Bennelongia Environmental Consultants

Wattle Grove South SRE Invertebrate Fauna Desktop Assessment

Prepared for:

JBS&G Pty Ltd

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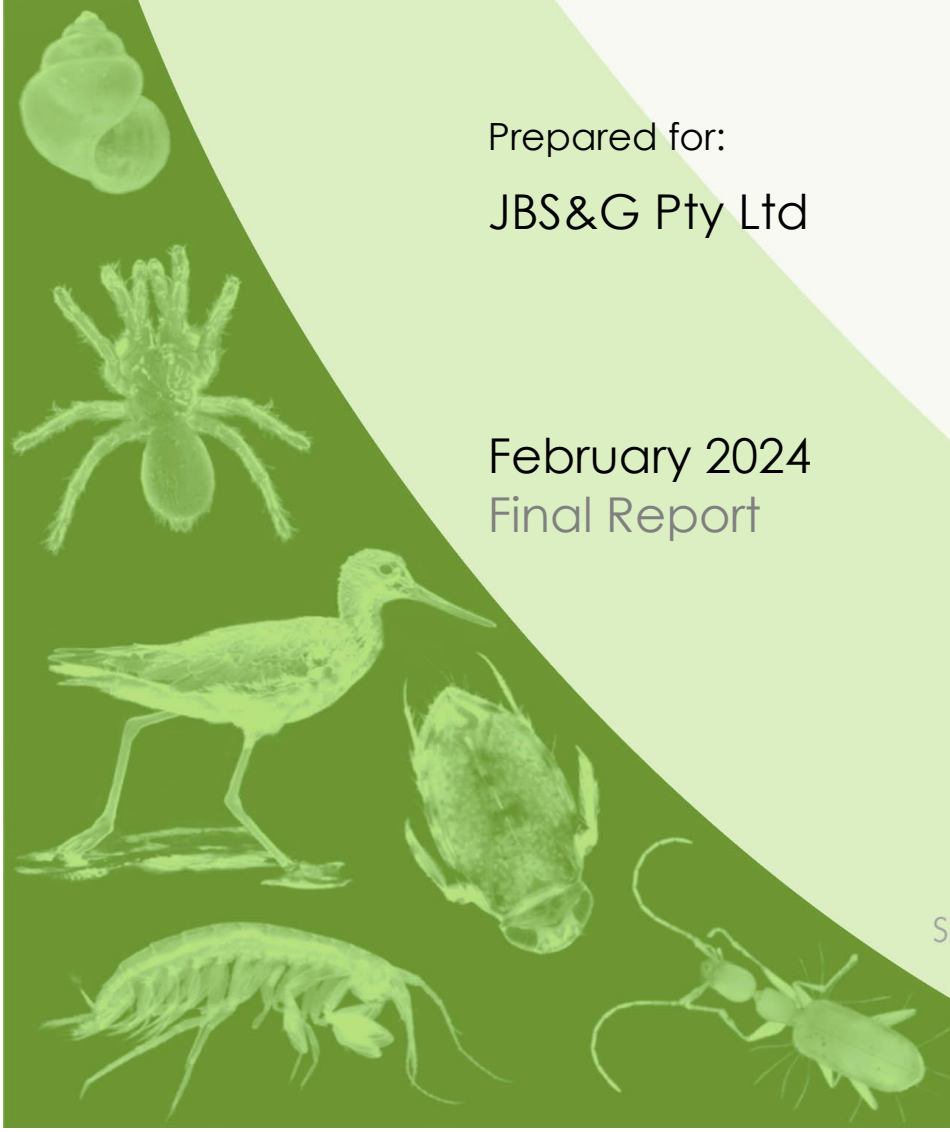
Final Report



Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Wattle Grove South SRE Invertebrate Fauna Desktop Assessment

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EXECUTIVE SUMMARY

The Western Australian Planning Commission is proposing future rezoning of approximately 125.5 ha of land in Wattle Grove from 'Rural' to 'Urban'. The land is southeast of the intersection of Tonkin Highway and Welshpool Road East/Crystal Brook Road and is subject to Metropolitan Region Scheme Amendment 1388/57 Wattle Grove South (the MRS amendment). It will affect approximately 80 rural-residential lots. The purpose of this desktop assessment is to determine the likelihood of short-range endemic (SRE) and/or conservation significant invertebrate fauna occurring in the MRS amendment area.

The search area for the desktop assessment extended 50 km north and south of the MRS amendment, bordered on the east by the Darling Scarp and on the west by the Indian Ocean. Previous records of terrestrial invertebrate species were collated from Western Australian Museum and Bennelongia databases, along with published taxonomic literature, and online resources such as the Atlas of Living Australia. The Swan Coastal Plain bioregion supports a diverse assemblage of habitats and consequently many endemic and range-restricted species occur (Rix *et al.* 2015; Rix *et al.* 2010). The desktop search found 579 species (represented by 4738 records) of species belonging to SRE Groups collected in the search area. One quarter of these (154 species) are considered to be possible SREs, with two *confirmed SREs*, 137 *likely potential SREs* (37 of which are *likely potential SREs* because of deficient data) and 17 *unlikely potential SREs*.

Eight listed Threatened or Priority species have been recorded within the search area, including two trapdoor spiders and six species of bees, however, only limited (or no) occurrences of some of these species have been found in close proximity of the MRS amendment area.

Vegetation assessment undertaken in the MRS amendment area identified some remnants of *Banksia attenuata* woodlands and a small remnant of *Eucalyptus marginata* woodland, in 'good' and better condition, which are likely to provide the most suitable habitat for SRE fauna. However, these habitats exist as small discrete fragments occupying less than 4% of the MRS amendment area. Most of the vegetation within the MRS amendment is in degraded and completely degraded condition represented by scattered native and planted trees, planted gardens, and cleared areas, which provide more limited value habitat for SRE invertebrate. For that reason, although a diverse community of potentially restricted species occurs within the desktop search area, the small areas of residual habitat appropriate for SRE species in the MRS amendment area are considered to be less suitable for maintaining a large diverse structured SRE community within the MRS amendment area. Moreover, larger areas of SRE suitable habitat are more diverse and abundant outside the MRS amendment area than within it. Notwithstanding, as the remnant areas of *Banksia attenuata* and *Eucalyptus marginata* identified as being in 'good' or better condition are proposed to be retained and managed in conservation areas, they will continue to function to provide residual SRE suitable habitat and will not contribute to further fragmentation of SRE suitable habitat on the Swan Coastal Plain.

For these reasons, overall the Metropolitan Region Scheme Amendment 1388/57 Wattle Grove South from rural to urban is not expected to have significant impacts on the conservation values of SREs or other significant terrestrial invertebrates. It is acknowledged that access to remnant areas of the *Banksia attenuata* and *Eucalyptus marginata* is currently limited, however, it is recommended that SRE surveys are undertaken within the conservation areas in the future to ensure that management plans and actions for these areas are suitable and respond to the SRE that may be present.

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1. INTRODUCTION

The Western Australian Planning Commission is proposing future rezoning of approximately 125.5 hectares (ha) of land in Wattle Grove from 'Rural' to 'Urban' under the Metropolitan Region Scheme Amendment 1388/57 Wattle Grove South (hereafter referred to as 'the MRS amendment'). The land to be affected is located southeast of the intersection of Tonkin Highway and Welshpool Road East/Crystal Brook Road and occupies approximately 80 rural-residential lots (Figure 1).

