

# Bennelongia

Environmental  
Consultants

Earl Grey Lithium Project  
Short-Range Endemic  
Invertebrate Fauna  
Desktop Assessment

Prepared for:  
Covalent Lithium

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Final Report

Short-Range Endemics | Subterranean Fauna

Waterbirds | Wetlands





# Earl Grey Lithium Project Short-Range Endemic Invertebrate Fauna Desktop Assessment

Bennelongia Pty Ltd  
5 Bishop Street  
Jolimont WA 6014

P: (08) 9285 8722  
F: (08) 9285 8811  
E: info@bennelongia.com.au

ABN: 55 124 110 167

Report Number: 606

Report Version	Prepared by	Reviewed by	Submitted to Client	
			Method	Date
Draft	Kevin Sagastume-Espinoza	Robin Hare	Email	25 August 2023
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## EXECUTIVE SUMMARY

Covalent Lithium is investigating expansion opportunities associated with the Earl Grey Project. Accordingly, Covalent Lithium has engaged Bennelongia Environmental Consultants to prepare a desktop assessment to examine the likelihood that short-range endemic (SRE) invertebrates and/or listed terrestrial invertebrate species occur in the Project area and whether these species are likely to be impacted on by the proposed expansion.

This Report builds upon the previous desktop assessment for the Project outlined within Bennelongia (2019).

Previous records of SRE and listed species in the vicinity of the Project (a 100-km x 100-km search area) were collated and the prospectivity of habitats in the Project area for SRE species is evaluated.

Four SRE habitat units were identified in the Project area, predominantly comprising mallee woodlands on various substrates or landforms, but also including shrublands. These units represent widespread habitats with no evident connectivity issues; therefore, whilst various invertebrate species belonging to SRE Groups will occur, the prospectivity for restricted SRE invertebrate species is low. Moreover, the SRE Groups likely to be found in these habitat units tend to be widespread. All habitats identified extend outside the Project area and occur regionally outside the area covered by habitat/vegetation mapping. They are considered unlikely to represent or provide specialised microhabitats necessary to indicate prospectivity for SRE species such as outcropping rock, granites or banded ironstone formation (BIF).

Floristic, soil, and climate characteristics are moderately consistent across the habitat units present, suggesting that they are likely to represent similar habitats from the viewpoint of an SRE species. Mesic microhabitats within all four habitats include litter deposits that occur sparsely within a generally xeric landscape. Rock outcrops suitable for some specialist SRE taxa are absent. Based on the extent and connectivity of habitat units and lack of barriers to dispersal, species from SRE Groups at the Project are expected to be widespread. It is considered unlikely that any conservation listed invertebrate species protected by legislation occur within the Project area.

Sixty-nine species belonging to SRE Groups (i.e. various ground-dwelling invertebrate groups likely to contain SRE species) have been recorded in the search area. There are no records of Confirmed SRE species or listed invertebrate species. Thirty-two of the species belonging to SRE Groups appear to be widespread, twenty-eight are categorised as Data Deficient Potential SREs, seven are Unlikely Potential SREs, and two are Likely Potential SREs. The high proportion of Data Deficient SRE species is a reflection of data limitations, including the small number of records for each species and limited information about habitat requirements and species distributions. Most of the species categorised as Potential SREs (particularly the Data Deficient and Unlikely Potential SREs) are probably widespread.

The size of the area covered by the proposed development is negligible compared with the likely ranges of the SRE Group species that may be present. It is therefore considered unlikely that the Project will have significant conservation implications for SRE species or listed terrestrial invertebrate species.

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## 1. INTRODUCTION

Covalent Lithium Limited is proposing and expansion of the Earl Grey Lithium Project (henceforth 'the Project'). The Project is located approximately 100 km south-east of Southern Cross in Western Australia (Figure 1) and is located on part of the historic (abandoned) Mt Holland Project. This desktop review assesses the likelihood that short-range endemic (SRE) invertebrates and conservation-listed terrestrial invertebrate species occur in the Project area and updates the previous SRE assessment carried out by Bennelongia (2019).

The specific aims of the assessment are:

- To describe and evaluate the prospectivity of invertebrate fauna habitats in the Project area;
- To review records of SRE species and listed invertebrate species in the vicinity of the Project area;
- To determine the likelihood that SRE species and listed invertebrate species occur in the Project area, based on the types of habitats present and richness of SRE and listed species in surrounding areas; and
- To determine if Project is likely to have significant conservation impacts on any SRE species and/or listed invertebrate species.

### 1.1. Project Background

Between 2017-2019, Bennelongia completed a short-range-endemic (SRE) invertebrate assessment for the Earl Grey Project at Mt Holland. Covalent Lithium is now investigating expansion opportunities associated with the Project and requires an updated desktop assessment of this area.

The current approved Project occupies a total area of approximately 800 ha in size. The proposed expansion of the Project will require an additional approximately 1,600 ha of area. Predicted land disturbance is associated with standard mining infrastructure including new waste dumps, tailing storage facilities, and evaporation ponds.

A desktop assessment is required to examine the likelihood that short-range-endemic (SRE) invertebrates and listed terrestrial invertebrate species occur in the Project area and whether these species are likely to be impacted by the proposed development.

## 2. SRE FRAMEWORK

### 2.1. Conservation Framework

The *Biodiversity Conservation Act 2016* (BC Act) in Western Australia deals with the protection, conservation, and sustainable use of the state's biodiversity, and provides general protection for all native species. Some species are given special protection under the BC Act, primarily because they are rare, and are referred to as Threatened species. Species may also be recognised and protected as Threatened at the national level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There is a general concordance of species listed under the two acts, but the BC Act has greater invertebrate coverage.

Additionally, the Department of Biodiversity, Conservation and Attractions (DBCA) lists some Priority species for conservation; species are typically listed as Priority primarily when they are considered potentially under threat but there is insufficient evidence to support listing as Threatened. Priority species listed by DBCA are not afforded special protection under either the BC Act or EPBC Act.

Information available from the BC and EPBC Acts, as well as from the DBCA's list of Priority species, is often used to complement a species' SRE assessment. Additionally, when a taxon listed in these sources is found in a project area, the potential impact of development on that taxon requires additional consideration of that taxon's taxonomy, distribution, and habitat requirements.

## 2.2. Short Range Endemics

In addition to having ranges notionally less than 10,000 km<sup>2</sup>, SRE species usually have patchy distributions within their range, slow growth, low fecundity, and poor dispersal capabilities. Guidelines for the consideration and assessment of SRE invertebrates in Western Australia are provided in the *Environmental Factor Guideline: Terrestrial Fauna* (EPA 2016a) and *Technical Guidance: Sampling of short range endemic invertebrate fauna* (EPA 2016b). Assessment focusses on SRE Groups, which are higher-level taxonomic groupings known to contain moderate to high proportions of SRE species. SRE Groups include land snails (Gastropoda), millipedes (Diplopoda), centipedes (Chilopoda), pseudoscorpions (Pseudoscorpiones), scorpions (Scorpiones), spiders (Araneae; mainly trapdoor spiders, Mygalomorphae), slaters (Isopoda), and in mesic landscapes velvet worms (Onychophora) and earthworms (Oligochaeta).

Not all species in SRE Groups have restricted ranges; some or indeed many may be widespread. Determining whether a species belonging to an SRE Group is in fact an SRE is often difficult. One approach is to assume that the distribution of a species reflects the extent of its preferred or obligate habitat(s), and that species found only in restricted or patchy habitats have smaller ranges than those collected from extensive or common habitats. However, in cases where short range endemism is driven by life history characteristics, a species may be a true SRE but inhabit a widespread, apparently well-connected habitat (Harvey 2002; Harvey *et al.* 2015; Harvey *et al.* 2011; Rix *et al.* 2015). Therefore, several factors are considered in conjunction when evaluating the SRE status of a species and the likelihood of threat to that species. These factors include the known range of the species; habitat(s) at the collection site(s) and the spatial extent and connectivity of these habitats; and the distribution patterns of phylogenetically related surrogate species (ideally members of the same genus).

In order to synthesise investigations of these factors in the context of determining SRE status, this report follows the Western Australia Museum's (WAM) classification system for SREs in recognising three categories:

1. **Confirmed SRE** species have a known distribution range smaller than 10,000 km<sup>2</sup>. The taxonomy is well known, and the group well represented in collections and/or via comprehensive sampling.
2. **Potential SRE** species belong to a group with gaps in our knowledge of its distribution, either because the group is not well represented in collections, taxonomic knowledge is incomplete, or the distribution is poorly understood due to insufficient sampling.
3. **Widespread (not SRE)** species have a known distribution range larger than 10,000 km<sup>2</sup>. The taxonomy is well known, and the group is well represented in collections via comprehensive sampling.

In many surveys, most species fit the **Potential SRE** category, but the likelihood of species within the category actually being SREs varies substantially. In an attempt to increase the accuracy of categorisation, for the purposes of this report the Potential SRE category is further sub-divided into three categories:

- A. **Data Deficient**, indicating that insufficient data are available to determine SRE status. Insufficiency of data may be caused either by a lack of geographic or taxonomic information, or because the individuals sampled are not identifiable to species level (e.g. nondiagnostic sex, juvenile, damaged). This category is applied only to those species that belong to a known SRE Group, rather than being applied to any undescribed species in the records.

- B. **Unlikely SRE** species status is applied in one of two cases. First, the species belongs to an SRE Group but has been collected from many sites and/or multiple habitats. Second, the species belongs to a smaller taxonomic group within the SRE Group that tends not to contain SREs.
- C. **Likely Potential SRE** species are from taxonomic groups in which SREs are likely, and when specimens have been collected from one or very few sites and/or habitats.

In the context of these categories, identifying a species as a Potential or Confirmed SRE is often only the first step in determining the impacts of mining activities on that species. Even a Confirmed SRE species may be locally widespread around a project area, and therefore at minimal risk of disturbance. The actual level of threat to an SRE species depends on its distribution relative to the development footprint, rather than its SRE status alone. Determining the likely level of threat to a species therefore requires further consideration of the extent of the species' preferred habitat, both within and beyond the area of activity.

### 3. LANDSCAPE SETTING

#### 3.1. Project Location

The Project lies within the Southern Cross (COO2) sub-region of the Coolgardie bioregion according to the Interim Biogeographic Regionalisation of Australia (IBRA; Figure 1). The Southern Cross sub-region is characterised by gently undulating uplands dissected by broad valleys with bands of low greenstone hills (Cowan 2001). The dominant land uses are grazing on native pastures, Crown reserves, cultivation for dry land agriculture, and conservation reserves. The climate is Mediterranean, with 300–350 mm mean annual rainfall, most of which falls in winter.

