Burrowing Crayfish (Engaewa sp.) Literature and Habitat Preference Assessment

Talison Greenbushes

Talison Lithium Pty Ltd

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Prepared by:

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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Talison Lithium Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Acronyms and Abbreviations

AEAP	Annual Ecological Assessment Program
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
EPBC	Environment Protection and Biodiversity Conservation
IUCN	International Union for Conservation of Nature
IBRA	Interim Biogeographic Regionalisation for Australia

1.0 Introduction

1.1 Background

Talison Lithium Australia Pty Ltd (Talison) operates the Greenbushes Lithium Mine, a mining and spodumene (lithium bearing mineral) concentrating operation, located in Greenbushes in south-west Western Australia. The mine is situated in the headwaters of three tributaries of the Blackwood River; Norilup Brook, Woljenup Creek and Hester Brook. An Annual Ecological Assessment Program (AEAP) has been conducted in spring season since 2016 for detection of potential impacts of adverse water quality on Norilup Brook aquatic fauna. At the request of the Regulator (DWER), the AEAP underwent a technical review in mid-2023 and the scope was revised to include additional monitoring sites on Norilup Brook, Hester Brook and Woljenup Creek, and improve the scientific rigor of the program. The main objective of the revised AEAP was to assess if water originating from the mine operation poses any ecological health risks to the downstream receiving aquatic environments, including that of the Blackwood River.

Consultation with the Department of Biodiversity, Conservation and Attractions (DBCA) highlighted a potential for species of burrowing crayfish (*Engaewa* sp.) to occur within the Talison Greenbushes tenement and receiving wetlands. There are five species of *Engaewa* species that occur in the south-west of Australia, of which one is listed by the EPBC Act, the Margaret River Burrowing Crayfish (*E. pseudoreducta* – Critically Endangered). Additionally, three species are listed by the IUCN red list; the Dunsborough Burrowing Crayfish (*E. reducta* – Endangered), the Walpole Burrowing Crayfish (*E .walpolea* - Endangered) and the Margaret River Burrowing crayfish (Critically Endangered). The two remaining species, the Augusta Burrowing Crayfish (*E. similis*) and the Shannon Burrowing crayfish (*E. subcoerulea*) are of Least Concern (IUCN 2024), however could be considered as Endangered due to habitat fragmentation and habitat loss from anthropogenic impacts (Morgan *et al*., 2011).

1.2 Study Purpose

The purpose of this literature review is to summarise the currently known information on the distribution and habitat preferences of species within the Engaewa genus and assess the likelihood of the presence of Engaewa sp. within the project area.

1.3 Scope of Work

SLR proposes the following scope of works to meet the requirements raised by DBCA for the presence/absence of Engaewa sp. burrowing crayfish within the Talison Greenbushes area:

- A database search and associated literature review outlining the existing available information on the species of burrowing crayfish likely to occur in the area, as well as any knowledge gaps, relatable to the Project Area.
- Methodology for surveys targeting burrowing crayfish, based on the results and recommendations from the literature review.
- A review of the current budget of the AEAP in consideration of any additional methodology regarding to burrowing crayfish surveys.

2.0 Methods

The study area for the desktop review was comprised of the Talison Greenbushes mine buffer area and all inland surface waters up to 50 km from centre of the Greenbushes mine. This encompassed a large 7,854 km^2 circular area around a point representing the approximate centre of the Greenbushes mine (Zone 50H; Easting: 413442, Northing: 6252116). The resultant study area selected for this literature review covered portions of both the Jarrah Forrest and Warren Bioregions (DAWE, 2021)

Publicly available, relevant aquatic biology survey reports research specific to the *Engaewa* genus and south-western Australia were sourced and reviewed including but not limited to, relevant scientific reports and grey literature. The main aquatic biology reports reviewed are summarised in Table 1.

Table 2 lists the databases searched to ascertain distributions and habitat preferences of species of burrowing crayfish relevant to this desktop assessment.

The literature review and database searches did not reveal any burrowing crayfish reports specific to the area encompassing the Greenbushes mine, resulting in literature from a larger range (50km radius) being used as to identify information regarding the distribution and habitat preferences of members of the *Engaewa* genus. This is likely due to the highly cryptic nature of burrowing crayfish making them difficult to observe, resulting in sparse biological publications on the genus.

Table 1. Main aquatic biology reports relevant to the study area and *Engaewa* genus, arranged by year of publication (for full citation, see References section).