The Environmental Protection Authority (EPA) has identified terrestrial fauna, including short-range endemic (SRE) invertebrates, as a *Preliminary Key Environmental Factor* for the MRS amendment. The objectives in respect of SRE fauna (EPA 2016b) are to:

- Ensure the protection of key habitats for SRE species;
- Maintain the distribution, abundance and productivity of populations of SRE taxa; and
- Ensure that the conservation status of SRE taxa is not adversely changed as a result of development proposals.

The Environmental Protection Authority (EPA) has identified terrestrial fauna, including short-range endemic (SRE) invertebrates, as a *Preliminary Key Environmental Factor* for the MRS amendment. The purpose of this desktop assessment is to determine the likelihood of conservation significant and SRE invertebrate fauna occurring in the MRS amendment area according to EPA guidelines (EPA 2016b). The specific aims of the report are to assess:

- The likelihood of SRE species occurring in the MRS amendment area, based on the occurrence of potential SRE species in the vicinity of the MRS amendment area;
- The suitability of the MRS amendment area for SRE and listed invertebrates based on the types of habitat present;
- The likelihood of any listed invertebrate species occurring at the MRS amendment area; and
- The significance of any potential impacts on SREs and other conservation significant invertebrates as a result of the MRS amendment.

2. CONSERVATION FRAMEWORK

2.1. Listing of Threatened Terrestrial Invertebrates

The listing of species for special protection is governed at the federal level under the *Environment Protection and Biodiversity Conservation Act 1999* and at the state level under the *Biodiversity Conservation Act 2016*. The state-level listing of Threatened species (Critically Endangered, Endangered and Vulnerable species; Appendix 1) is maintained by the Department of Biodiversity, Conservation and Attractions (DBCA); additionally, the DBCA maintains a list of Priority species that potentially require protection but do not currently meet survey or data requirements for formal Threatened status (see Appendix 1 for definitions of Priority Categories).

2.2. SRE Terrestrial Invertebrates

In addition to examining the impact of developments on Threatened and Priority fauna, the assessment of impacts on SRE invertebrates in Western Australia is prescribed by the Environmental Protection Authority (EPA 2016a, b). Under this framework, SRE species are broadly defined as having an overall range of less than 10,000 km^2, following Harvey (2002). They are usually characterised by patchy or fragmented distributions within their range, slow growth, low fecundity and poor dispersal capabilities. Assessment of environmental impacts on SREs typically focuses on several taxonomic groups (the SRE Groups) that are essentially ground-dwelling and are known to contain high proportions of species with these characteristics. In southwestern Australia, the SRE Groups include land snails (Gastropoda); millipedes (Diplopoda); centipedes (Chilopoda); pseudoscorpions (Pseudoscorpiones); scorpions (Scorpiones); spiders [Araneae, mainly Mygalomorphae (trapdoor spiders), but also some modern

spiders within Aranaeomorphae]; slaters (Isopoda), harvestmen (Opiliones), velvet worms (Onychophora) and earthworms (Oligochaeta).

The SRE Groups listed above provide a useful practical framework for identifying potential restricted species, however it is important to note two further points. First, SREs can also occur in groups where most other species are widespread because they have high vagility, ecological plasticity or xeric adaptation (Framenau *et al.* 2008; Rix *et al.* 2015). Second, many species belonging to SRE Groups are in fact widespread. Therefore, determining whether a species has a significantly restricted range (notionally <10,000 km^2) is more difficult than simply identifying them as belonging to an SRE Group. One guide to the range of an SRE Group species is that it is likely to be confined to the extent of its preferred or obligate habitat(s), so that species that are only found in restricted or patchy habitats usually have smaller ranges than those collected from extensive or common habitats. Nevertheless, some groups occurring in widespread habitats are subject to regular species turnover (e.g. due to climatic gradients), which results in a species occupying only part of a widespread habitat and, therefore, being an SRE with a range that is much smaller than the extent of its apparently suitable habitat (Rix *et al.* 2015).

In this desktop assessment, the SRE status of each species recorded in the search area was determined using a modified version of the Western Australian Museum's (WAM) SRE classification system (Appendix 2). The modifications used by Bennelongia aim to account for the fact that many recorded species have limited available data on their taxonomy, range, habitat preferences, and/or natural history.

As a first step in classification, species in the SRE Groups identified above were assigned to the following categories:

- **Confirmed SREs** have a known range <10,000 km^2. The taxonomy is well known, and the group well represented in collection and/or via comprehensive sampling.
- **Potential SREs** are species for which there are gaps in knowledge, either because they are not well represented in collections, taxonomic knowledge is incomplete, or the distribution is poorly understood due to insufficient sampling.
- **Widespread (not an SRE)** species have a known distribution range >10,000 km^2. The taxonomy is well known, and the group well represented in collections via comprehensive sampling.

Potential SREs are assigned as *likely* or *unlikely potential SREs* based on the following information (if available):

- Habitat indicators and degree of specialisation (e.g. occur only in habitat typical of SREs; occur in one or multiple habitats);
- Research and expertise (assigned by expert; use expert information of the biology and ecology of related species); and/or
- Molecular evidence regarding the genetic variability within sampling areas.

If species are data deficient in all these areas, the precautionary approach was taken of assigning them as data deficient *likely potential SREs*; although we highlight these species in our results and note the lack of available data.

Additionally, while species are considered *confirmed SREs* if their known, or likely range, is less than 10,000 km^2, even *confirmed SREs* can be locally widespread around and, at the scale of, a project area. Thus, identifying SRE species is only the first step in a filtering process used to determine which ground-dwelling species may be threatened by a proposed development. The actual level of threat to an SRE species depends on its distribution relative to the development footprint, rather than SRE status alone. Determining this level of threat requires consideration of the extent of the species' preferred habitat, both within and outside the study area, as well as the likely area of disturbance of this preferred habitat as a result of the proposal.

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GCS GDA 1994
Author: Rhare
Date: 17/01/2023

Figure 1: Location of the MRS amendment area with respect to local major roads and IBRA bioregions.

Legend

- Towns
- Project location
- Main roads
- Project boundary

IBRA bioregions

- Jarrah Forest
- Swan Coastal Plain

3. LOCAL ENVIRONMENT

3.1. Regional setting: Swan Coastal Plain

The Perth metropolitan area is located within the Swan Coastal Plain, one of the 89 Australian bioregions recognised by the Interim Biogeographic Regionalisation of Australia (IBRA). The Swan Coastal Plain covers low-lying areas from Cape Naturaliste to Jurien Bay, bordered to the west by the Indian Ocean and to the east by the Darling Scarp. The surface geology of the region primarily consists of a parallel series of Quaternary sand dunes, along with areas of alluvial, colluvial and lacustrine deposits (Figure 2). The bordering Darling Scarp is an uplifted section of the much older (Archean) Yilgarn Craton, which primarily consists of granite terrains (Myers and Watkins 1985). The climate of the Swan Coastal Plain is Mediterranean, with cool, wet winters and warm, dry summers. The plain is part of a broader, ancient landscape in southwestern Australia that is isolated by bordering oceans and arid areas and has remained unglaciated for hundreds of millions of years (Hopper and Gioia 2004). As a result of the long period of isolation, weathering, and climatic stability the region is characterised by high levels of diversity and endemism in both its flora and fauna; indeed, the Southwest Australian Floristic Region is recognised as a listed global diversity hotspot (Hopper and Gioia 2004). The Swan Coastal Plain itself is characterised by seasonally wet eucalypt (e.g. jarrah, *Eucalyptus marginata*, and marri, *Corymbia calophylla*) and *Banksia* woodlands, with more open forests (e.g. tuart, *E. gomphocephala*, and peppermint, *Agonis flexuosa*) common in some places, particularly south of Bunbury (Rix *et al.* 2015). Along the coast in the northern part of the subregion, as it crosses into the transitional rainfall zone, sandy heathlands and shrublands ('Kwongan' vegetation) can be prevalent (Rix *et al.* 2015).

