Memorandum

To	Tania Liaghati, Manager EIA North, EPA Services.	CC	Dr Robert Hughes, Director EPA Services.
From	Julie Mahony, Manager- Environmental Approvals	Date	18 January 2023
Subject	*Minuria Tridens* MS1175 Research Strategy and EPBC 2018/8236 Offset Strategy		

BCI Minerals (BCI), with input from Phoenix Environmental Sciences has developed this research strategy to build a knowledge base and inform the potential for re-establishment of a population of *Minuria tridens (M. tridens) in the region.* This Strategy includes propagation/translocation trials for *Minuria tridens* at the Mardie Project (the Project). This Strategy is intended to meet the requirements of:

- Ministerial Statement No 1175 (MS1175) condition 5-3(2)(b), and
- EPBC 2018/8236 condition 25.b.iii.

1. INTRODUCTION

Mardie Minerals Pty Ltd (a wholly-owned subsidiary of BCI) is developing the Project, located approximately 80 km southwest of Karratha, Western Australia (WA). Populations of *M. tridens* have been recorded at the Project (Phoenix 2019a, 2021). The species is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Priority 1 flora at the State level.

It has been determined that avoidance of impacts to some plants of *M. tridens* at the Project is unavoidable (Figure 1). hence a Research Strategy was developed by Phoenix Environmental Services in accordance with MS1175 condition 5-3(2)(b) which states:

> "where individuals of *Minuria tridens* are identified during pre-clearance surveys and cannot be avoided, development of a research strategy to inform the potential for re-establishment of a population of *Minuria tridens* in the region."

The Research Strategy dated 18 August 2022 was approved by EPA Services on 20 September 2022 (Attachment 1) on the condition that the Strategy be revised to include a second regional survey.

In addition to the requirements of MS1175, any impact to recorded plants/populations of *M. tridens* are subject to condition 25 of EPBC 2018/8236, copied below. This version of the Strategy has been revised to fulfil the purpose of offset strategy to fulfil EPBC 2018/8236 condition 25.b.iii.:

25. To minimise **impacts** on **EBPC Act** listed ***Minuria tridens***, the proponent must:

    a. Comply with conditions 5-1(2) to 5-4 of **WA Approval**. Reporting in condition 5-3(2) of the **WA Approval** must also be provided to the **Department** for review and the **Minister's** approval.

b. If any ***Minuria tridens*** individuals or populations are found within the **development envelope** during the pre-clearance surveys required in condition 5-2 of the **WA Approval**, the proponent must do the following:

   i. Avoid the individual or population, if practicable.

   ii. If avoidance is not practicable then liaise with the **Department** to seek the possibly of translocating the individual(s) or populations(s).

   iii. If avoidance and translocation is not possible, then the approval holder must, prior to **impact** on the ***Minuria tridens*** individual or population, submit an Offset Strategy specifying how the **impact** will be offset in accordance with the **Environmental Offsets Policy**. If the Offset Strategy has not been approved by the **Minister** in writing within 9 months of the **impact**, and the **Minister** notifies the approval holder that the Offset Strategy is not suitable for approval, the **Minister** may, at least two months after so notifying the approval holder, approve a version of the Offset Strategy revised by the **Department**. The approval holder must implement the approved Offset Strategy for the remainder of the **life of the project**.

c. Complying with condition 12-1 of the **WA Approval** to monitor and manage **weed infestation**, feral rabbits, and indirect **impacts** of changes to groundwater and surface hydrology to the ***Minuria tridens*** individuals and populations identified in *Phoenix – Detailed Flora and vegetation survey for the Mardie project* (June 2020) and any ***Minuria tridens*** found during the pre-clearance surveys. This monitoring must be undertaken yearly for the **life of the project** or until suitable **evidence** is presented to the **Minster** who confirms in writing that ongoing monitoring is no longer required.

d. If any changes are recorded to ***Minuria tridens*** individuals and/or populations during this monitoring, the approval holder must contact the **Minister** within 6 months of known changes with a report that details further mitigation measures and management actions that will be implemented to mitigate the possible **impacts** to the ***Minuria tridens*** individuals and populations.

e. If the report identifies that mitigation and management actions are not possible, then condition 25(b)(iii) must be followed.