Year of Publication	Author	Report Title	Report Type
1967	Riek	The Freshwater Crayfish of Western Australia (Decapoda: Parastacidae)	Scientific Journal Publication
1997	Horwitz	Comparative endemism and richness of the aquatic invertebrate fauna in peatlands and shrublands of far south-western Australia	Scientific Journal Publication
2000	Horwitz and Adams	The systematics, biogeography and conservation status of species in the freshwater crayfish genus *Engaewa* Riek (Decapoda: Parastacidae) from south-western Australia	Scientific Journal Publication
2005	Morgan and Beatty	Baseline study on the fish and freshwater crayfish fauna in the Blackwood River and its tributaries receiving discharge from the Yarragadee Aquifer	Report prepared for the Department of Environment
2009	DAWE	Approved Conservation Advice for *Engaewa pseudoreducta* (Margaret River Burrowing Crayfish)	Minister Approved conservation advice memo
2013	Davies and Steward	Aquatic biodiversity in the Mediterranean climate rivers of southwestern Australia	Scientific Journal Publication
2014	Burnham	Systematics and biogeography of the Australian burrowing freshwater crayfish genus *Engaewa* Riek (Decapoda: Parastacidae)	PhD Thesis

2024	Dawkins et al.	Testing multiple environmental DNA substrates for detection of the cryptic and Critically Endangered burrowing freshwater crayfish *Engaewa pseudoreducta*	Scientific Journal Publication

Table 2. Database searches

Database	Description	Authority	Area of search / Keywords
Protected Matters Search Tool	Search conducted by SLR on 1st October 2024	DCCEW	Within 50km of the Greenbushes mine
Dandjoo Biodiversity Data Repository	Search conducted by SLR on 1st October 2024	DBCA	Western Australia
Freshwater Fish Distribution in Western Australia	Search conducted by SLR on 1st October 2024	DPIRD	Search for all records of *Engaewa*
Healthy Rivers South-West	Search conducted by SLR on 1st October 2024	DWER	Search for all records of *Engaewa*
The Australian Faunal Directory (AFD)	Utilised in assessing taxonomic status and distribution of *Engaewa*	Australian Biological Resources Study (ABRS; an initiative of DCCEW)	Search for all records of *Engaewa*
Atlas of Living Australia (ALA)	Search conducted by SLR on 1st October 2024. Utilised in assessing taxonomic status and distribution of *Engaewa*	Collaborative project between academic, private and community groups.	Search for all records of *Engaewa*

3.0 Results

3.1 Genus Overview

The genus *Engaewa* is comprised of five described species with two additional clades identified in a 2014 PhD thesis by Quinton Burnham. All members of the genus occupy a coastal distribution throughout the High Rainfall Zone (the region that annually receives rainfall more than 800mm) of south-western Australia. *Engaewa* species are differentiated from the more commonly known crayfish species of the genus *Cherax* (e.g. Marron, Koonac, Yabbies) through a range of behavioural and morphological adaptations to their burrowing behaviours. The characteristic features of burrowing crayfish species include a reduction in abdominal size, broad and short chelae and the presence of an abdominal flap on females, which may serve to both shield eggs and maintain a moist microclimate around them (Burnam, 2014).

Burrowing crayfish species are often described as ecosystem engineers due to their burrowing behaviours, which enhance the flow of oxygen, water and nutrients through soil profiles in

addition to modifying habitat to create refuges for other aquatic species (DAWE, 2009). Crayfish species within the genus *Cherax* also demonstrate burrowing behaviour although they are typically much shorter and complex in structure. Externally, the burrows created by *Cherax* produce smaller 'chimneys' composed of relatively large pellets of sediment, contrasted with chimneys created by *Engaewa* which typically are conical in shape and can reach up to approximately 35 cm high. The sediment pellets of *Engaewa* chimneys are much smaller in size compared to that of Cherax, however pellets can occasionally reach up to 2 cm in diameter (Burnham, 2014).

Previous studies of burrowing crayfish species have identified the swamp systems present in south-western Australia to be suitable habitat for *Engaewa*, however due to increasing anthropogenic influence and alteration of habitat because of climate change, these habitats are becoming increasingly fragmented. This fragmentation has resulted in the five described species of this genus occupying distinct geographical distributions across the south-west of Australia, with only a singular case of sympatry recorded across all the literature encountered throughout this review. Burnham identified that the distributional boundaries of *Engaewa* species seem to coincide with an elevation limit of approximately 90 m, suggesting that *Engaewa* has limited ability to penetrate higher reaches from the low-lying coastal plains that the species favours (Burnham, 2014). Most the area surrounding Talison's Greenbushes mine is situated at an elevation greater than 200 m, which presents a potential geographical barrier for access by *Engaewa* (Figure 1).