3.2. SRE invertebrates of the Swan Coastal Plain

Despite its proximity and familiarity to most residents of Western Australia, the fauna of the Swan Coastal Plain has traditionally received less formal survey attention than other sub-regions of southwestern Australia (Rix *et al.* 2010), despite much ad-hoc collecting. It has also often been assumed that complex topologies such as the Darling Scarp will be more conducive to ground-dwelling invertebrate SRE species than flat landscapes such as the Swan Coastal Plain, due to the occurrence of gullies and granite outcrops providing damp, sheltered environments and other refugial habitats. However, there is considerable habitat variability on the Swan Coastal Plain and many endemic and range-restricted species occur (Rix *et al.* 2015; Rix *et al.* 2010). These include spiders occupying leaf-litter habitats on Quindalup dune systems (Rix 2006; Rix *et al.* 2015; Rix *et al.* 2010), and the millipede genus *Antichiropus,* one of the most diverse invertebrate genera in Western Australia (Framenau *et al.* 2008), contains one described species and likely several undescribed species that are endemic to bushland of the Swan Coastal Plain (Car *et al.* 2013). Bushland remnants in the Perth metropolitan area are considered important residual habitats for invertebrates; with larger remnants tending to host more diverse invertebrate communities (Harvey *et al.* 1997).

Extensive fragmentation of original habitats associated with the Perth metropolitan area has threatened the persistence of specialist and low-dispersing invertebrate species. For example, Rix *et al.* (2017a) found that the trapdoor spider *Idiosoma sigillatum* had declined across much of its former range and was now restricted to remnant reserves and woodland in and around the Perth metropolitan area, resulting in it meeting the criteria for 'vulnerable' assessment on the IUCN Red List. There are also several species of invertebrates on the Swan Coastal Plain from groups typically considered non-SRE that have been formally listed as threatened, such as native bees and moths (Pille Arnold *et al.* 2019; Williams 2009).

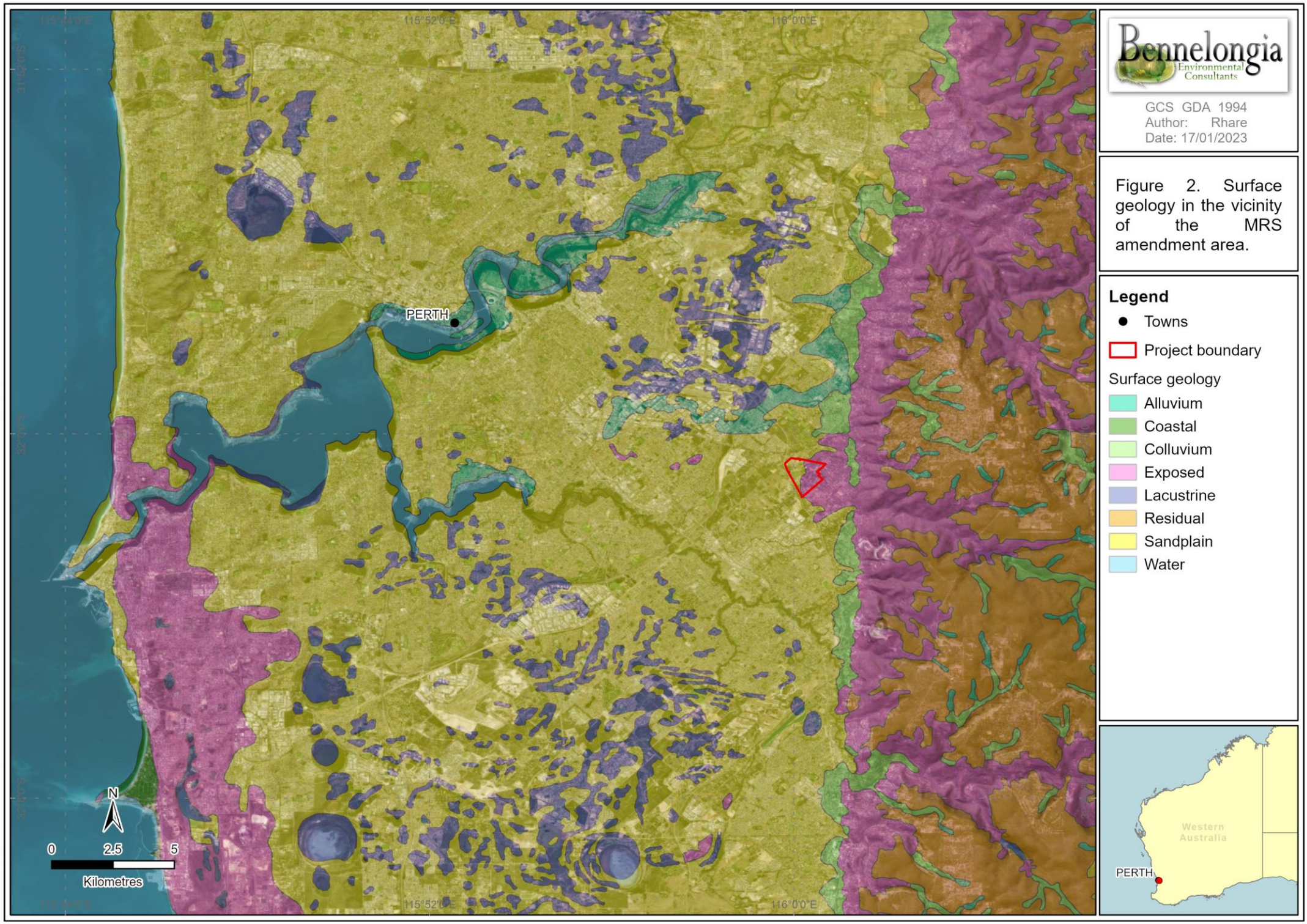

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Figure 2. Surface geology in the vicinity of the MRS amendment area.

Legend

- Towns
- Project boundary

Surface geology

- Alluvium
- Coastal
- Colluvium
- Exposed
- Lacustrine
- Residual
- Sandplain
- Water

4. METHODS

Existing records of terrestrial invertebrate species were collated from WAM and Bennelongia databases, along with published taxonomic literature, and online resources such as the Atlas of Living Australia, for a search area extending 50 km north and south of the MRS amendment area, bordered on the east by the Darling Scarp and on the west by the Indian Ocean. Although the MRS amendment area lies near the Darling Scarp, the latter was excluded from the search area because it is topographically and geologically distinct from the Swan Coastal Plain, and likely to contain many habitats and species that are not representative of the MRS amendment area. We first determined whether any invertebrates recorded in the search area were listed as Threatened or Priority species. For the remaining species, we applied the criteria outlined in Section 2.2 to identify *confirmed* or *potential SREs*. Many of the records were higher order identifications for which the species had not been determined; these were retained in the final list only if there were no other species-level identifications within the same taxonomic group.