#### 3.2. Geological settings

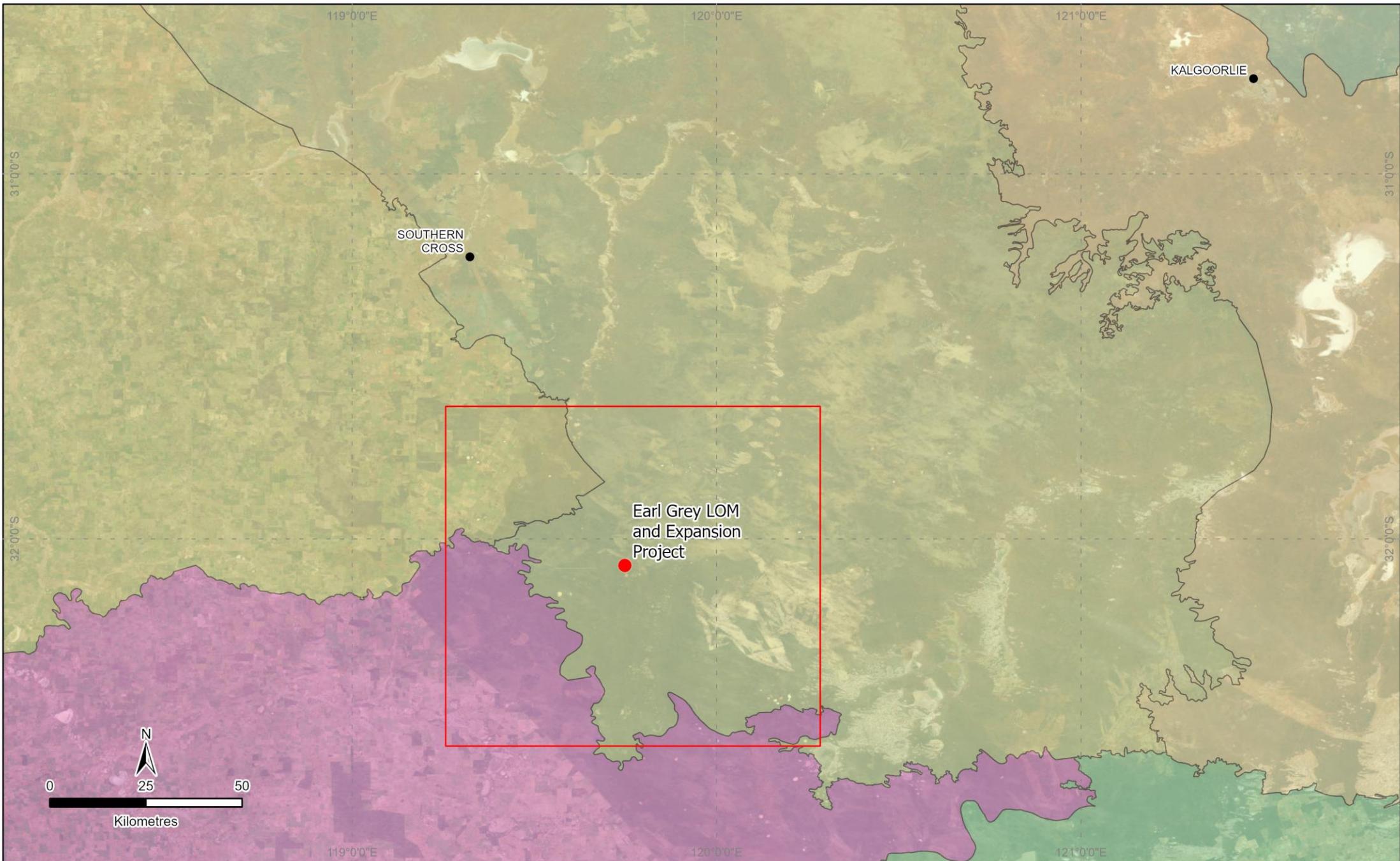
The Project area lies over the Yilgran Craton (Figure 2) and is dominated by granite rock strata interrupted by parallel intrusions of Archaean greenstone from which drainage is occluded. Chains of saline playa lakes occur in valleys surrounded by samphire shrublands. The Project lies directly over aeolian sandplains (REGID 27440) with residual deposits and exposed saprolite rock (REGID 28985; Figure 2). Alluvium deposits (REGID 28737) within drainage channels and floodplains and colluvium slope deposits (REGID 28622) lie near the Project area.

#### 3.3. Vegetation

Diverse *Eucalyptus* woodlands occur in the valleys and on low greenstone hills. Mid-level granite outcrops support *Borya constricta* (resurrection bush), *Acacia acuminata*, and *Eucalyptus loxophleba*. The salt lake surfaces support dwarf shrublands of samphire while the upper levels in the landscape are eroded and yield yellow sandplains, gravelly sandplains, and lateritic breakaways and support stands of mallee and scrub-heathland. Mallee (*Eucalyptus leptopoda*, *E. platycorys* and *E. scyphocalyx*) and scrub-heaths (*Allocasuarina corniculata*, *Callitris preissi*, *Melaleuca uncinata*, and *Acacia beauverdiana*) occur on these uplands, as well as on sand lunettes associated with playas along the broad valley floors, and sand sheets around the granite outcrops. The scrubs are rich in endemic acacias and Myrtaceae (Cowan 2001).

Thirty-three vegetation communities were identified across the Project area, generally combinations of eucalypt woodlands with an understory of *Melaleuca* shrubs or *Allocasuarina*-dominated shrublands (Mattiske 2022). The structure and species composition of woodlands mapped in the Project area were similar to those mapped in other nearby surveys; the vegetation communities identified by Mattiske (2022) were present not only at the LOM Expansion, but also at haul roads, powerline corridors, and proposed wind farm areas, suggesting they are locally widespread and not restricted to the Project area.





**Bennelongia**  
Environmental Consultants

GCS GDA 1994  
Author: K. Sagastume  
Date: 18/07/2023



**Legend**

- Project Point
- Towns
- Desktop search area

**IBRA7 subregions**

- Eastern Goldfield
- Eastern Mallee
- Eastern Murchison
- Merredin
- Southern Cross
- Western Mallee

Figure 1. Location of the Project mapped over IBRA 7 sub-regions and showing search area encompassed by the desktop assessment..

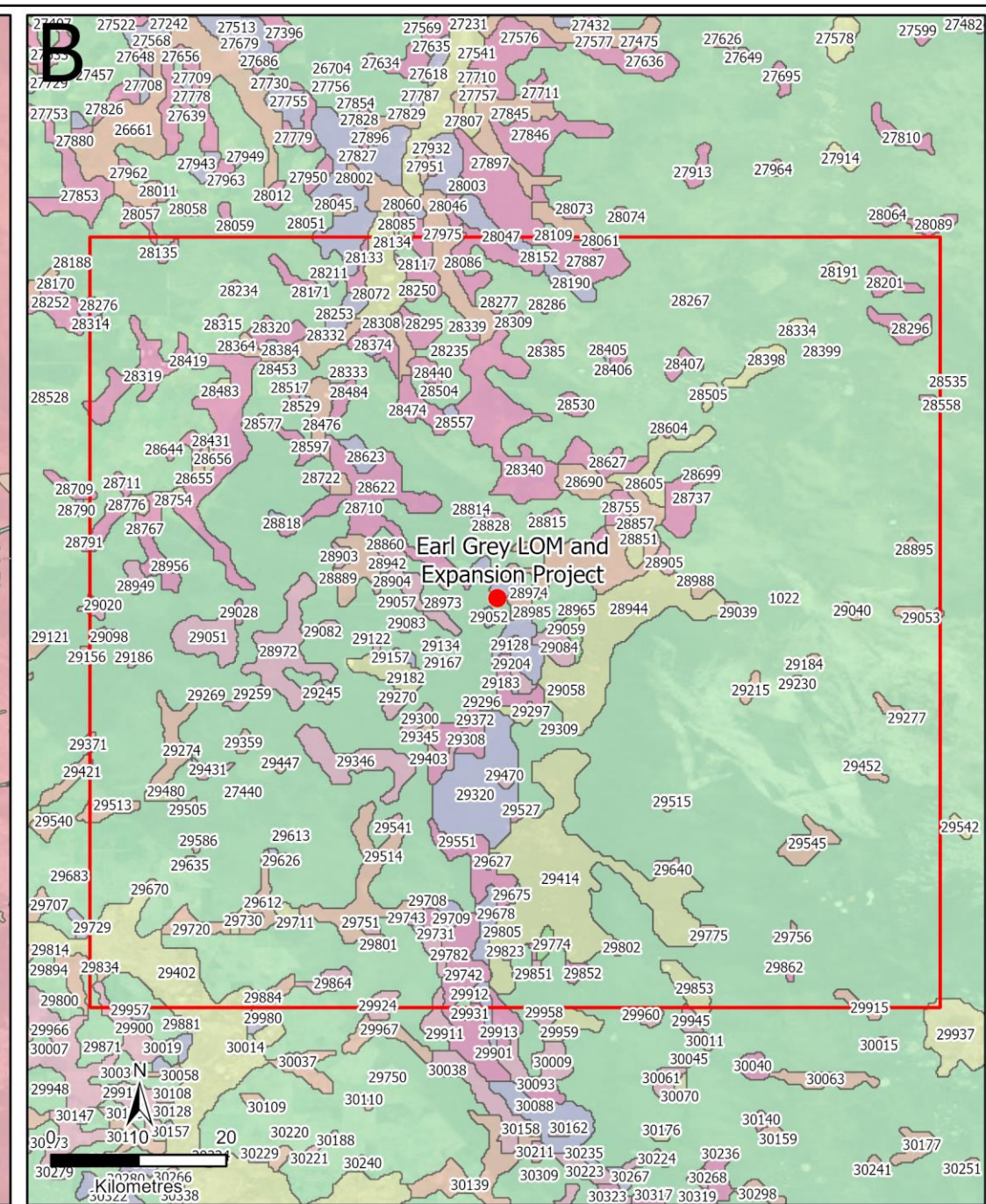
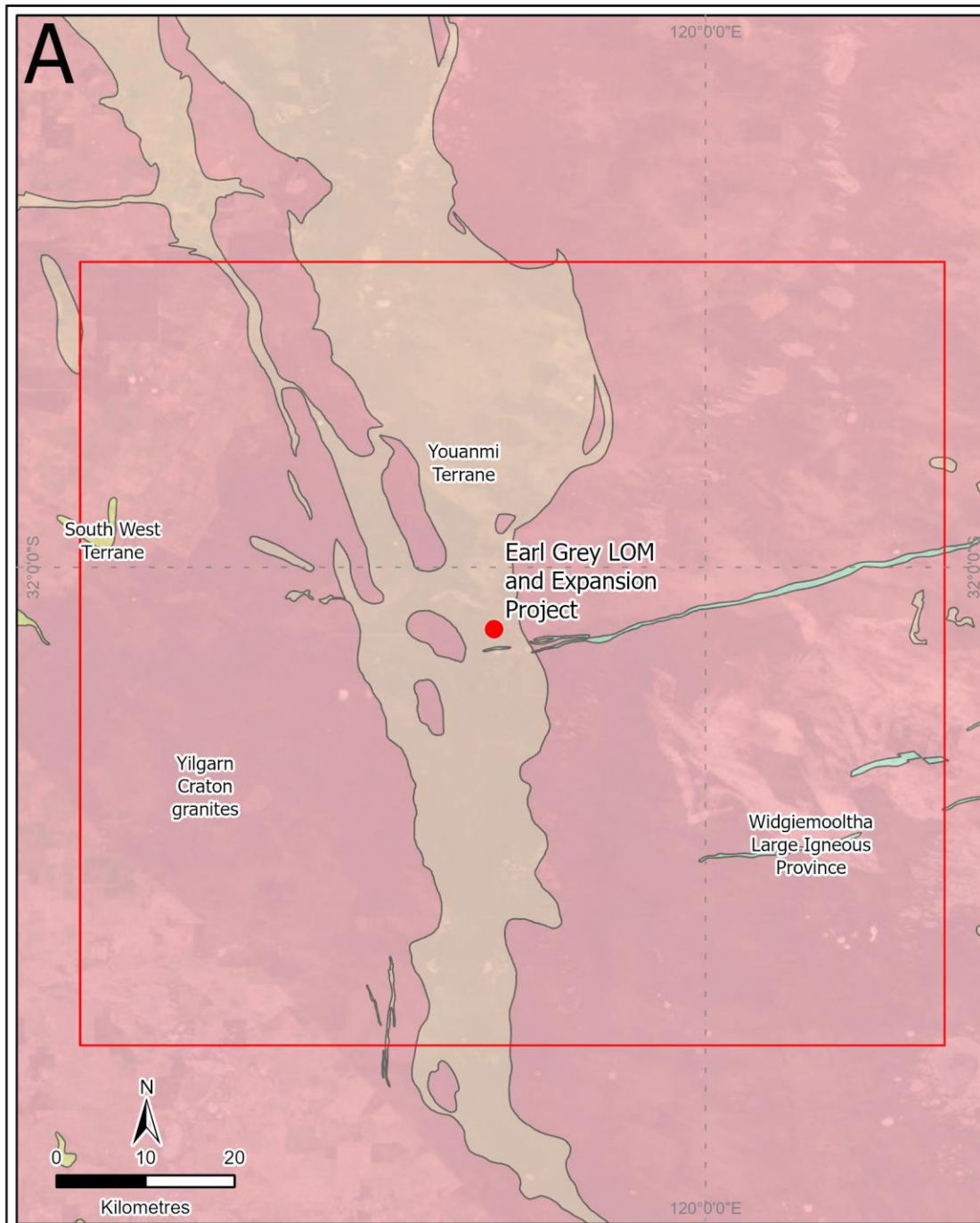