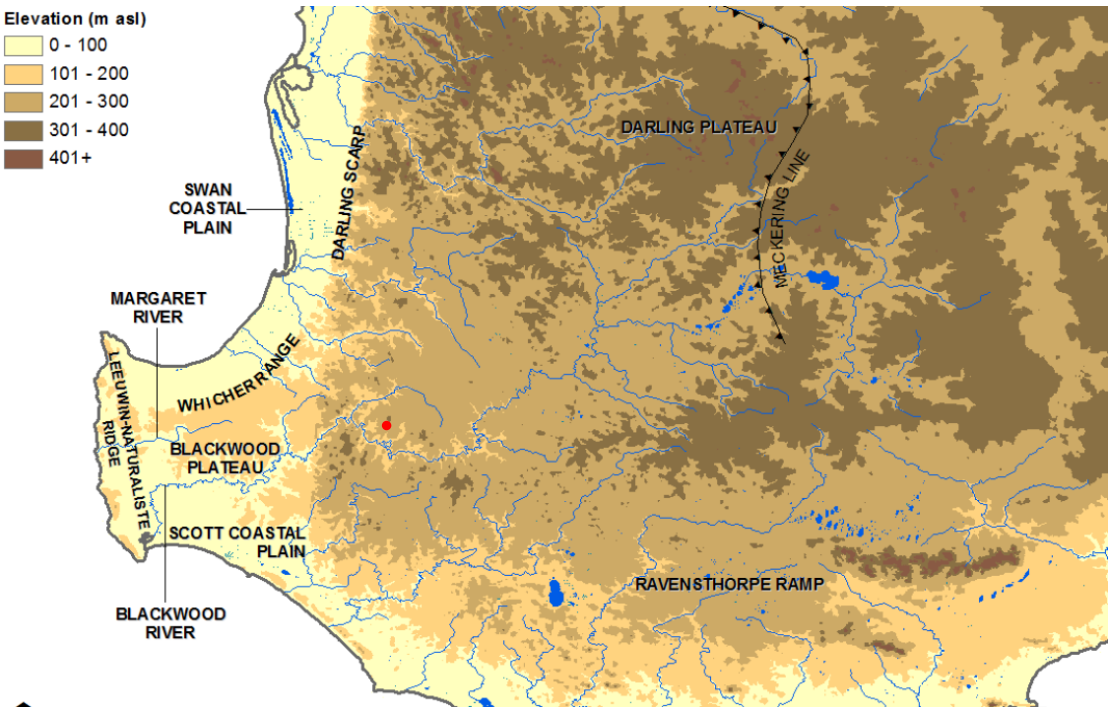

Figure 1 Major geologic features and elevation of south-western Australia (Burnham, 2014). The red circle represents the approximate location of the Greenbushes mine.

3.2 *Engaewa pseudoreducta*

Engaewa pseudoreducta is currently listed as Critically Endangered at a state level under the BC Act (DBCA, 2024), national level under the EPBC Act and international level in the IUCN Red list (IUCN, 2024). The species is only known from one area near Margaret River and is comprised of two extant populations occupying an area of approximately 72 km^2 in the headwaters of a small tributary to the Margaret River (Figure 2). The most well-known, southern population of *E. pseudoreducta* occur at an elevation of approximately 110-120 m in very narrow headwater drainages, with a dense vegetation structure and heavy clay soils. The northern population of *E. pseudoreducta* occupies an area with an elevation of approximately 40m with flat, plain type habitat with sparse vegetation and soils predominantly comprised of coarse white sand rather than clay (Burnham, 2014). Burrows of this species have been observed to reach up to two meters in depth with small chimneys comprised of clay pellets typically found at the burrow's entrance (DAWE, 2009).