This document outlines the initial approach and methods for the development of the Strategy. It has been informed by the National Recovery Plan for *Olearia macdonnellensis*, *Minuria tridens* (Minnie Daisy) and *Actinotus schwarzii* (Desert Flannel-flower) (Nano and Pavey 2008).

In the event that regional surveys fail to find additional populations of the species, a Translocation Plan, informed by research trials and surveys will be developed and submitted to the CEO as per Table 3 of this Strategy.

2. THREATS

There is limited information available on the West Australian populations of *M. tridens* therefore it is difficult to predict threats to the species.

Based on information available on the Northern Territory populations, it is reasonable to assume that the Mardie populations may be threatened by:

Exotic grass invasion

M. tridens is threatened by the invasion of the exotic perennial grass *Cenchrus ciliaris* (buffel grass) into core habitat areas. The Alice Springs Municipality sites are most severely affected (Kerrigan & Albrecht 2006a).

Mesquite (*Prosopis pallida*) Mardie Minerals aims to limit the spread of introduced weed species via the implementation of the Mesquite Management Plan required by condition 13 (a-e) of EPBC 2018/8236.

Fire

While this species has some resprouting capacity, its overall fire response is poorly known.

Mardie Minerals intends to engage a third party to test germination stimulants including fire/ smoke on collected seeds. Cleaning and treatment steps will follow methods outlined in Erickson et al. (2016) and (2017).

Low inter-population gene exchange

There is little information on the population genetics of *M. tridens*, but given their fragmented distribution, it is possible that in each case there is little genetic exchange among populations and a high level of inbreeding within.

Mardie Minerals intends to engage a third party to assess genetic diversity within the Mardie populations.

Low seed set

Preliminary assessment indicates that seed set in *M. tridens* is poor and highly variable (Kerrigan & Albrecht 2006a). The species is patchily distributed and a restriction on the movement of pollinators among populations may constrain viable seed production. Alternatively, seed set in *M. tridens* may be resource (i.e. nutrient) limited given that it occupies extremely high pH soils.

A literature search will be conducted to determine reproduction characteristics of *M. tridens.*

Predators

Other species of *Minuria* are known to be palatable to macropods, stock (Urban 1990; Department of Sustainability and Environment 2004) and caterpillars (Haase 1986).

Annual monitoring will inform whether Mardie populations are targeted by predators.

3. RECOVERY PLAN OBJECTIVES & PERFORMANCE CRITERIA

Table 1 below outlines how Mardie Minerals' actions align with the National Recovery Plan Objectives and Performance Criteria.

Table 1:Relationship between National Recovery Plan Objectives, Performance Criteria and Actions