Figure 2. Surface geology (A) and Regolith (B) around the Project area.

## 4. POTENTIAL EFFECTS

There are two broad types of effects on fauna associated with the development of mining infrastructure and subsequent mining operations:

1. *Primary impacts.* Activities that result in habitat loss, with the expectation that no animals in the area of lost habitat will survive. Species with a range (or local population) restricted to the area of primary impact are likely to become extinct or to lose the local population. In the case of SRE species, land clearing is the most common activity causing a primary impact.
2. *Secondary impact.* Activities that result in degradation (but not loss) of habitat cause secondary impact and the species with a range (or local population) restricted to the area of secondary impact are likely to experience reduced population size. However, persistence of the species is unlikely to be threatened directly by the secondary impact. In the case of SRE species, vehicle movements (because of the dust generated), fire, grazing, and clearing of small areas and infrastructure corridors (because of fragmentation and edge effects) are common activities causing secondary impact. Activities such as blasting may also potentially have a secondary impact immediately around a mine pit (due to fly-rock, noise, vibration).

No detailed analysis of species distributions in relation to areas of impact associated with the Project are provided because the results of this desktop survey seek to provide a picture of the type of SRE Group community that are likely to occur in the Project area and the broad characteristics of the species in the community. Habitat mapping in the Project area also provides information about the likely ranges of the SRE Group species occurring in the Project area.

## 5. METHODS

A square of 100 km x 100 km centred around the Project was searched (vertices 31.6079°S, 119.2351°E and 32.5385°S, 120.2626°E) for records belonging to SRE invertebrate fauna. Geological and hydrogeological reports were reviewed to assess whether prospective habitat for SRE fauna is likely to occur in and around the Project area. Search area records were primarily compiled from WAM and Bennelongia databases. Published research papers, environmental reports, and online resources such as the Atlas of Living Australia (ALA 2023) and the Australian Faunal Directory (ABRS 2023) were also reviewed.

Raw datasets were filtered to prioritise species belonging to known SRE Groups and excluding species known to have widespread distributions or to be of least conservation concern. Species data were investigated spatially and cross-referenced with other records, including those outside the search area, to determine the likely distribution of each species relative to the Project. Habitat mapping follows vegetation associations identified by Mattiske (2018) and Mattiske (2022) which were modified and merged to highlight distinct habitat units suitable to support species belonging to SRE Groups.

Assessment of SRE habitats utilised two primary resources: vegetation mapping and regolith mapping. The vegetation mapping of Beard *et al.* (2013) classifies some 900 vegetation associations into 50 major vegetation types and 20 vegetation mosaics across Australia based on structure, physiognomy, floristics, and ecological and regional attributes. The digital 1:500,000 regolith map of WA (Marnham and Morris 2003) is a compilation of finer-scale (1:250,000 and 1:100,000) geological maps and simplifies prevailing geologies, including areas of outcropping, residual or relict units, and seven depositional regolith units. In combination, these resources provide a reasonable indication of regional and, to a lesser extent, local habitat units.

In addition to broad-scale vegetation and regolith mapping, previous assessments of flora and vegetation (Mattiske 2018, 2022) and fauna (Western Wildlife 2017) were reviewed to incorporate finer-

scale habitat information for the Project area. Habitat units identified in those assessments were appropriately modified to reflect the context of habitats suitable for SRE invertebrates. For example, some vegetation units were amalgamated into single SRE habitats due to similarity from the viewpoint of ground-dwelling invertebrates. The merging of a number of vegetation units into broader SRE habitat types is considered justified; many vegetation communities were delineated based on the dominance of a particular eucalypt species or the presence of a particular understorey species, differences unlikely to affect the provision of SRE habitats significantly.

Habitat suitability for SREs was then assessed based on soil structure and geological diversity, along with the vegetation types present and their degree of shade and shelter. Emphasis is usually placed on identifying relict, isolated, sheltered or moist habitats, but 'specialist' habitats such as rock outcrops and ranges may also harbour SRE species. The extent of habitat types beyond the Project area was also evaluated, as well as the extent of habitat connectivity and the presence of habitat isolates, which might restrict dispersal by SRE fauna.

## 6. DESKTOP RESULTS

A total of 891 records from specimens belonging to SRE Groups were recovered from the desktop search area. From those, 720 records representing 69 identifiable species (Table 1) and 171 records representing 25 higher order taxa (Appendix 2) were recognised as occurring within the search area (Figure 3). The 69 identifiable species belonging to SRE Groups are categorised as follows:

- 32 are Widespread species without conservation concern;
- 28 are categorised as Data Deficient Potential SREs due to taxonomical uncertainty, limited number of records (singletons), or unknown biology and habitat requirements;
- 7 species are categorised as Unlikely Potential SREs because their current distributions suggest restricted ranges, but they are known from widespread habitats and are therefore not expected to have truly restricted distributions; and
- 2 species are categorised as Likely Potential SREs as their habitat requirements and current distributions suggest they might have restricted ranges.

No Confirmed SREs have been found within the desktop area.

### 6.1.1. Potential SRE Species

Although 37 species recorded in the search area were classified as Potential SREs (Data Deficient, Unlikely Potential, and Likely Potential), not all of them are expected to have truly restricted distributions. To better differentiate the likelihood of each species having a restricted distribution, the WAM subcategories for Potential SREs are used in this report. Most of the Potential SREs (28 species) are categorised as Data Deficient species due to one or more of the following reasons: the species is the sole member found from a particular genus (even when it's a higher order or unidentified 'sp.');

the species is represented by a single collection from a unique locality; and/or the species is recognised as distinct through molecular or morphological characters but little is known about its habitat requirements or actual distribution (Table 1). No further discussion regarding the Widespread or Data Deficient is provided.

Nine undescribed species, all mygalomorph spiders, were classified as potential SREs (Unlikely Potential and Likely Potential). All were identified to existing 'MYG' codes used in scientific manuscripts, which differentiate between morphologically or genetically distinct putative taxa that await description. The possible distributions of the Potential SRE species are discussed below.

**Table 1.** Invertebrate species from SRE Groups recorded previously around the Project area.  
 Approximate known ranges are given for undescribed species based on WAM records where possible.