5. DESKTOP RESULTS

5.1. Habitat types in the MRS amendment area

The MRS amendment area is located on the border of three vegetation complexes mapped by Heddle *et al.* (1980) (Figure 3):

- *Forrestfield Complex*: Vegetation ranges from open forest of *Corymbia calophylla – Eucalyptus wandoo – E. marginata* to open forest of *E. marginata – C. calophylla – A. fraseriana – Banksia* spp; associated with Ridge Hill Shelf landform;
- *Southern River Complex*: Open woodland of Marri-Jarrah-banksia on the elevated areas and a fringing woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* along the streams;
- *Guildford Complex*: A mixture of open forest to tall open forest of *C. calophylla – E. wandoo – E. marginata* and woodland of *E. wandoo* (with rare occurrences of *E. lane-poolei*). Minor components include *E. rudis – M. rhaphiophylla*.

Specific vegetation assessment was undertaken by AECOM (2020), where the survey area included the MRS amendment area. JBS&G (2024) undertook further ecological surveys within the MRS amendment areas and confirmed that three native vegetation communities are present (Table 1), along with significantly altered land (including planted trees, gardens, scattered trees, and cleared areas). These communities are represented by small, discrete remnants of vegetation and comprise less than 4% of the MRS amendment area, with conditions varying from 'Excellent' to 'Degraded'. The majority of the vegetation condition within the MRS amendment area is 'Completely Degraded/Cleared' (96.91%); (JBS&G 2024).

Table 1. Vegetation communities within the MRS amendment area as identified by AECOM (2020) and confirmed by JBS&G (2024).

Vegetation community	Description
BaEpPf Banksia Woodland (3.37%)	*Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* low open woodland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Allocasuarina humilis* low shrubland over *Phlebocarya filifolia, Mesomelaena pseudostygia* and *Lepidosperma leptostachyum* low sedgeland.
BmXpEc Banksia Woodland (0.34%)	*Banksia menziesii, Allocasuarina fraseriana* and *Eucalyptus todtiana* low open woodland over *Xanthorrhoea preissii*, *Eremaea pauciflora var. pauciflora* and *Stirlingia latifolia* low open shrubland over **Ehrharta calycina*, *Dasypogon bromeliifolius* and *Anigozanthos manglesii subsp. manglesii* mixed grass and forbland.
EmMpLp *E. marginata* Woodland (0.10%)	*Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana* mid open forest over *Mesomelaena pseudostygia* and *Tetraria octandra* low sedgeland with *Lomandra preissii, Tricoryne elatior* and *Dampiera linearis* low open forbland.

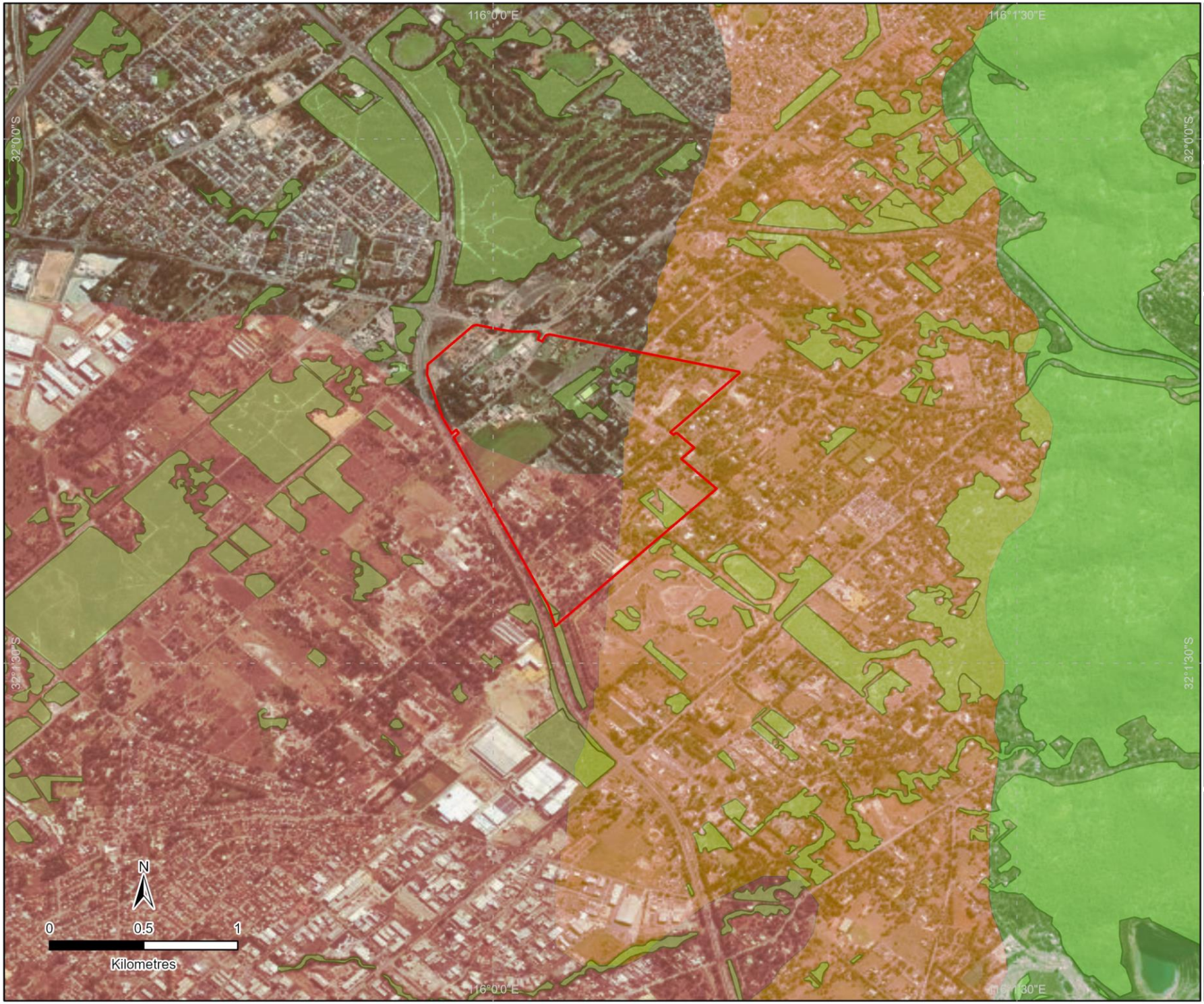

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Figure 3. Vegetation complexes and native vegetation extent in the MRS amendment area.

Legend

- Project boundary
- Native Vegetation Extent (DPIRD-005)

Vegetation Complexes

Swan Coastal Plain (DBCA-046)

- Forrestfield Complex
- Guildford Complex
- Southern River Complex

South West forest region of Western Australia (DBCA-047)

- Darling Scarp, DS2

As a result, the native vegetation of the MRS amendment area is broadly composed of small discrete areas of remnant *Banksia*/eucalypt woodland, which represent suitable SRE habitat. *Banksia*/eucalypt woodlands have moderate suitability for SRE fauna (Invertebrate Solutions 2019), and generally are known to support priority and range-restricted invertebrates, such as the graceful sun moth (*Synemon gratiosa*), which has a range of 5000 km^2 (i.e. meets SRE criterion but not treated as an SRE in assessment because not a ground-dwelling SRE Group species), endemic millipedes of the genus *Antichiropus* (Threatened Species Scientific Committee 2016), and Douglas's broad-headed bee (*Hesperocolletes douglasi*, also not an SRE Group species) (Pille Arnold *et al.* 2019). Harvey *et al.* (1997) found remnant bushland in the Perth region to hold moderate to high diversity of various invertebrate groups, including mygalomorph spiders. Microhabitats appropriate for SRE species potentially found within the MRS amendment area include bark, leaf litter, soil humus and large debris.