Specific Objectives	Performance Criteria	Actions
1. Quantify distribution, abundance and population dynamics using long-term monitoring surveys.	The distribution limits and dynamics of populations are understood.	1. Mardie Minerals commit to carrying out two targeted regional surveys to map the extent of suitable habitat and possibly identify additional populations within the region.
2. Maintain or enhance habitat quality and extent.	Habitat quality and extent is maintained or enhanced.	1. Mardie Minerals commit to carrying out two targeted regional surveys to map the extent of suitable habitat and possibly identify additional populations within the region. 2. Population and habitat monitoring at selected sites in the Disturbance Envelope will be completed as per Condition 12-1(4) of Ministerial Statement No. 1175. 3. Management strategies for key threatening processes identified during the literature reviews for developing the Mesquite Management Plan and Construction Environmental Management Plan.
3. Understand critical ecological attributes including the fire response, life history characteristics, and reproductive and seed biology.	Adequate knowledge of the influence of fire and other ecological processes on the persistence of the species is available.	4. In the event that regional surveys do not find additional populations, Mardie Minerals will collaborate with a third party expert to apply for a grant to allow research on fire ecology, reproductive biology, and seed storage potential undertaken as part of the Translocation Plan. 5. Plants inside the Development Envelope will be monitored annually for the life of the Project, providing data on their biology. 6. Seed/plant material may be harvested to support investigations into reproduction.
4. Implement ex-situ conservation measures that ensure representative sampling of each species' genetic diversity.	Ex-situ seed collections are sourced from widely dispersed subpopulations.	7. Mardie Minerals will collect seeds from disturbed specimens from within the Disturbance Envelope. Seed will be provided to a third party (eg consultant or DBCA) for genetic testing.
5. Define management units for widely spaced populations.	The genetic structure of populations is understood.	8. As part of the research outlined in Action #4, Mardie Minerals will engage a specialist third party with the capability to determine genetic differentiation of individual populations identified in the Mardie and regional surveys. Research will also include conducting a taxonomic determination against the type specimen. These actions will inform definition of management units for the National Recovery Plan.
6. Incorporate traditional ecological knowledge and management practice into the recovery process	Management of the species is informed by traditional ecological knowledge	9. Traditional owners will be invited to participate surveys/ studies and contribute knowledge which could be incorporated into trials.
7. Inform and involve the community and all stakeholders in the recovery process.	Community and stakeholder-based networks are maintained and enhanced.	10. Survey, research and studies will be available to stakeholders via the annual compliance assessment report for MS1175 and the annual compliance report required by EPBC 2018/8236. Reports will be published on the company website.