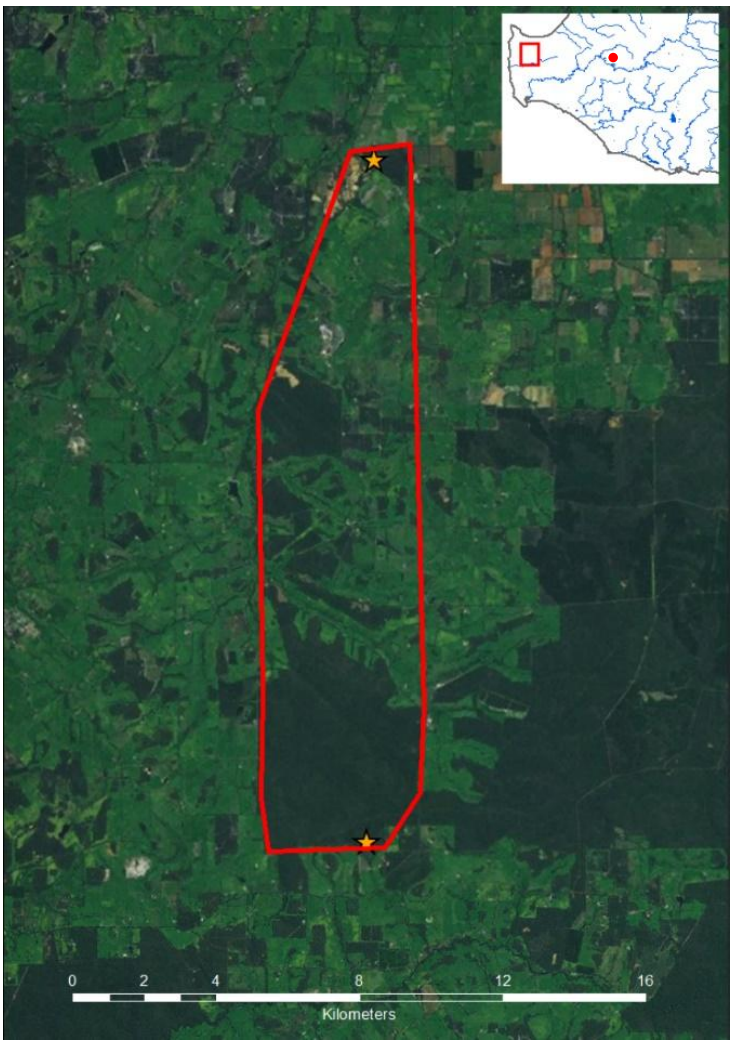

Figure 2 Distribution of *Engaewa pseudoreducta* (Burnham, 2014). The red polygon represents the Extent of Occurrence of this species.

The Protected Matters Search Tool was the only database that indicated that the species or species habitat may occur within the buffer area, however the closest distance from this project area to the Greenbushes mine was approximately 24km (Figure 3). The 2023 spring Annual Ecological Assessment Program (AEAP) identified locations sharing similar habitat characteristics in terms of vegetation and soil composition as those described in locations where *E. pseudoreducta* populations are confirmed (SLR, 2024). However, it is very unlikely that this species would occur within the project area. This is due to a range of factors including, the extremely restricted known distribution of the species, the high level of fragmentation of suitable habitat between the known populations and mining project area and the elevation of the project area being significantly greater than the elevation limit of that coincides with the distributional boundaries of species within the *Engaewa* genus (Burnham, 2014).

Figure 3 Results from the Protected Matters Search Tool for the possible distribution of *Engaewa pseudoreducta*. The red circle represents the approximate location of the Greenbushes mine.

3.3 *Engaewa reducta*

Engaewa reducta is currently listed as Endangered at a state level under the BC Act (DBCA, 2024), Critically Endangered at a national level under the EPBC Act and Endangered at an international level in the IUCN Red list (IUCN, 2024). The species distribution is divided across two areas with an approximate area of 939 km^2 and is found primarily in sandy, deep draining soils in areas of generally open vegetation with little to no tree canopy. In the northern end of their distribution, *E. reducta* may also be present in tea-tree swamps. (Figure 4). The northern populations of *E. reducta* occur at an elevation of approximately 20-75 m whilst the southern populations typically occur at an elevation of approximately 25-50 m. Burrows of this species are typically large and expansive with large sandy chimneys typically found at the burrows entrance (Burnham, 2014).

None of the databases searched for this literature review provided any additional information regarding the distribution or habitat preferences of this species. The 2023 AEAP did not identify locations sharing similar habitat characteristics in terms of soil composition as those described in locations where *E. reducta* populations are confirmed (SLR, 2024). It is therefore highly unlikely that this species would occur within the project area. This is due to several factors, including the species' highly limited distribution, the significant fragmentation of suitable habitats between known populations and the mining project area, and the fact that the project's elevation is substantially higher than the elevation range within which species of the *Engaewa* genus are typically found.