5.2. SRE invertebrates in the search area

The desktop search recovered 4738 records of animals belonging to SRE Groups from the search area, classifiable to 579 species (we show only SRE and potential SRE species in Appendix 3). One quarter of these species (154 species) are considered to be SRE or potential SRE species with known or potential ranges of <10,000 km^2. Of these, two species were considered *confirmed SREs*; the anapid spiders *Raveniella arenacea* and *R. subcirrata*, which are endemic to the Swan Coastal Plain (Rix *et al.* 2010). Of the 152 species assigned as *potential SREs*, 135 were considered *likely potential SREs* (37 of these due to data deficiency) and 17 were considered *unlikely potential SREs*. Comments on the SRE Groups and likely habitats in comparison to the MRS amendment area are provided below. Owing to the large number of *likely potential SRE* species, comments on each group are general.

Araneomorph (modern) spiders

A total of 52 *likely potential* or *confirmed SRE* species of ground-dwelling modern spiders have been recorded in the search area (14 families represented in total). Many of these species are associated with remnant *Banksia*/eucalypt habitats similar to those in the MRS amendment area. They include several species of jumping spider in the genera *Lycidas* and *Maratus* that are litter dwellers of forest habitats and/or have only been recorded from coastal distributions of the Perth area (Richardson *et al.* 2006; Waldock 2013). *Raveniella arenacea* and *R. subcirrata* are two species of *confirmed SRE* micropholcommatid spiders found only in leaf litter habitats of Quindalup dune systems (Rix *et al.* 2010).

Mygalomorph (trapdoor) spiders

Mygalomorph spiders are well known as *potential* SREs. They show slow responses to changes in habitat or environment (Main 2001) and can be extremely long-lived (Mason et al. 2018b). The desktop search returned 37 *potential SRE* species, with the highest number of species within the family Anamidae. Although the vast majority of these records are of undescribed species, with little or no information about their habitats or distribution, they belong to genera known to contain species with restricted ranges, such as *Missulena, Aname*, *Teyl* and *Idiosoma* (Harvey *et al.* 2012; Main 1985; Miglio *et al.* 2014; Rix *et al.* 2018). Additionally, trapdoor spider communities are known to occur in *Banksia* woodland habitats similar to those of the MRS amendment area (Mason *et al.* 2019; Mason *et al.* 2018; Rix *et al.* 2018).

Opiliones (harvestmen)

Two *potential SRE* species of harvestmen were recorded in the search area. The undescribed species of *Megalopsalis* and *Nunciella* were considered *likely potential SREs* due to data deficiency. While harvestmen may often be SREs because of limited dispersal capability and specialised microhabitat requirements (Framenau *et al.* 2008), the likely distributions of these two species cannot be determined without further taxonomic information. In relation to the specific habitats within the MRS amendment area, it is currently unclear whether species of *Megalopsalis* or *Nunciella* have any association with *Banksia* woodland, although there are records of the genera from Perth jarrah habitats (e.g. Koch and Majer 1980).

Pseudoscorpions

A total of six *potential SRE* species of pseudoscorpions were recorded from four families in the search area. Although many species recorded are from groups known to be associated with restricted ranges and specialised habitat preferences (e.g. Chernetidae, Garypidae), it is difficult to determine their likely ranges species by species.

Scorpions

The desktop search returned six *potential SREs* species of scorpion in two families (Buthidae and Urodacidae). Five of these were undescribed species of *Lychas* (four species) and *Urodacus* (one species). The described species was *Urodacus* planimanus, which is only known from southwest Western Australia (Koch 1977; Volschenk *et al.* 2012). In general, members of the family Urodacidae are likely to prefer rock outcropping on slopes of the Darling Scarp rather than the more uniform topography of the metropolitan Perth area (Koch 1977).

Isopods (slaters)

Eighteen slater species belonging to three families (Armadillidae, Philosciidea and Styloniscidae) were considered *potential SREs* within the search area. Several of these are morphospecies of *Buddelundia* known from soil, leaf litter and log microhabitats in bushland remnants on sandy soils of the Swan Coastal Plain (Judd 2004). It is uncertain whether these isopod groups are associated with *Banksia* woodland, but jarrah (which is present in limited numbers in the MRS amendment area) appears to be an important component of many prospective habitats for such species (Judd 2004).

Chilopods (centipedes)

A total of six species of centipede within the search area were considered *potential SREs*, including three species belonging to the order Scolopendrida (families Cryptopidae and Scolopendridae), two from the order Geophilida (family Chilenophilidae), and one species from the order Lithobiomorpha (unknown family). From these, *Eurytion incisunguis* and *Notiasemus glauerti* are the described species, known only from the Perth area, and considered *likely potential SREs*. Habitat requirements for these species are unclear, however, *N. glauerti* has been collected from remnant bushland likely to resemble that of the MRS amendment area (Koch 1985).

Diplopods (millipedes)

Of the millipedes, 16 of the 20 species in the list are from the genus *Antichiropus*, which is large and widely distributed. However, *Antichiropus* species are limited in dispersal ability and are frequently SREs with very small distributions (Car *et al.* 2013). As a result, all species were considered *likely potential SREs*. The desktop also returned three described species of millipedes belonging to the families Dalodesmidae (*Sphaerotrichopus ramosus*) and Iulomorphidae (*Dinocambala ingens* and *Podykipus collinus*), and one unidentified species of the family Siphonotidae. The two iulomorphid species are both restricted to the Perth area and also considered *likely potential SREs* (Edward and Harvey 2010; Framenau *et al.* 2008). Due to little information regarding the distribution of *S. ramosus*, the species is considered *likely potential SREs* due to data deficiency.

Gastropods (land snails)

The desktop search returned six *likely potential SRE* species of snail from the families Bothriembryontidae, Charopidae, Punctidae and Succineidae. *Bothriembryon* species (two in the search area) are typically limited to cool, moist microhabitats in coastal southwestern WA (Whisson 2019), and many are considered SREs (Framenau *et al.* 2008). Many *Bothriembryon* species are known to inhabit *Banksia*-jarrah woodlands on sandy soils (Whisson and Ryan 2019), which resembles the habitat type found at the MRS amendment area. The charopid species (*Epinicium restifer* and *Luinodiscus sublestsa*) are from a group composed mostly of widely distributed species that are primarily leaf litter dwellers in refugial damp woodland patches (Shea *et al.* 2012), but both recorded species are known only from the Perth area. Similarly, *Succinea contenta* has only been recorded in the Perth area and Rottnest Island. One unidentified species belonging to the genus *Westralaoma* was considered *likely potential SRE* due to data deficiency.

5.3. Threatened and Priority species in the search area

The desktop assessment returned eight listed terrestrial invertebrate species within the search area (Table 2; Figures 4 and 5). This includes two Priority species of mygalomorph spiders, three Priority species of bees and three Threatened species of bees. Several of these species have been found in bushland remnants in Perth that resemble the remnant vegetation habitats in the MRS amendment area.