No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
	<b>Araneae</b>						
1	<b>Actinopodidae</b>	<i>Missulena</i> sp.	3	Data Deficient	Some species might have restricted distributions.	35-50 km	Moderate
2	<b>Anamidae</b>	<i>Aname</i> `mainae`	5	Widespread	The species is currently widespread and is suspected to be a species group with many undescribed species.	35-40 km	Moderate
3		<i>Aname</i> `MYG010`	6	Widespread	Undescribed species with relative widespread distribution. Also found outside of the search area.	35-50 km	Moderate
4		<i>Aname</i> `MYG181`	3	Likely Potential	Known only from 3 close-by localities covering approximately 6.5 km <sup>2</sup> . It is likely the species will be found outside its current range with further collection efforts.	30-45 km	Low
5		<i>Aname</i> `MYG182`	1	Unlikely Potential	Known from the Mallee and Esperance Plains bioregions; part of Clade 5 (Rix <i>et al.</i> 2021).	48 km	Low
6		<i>Aname</i> `MYG461`	1	Likely Potential	Currently known only from the Coolgardie bioregion; part of Clade 5 (Rix <i>et al.</i> 2021).	30 km	Low
7		<i>Kwonkan</i> `MYG060`	2	Data Deficient	Known only from two specimens collected at a single locality.	35 km	Low
8		<i>Kwonkan</i> `MYG183`	1	Data Deficient	Known from singleton collected approximately 50 km south-west of the Project.	48 km	Low
9		<i>Kwonkan</i> `MYG702`	1	Data Deficient	Known from singleton collected approximately 55 km north-west of the Project.	55 km	Low
10		<i>Proshermacha</i> `MYG429`	1	Unlikely Potential	Recorded approximately 55 km north-west of the Project. Species has also been	55 km	Low

No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
					recorded from outside of the search area and is not expected to have a restricted distribution.		
11		<i>Teyl</i> `MYG012`	2	Unlikely Potential	Known from 2 records approximately 30 km south of the Project. Has also been collected outside of the search area and is not expected to have a restricted distribution.	30 km	Moderate
12		<i>Teyl</i> `MYG457`	2	Data Deficient	Known from 2 specimens from neighbouring localities approximately 55 km north-west from the Project. Little is known of its actual distribution and habitat requirements.	55 km	Low
13		<i>Teyl</i> `MYG480`	1	Data Deficient	Known from singleton collected approximately 55 km north-west of the Project.	55 km	Low
14		<i>Teyl damsonoides</i>	10	Widespread	Widely recorded outside of the search area.	35-40 km	Moderate
15		<i>Teyl luculentus</i>	2	Widespread	Widely recorded outside of the search area.	33 km	Moderate
16	<b>Barychelidae</b>	<i>Idiommata</i> `yelbeni`	1	Data Deficient	Undescribed species known from a single specimen. Little is known of its actual distribution and habitat requirements.	45 km	Low
17		<i>Synothele</i> `forrestiana`	1	Data Deficient	Undescribed species known from a single specimen. Little is known of its actual distribution and habitat requirements.	35 km	Low
18		<i>Synothele longbottomi</i>	1	Widespread	Widely recorded outside of the search area.	35 km	Moderate
19	<b>Euagridae</b>	<i>Cethegus</i> sp.	2	Data Deficient	Unidentified specimens. In WA the genus comprises a single species, <i>C. fugax</i> , which is suspected to be a species complex.	30-35 km	Moderate

No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
					Given this is the only record from the family it is considered a distinct species.		
20	<b>Halonoproctidae</b>	<i>Conothele</i> `MYG059`	2	Unlikely Potential	Undescribed species known from approximately 55 km north-west from the Project. It has also been collected outside of the search area and is known to occur within the South Wheatbelt (WAM 2023).	55 km	Moderate
21		<i>Gaius cooperi</i>	2	Widespread	Previously known under the identification code `MYG063`, and later described by Rix <i>et al.</i> (2018c) as <i>Gaius cooperi</i> , a species with a widespread distribution in the Mallee and surrounding bioregions.	30 km	Moderate
	<i>Gaius</i> `MYG063`	11					
22	<b>Idiopidae</b>	<i>Idiosoma</i> `bifida spp. grp`	1	Data Deficient	Unidentified specimens assigned to the <i>I. bifida</i> species group. This species group was later revised and transferred to a different genus (Rix <i>et al.</i> 2017), <i>Eucanippe</i> , and subsequently described as <i>Eucanippe bifida</i> (Rix <i>et al.</i> 2018b).	33 km	Low
23		<i>Idiosoma</i> `MYG064`	25	Unlikely Potential	Has been also recorded from outside of the search area and from disturbed habitats. It is not expected that the species will have a restricted distribution.	35-45 km	Moderate
24		<i>Idiosoma</i> `MYG065`	13	Unlikely Potential	Has been also recorded from outside of the search area and from disturbed habitats approximately 80 km south of the Project. It is not expected that the species will have a restricted distribution.	35-45 km	Moderate
25		<i>Idiosoma</i> `MYG706`	1	Data Deficient	Singleton known from approximately 55 km north-west of the Project. Little is known of its actual distribution and habitat requirements.	55 km	Low

No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
26		<i>Idiosoma</i> `MYG707`	2	Data Deficient	Known from 2 neighbouring localities approximately 55 km north-west of the Project. Little is known of its actual distribution and habitat requirements.	55 km	Low
27		<i>Idiosoma</i> `species A (Biota)`	2	Unlikely Potential	Undescribed species recorded approximately 40 km south of the Project. Has also been collected from outside of the search area and is not expected to have a restricted distribution.	40 km	Moderate
28		<i>Eucanippe</i> sp.	1	Data Deficient	Unidentified singleton. Given it is the only record from the genus it is considered a distinct species.	30 km	Low
29		<i>Eucyrtops</i> sp.	31	Data Deficient	Unidentified specimens. Given they represent the only record for this genus they are considered a distinct species.	15-45 km	High
<b>Geophilida</b>							
30	<b>Mecistocephalidae</b>	Geophilida `CHI0009`	2	Data Deficient	Undescribed geophilid from approximately 55 km north-west of the Project. Little is known of its actual distribution and habitat requirements.	55 km	Low
<b>Isopoda</b>							
31	<b>Armadillidae</b>	<i>Buddelundia</i> `sp. 39pr`	4	Data Deficient	Undescribed species. Little is known about its actual distribution and habitat requirements.	50 km	Low
32		<i>Acanthodillo</i> sp.	20	Data Deficient	Unidentified specimens. Given these represent the only records for this genus they are considered a distinct species.	50 km	Low
33	<b>Philosciidae</b>	? <i>Laevophiloscia</i> sp.	1	Data Deficient	Unidentified specimens within genus. Given these represent the only records of this genus in the search area they are considered a distinct species.	50 km	Low



No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
34	<b>Platyarthridae</b>	<i>Trichorhina</i> sp.	1	Data Deficient	Unidentified specimens within genus. Given these represent the only records of this genus in the search area they are considered a distinct species.	50 km	Low
	<b>Polydesmida</b>						
35	<b>Paradoxosomatidae</b>	<i>Antichiropus exclamatus</i>	5	Widespread	Broad distribution known from the Great Western Woodlands, extending from Pyramid Lake to Newman Rocks ((Car and Harvey 2014)). Further collection records extend the linear range to approximately 280 km, with the closest record to the Project area found 12 km south-west.	15-45 km	High
	<b>Pseudoscorpiones</b>						
36	<b>Atemnidae</b>	<i>Oratemnus</i> sp.	7	Data Deficient	Unidentified specimens which may belong to one of several described species. Since they represent the only records for the genus they are considered a distinct species in this report.	45-50 km	Low
37	<b>Chernetidae</b>	<i>Haplochernes ?ramosus</i>	1	Widespread	Suspected to belong to the widespread species <i>H. ramosus</i> . The taxonomical status is uncertain, hence the '?' before the specific epithet. The genus is known to contain widespread species.	45 km	Low
38	<b>Chthoniidae</b>	<i>Austrochthonius</i> sp.	1	Data Deficient	Undescribed species for which little is known of its habitat requirements or actual distributions. Given it represents the only record for this genus it is considered a distinct species.	50 km	Low
39	<b>Garypidae</b>	<i>Synsphyronus</i> sp.	21	Data Deficient	Unidentified specimen likely to belong to one of several described species. Given it	50 km	Low

No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
					represents the only member of the genus it is here considered a distinct species.		
40	<b>Garypinidae</b>	<i>Amblyolpium</i> sp.	2	Data Deficient	Unidentified specimen likely to belong to one of several described species. Given it represents the only member of the genus it is here considered a distinct species.	50 km	Low
41		<i>Beierolpium</i> `sp. 8/4`	8	Data Deficient	Unidentified specimen likely to belong to one of several described species. Given it represents the only member of the genus it is here considered a distinct species.	45-50 km	Low
42	<b>Olpiidae</b>	<i>Indolpium</i> sp.	4	Data Deficient	Unidentified specimen likely to belong to one of several described species. Given it represents the only member of the genus it is here considered a distinct species.	35-50 km	Moderate
43		<i>Austrohorus</i> sp.	1	Data Deficient	Unidentified specimen likely to belong to one of several described species. Given it represents the only member of the genus it is here considered a distinct species.	50 km	Low
	<b>Scolopendrida</b>						
44	<b>Cryptopidae</b>	<i>Cryptops</i> `CHI012`	1	Data Deficient	Known from a single specimen	50 km	Low
45		<i>Cormocephalus aurantipes</i>	5	Widespread	Widespread throughout the Southwest, with records extending north to the Pilbara and Kimberley.	37 km	Moderate
46		<i>Cormocephalus bungalbinensis</i>	10	Widespread	Known from south-western WA, from Marloo to Bungalbin Hill and Lake Cronin in the Eastern Goldfields ((Koch 1983))	33 km	Moderate
47	<b>Scolopendridae</b>	<i>Cormocephalus strigosus</i>	1	Widespread	Isolated but widespread records throughout WA.	33 km	Moderate
48		<i>Cormocephalus turneri</i>	22	Widespread	Distributed throughout most of WA except for the Kimberley region.	35 km	Moderate
49		<i>Ethmostigmus rubripes</i>	29	Widespread	Widespread throughout Australia.	30-40 km	Moderate

No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
50		<i>Scolopendra laeta</i>	30	Widespread	Widespread throughout Australia.	30-35 km	Moderate
51		<i>Scolopendra morsitans</i>	6	Widespread	Widespread throughout Australia.	30-35 km	Moderate
	<b>Scorpiones</b>						
52	<b>Bothriuridae</b>	<i>Cercophonius michaelsoni</i>	3	Widespread	Widespread species from the interior Southwest.	35-45 km	Moderate
53		<i>Cercophonius sulcatus</i>	1	Widespread	Most common in coastal areas throughout the Southwest.	37 km	Moderate
54	<b>Buthidae</b>	<i>Isometroides `vescus`</i>	7	Widespread	Only one species within the genus. Suspected to be a species complex made up of many undescribed species.	30-35 km	Moderate
55		<i>Lychas `adonis`</i>	5	Widespread	Undescribed morphospecies with widespread records outside the search area.	35 km	Low
56		<i>Lychas annulatus</i>	12	Widespread	Widespread outside the search area. Discussion is ongoing regarding the taxonomical certainty of this species name, as it is variously considered a synonym of <i>Hemilychas alexandrinus</i> , <i>Lychas mjobergi</i> , and <i>L. truncatus</i> (Koch 1977). It is also suspected to be a species complex.	30-40 km	Moderate
57		<i>Lychas jonesae</i>	4	Widespread	Considered a synonym of <i>Lychas marmoreus</i> (Koch 1977).	30-35 km	Moderate
58		<i>Lychas splendens</i>	5	Widespread	Considered a synonym of <i>Lychas marmoreus</i> ((Koch 1977)).	50 km	Low
59	<b>Urodacidae</b>	<i>Urodacus `armatus`</i>	22	Widespread	<i>Urodacus armatus</i> is a widespread species considered a species complex with numerous undescribed species. The species <i>U. woodwardii</i> was synonymised with <i>U. armatus</i> by Koch (1977) and is not considered a valid species name.	35 km	Moderate
		<i>Urodacus `woodwardii`?</i>	10				