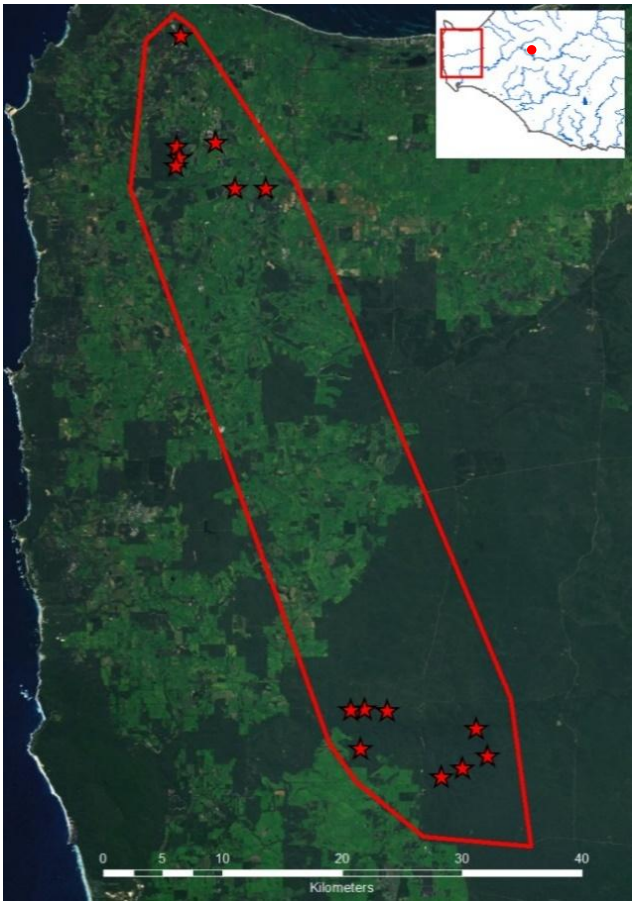

Figure 4 Distribution of *Engaewa reducta* (Burnham, 2014). The red polygon represents the Extent of Occurrence of this species. The red circle represents the approximate location of the Greenbushes mine.

3.4 Engaewa subcoerulea

Engaewa subcoerulea is currently listed as Least Concern at a state level under the BC Act (DBCA, 2024), national level under the EPBC Act and international level in the IUCN Red list (IUCN, 2024). The species is reasonably widespread across an area of approximately 2,113 km^2 on the southern coast of Western Australia (Figure 5). Many of the populations present within this area are located within protected areas on large coastal plains, which drastically improves the resilience of this species to many of the issues facing other species of *Engaewa*. They are known to dig expansive burrow systems, occasionally exceeding two metres in depth and as such the chimneys produced by this species tend to be very large in comparison to

other species within the *Engaewa* genus. *E. subcoerulea* populations occur at an elevation range of approximately 10 - 90 m in sandy soils in areas of both sparse and dense vegetation (Burnham, 2014).

None of the databases searched for this literature review provided any additional information regarding the distribution or habitat preferences of this species. The 2023 AEAP did not identify locations sharing similar habitat characteristics in terms of soil composition as those described in locations where *E. subcoerulea* populations are confirmed. Therefore, it is highly unlikely that this species would occur within the project area due to the geographical distance between the currently known distribution of the species and the Talison mine.

