful if this plan could be provided for assessment.			

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
Human Health					
9	Department of Health (DoH)	Address the public health considerations that were provided to the proponent in correspondence dated 7 December 2017. These considerations were not addressed in Section 9 of the ERD.	These considerations were addressed directly to the DoH. Refer to Appendix 10 for correspondence to DoH.		
Social Surroundings					
10	Department of Planning, Lands and Heritage	It is noted that five Aboriginal heritage places within the proposed development envelope to which the *Aboriginal Heritage Act 1972* (AHA) may apply. An assessment as	Hastings notes this comment and agrees with the Department of Planning, Lands and Heritage.		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		to whether the AHA applies to these locations has not yet been undertaken. The proponent state it has and will continue to conduct consultation and appropriate heritage surveys with the native title claimants Thin-Mah Warianga, Tharrikari, Jiwarli people. Based on the figures provided by the proponent, ethnographic and cultural heritage surveys have been conducted covering a majority of the operational			

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		physical elements of the proposed development envelope and indicative disturbance footprint. The proponent states that no impacts to known areas of heritage significance will occur as a result of implementation of the proposal. If future surveys identify Aboriginal heritage sites within the disturbance footprint then the proponent will avoid the impact where possible. Where Aboriginal heritage is not able			

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		to be avoided applications will be made under section 18 of the AHA. The DPLH considers that potential impacts to Aboriginal sites are able to be managed through the processes as outlined in the AHA.			
11	Department of Planning, Lands and Heritage	The Cultural Heritage Management Plan and heritage agreement should be provided.	The Cultural Heritage Management Plan is provided in Appendix 7. The Native Title Agreement is a confidential, legally binding document that cannot be released beyond Hastings and the Native Title claimants.		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
12	Department of Environment and Energy	Address the potential impacts to the cultural heritage significance of the watercourses from aquifer contamination. Measures to address potential watercourse and aquifer contamination are proposed in Section 6.6 of the ERD, including water management planning, a groundwater operating strategy, radiation waste strategy and monitoring (surface and groundwater) as well as planning for Mine Closure.	The Cultural Heritage Management Plan (Appendix 7) acknowledges the importance of the cultural heritage significance of the watercourses and potential impacts on the traditional uses and practices associated with water in this landscape.	It is noted that the Yangibana Cultural Heritage Management Plan (YCHMP) (Appendix 7) includes a section at 3.23 titled 'River and Creek Values'. It states that the 'Riparian ecosystems have significant heritage values'. It appears the YCHMP does not specifically address the comments made about water at item 12. For instance, the proponent should expand on the traditional uses and practises associated with water (if culturally appropriate), the impacts of the proposal (if any) on these practises and any related mitigation measures. The response should note that revised content in the YCHMP will over-ride what will otherwise be inconsistent information in section 6.4 of	Section 3.2.3 of the Cultural Heritage Management Plan has been expanded to include further information on the values of the rivers and creeks, and potential impacts. Mitigation actions have already been addressed in the previous revision of this section. The YCHMP will remain as a draft until the Implementation Committee have reviewed the document. These comments will be shared with the Implementation Committee for their consideration.

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		Section 6.4 Potential impacts should acknowledge the cultural heritage significance of the watercourses and potential impacts on the traditional uses and practices associated with water in this landscape.		the Environmental Review Document.	
13	Department of Environment and Energy	To address community concerns regarding the potential for indirect impacts on heritage values from recreation use of the Lyons River provide detail on induction training for mine employees.	The Environmental Induction for the minor or preliminary works currently being undertaken at site is attached as Appendix 11 as evidence of induction training in place. This will remain in place until the Implementation Committee (as per the Native Title Agreement) determines how best to implement the induction program and level of detail in this program. This is yet to be developed by the Implementation	The Environmental Induction for the minor or preliminary works at Appendix 11 includes a page on 'Aboriginal Heritage' and an Induction Program that has yet to be developed by the Implementation Committee. The Induction Program will need to cover all the points raised in item 13 such as respecting heritage sites,	Hastings notes this feedback and will raise these comments with the Implementation Committee.