Table 2. Listed Threatened and Priority terrestrial invertebrates within the search area

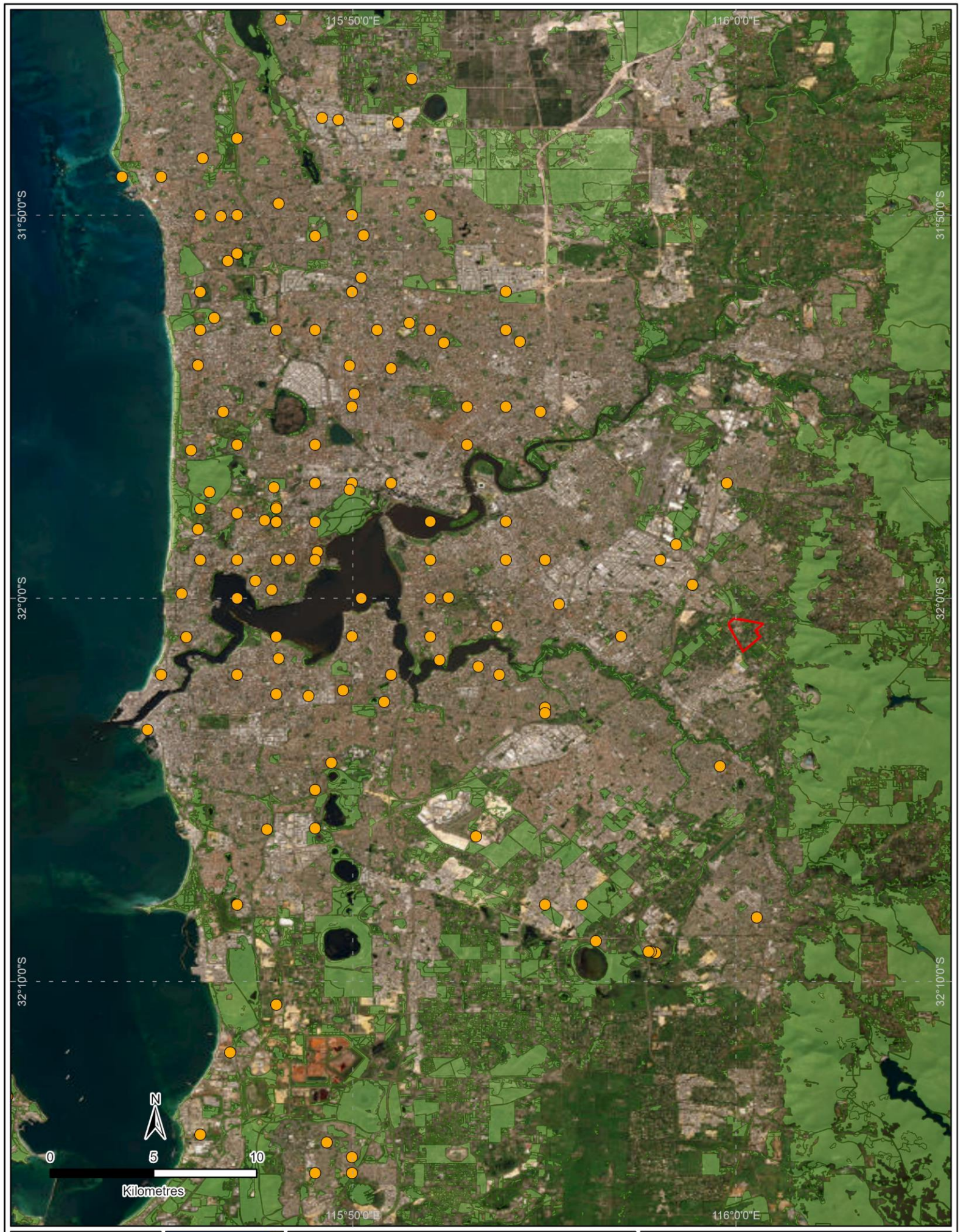
Higher Classification	Lowest Identification	BCA (2016) Status	EPBC (1999) Status
Arthropoda			
Arachnida			
Araneae			
Mygalomorphae			
Idiopidae	*Euoplos inornatus*	P3	
	Idiosoma sigillatum	P3	
Insecta			
Hymenoptera			
Colletidae	*Glossurocolletes bilobatus*	P2	
	Hesperocolletes douglasi	CR	
	Hylaeus globuliferus	P3	
	Leioproctus contrarius	P3	
	Leioproctus douglasiellus	EN	CR
	Neopasiphae simplicior	EN	CR

Trapdoor spiders

Europlos inornatus is a species of trapdoor spider mainly found on the western Darling Scarp, with one record at the Mt Henry peninsula in Salter Point, approximately 13 km west of the MRS amendment area (Figure 4). The most commonly recorded of the listed species within the search area is the shield-backed spider *Idiosoma sigillatum* with more than 200 records from within the search area (Figure 4), including in the close vicinity of the MRS amendment area. As its distribution has declined from its historical range, wooded urban remnants are important for this species (Rix *et al.* 2018; Rix *et al.* 2017b).

Native bees

The remaining six species are native bees (Figure 5). *Glossurocolletes bilobatus* is endemic to south-west Australia and has been collected from one location within the search area, at the Hartfield Park in Forrestfield, approximately 2.5 km southwest of the MRS amendment area. This species is rated as likely to occur in the Threatened Ecological Community '*Banksia* Woodlands of the Swan Coastal Plain' (Threatened Species Scientific Committee 2016). Douglas' broad-headed bee, *Hesperocolletes douglasi* was originally described from a specimen on Rottnest Island. However, Pille Arnold *et al.* (2019) found a second specimen from remnant *Banksia* woodland of the northern Perth area. It is unclear whether this species occurs in other *Banksia* woodland remnants in the metropolitan area. The Priority 3 bee *Hylaeus globuliferus* records in the search area are from bushland remnants in the northern suburbs of Perth, approximately 38 km northwest of the MRS amendment area, and may rely on *Banksia* and other Proteaceae species (Houston 2018). The short-tonged bee *Leioproctus contrarius* and the congeneric critically endangered *L. douglasiellus* are rated as likely to be inhabitants of 'the *Banksia* Woodlands of the Swan Coastal Plain' ecological community (Threatened Species Scientific Committee 2016). *L. contrarius* has only been observed on the Swan Coastal Plain, while *L. douglasiellus* was previously collected in eastern Australia, though currently its population is believed to be restricted to suburban Perth (DSEWPC 2013). Finally, the threatened bee *Neopasiphae simplicior* is known from a single location within the Forestdale Lake Nature Reserve (DEWHA 2008), and is rated as likely to occur in *Banksia* Woodland SCP ecological communities (Threatened Species Scientific Committee 2016).



Bennelongia Environmental Consultants

GCS GDA 1994
Author: Rhare
Date: 17/01/2023

Legend

- Project boundary
- Native Vegetation Extent (DPIRD-005)
- *Idiosoma sigillatum*

Figure 4. Records of *Idiosoma sigillatum* in the Perth metropolitan area.

Bennelongia Environmental Consultants

GCS GDA 1994
Author: Rhare
Date: 17/01/2023

Legend

- Project boundary
- Native Vegetation Extent (DPIRD-005)

Records

- Spiders
- Bees

Figure 5. Records of other Threatened and Priority invertebrate species in the Perth metropolitan area.

6. CONCLUSIONS

The MRS amendment area lies on the Swan Coastal Plain, at the border with the Darling Scarp, and includes remnants of three vegetation communities that can be condensed into two main vegetation types: *Banksia attenuata* woodland and *Eucalyptus marginata* woodland. While these vegetation types are considered to provide the most suitable habitat for SRE fauna, they are present as small fragments of remnant bushland in the MRS amendment area, with most of the remaining vegetation consisting of planted trees, gardens, scattered trees, together with significant cleared areas. The condition of most of the vegetation in the area was identified as either cleared or completely degraded with only the small remnants of native vegetation identified as being in 'good' or better condition.