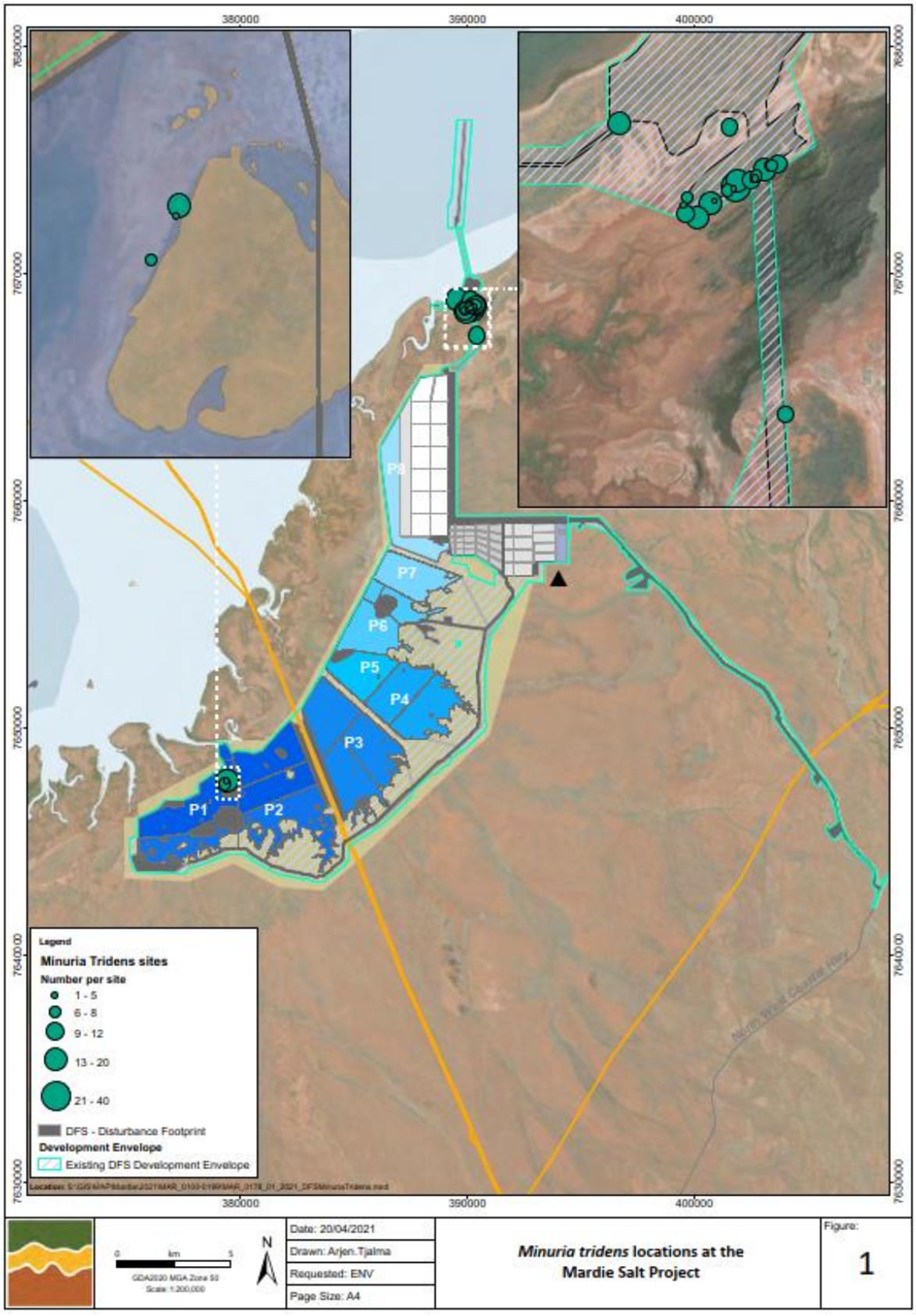

Figure 1 ***Minuria tridens*** **locations at the Mardie Salt Project**

4. METHODS

4.1 Status and description of *Minuria tridens*

Documents and databases describing population numbers and location records for *M. tridens* (**Table 2**) will be reviewed to provide a description of the current status and distribution of the species.

4.2 Identification of suitable habitat for *Minuria tridens*

M. tridens records from the surveys at the Project will be reviewed to determine known habitat for the species. Aerial imagery, topographical mapping and Phoenix's spatial database will be interrogated to identify potential suitable habitat outside of the Project development envelope.

A survey strategy will then be devised to search for suitable habitat/translocation sites for *M. tridens* outside of the development envelope. The survey strategy will be provided to the Department of Biodiversity, Conservation and Attractions (DBCA) for consultation on potential further research into the habitat for *Minuria tridens.*

4.3 Regional searches for *Minuria tridens*

Following consultation with DBCA and potential further research into suitable habitat for *Minuria tridens*, regional surveys targeting identified suitable habitat will be conducted. If other vegetation surveys have been conducted in the region (e.g. by other proponents/operators), Mardie Minerals will seek opportunities to share spatial data to ensure relevant habitats are surveyed.

The surveys will be conducted during the optimal season to search for the species to be defined in consultation with DBCA and informed by learnings from Phoenix's pre-clearance surveys at Mardie during which M. tridens was recorded. The results of the survey will be provided in a brief report that provides:

- Introduction/background of surveys including outline of consultation process with DBCA
- Detailed survey methods
- Survey outcomes, including:
    - Representative specimens from any populations located
    - Maps and spatial data of all populations located
    - Description of habitat for each population
    - Plant counts for each population
    - A record of the phenological state of plants at each population

4.4 Determination of reproduction characteristics and phenological cycle of *M. tridens*

A literature search will be conducted to determine reproduction characteristics of *M. tridens.*

Phoenix data will also be interrogated to determine the indicative phenological cycle of *M. tridens*, based on observations from several field surveys. This data will be used to devise a monitoring plan to record flower and seed set.

4.5 Translocation and propagation trials

A translocation trial will be developed utilising information provided in the guidelines for translocation of Threatened flora (Commander *et al.* 2018). It is proposed to conduct the translocation trial using plants/ plant material that will be impacted by the initial vegetation clearing works.

Seeds harvested from site will be provided to a third party for germination testing. The germination testing results can be used to inform potential future propagation trials.

4.6 Investigations and *Minuria tridens* translocation plan

If regional survey(s) fail to find additional populations of *M. tridens*, Mardie Minerals will coordinate with a third party expert to seek grant funding for research into the genetics and reproductive biology of *M. tridens* at Mardie and the possibility of translocation to establish another population in the region.