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		The Traditional owners/custodians have requested induction training for mine employees. Little detail is provided about this program (except a presentation about the cultural values) and it is the Department's expectation that this program should be co-designed and delivered with the Indigenous community. The program should address awareness and education about the legal and agreed project	Committee. Hastings will raise the DoEE's comments with the Implementation Committee.	staying away from the Thalaankaya corroboree site, avoiding recreational activity and impacts on rivers and creeks.	

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		operational/management requirements to protect heritage as well as ensuring employees respecting these heritage sites, including by avoiding recreational activity and impacts along the rivers and creeks and particularly staying away from the *Thalaankaya* corroboree site (which while outside of the development footprint is within walking distance of the proposed mine accommodation facilities).			

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
14	Department of Environment and Energy	Note that Section 11.3.1 makes statements about 'Commonwealth Heritage Places' however the places referenced are not listed Commonwealth heritage places under the EPBC Act but rather places listed on the former register of the National Estate. While relevant to the referral, they are not a 'matter protected' under the EPBC Act (except where they fall within a place included in the EPBC National Heritage List - s.15B or on Commonwealth	Noted and thank you for making this correction.		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		land - s.26). This register ceased to be a statutory heritage list as of 2012, although it continues to be used as an inventory of Australian heritage places that were registered between 1976 and 2007, and information source for owners and managers.			
15	Department of Environment and Energy	Discussion required on the impacts of the proposal on the communities in terms of social or economic impacts or benefits. Include, but do not limit to: How many jobs will be created during construction and	The Project will create up to 350 jobs during construction and 240 jobs during operations. Hastings aims to have 10% FTE for Aboriginal people and has achieved 14% during the minor or preliminary works program. Hastings is providing a financial contribution towards an indigenous development program. The local community are represented by pastoralists', however the regional community will benefit economically from fuel supply, food supply, employment and provision of other goods and services to the Project. The Project	Hasting's response should be amended to acknowledge that the local community is not only represented by pastoralists. The local community is wider, and includes Indigenous people with connections to country.	Hastings acknowledges that the local community does include the indigenous people with connections to country.

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		for ongoing operation? Are any opportunities being offered for indigenous development programs? How is the proposal likely to impact the local community in terms of economic benefits? Are there likely to be any social issues resulting from a fly-in-fly-out community vs local employees?	aims to employ local people where possible. There will likely be FIFO via Perth, as well as Carnarvon to facilitate local employment opportunities. Hastings is working with the Gascoyne Development Commission to maximise the benefits to the local communities.		
consultation					
16	Department of Health	Consultation regarding public health considerations were not reflected in the Stakeholder Consultation	Hastings apologises that these records were not captured in Section 3.3 of the ERD. The correspondence, which also summarises consultation with the department is in Appendix 10.		

No.	Submitter	Submission and/or issue	Response to comment	EPA Services/Agency comment on response (Feb 2019)	Proponent Response
		(Section 3.3) of the ERD.			

3. REFERENCES

ATC Williams, 2018. *Tailings Storage Facility Design Report*. Rev 0. Unpublished report for Hastings Technology Metals Limited, August 2018.

Canadian Council of Ministers of the Environment, 2011. *Canadian Water Quality Guidelines for the Protection of Aquatic Life: Uranium*.

Corbett, M.K., Eksteen, J.J., Niu, X-Z., Croue, J-P. and Watkin, E.L., 2017. Interaction of phosphate solubilising microorganisms with natural rare-earth phosphate minerals: a study utilising Western Australian monazite. *Bioprocess and Biosystems Engineering*, 40, 929-942.

Ecoscape Australia, 2015. *Yangibana Project Biological Assessment: Flora and Vegetation*, unpublished report prepared for Hastings Technology Metals Limited, December 2015.

Ecological Australia, 2018. *Yangibana Rare Earths Project Flora and Fauna Survey*, version 3, unpublished report prepared for Hastings Technology Metals Limited, 31 January 2018.

Elliott, H.A., Wall, F., Chakhmouradian, A.R., Siegfried, P.R., Dahlgren, S., Weatherley, S., Finch A.A., Marks, M.A., Dowman, E. and Deady, E., 2018. Fenites associated with carbonatite complexes: A review. *Ore Geology Reviews*, 93, 38-59.