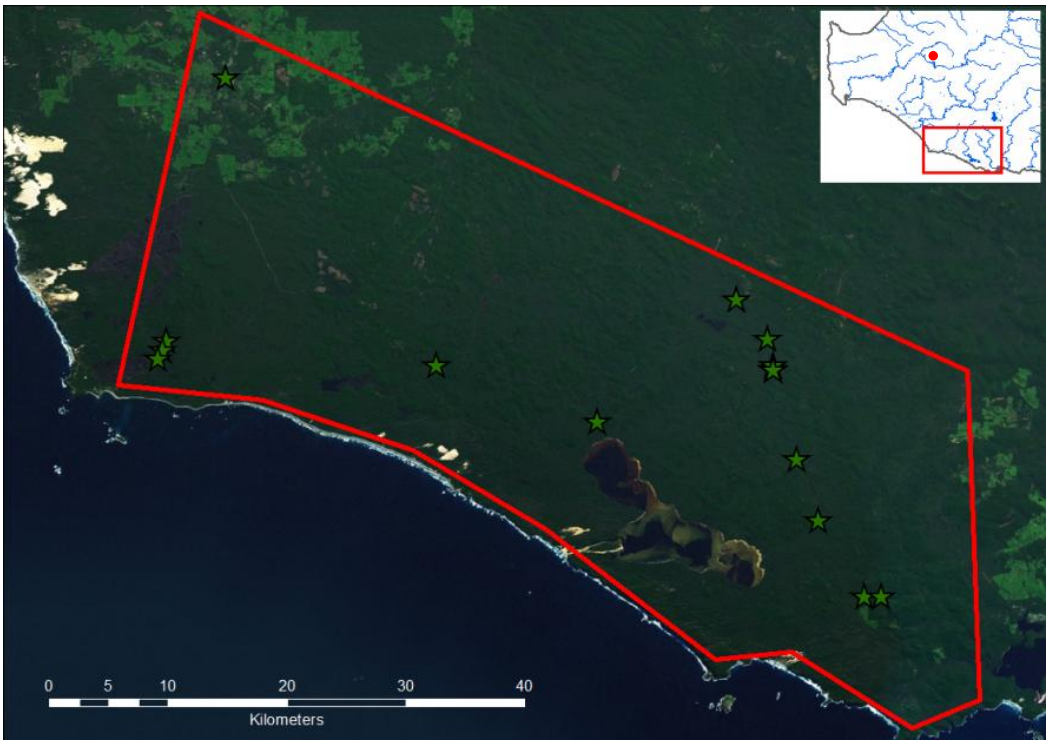

Figure 5 Distribution of *Engaewa subcoerulea* (Burnham, 2014). The red polygon represents the Extent of Occurrence of this species. The red circle represents the approximate location of the Greenbushes mine.

3.5 *Engaewa similis*

Engaewa similis is currently listed as Least Concern at a state level under the BC Act (DBCA, 2024), national level under the EPBC Act and international level in the IUCN Red list (IUCN, 2024). The species is reasonably widespread across an area of approximately 4,275 km^2 (Figure 6). Many of the populations present within this area are located within protected areas, which drastically improves the resilience of this species to many of the issues facing other species of *Engaewa*. This species is known to occupy two distinct habitat types, based on geographic region. In the more southern part of their distribution, habitats are characterised by deeply draining sandy coastal soils and sparse and stunted vegetation. The northern populations more commonly occur in areas with moist peaty loam soil covered by canopy of small trees. Burrow complexity and structure vary depending on the composition of sediment and can range from burrow systems exceeding depths of two meters to much shallower, laterally branching systems. The northern populations of *E. similis* occur at an elevation of

approximately 25 – 115 m whilst the southern populations typically occur at an elevation of approximately 10 – 30 m (Burnham, 2014).

None of the databases searched for this literature review provided any additional information regarding the distribution or habitat preferences of this species. The 2023 AEAP did not identify locations sharing similar habitat characteristics in terms of soil composition as those described in locations where *E. similis* populations are confirmed (SLR, 2024). Therefore, it is highly unlikely that this species would occur within the project area surrounding the Greenbushes mine. This is due to several factors, including the species' highly limited distribution, the significant fragmentation of suitable habitats between known populations and the mining project area, and the fact that the project's elevation is substantially higher than the elevation range within which species of the *Engaewa* genus are typically found.

Figure 6 Distribution of *Engaewa similis* (Burnham, 2014). The red polygon represents the Extent of Occurrence of this species. The red circle represents the approximate location of the Greenbushes mine.

3.6 *Engaewa walpolea*

Engaewa walpolea is currently listed as Critically Endangered at a state level under the BC Act (DBCA, 2024), national level under the EPBC Act and international level in the IUCN Red list (IUCN, 2024). This species occupies a coastal distribution on the southern coast of Western Australia with an area of 127 km^2 (Figure 7). This species tends to be found in areas with very dense vegetation and shallow peaty loam soils overlaying a layer of gravel or clay. The burrow systems of this species are typically shallow and structurally simple, rarely exceeding 50cm in depth. As a result of this, burrow chimneys are generally small and occasionally completely absent. *E. walpolea* populations typically occur at an elevation range of approximately 0 – 30 m (Burnham, 2014).

None of the databases searched for this literature review provided any additional information regarding the distribution or habitat preferences of this species. The 2023 AEAP identified locations sharing similar habitat characteristics in terms of vegetation and soil composition as those described in locations where *E. walpolea* populations are confirmed. However, it is highly unlikely that this species would occur within the project area surrounding the Greenbushes mine. This is due to several factors, including the species' highly limited distribution, the significant fragmentation of suitable habitats between known populations and the mining project area, and the fact that the project's elevation is substantially higher than the elevation range within which species of the *Engaewa* genus are typically found.