The desktop assessment returned 2 *confirmed SRE* species, 135 *likely potential SRE* species (with 37 of these due to data deficiency), 17 *unlikely SRE* species and 425 widespread species within the search area. The list of species with some possibility of being SREs includes 52 species of araneomorph spider, 37 species of mygalomorph spider, 20 species of millipede, 18 species of slater, seven species of pseudoscorpion, six species each of scorpion, centipede and land snail, and two species of harvestman. Additionally, eight listed Threatened or Priority species were identified within the search area, including two trapdoor spiders and six species of bee, however, only very limited (or no) occurrences of some of these species have been found in close proximity of the MRS amendment area.

There is a great deal of taxonomic and ecological uncertainty in many of the records from the desktop search area. It is possible this taxonomic uncertainty has inflated species numbers but it is clear that a diverse community of potentially restricted species occurs in the desktop search area and, by implication, in the MRS amendment area as well if habitat fragmentation has not already eliminated these species. The remnant areas of *Banksia attenuata* and *eucalyptus marginata* identified as being in 'good' or better condition provide the most suitable habitat for SRE fauna. It is understood that these are proposed to be retained and managed in conservation areas, and if so, they will continue to function to provide residual SRE suitable habitat and will not contribute to further fragmentation of SRE suitable habitat on the Swan Coastal Plain.

On this basis, it is considered that overall the Metropolitan Region Scheme Amendment 1388/57 Wattle Grove South from rural to urban is not expected to have significant impacts on the conservation values of SREs or other significant terrestrial invertebrates.

It is acknowledged that access to remnant areas of the *Banksia attenuata* and *eucalyptus marginata* is currently limited, however, it is recommended that SRE surveys are undertaken within the conservation areas in the future to ensure that management plans and actions for these areas are suitable and respond to the SRE that may be present, particularly in relation to the control of weeds, fire and other disturbances.

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Appendix 1. Threatened and Priority Species Categories

Western Australia – Biodiversity Conservation Act (2016)
The following is reproduced from:
Department of Biodiversity, Conservation and Attractions. *Conservation Codes for Western Australian Flora and Fauna*. Available at: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf (Accessed 28 October 2022).

Threatened species
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

- CR, Critically Endangered: Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".
- EN, Endangered: Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".
- VU, Vulnerable: Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Priority species
Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

- P1: Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
- P2: Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
- P3: Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not

meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

- P4: (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Australia – Environmental Protection and Biodiversity Conservation Act 1999

Listing of species under the EPBCA 1999 is based on the IUCN Red List categories and criteria for threatened species listing. In addition to the categories Extinct (EX) and Extinct in the Wild (EW), these include:

- CR, Critically Endangered: Considered to be facing an extremely high risk of extinction in the wild
- EN, Endangered: Considered to be facing a very high risk of extinction in the wild.
- VU, Vulnerable: Considered to be facing a high risk of extinction in the wild.

These considerations are based on the criteria set out in:
IUCN (2000) *IUCN Red List and Criteria, V 3.1*. Available at http://s3.amazonaws.com/iucnredlist-newcms/staging/public/attachments/3097/redlist_cats_crit_en.pdf (Accessed 28 October 2022).

Additionally, under the EPBCA 1999 species in Australia can be listed under the category Conservation Dependent, if:

(a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming Vulnerable, Endangered or Critically Endangered; or
(b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

For more information, see:
Threatened Species Scientific Committee (2014) *Guidelines for assessing the conservation status of a native species*. Available at https://www.dcceew.gov.au/sites/default/files/env/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2021.pdf (Accessed 28 October 2022).

Appendix 2. Western Australian Museum SRE Classification System

Confirmed SREs are species with well understood taxonomy that are well represented in collections or come from areas that have been well sampled and have a known distribution range <10,000 km^2.
Potential SREs are species that belong to genus or other taxonomic grouping for which there are gaps in our knowledge, either because the taxon is not well represented in collections, taxonomic knowledge is incomplete, or species distributions are imperfectly understood because sampling has been patchy.
Widespread (not SRE) species have a known distribution range >10,000 km^2. The taxonomy of the species is well understood, and it is well represented in collections.

The WAM uses five further sub-categories if a species is determined to be a "Potential SRE". These relate to the reasons for treating a species as a Potential SRE:

1. Data deficient: This is a precautionary sub-category classification where the species is treated as a Potential SRE because there are insufficient data available to determine SRE status, either because there is a lack of geographic and taxonomic information, or because the individuals sampled cannot be identified to species level (e.g. wrong sex, juvenile, damaged);

2. Habitat Indicators: Here and in the following sub-categories, there is some evidence available from which the likely SRE status of the species may be inferred. For example, habitat indicators may suggest a species is likely to be an SRE because of its association with a particular habitat;

3. Morphological Indicators: The likely SRE status of a species may be determined through its morphological characteristics;

4. Molecular Evidence: DNA sequence data reveal patterns congruent with the species being an SRE; and

5. Research & Expertise: Available research data and/or WAM expertise may provide the basis for considering a species likely to be an SRE.

Appendix 3. Species from SRE Groups in the Search Area

Species marked with an asterisk under the SRE category column were data deficient and assigned as *Likely potential SREs* by default (see Section 2.2).

Higher Classification	Lowest dentification	SRE category
Arthropoda		
Chelicerata		
Arachnida		
Araneae		
Araneomorphae		
Anapidae	*Micropholcomma `sp.`*	Likely potential SRE
	Raveniella arenacea	Confirmed SRE
	Raveniella subcirrata	Confirmed SRE
Araneidae	*Paralarinia `sp.`*	Likely potential SRE*
Hersiliidae	*Tamopsis darlingtoniana*	Likely potential SRE*
Lamponidae	*Lamponusa gleneagle*	Likely potential SRE
	Pseudolampona woodman	Likely potential SRE
Lycosidae	*Artoria `sp.`*	Unlikely potential SRE
Malkaridae	*Westrarchaea sinuosa*	Likely potential SRE
Miturgidae	*`Miturgopelma` `echidna`*	Unlikely potential SRE
Oonopidae	*Opopaea framenaui*	Likely potential SRE*
	Opopaea gracillima	Likely potential SRE*
	Opopaea marangaroo	Likely potential SRE*
	Opopaea rixi	Likely potential SRE*
	Orchestina `aeroporta`	Likely potential SRE*
	Xestaspis `UBS Cat sp. 128`	Likely potential SRE*
	Xestaspis `UBS Cat sp. 129`	Likely potential SRE*
	Xestaspis `UBS Cat sp. 19`	Likely potential SRE*
Orsolobidae	*Tasmanoonops `tuberosus`*	Likely potential SRE
Salticidae	*Holoplatys dejongi*	Likely potential SRE*
	`Lycidas` `big embolis`	Likely potential SRE
	Lycidas `Brookdale sp. 1`	Likely potential SRE
	Lycidas 'gyngyn'	Likely potential SRE
	Maratus clupeatus	Likely potential SRE
	Maratus gemmifer	Likely potential SRE
	Maratus mungaich	Likely potential SRE
	Maratus `roo`	Likely potential SRE*
	Maratus speciosus	Likely potential SRE
	Maratus speculifer	Likely potential SRE
	Maratus spicatus	Likely potential SRE
	Proszynellus nasalis	Likely potential SRE*
Theridiidae	*`Ctenopalpus` `thaleri`*	Likely potential SRE*
	`Diagmogala` `molliventer`	Likely potential SRE*
	`Tremaulus` `grayi`	Likely potential SRE*
	Billima attrita	Likely potential SRE*
	Enoplognatha `UBS Cat sp. 103`	Unlikely potential SRE