No.	Higher Classification	Lowest ID	No. of records	SRE Status	Comments	Distance from Project (linear km)	Likelihood of occurrence within the Project
60		<i>Urodacus novaehollandiae</i>	3	Widespread	Suspected to be a widespread species complex made up of numerous undescribed species.	35-50 km	Moderate
	<b>Stylommatophora</b>						
61	<b>Bothriembryontidae</b>	<i>Bothriembryon distinctus</i>	10	Widespread	Originally described from near Cocklebiddy. Known known to have a widespread distribution.	50 km	Low
62		<i>Bothriembryon dux</i>	2	Widespread	Widespread distribution along the southern coast of WA	50 km	Low
63	<b>Gastrocoptidae</b>	<i>Gastrocopta bannertonensis</i>	22	Widespread	Widespread throughout most of WA.	50 km	Low
64		<i>Gastrocopta margaretae</i>	5	Widespread	Widespread throughout most of Australia.	45 km	Low
65	<b>Punctidae</b>	<i>Westralaoma cf. aprica</i>	56	Widespread	Specimens suspected to belong to <i>W. aprica</i> , which is a widespread species.	50 km	Low
66		<i>Westralaoma expicta</i>	22	Widespread	Widespread throughout most of WA.	45 km	Low
		<i>Westralaoma cf. expicta</i>	197		Specimens suspected to belong to <i>W. expicta</i> , not considered as a different species.		
67	<b>Pupillidae</b>	<i>Pupoides adelaidae</i>	8	Widespread	Widespread throughout most of Australia.	30 km	Moderate
68		<i>Pupoides myoporinae</i>	3	Widespread	Widespread throughout most of Australia.	50 km	Low
	<b>Scutigeromorpha</b>						
69	<b>Scutigeridae</b>	<i>Pesvarus sp.</i>	4	Data Deficient	Unidentified specimens within the genus. Given they represent the only record from this genus they are considered a distinct species.	35 km	Moderate
<b>TOTAL</b>			<b>720</b>				

## **ANAMIDAE**

### **Aname `MYG181`**

Three specimens of the species *Aname* `MYG181` (Anamidae) were recovered from three neighbouring localities covering approximately 6.5 km<sup>2</sup>, approximately 50 km south of the Project area (Figure 3). Collection sites occurred in medium eucalypt woodland (Beard *et al.* 2013) but no fine-scale habitat information is available. As with many other mygalomorph taxa, *Aname* is largely undefined at the species level and has been recognized as one of the most (probably the most) diverse mygalomorph spider genus in Australia, with numerous undescribed species recognised based on molecular sequencing (Rix *et al.* 2021). Following the current known distribution of *Aname* `MYG181` and the fact it has not been collected outside of the search area, we categorise the species as a Likely Potential SRE. However, it is expected that future collection efforts will expand the current known distribution of the species, in which case an SRE reassessment should be made.

### **Aname `MYG182`**

A single specimen from *Aname* `MYG182` was recovered from the search area. However, this species is known to occur within the Mallee and Esperance Plains bioregions of WA as part of the 'Clade 5' recognized by Rix *et al.* (2021), and outside of the search area. It is therefore not expected that the species will have a restricted distribution, and hence is categorised as an Unlikely Potential SRE.

### **Aname `MYG461`**

*Aname* `MYG461` has been recorded in the search area as a singleton approximately 32 km south of the Project (Figure 3). Fine-scale habitat information is not available, but broad-scale mapping puts the collection site in medium eucalypt woodland (Beard *et al.* 2013). This species is also part of 'Clade 5' (Rix *et al.* 2021) and is currently known only from the Coolgardie bioregion, for which reason it is categorised as a Likely Potential SRE.

### **Proshermacha `MYG429`**

*Proshermacha* is one of the least studied genera within the family Anamidae. It currently contains 11 described species (World Spider Catalog 2023), but many undescribed molecular species are also known (Harvey *et al.* 2018). *Proshermacha* `MYG429` was recorded within the search area from one specimen approximately 55 km north-west of the Project area (Figure 3) and has also been found outside of the search area, for which reason it is not expected to have a restricted distribution and is categorised as an Unlikely Potential SRE.

### **Teyl `MYG012`**

The genus contains seven described species (World Spider Catalog 2023). The genus, previously known by the junior synonym *Merridinia*, occurs throughout southern and central Australia in both mesic and arid habitats (Harvey *et al.* 2018). Numerous undescribed species have been identified molecularly in Australia, including *Teyl* `MYG012`, which was recorded from two specimens approximately 30 km south of the Project area (Figure 3). Given the species has also been collected outside of the Project area and that it is not expected to have a restricted distribution, it is categorised as an Unlikely Potential SRE.

## **HALONOPROCTIDAE**

### **Conothele `MYG059`**

This species is the only member of the family Halonoproctidae (previously Ctenizidae) and is known from only two specimens 55 km north-west from the Project (Figure 3). Like many other trapdoor spider groups in Western Australia, *Conothele* contains many undescribed species, and some are probably SREs (Huey *et al.* 2019). The species *Conothele* `MYG059` has been recorded from the South Wheatbelt (WAM 2023), and the specimens reported here were found within eucalypt woodland habitat. This species has been collected outside the search area; this, combined with the habitat preference indicate, suggest the species is unlikely to have a restricted distribution. It is, therefore, categorised as an Unlikely Potential SRE.

## **IDIOPIDAE**

### ***Idiosoma* `MYG064`**

The family Idiopidae has been recently revised (Rix *et al.* 2017), resulting in the synonymisation of the junior genera *Aganippe* and *Anidiops* with *Idiosoma* (Rix *et al.* 2017). Following the family revision, the genus *Idiosoma* was also revised, in particular the `nigrum group` (Rix *et al.* 2018a). As a result, numerous species were described, but even more were recognised based on molecular sequencing and remain undescribed. *Idiosoma* `MYG064` is an undescribed species that appears to be abundant within the search area, and that has been found outside of the search area. It is not expected to have a restricted distribution and is therefore categorised as an Unlikely Potential SRE.

### ***Idiosoma* `MYG065`**

This species was represented by 13 specimens collected approximately 40 km south of the Project from disturbed habitats, although some of the records came from medium eucalypt woodland, with some additional records from abutting mallee shrubland. The genus *Idiosoma* contains a high proportion of likely SRE species (Castalanelli *et al.* 2014; Framenau *et al.* 2008) and the species *I.* `MYG065` is here categorised as an Unlikely Potential SRE.

### ***Idiosoma* `species A (Biota)`**

Four specimens of this idiopid were recorded 30–40 km south of the Project. These sites occur in medium eucalypt woodland, as described by Beard *et al.* (2013). This species has also been recorded from outside the search area. Given the genus is widely and frequently recorded across the Avon Wheatbelt, Coolgardie, and Mallee regions, this species is categorised as an Unlikely Potential SRE.

## **6.1.2. Conservation Listed Invertebrate Species**

A total of 21 invertebrate species are listed under the DBCA's priority fauna list for the Wheatbelt region. Of those, 12 belong to SRE Groups: the trapdoor spiders *Bertmainius monachus*, *Idiosoma castellum*, *I. dandaragan*, *I. kopejtkorum*, *I. kwongan*, *I. mcclenstorum*, *I. mcnamarai*, *I. nigrum*, *Kwonkan eboracum*, *Teyl* sp. (MYG693); and the bothriembryontid land snails *Bothriembryon bradshawi* and *B. praecelsus*. The remaining listed species include representatives of fairy shrimps, brine shrimps, water fleas, woolybush bees, bush crickets, the arid bronze butterfly, and a freshwater mussel (DBCA 2022b).

Desktop review did not identify any records of listed invertebrate species from the search area, and most of the listed Wheatbelt species are unlikely to occur in the vicinity of the Project. The exceptions are *Idiosoma nigrum*, *I. mcnamarai*, and *I. castellum*, which may possibly occur in the vicinity of the Project, although it is unlikely. The distribution and potential conservation implications of the listed species belonging to SRE Groups are discussed below.

### **Talyuberlup pygmy trapdoor spider (*Bertmainius monachus*)**

This trapdoor spider occurs at only at three sites in the western portion of the Stirling Range (270 km south-east from the Project) and is categorised as Endangered under the Biodiversity Conservation Act (DBCA 2022a). The known total area occupied by the spider is less than a few hundred square meters, and the total distribution is exceedingly small, with the known populations comprising few individuals known to be highly susceptible to destruction by wildfire due to their short burrows (Harvey *et al.* 2015). This species is not expected to occur near the Project area.

### **Bothriembryontid land snails (*Bothriembryon bradshawi* and *B. praecelsus*)**

*Bothriembryon praecelsus* is categorised as Extinct under the Biodiversity Conservation Act (DBCA 2022a). Although Whisson (2019) reports putative new collection localities for the species (195 km north-west from the Project), further taxonomical revision is needed to confirm such statement.

On the other hand, *Bothriembryon bradshawi* is considered as a Priority 3 by DBCA (2022b). Whisson (2019) reports new records for the species found within open wandoo forest near the type locality of

Tambellup (280 km south-west from the Project). Neither of the species is expected to be found near the Project area.