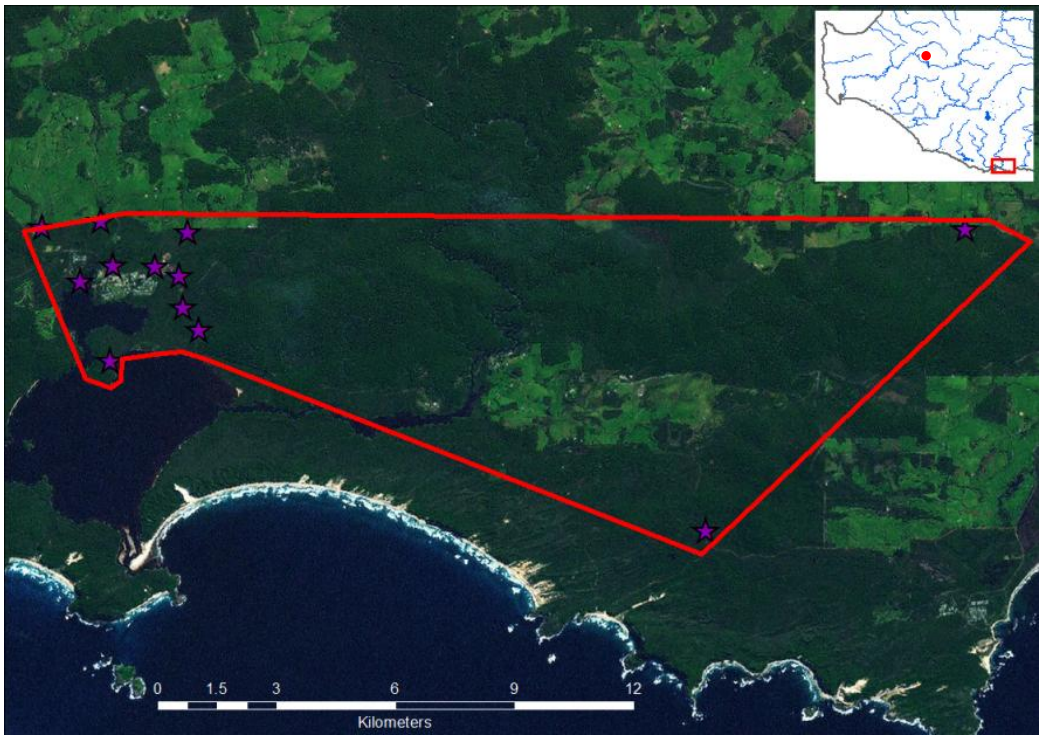

Figure 7 Distribution of *Engaewa walpolea* (Burnham, 2014). The red polygon represents the Extent of Occurrence of this species. The red circle represents the approximate location of the Greenbushes mine.

4.0 Conclusion and Recommendations

The results of the literature review and data base searches indicate that given the coastal distribution, habitat fragmentation and limited dispersal capabilities of burrowing crayfish, it is highly unlikely that *Engaewa sp.* are present in proximity to Talison's Greenbushes mining operations. However, no study specifically targeting burrowing crayfish has occurred in the project area.

Historically, surveys for burrowing crayfish were conducted through manual excavation of burrows to capture and identify crayfish, however this did not always result in crayfish being captured. This method of surveying is highly destructive to both the crayfish's habitat and to the surrounding environment and as such should be avoided where possible. A non-destructive methodology that has been utilised for capturing a different genus (*Engaeus*) of burrowing crayfish in Victoria. This method involves placing a small one-way 'Norrocky' trap to capture crayfish as they exit their burrows. Although this method is relatively non-invasive, capture rates are low even when trialling modified versions to improve effectiveness (Bryant et al., 2014).

More recently, eDNA has become a more commonplace methodology for species detection in aquatic environments. Metabarcoding is an effective and non-destructive method for detecting multiple species concurrently through the analysis of soil or water samples. Dawkins' 2024 paper outlines a recent study in which multiple eDNA substrates were compared for their effectiveness in detecting *E. pseudoreducta*. This study identified sediment pellets from *Engaewa* chimneys to be the most effective substrate for determining presence of *E. pseudoreducta* when compared to burrow scrapes or water samples (Dawkins et al, 2024).