EPA, 2016. *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*. Government of Western Australia, Environmental Protection Authority (EPA), December, 2016.

Gad, G.M., 2007. Geomycology: biogeochemical transformations of rocks, minerals, metals and radionuclides by fungi, bioweathering and bioremediation. *Mycological Research*, 111, 3-49.

Groundwater Resource Management (GRM), 2017. *Stage I Fractured Rock Hydrogeological Assessment.* Unpublished report for Hastings Technology Metals Limited, February 2017.

Groundwater Resource Management (GRM), 2018a. *Stage II Fractured Rock Hydrogeological Assessment.* Unpublished report for Hastings Technology Metals Limited, April 2018.

Groundwater Resource Management (GRM), 2018b. *Stage II Palaeochannel Hydrogeological Assessment.* Unpublished report for Hastings Technology Metals Limited, June 2018.

Halse, S., and Pearson, G., 2014. Troglofauna in the vadose zone: comparison of scraping and trapping results and sampling adequacy. *Subterranean Biology* 13, 17-34.

Hastings Technology Metals Limited (Hastings), 2018. *Yangibana Rare Earths Project Environmental Review Document*, Rev 4. Advertised 1-28 October, 2018.

Herrmann, H., Nolde, J., Berger, S. and Heise, S., 2016. Aquatic ecotoxicity of lanthanum – a review and an attempt to derive water and sediment quality criteria. *Ecotoxicology and Environmental Safety*, 124, 213-238.

MEND, 2004. Review of Water Quality Issues in Neutral pH Drainage: Examples and Emerging Priorities for the Mining Industry in Canada. MEND Report No 10.1

Pirajno, F., Gonzalez-Alvarez, I., Chen, W., Kyser, K.T., Simonetti, Leduc, E. and Le Gras, M., 2014. The Gifford Creek Ferrocarbonatite Complex, Gascoyne Province, Western Australia: Associated fenitic alteration and a putative link with the ~1075 Ma Warakurna LIP. *Lithos*, 202-203, 100-119.

RadPro, 2016. *Baseline Radiation Report*, unpublished report prepared by Radiation Professionals (RadPro) for Hastings Technology Metals Limited, November 2016.

RSHS and Hastings, 2016. *Radiation Management Plan*. Rev 0, 15th December 2016.

Sonter and Carter, 2015. A Gamma Literature Survey, *Radiation Protection in Australasia - Journal and Newsletter of the Australasian Radiation Protection Society*, 32, 1, pp4-9.

Trajectory, 2017. *Yangibana Rare Earths Project Landform Evolution Study*, unpublished report prepared for Hastings Technology Metals Limited, August 2017.

Trajectory and Graeme Campbell and Associates, 2016. *Yangibana Rare Earths Project Waste Rock and Preliminary Tailings Characterisation Report*, unpublished report prepared for Hastings Technology Metals Limited, December 2016.

Trajectory and Graeme Campbell and Associates, 2017. *Yangibana Rare Earths Project Tailings Characterisation Report*, unpublished report prepared for Hastings Technology Metals Limited, December 2017.

Trajectory and Graeme Campbell and Associates, 2018. *Yangibana Rare Earths Project Tailings Leach Study Report*, unpublished report prepared for Hastings Technology Metals Limited, June 2018.

US EPA, 2012. *Rare Earth Elements: A Review of Production, Processing, Recycling and Associated Environmental Issues*. US EPA Report EPA 600/R-12/572.

US EPA, 2017. *Leaching Environmental Assessment Framework (LEAF) How-to Guide: Understanding the LEAF Approach and How and When to Use It.*

Verouter, T., Reiller, P.E., Ansoborlo, E., Février, L., Gilbin, R., Lomenech, C. and Philippini, V., 2015. A modelling exercise on the importance of ternary alkaline earth carbonate species of uranium (VI) in the inorganic speciation of natural waters. *Applied Geochemistry*, 55, 192-198.

Verplanck, P.L., Van Gosen, B.S.,Seal, R.R. and McCafferty, A.E., 2014. *A deposit model for carbonantite and peralkaline intrusion-related rare earth element deposits*. U.S. Geological Survey Scientific Investigations Report 2010-5070-J.