**Tree-stem trapdoor spider (*Idiosoma castellum*)**

This mygalomorph spider is listed as Priority 4 by DBCA (2022b). The species is geographically moderately widespread but is restricted to hillslopes (lower slopes to upper ridges) and banded ironstone formations in gravelly loam soils and has been found to be reasonably common around hills at Windarling, Mt Jackson, and Koolyanobbing (Bamford 2009), however, this seems to be a product of localized sampling in the area. The species has also been collected from Helena & Aurora Ranges and Die Hardy Ranges, and nearest record of *I. castellum* to the Project is approximately 60 km to the north (WAM records). The species is not considered an SRE. The Project landscape in terms of soil and topography comprises gently undulating sandplain with duplex sandy gravel soil, and broad valleys and drainage lines with loamy duplex soils in low-lying areas (MBS 2017). Given the lack of suitable topographical formations in the Project area, the occurrence of *Idiosoma castellum* is unlikely and the species is unlikely to be affected by proposed developments.

**Dandaragan Plateau shield-backed trapdoor spider (*Idiosoma dandaragan*)**

This species was recently described (Rix *et al.* 2018a) and was previously known by the identification code `MYG477`. It is part of the `sigillate complex` from the diverse *sigillatum* clade and has a restricted distribution along the eastern margin of the Dandaragan Plateau (over 450 km north-west from the Project). The species has a known extent of nearly 1,500 km<sup>2</sup>, which when paired with its known geographic range (<500 km<sup>2</sup>) and the decline in extent and quality of habitat in its known area of occurrence has led to the species being categorised as Endangered by Rix *et al.* (2018a) and as Priority 2 by the DBCA (2022b). Given its current known distribution and habitat requirements, the species is not expected to occur near the Project area.

**Lake Goorly shield-backed trapdoor spider (*Idiosoma kopejtkorum*)**

Previously known by the WAM identification code `MYG521`, this recently described species is part of the `sigillate complex` from the northern *clypeatum* clade (Rix *et al.* 2018a). The species appears to be restricted to the north-eastern Wheatbelt bioregion of south-western Western Australia in a small area surrounding Lake Goorly (345 km north-west from the Project). Although the species was initially collected from Mount Gibson in the 1950s, the species gained attention during environmental impact assessment surveys conducted in the resource-rich Mummaloo region in 2012. In 2017, *I. kopejtkorum* was formally assessed and listed as Endangered under the Biodiversity Conservation Act (DBCA 2022b; Rix *et al.* 2018a). The north-eastern Wheatbelt is a heavily cleared area, and this species is at risk from mining and minerals resource development. Nevertheless, given its current known distribution it is not expected to be found near the Project area.

**Kwongan heath shield-backed trapdoor spider (*Idiosoma kwongan*)**

This species, previously known under the identification code `MG472`, is a poorly known species with an apparently restricted distribution in the southern Geraldton Sandplains bioregion of south-western Western Australia (over 500 km north-west from the Project). It is currently known from an extent of occurrence of nearly 500 km<sup>2</sup> (although considered an underestimate) and from heathland habitat, and is considered as Priority 1 by DBCA (2022b). The species is not expected to be found close to the Project area.

**Julimar shield-backed trapdoor spider (*Idiosoma mcclenestorum*)**

A member of the *sigillatum* clade and formerly known by the identification code `MYG474`. The species is considered rare, with a highly restricted distribution in the northern Jarrah Forest bioregion of south-western Western Australia (330 km west from the Project). It has a known extent of nearly 1,500 km<sup>2</sup> and occurs in fragmented sites subject to continued decline in continuity and quality. Rix *et al.* (2018a) described the species and suggested under their conservation assessment that it should be considered as Endangered, however, the species is not listed as a conservation important species by the Biodiversity

Conservation Act (EPBC 1999). It is considered as a Priority 2 species by the DBCA (2022b). Given its known extent and habitat requirements, the species is not expected to occur close to the Project area.

**Central-eastern Wheatbelt shield-backed trapdoor spider (*Idiosoma mcnamarai*)**

This rare species, formerly known by the identification code `MYG520`, has a restricted distribution in the central-eastern Wheatbelt bioregion of south-western Western Australia. The nearest record of this species is from 155 km north-west of the Project. With a known extent of occurrence of nearly 6,000 km<sup>2</sup> and an area of occupancy within that range of <500 km<sup>2</sup>, the species was categorised as Endangered by Rix *et al.* (2018a) under their conservation assessment. It is considered as Priority 1 by DBCA (2022b). Given its current known distribution, it is possible for the species to be found close to the Project, although it is unlikely.

**Shield-backed trapdoor spider (*Idiosoma nigrum*)**

This trapdoor spider was historically listed as Schedule 3 (Vulnerable) under the WC Act, Act which was later replaced and the species was then re-categorised as Endangered under the Biodiversity Conservation Act (EPBC 1999). *Idiosoma nigrum* is now known to be restricted to the central Avon Wheatbelt and eastern Jarrah Forest IBRA bioregions (Rix *et al.* 2018a; Rix *et al.* 2017), adjacent to the Southern Cross sub-region in which the Project occurs. The primary habitat for *Idiosoma nigrum* is recognised as coincident open eucalypt woodland and *Acacia acuminata* understorey and similar vegetation units were identified near the Project area. Despite this apparently suitable habitat, the Project area is too far east for the occurrence of *Idiosoma nigrum* and sampling in the vicinity of the Project has not collected the species (WAM records). Therefore, it is considered the Project will not affect the conservation status of *Idiosoma nigrum*.

**Open-holed trapdoor spiders (Anamidae: *Kwonkan eboracum* & *Teyl* sp. (MYG693))**

Two species of open-holed trapdoor spiders are considered as Critically Endangered by the Biodiversity Conservation Act (DBCA 2022a) as they both face extremely high risks of extinction in the wild in the immediate future. The type locality for *Kwonkan eboracum* consists of heath shrubland on yellow sand adjacent to salmon gum and gimlet woodlands. This habitat has been mostly cleared within the type locality and only a narrow strip remains along a road verge (Avon Catchment Council 2007), over 200 km north-west from the Project.

The preferred habitat of *Teyl* sp. (MYG693) is swamp areas on high terrain, from it was originally described near Minnivale. However, most of the presumed geographic range of this species has been cleared, with only one known extant population of the species located on a DEC-managed Nature Reserve (C21475) in the Western Australia Wheatbelt, approximately 270 km north-west from the Project. Given their current known distributions, neither of the species are expected to occur close to the Project area (Avon Catchment Council 2007).

Out of the 12 listed species belonging to SRE Groups and found within the Wheatbelt region, only three mygalomorph spider species may be found near the Project area: *Idiosoma nigrum*, *I. mcnamarai*, and *I. castellum*. However, given their current known distributions and habitat requirements, it is unlikely for them to be found within the Project area.

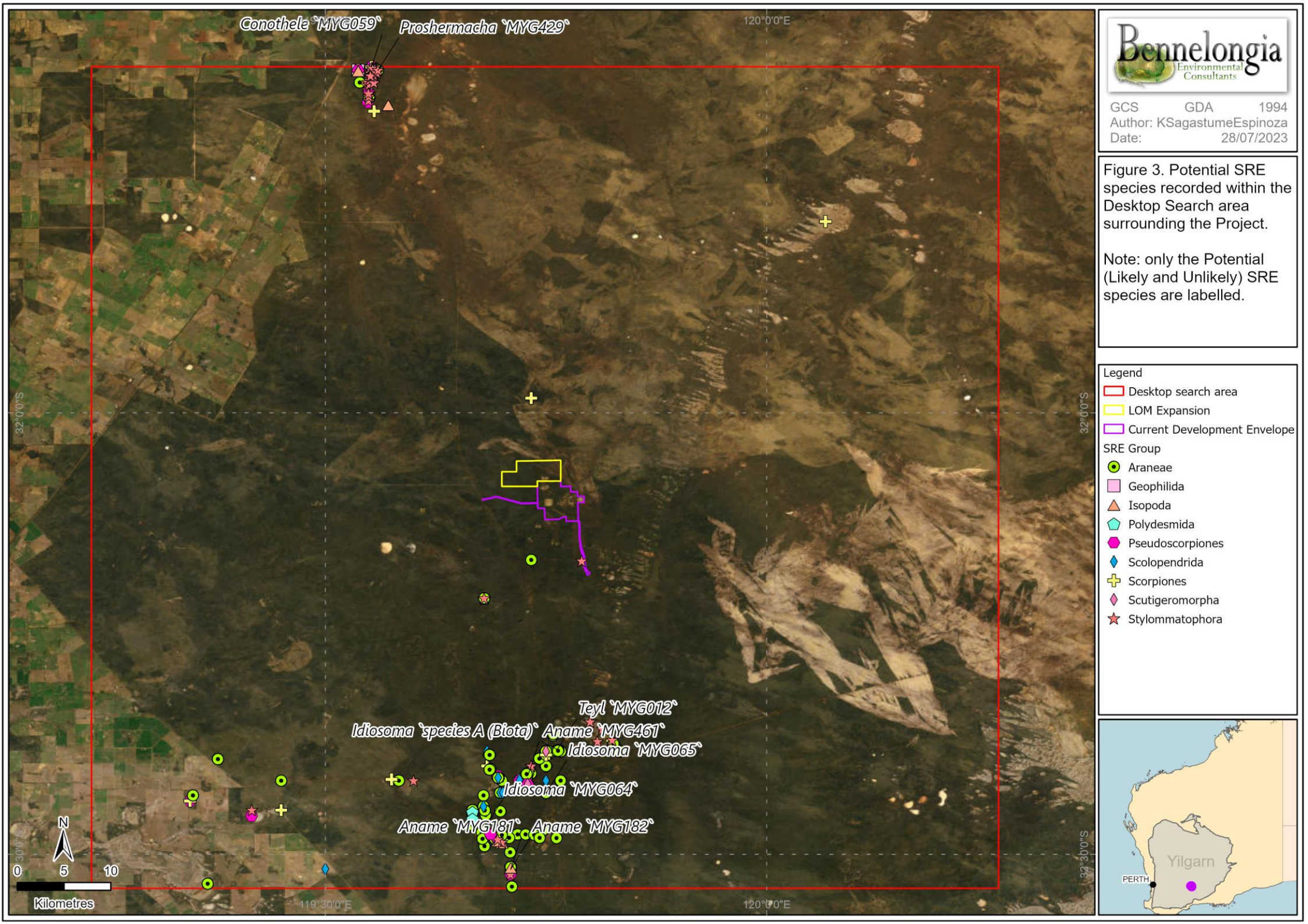


Figure 3. Potential SRE species recorded within the Desktop Search area surrounding the Project.

Note: only the Potential (Likely and Unlikely) SRE species are labelled.