A preliminary literature search (**Table 2**) has determined pre-sowing treatments and germination conditions (e.g., temperature, light) can significantly increase germination of Asteraceae species. Further literature searches and trials would be conducted to identify presowing treatments and germination conditions to be trialled to optimise germination of *M. tridens.*

In addition, the preliminary literature search identified that Asteraceae species may be vegetatively propagated and transplanted. Further literature searches will be conducted to identify vegetative propagation methods to maximise propagation of Asteraceae species to inform development of trials to propagate *M. tridens*.

In the meantime, as mentioned above, Mardie Minerals will provide plant material and monitoring data to third parties.

An indicative timetable is provided in Table 3. Timeframes are subject to availability of specialist botanical resources and logistics.

Yours Sincerely,

Julie Mahony
Manager, Environmental Approvals

BCI Minerals

Table 2 Documents and databases to be reviewed

Reference	Title
Nano and Pavey (2008)	National Recovery Plan for Olearia macdonnellensis, Minuria tridens (Minnie Daisy) and Actinotus schwarzii (Desert Flannel Flower)
Phoenix (2019b)	Flora and vegetation assessment for the Mardie Project
Phoenix (2021)	Minuria tridens targeted search at Mardie Salt Project
WA Herbarium (1998-)	FloraBase
ALA (2022)	Atlas of living Australia
Afolayan et al. (1997)	Germination in Helichrysum aureonitens (Asteraceae): Effects of temperature, light, gibberellic acid, scarification and smoke extract
Schutz et al. (2002)	Seed dormancy, after-ripening and light requirements of four annual Asteraceae in south-western Australia
Wassner and Ravetta (2000)	Vegetative propagation of Grindelia chiloensis (Asteraceae)
Diatta et al. (2020)	Evaluation of biomass and vegetative propagation of Spilanthes oleracea Jacq. (Asteraceae)
Collier and Garbnett (2017)	Threatened plant translocation case study: Cassinia rugata (Wrinkled Dollybush), Asteraceae
Commander et al. (2018)	Guidelines for the translocation of Threatened plants in Australia
Erickson et al. (2016)	Seed collection, cleaning, and storage procedures. Pilbara seed atlas and field guide: plant restoration in Australia's arid northwest

Table 3 Indicative timeframe for *Minuria tridens* propagation research

Task	Timeframe
Status and description of *M. tridens*	March 2023
Identification of suitable habitat for *M. tridens*	September 2022 - complete
Translocation trials using : • Plants/ plant material from the north end of intertidal causeway (Figure 1) • Up to nine plants in Ponds 1 and 2 (Figure 1).	January 2023 May 2023[1]
Monitoring of reproduction characteristics and phenological cycle of in situ *M. tridens* at Mardie	January 2023 - September 2024
Investigation of translocation methods	January 2023 - September 2024
Regional surveys for *M. tridens*	Nominally July 2023[2] - September 2023 July 2024 – September 2024

Task	Timeframe
Seek access to additional regional survey data for *M. tridens* habitat and/or records.	Commenced – reliant on other regional proponents.
Report on Mardie reproductive biology investigations and translocation trial outcomes.	Annually in MS1175 Compliance Assessment Report.
If no further populations are found in regional surveys	
In collaboration with a third party expert, apply for a grant to allow research on fire ecology, reproductive biology, and seed storage potential.	2024, pending outcome of regional survey(s)
Subject to grant, develop and submit to DWER CEO *M. tridens* translocation plan.	December 2025

[1] dependent on phenological status of known populations, searches to be conducted when plants are in flower/fruit

[2] dependent on forecast rainfall events

References

Afolayan, A., Meyer, J. & Leeuwner, D. 1997. Germination in Helichrysum aureonitens (Asteraceae): Effects of temperature, light, gibberellic acid, scarification and smoke extract. South African Journal of Botany 69: 22-24.