Although the literature review has indicated that it is highly unlikely for burrowing crayfish to occur in proximity to Talison's Greenbushes mine, it is not possible with the current information to state with absolute certainty that Engaewa are absent. Should Talison request SLR to conduct a targeted survey for *Engaewa* in the project area, an approximate costing for a two-day survey aiming to collect *Engaewa* chimney pellets for metabarcoding is outlined in Table 3 below.

Table 3 Budget for a two-day targeted survey for burrowing crayfish surrounding the Greenbushes mine.

Expense	Cost
Fieldwork	$ 7,115.50
Laboratory analysis	$ 3,450.00
Reporting and Project Management	$ 2,610.00
Total	$ 13,175.50

5.0 References

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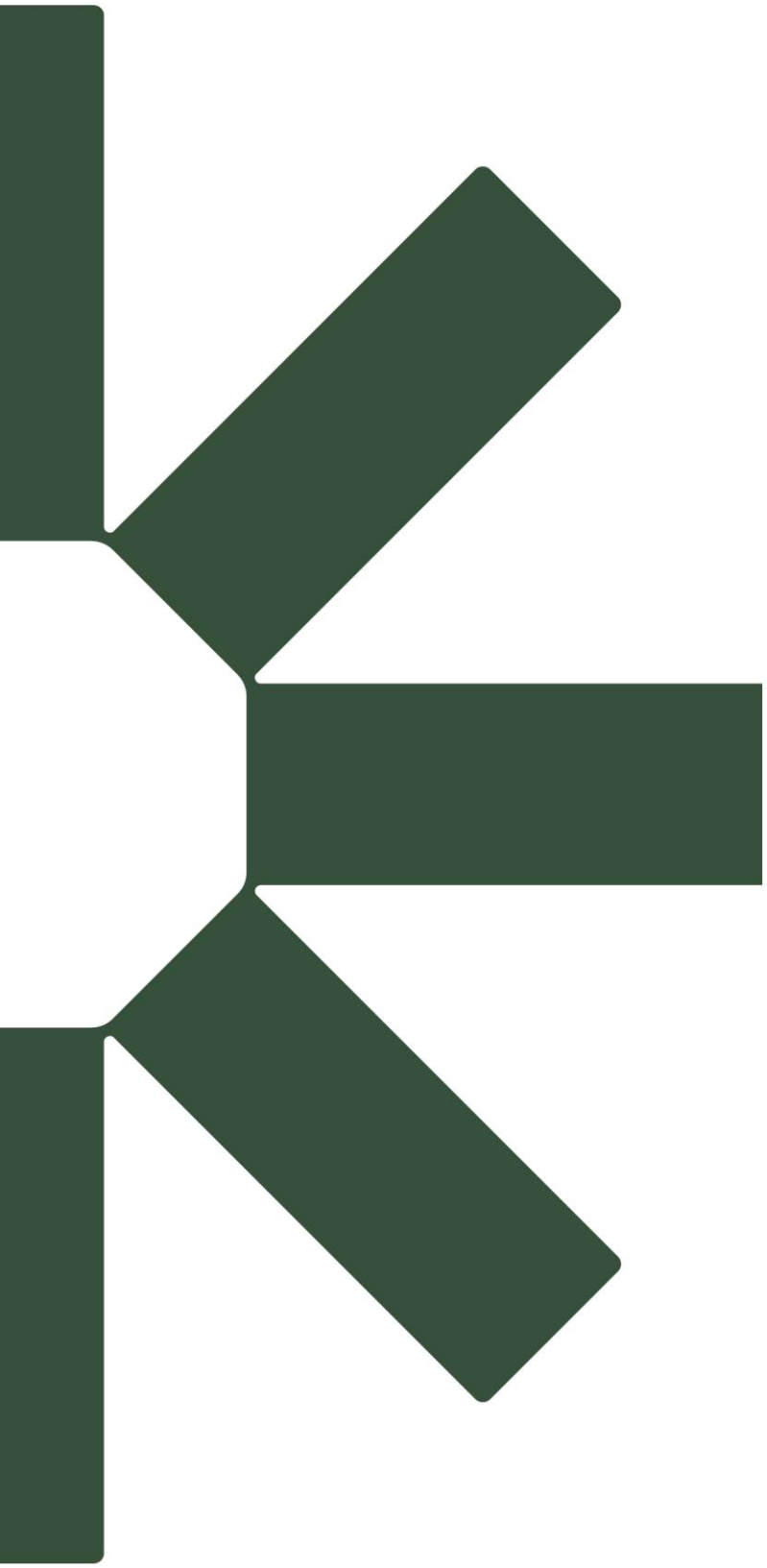

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