Legend

- Desktop search area
  - LOM Expansion
  - Current Development Envelope
- SRE Group
- Araneae
  - Geophilida
  - ▲ Isopoda
  - ◊ Polydesmida
  - ◆ Pseudoscorpiones
  - ◆ Scolopendrida
  - + Scorpiones
  - ◆ Scutigermorpha
  - ★ Stylommatophora



*Conothele* 'MYG059' *Proshermacha* 'MYG429'

120°0'0"E

32°0'0"S

32°0'0"S

*Teyl* 'MYG012'

*Idiosoma* 'species A (Biota)' *Aname* 'MYG461'

*Idiosoma* 'MYG065'

*Idiosoma* 'MYG064'

*Aname* 'MYG181' *Aname* 'MYG182'



119°30'0"E

120°0'0"E

32°30'0"S



## 6.2. Assessment of SRE habitats

The vegetation mapping of Beard *et al.* (2013) suggests the Project lies within a vegetation type characterised as “Shrublands; mallee scrub, *Eucalyptus eremophila* type” (Figure 4; Appendix 1 shows Veg Association codes). Mallee is predominant in the Mallee Bioregion but extends into the Avon, Wheatbelt, Coolgardie, Esperance Plains, and Hampton bioregions where it can form mosaics consisting of mallee with patches of woodland (Beard *et al.* 2013). Regolith around the Project area comprises sandplains, with numerous associations of exposed rocks and residual deposits, i.e. alluvium and colluvium, occurring sparsely nearby (Figure 4).

### 6.2.1. Habitat units in the Project area

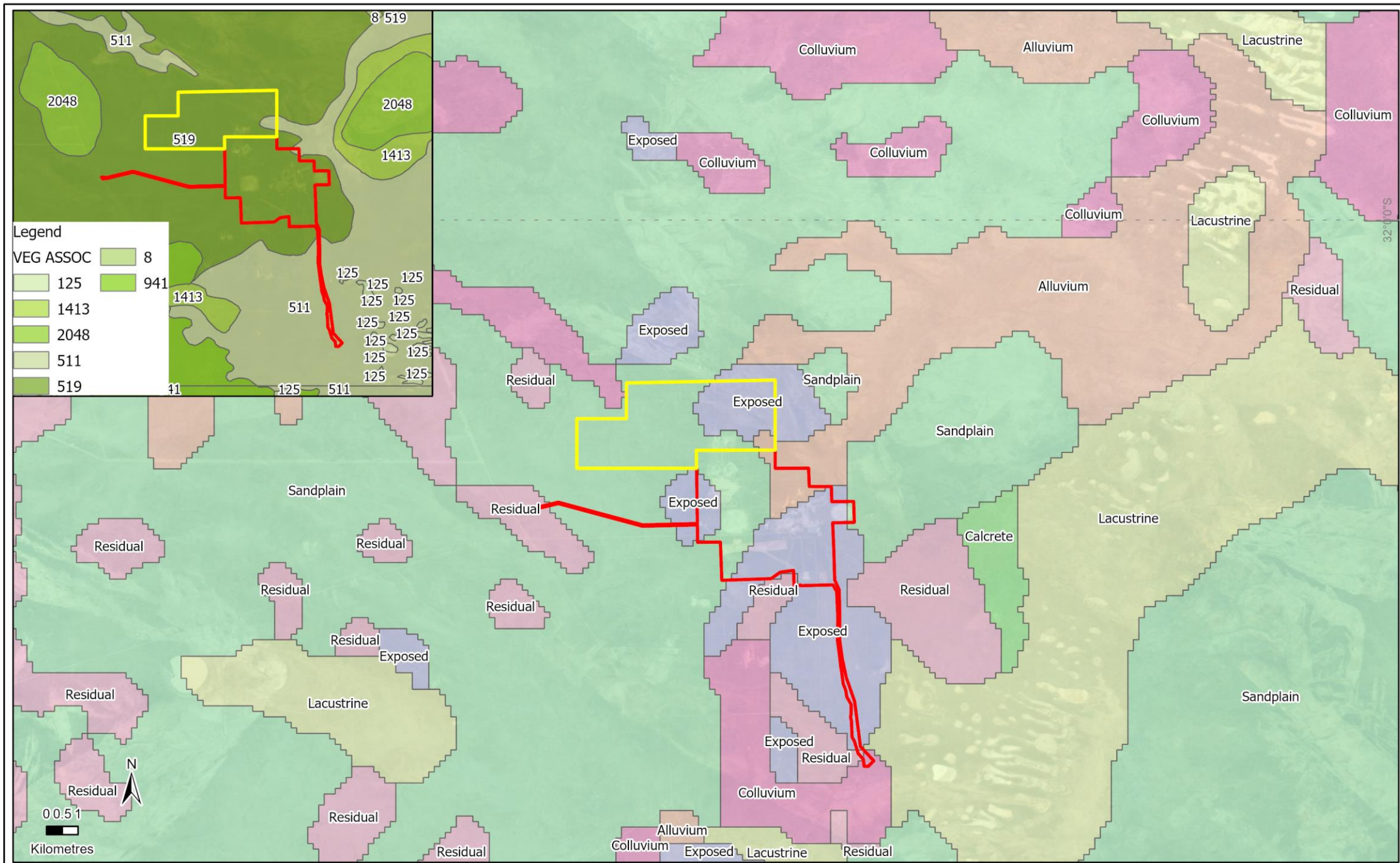
Four broad habitat units have been mapped by Bennelongia in and around the Project area as being prospective for invertebrate species belonging to SRE Groups (Figure 5): shrublands, open mallee woodland, mallee woodland, and burnt open mallee woodland (Table 2; Figure 5). The most abundant habitat within the LOM Expansion proposed envelope comprises shrubland habitat (>34%), followed by open mallee woodland (>27%) and mallee woodland (>19%). The least abundant habitat type was burnt open mallee woodland (>14%). Cleared land represented the smallest portion in the Project area (>4%). Refer to Bennelongia (2019) for areas habitats units outside of the proposed expansion area.

#### 1. Shrublands

This habitat is made up of five similar vegetation associations (Table 2) and is characterised by tall shrubland (ranging from open to closed) over sparse heathland and shrubland on clay soils. It covers 571 ha within the development envelope (over 34%) and is found outside of the Project area where it is considered regionally extensive (Figure 5). This type of habitat, although likely to be occupied by species belonging to SRE Groups such as mygalomorph spiders and scorpions, is not considered to yield significant microhabitats and restricted SRE species are unlikely to occur in this habitat. Larger trees that would provide leaf litter, bark, and shade cover are absent, and so are surface rocks and rocky outcrops, suggesting an overall low prospectivity for SRE species.

**Table 2.** Summary of SRE habitats identified in the Project area and surrounds.

SRE Habitat	Vegetation Communities (Mattiske 2018)	TOTAL AREA MAPPED (ha)	AREA WITHIN LOM EXPANSION ENVELOPE (ha)	PERCENTAGE OF DEVELOPMENT ENVELOPE AREA
1. Shrublands	H1, S1, S2, S3, S3b	1,549	571	34.65%
2. Open mallee woodland	MW6, MW7, S4, W5, W6, W7, W9, W10, W12, W13, W14, W17, W18, W19, W21, W22, W23, W26, W28	2,620	448	27.21%
3. Mallee woodland	W4, W8 W11, W25	1,342	327	19.82%
4. Burnt open mallee woodland	W15, W16, W20, W23b, W24	565	231	14.03%
Cleared land	CL	696	71	4.29%
<b>Total</b>		<b>6,772</b>	<b>1,648</b>	<b>100%</b>



GCS GDA 1994  
 Author: K. Sagastume  
 Date: 9/08/2023

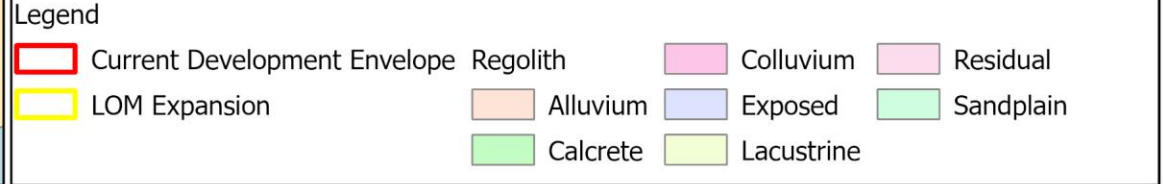


Figure 4. Regolith around the Project area.  
 Note: Inset shows Pre-European Beards Vegetation Associations.

## **2. Open mallee woodland**

This is second most common and widespread SRE habitat type in the mapped area, combining 19 mallee open woodland communities (Table 2) and covering 448.34 ha (>27%) of the development envelope (Figure 5). However, it was the most abundant SRE habitat in the total mapped area (including the current development envelope and LOM expansion; Table 3). It is characterised by open mallee woodland over sparse shrubland or heathland on grey, brown, orange, yellow, and red clays and sandy clays on flats and slopes. It differs from Mallee Woodland SRE habitat in having a more open structure, although given limited scope for field observations it is possible that a suite of fauna from SRE Groups is common to both units, due to the similar microhabitats present. Even though rocky patches are present in this habitat type they do not constitute specialised rocky habitats such as outcrop formations which are suitable for SRE species. Clayey soils may aid in moisture retention and deposits of bark and leaf litter around the bases of trees are likely to be utilised by species from SRE Groups. However, due to the wide extent of this habitat type both within and beyond the development envelope and wider region, a low degree of prospectivity for SRE species is inferred.

## **3. Mallee woodland**

This unit is an amalgamation of four mallee woodland vegetation communities (Table 2) over sparse shrubland or heathland on red, orange, and brown clays or sandy clays on flats and slopes. This habitat type is expected to hold similar diversity of species as the open mallee woodland, although these might be found in larger numbers given the higher densities of mallee trees. It covers 326.59 ha (>19%) of the Project development envelope (Figure 5) and is part of regionally extensive vegetation associations which occur outside the development envelope. Deposits of leaf litter, especially at the base of mallees, provide some refuge for mesic and soil-dwelling groups, while clayey soils may impede vertical drainage and help to retain moisture. Surface rocks are occasional, or absent, throughout. Although SRE Groups are likely to occur in deposits of leaf litter, this unit is of low prospectivity for SRE species due to its wide extent and good regional connectivity.