ALA. 2022. Atlas of Living Australia. Available at: http://www.ala.org.au/

Collier, P. & Garbnett, R. 2017. Threatened plant translocation case study: Cassinia rugata (wrinkled Dollybush), Asteraceae. Australiasian Plant Conservation 26: 21-24.

Commander, L., Coates, D. J., Broadhurst, L., Offord, C., Markinson, R. & Matthes, M. 2018. Guidelines for the translocation of threatened plants in Australia: Third Edition. Australian Network for Plant Conservation, Canberra, Australian Capital Territory.

DAWE. 2022. Approval. Mardie Project, 80 km souith west of Karratha, WA (EPBC 2018/8236). Department of Agriculture, Water and the Environment, Canberra, ACT.

Department of Sustainability and Environment. 2004. Velvet Daisy-bush Olearia pannosa subsp. cardiophylla. Action Statement.

Diatta, W., Diatta, K., Fall, A. & Dieng, S. 2020. Evaluation of biomass and vegetative propagation of Spilanthes oleracea Jacq. (Asteraceae). Journal of Botanical Research 2: 1-3.

Erickson, T.E. & Merritt, D.J. 2016. Seed collection, cleaning, and storage procedures. Pilbara seed atlas and field guide: plant restoration in Australia's arid northwest (eds T.E. Erickson, R.L. Barrett, D.J. Merritt & K.W. Dixon), pp. 7-16. CSIRO Publishing, Dickson, Australian Capital Territory.

Erickson, T.E., Munoz-Rojas, M., Kildisheva, O.A., Stokes, B.A., White, S.A., Heyes, J.L., Dalziell, E.L., Lewandrowski, W., James, J.J., Madsen, M.D., Turner, S.R. & Merritt, D.J. 2017. Benefits of adopting seed-based technologies for rehabilitation in the mining sector: a Pilbara perspective. Australian Journal of Botany, 65, 646-660.

Haase, P. (1986) Phenology and productivity of Olearia ilicifolia (Compositae) at Arthur's Pass, South Island, New Zealand. New Zealand Journal of Botany 24: 369-379.

Kerrigan, R. & Albrecht, D. (2006a) Minuria tridens. Threatened species profile at

www.nt.gov.au/NRETAS/wildlife/threatened/pdf/plants/Minuria_tridens_VU.pdf.

Minister for Environment; Climate Action. 2021. Statement that a proposal may be implemented (Environmental Protection Act 1986). Statement No. 1175 Mardie Project. Minister for Environment; Climate Action, Perth, WA.

Nano, C. & Pavey, C. 2008. National Recovery Plan for Olearia macdonnellensis, Minuria tridens (Minnie Daisy) and Actinotus schwarzii (Desert Flannel Flower). Department of Natural Resources, Environment, The Arts and Sport, Alice Springs, NT. National Recovery Plan. Available at: https://www.agric.wa.gov.au/declared-plants/declared-plant-requirements

Phoenix. 2019a. Detailed flora and vegetation survey for the Mardie project. Phoenix Environmental Sciences, Balcatta, WA. Unpublished report prepared for BCI Minerals Ltd.

Phoenix. 2019b. Flora and vegetation assessment for the Mardie Project. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished memo prepared for BCI Minerals Ltd.

Phoenix. 2021. Minuria tridens targeted search at Mardie Salt Project. Unpublished memo prepared for BCI minerals (Mardie Salt Project).

Schutz, W., Milberg, P. & Lamont, B. 2002. Seed dormancy, after-ripening and light requirements of four annual Asteraceae in south-western Australia. Annals of Botany 90: 707-714.

WA Herbarium. 1998-. FloraBase - the Western Australian Flora. Department of Biodiversity, Conservation and Attractions. Available at: http://florabase.dpaw.wa.gov.au/

Wassner, D. & Ravetta, D. 2000. Vegetative propagation of Grindelia chiloensis (Asteraceae). Industrial crops and products 11: 7-10.

Attachment 1 - DWER EPA Services letter of approval - *Minuria tridens* Research Strategy dated 18 August 2022.