## **4. Burnt open mallee woodland**

This habitat comprises five vegetation associations and occurs towards the north-eastern edge of the development envelope (Figure 5). It covers an area of 231.12 ha (>14%) and has been identified also outside the development envelope. The separation of this habitat from other open mallee woodland units is based on the fact that bushfires have the tendency to affect localized species diversity, and SRE Groups such as some trapdoor spiders, pseudoscorpions, and land snails can be severely affected by them. However, this is not a restricted habitat and is expected to be reduced significantly after vegetation recovers. Any species found within the surrounding mallee woodland and open mallee woodlands are expected to occur within this habitat, with the most susceptible species to be affected by fires being the leaf litter dwellers such as slaters, millipedes, and some pseudoscorpions. Given this is a seasonal habitat subject to constant change and transformation, its prospectivity for SRE species is considered low.

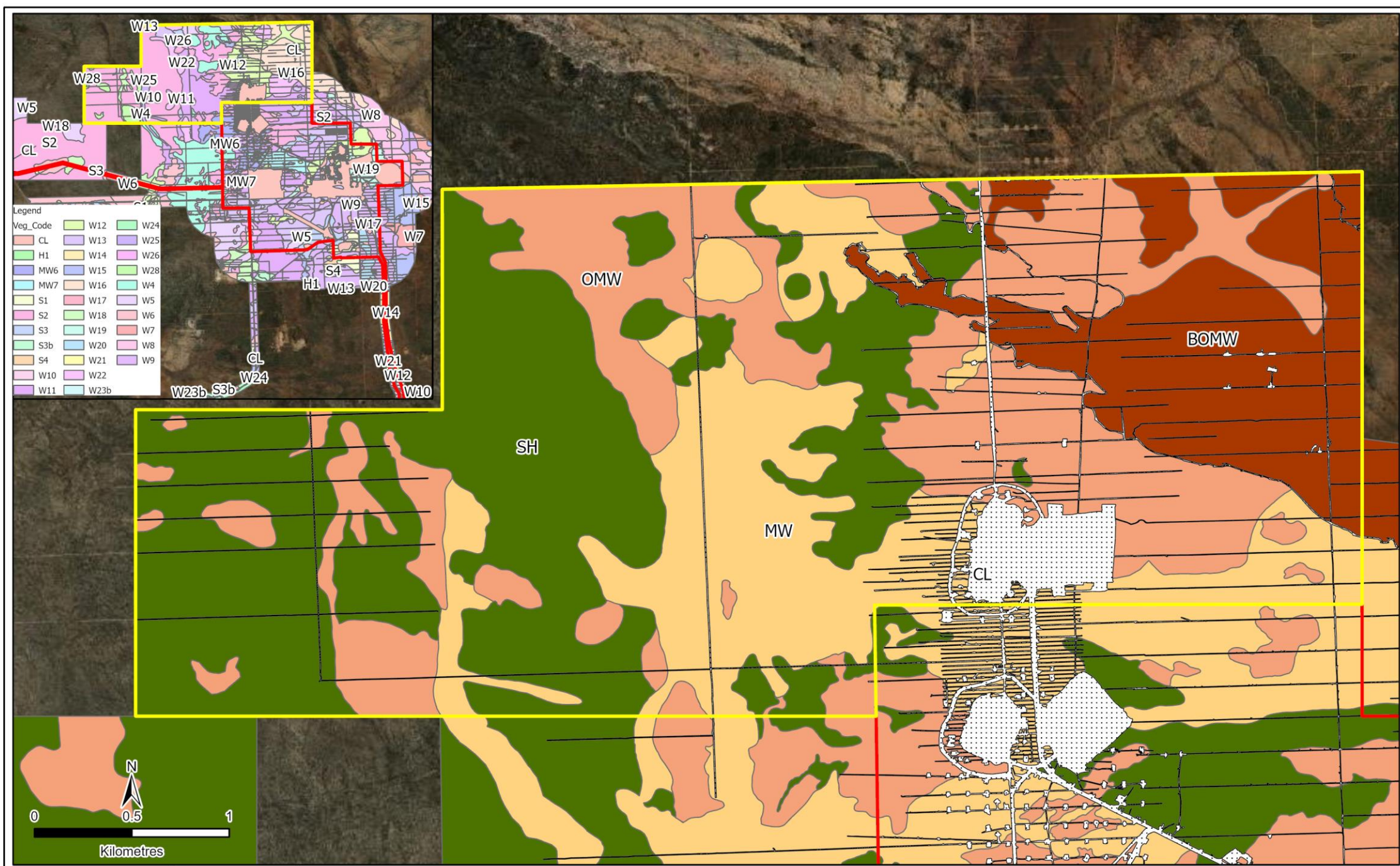


Figure 5. SRE Habitats found inside the LOM Expansion.  
 Note: Inset shows detailed Veg Units inside the LOM Expansion in relation to the Current Development Envelope.

### 6.2.2. Overview of SRE Habitat Prospectivity

Habitat units within the Project area reflect the wider landscape, as illustrated by both broad-scale regional vegetation mapping (Beard *et al.* 2013) and more detailed assessments of vegetation communities and fauna habitats across the Earl Grey (Matiske 2018, 2022; Western Wildlife 2017). While detailed mapping shows some habitat fragmentation, all units within the Project area also broadly extend beyond the Project area (Figure 5).

Bennelongia's SRE habitat mapping agrees with the findings of Western Wildlife (2017) in that relatively few fauna habitats can be identified within the numerous vegetation units. Most of the identified habitats have similar terrains, sun exposure, and moisture which makes it unlikely that habitat characteristics will prevent long-term dispersal of any SRE species.

Although some vegetation units might show fragmentation patterns, no significant barriers have been identified from the desktop study that would suggest there are substantial dispersal barriers between the SRE habitats. Thus, it is considered that any species belonging to SRE Groups and present at the Project area will for the most part have relatively widespread ranges.

## 7. CONCLUSIONS: SRE AND LISTED INVERTEBRATES

This report updates previous SRE desktop assessments surrounding the Project area (Bennelongia 2019). At least 69 species from SRE Groups have been recorded in the 100 km x 100 km desktop study area surrounding the Project, representing an additional 21 species from SRE Groups identified previously for the same search area (Bennelongia 2019).

No confirmed SRE invertebrate species have been recorded in this area.

The desktop assessment indicated 2 Likely Potential SREs, 7 Unlikely Potential SREs, 28 Data Deficient Potential SREs, and 32 Widespread species within the desktop study area. Potential SRE (Likely and Unlikely) species are limited to nine undescribed mygalomorph species. It is likely that many of these potential SRE species will have wider distributions than currently known, but until further taxonomical revision is undertaken, they can only be categorised as Potential SREs.

No conservation-listed invertebrate species were recovered in the desktop search; it is unlikely that any of them occur close to or within the Project area.

Four SRE habitat units were identified at the Project, predominantly comprising variations of mallee woodlands, but also including shrublands. Cleared lands were not considered suitable SRE habitat. These habitat units reflect the wider landscape with which they are well connected, and major geographic barriers to dispersal are absent. All units are relatively similar in terms of flora, soil, climate, exposure, and moisture retention and probably provide analogous SRE microhabitats. Relict and mesic microhabitats prospective for specialist species (such as outcrops) within the Project area were not identified. The overall prospectivity of habitats in the Project area for SRE species is low.

Based on habitat and species records, it is likely that species belonging to SRE Groups occur within the development envelope of the Project. However, we emphasise that all habitat units within the area are widespread and well-connected across the wider landscape, meaning that any SRE Group species that occurs within the Project area is highly likely to occur outside the development envelope as well. The area covered by proposed expansion is small compared with the likely ranges of SRE Group species that may be present. Overall, it is unlikely that the expansion of the Project will have significant conservation implications to either SRE species or listed terrestrial invertebrate species, if present.

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## 9. APPENDICES

### Appendix 1. Vegetation association codes presented in Figure 4 (Beard *et al.* 2013).

Vegetation Association	Beard Code	Description
125	sl	Bare areas; salt lakes
128	r	Bare areas; rock outcrops
676	k3Ci	Succulent steppe; samphire
511	e8,9Mi	Medium woodland; salmon gum & morrel
8	e8,34Mi	Medium woodland; salmon gum & gimlet
522	e10,11Mi	Medium woodland; redwood ( <i>Eucalyptus transcontinentalis</i> ) & merrit ( <i>E. floctoniae</i> )
941	e8,9Mi/e10Si	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub, redwood
1413	acmSc	Shrublands; acacia, casuarina & melaleuca thicket
519	e15Si	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>
1148	x12SZc	Shrublands; scrub-heath in the Coolgardie Region
2048	x13SZc	Shrublands; scrub-heath in the Mallee Region

## Appendix 2. Higher order taxa records found during the desktop search.

\*These records are included in the total specimen count, but do not represent individually recognized species and therefore are not included as part of the main species list (Table 1).

No.	Higher Classification	Lowest ID	No. of records
	<b>Araneae</b>		
1	<b>Anamidae</b>	<i>Aname</i> sp.	31
2		<i>Kwonkan</i> sp.	3
3		<i>Proshermacha?</i> sp.	1
4		<i>Teyl</i> sp.	9
5	<b>Barychelidae</b>	<i>Idiommata</i> sp.	1
6		<i>Synothele</i> sp.	1
7		Barychelidae sp.	1
8	<b>Idiopoda</b>	<i>Gaius</i> sp.	1
9		<i>Idiosoma</i> sp.	39
10		Idiopoda sp.	13
	<b>Isopoda</b>		
11	<b>Armadillidae</b>	<i>Buddelundia</i> sp.	3
12		Isopoda sp.	1
	<b>Pseudoscorpiones</b>		
13	<b>Atemnidae</b>	Atemnidae sp.	1
14	<b>Chernetidae</b>	<i>Haplochernes</i> sp.	2
15		Chernetidae sp.	16
16	<b>Olpiidae</b>	<i>Beierolpium</i> sp.	3
17		Olpiidae sp.	3
	<b>Scolopendrida</b>		
	<b>Scorpiones</b>		
18	<b>Bothriuridae</b>	<i>Cercophonius</i> sp.	2
19	<b>Buthidae</b>	<i>Isometroides</i> sp.	7
20		<i>Lychas</i> sp.	3
21		Buthidae sp.	2
22	<b>Urodacidae</b>	<i>Urodacus</i> sp.	3
	<b>Stylommatophora</b>		
23	<b>Bothriembryontidae</b>	<i>Bothriembryon</i> sp.	19
24	<b>Gastrocoptidae</b>	<i>Gastrocopta</i> sp.	3
	<b>Scutigermorpha</b>		
25	<b>Scutigeridae</b>	Scutigera sp.	3
	<b>TOTAL</b>		<b>171</b>