Higher Classification	Lowest dentification	SRE category
	Enoplognatha bidens	Unlikely potential SRE
	Phycosoma `L1-complex`	Unlikely potential SRE
Thomisidae	*Xysticus periscelis*	Likely potential SRE*
Trochanteriidae	*Tinytrema yarra*	Likely potential SRE
Zodariidae	*`Asteron grp` `sp. 1 (942)`*	Likely potential SRE*
	`Australutica? Cat Gen.1` `UBS Cat sp. 2`	Likely potential SRE
	Asteron `species group`	Likely potential SRE*
	Australutica `Brookdale sp. 1`	Likely potential SRE*
	Australutica `UBS Cat sp. 119`	Likely potential SRE*
	Chilumena `sp. nov.`	Likely potential SRE*
	Holasteron wamuseum	Likely potential SRE
	Masasteron tuart	Likely potential SRE
	Neostorena `Brookdale sp. 1`	Likely potential SRE*
	Neostorena `sp. 2`	Likely potential SRE*
	Neostorena `UBS sp. 2`	Likely potential SRE*
	Pentasteron `sp. nov. 3`	Likely potential SRE*
Mygalomorphae		
Actinopodidae	*Missulena `black chelicerae`*	Likely potential SRE
	Missulena `hoggi spp. group`	Likely potential SRE
Anamidae	*`Chenistonia` `tepperi`*	Likely potential SRE
	Aname `BMYG200`	Likely potential SRE
	Aname `coastal plain`	Likely potential SRE
	Aname `false black wish-bone`	Likely potential SRE
	Aname `kwonkan spp. group.`	Likely potential SRE
	Aname `metropolitan`	Likely potential SRE
	Aname `MYG405`	Likely potential SRE
	Aname `MYG496`	Likely potential SRE
	Aname `MYG633`	Likely potential SRE
	Aname `sp. nov.`	Likely potential SRE
	Aname `UBS Cat sp. 126`	Likely potential SRE
	Aname `UBS sp. 2`	Likely potential SRE
	Chenistonia `maculata?`	Likely potential SRE
	Kwonkan `Cat sp. 126`	Likely potential SRE
	Kwonkan `MYG060`	Likely potential SRE
	Kwonkan `UBS Cat sp. 124`	Likely potential SRE
	Kwonkan `UBS Cat sp. 126`	Likely potential SRE
	Proshermacha `MYG449`	Likely potential SRE
	Proshermacha `MYG490`	Likely potential SRE
	Teyl `MYG249`	Likely potential SRE
	Teyl `UBS Cat sp. 148`	Likely potential SRE
	Teyl `UBS Cat sp. 149`	Likely potential SRE
	Teyl `waldockae`	Likely potential SRE
Barychelidae	*Idiommata `cf. blackwalli`*	Likely potential SRE
	Idiommata `UBS Cat sp. 123`	Likely potential SRE

Higher Classification	Lowest dentification	SRE category
	Synothele michaelseni	Likely potential SRE
	Synothele mullaloo	Likely potential SRE
	Synothele rastelloides	Unlikely potential SRE
Euagridae	*Cethegus `sp.`*	Likely potential SRE
Idiopidae	*Gaius `villosus?`*	Likely potential SRE
	Idiosoma `coastal plain sp.`	Likely potential SRE
	Idiosoma `MYG188`	Likely potential SRE
	Idiosoma `MYG189`	Likely potential SRE
	Idiosoma `rhaphiduca sp. group`	Likely potential SRE
	Idiosoma `sp. nov. nec (cf. rhaphiduca)`	Likely potential SRE
Opiliones		
Neopilionidae	*Megalopsalis `sp.`*	Likely potential SRE*
Triaenonychidae	*Nunciella `sp. nov.`*	Likely potential SRE*
Pseudoscorpiones		
Chernetidae	*`Genus indet.` `tarsus IV without tactile seta`*	Likely potential SRE
	`PSEAAF` `PSE130`	Likely potential SRE
Chthoniidae	*Austrochthonius `similis`*	Likely potential SRE*
	Austrochthonius `BPS455`	Likely potential SRE
	Austrochthonius `sp. nov. 4`	Likely potential SRE*
Garypidae	*Synsphyronus `sp.`*	Likely potential SRE
Olpiidae	*Beierolpium 8/4 `BPS456`*	Unlikely potential SRE
Scorpiones		
Buthidae	*Lychas `majeri`*	Likely potential SRE*
	Lychas `majerorum`	Likely potential SRE*
	Lychas `multipunctatus group`	Unlikely potential SRE
	Lychas `prendinii`	Unlikely potential SRE
Urodacidae	*Urodacus `SCO007, bullsbrook`*	Unlikely potential SRE
	Urodacus planimanus	Likely potential SRE
Crustacea		
Malacostraca		
Eumalacostraca		
Isopoda		
Ligiamorpha		
Armadillidae	*Acanthodillo flavus*	Unlikely potential SRE
	Armadillidae indet	Likely potential SRE*
	Buddelundia `sp. 1 (Judd 2002)`	Likely potential SRE
	Buddelundia `sp. 3 (Judd 2002)`	Likely potential SRE
	Buddelundia `sp. 4 (Judd 2002)`	Likely potential SRE
	Buddelundia `sp. 7 (Judd 2002)`	Likely potential SRE
	Buddelundia cinerascens	Likely potential SRE
	Buddelundia inaequalis	Likely potential SRE
	Buddelundia nigripes	Unlikely potential SRE
	Cubaris `sp. 1 (Judd 2002)`	Likely potential SRE
	Cubaris `sp. 2 (Judd 2002)`	Likely potential SRE

Higher Classification	Lowest dentification	SRE category
	Pseudodiploexochus `BIS495`	Likely potential SRE
	Spherillo `sp. 2 (Judd 2002)`	Unlikely potential SRE
	Spherillo `sp. 3 (Judd 2002)`	Unlikely potential SRE
Philosciidae	*Laevophiloscia `BIS493`*	Likely potential SRE
	Philosciidae *`BIS492`*	Likely potential SRE
	Philosciidae *`sp. 1 (Judd 2002)`*	Likely potential SRE
Styloniscidae	*Styloniscus `BIS496`*	Likely potential SRE
Myriapoda		
Chilopoda		
Geophilida		
Chilenophilidae	*Eurytion incisunguis*	Likely potential SRE
	Sepedonophilus `BGE065`	Likely potential SRE
Lithobiomorpha	Lithobiomorpha *sp.*	Unlikely potential SRE
Scolopendrida		
Cryptopidae	*Cryptops `cf. australis`*	Unlikely potential SRE
Scolopendridae	*Cormocephalus `BSCOL096`*	Unlikely potential SRE
	Notiasemus glauerti	Likely potential SRE
Diplopoda		
Polydesmida		
Dalodesmidae	*Sphaerotrichopus ramosus*	Likely potential SRE*
Paradoxosomatidae	*Antichiropus `darling, DIP062 `*	Likely potential SRE*
	Antichiropus `DPI078`	Likely potential SRE
	Antichiropus `eneabba/disgregus DIP078` +DIP126	Likely potential SRE
	Antichiropus `GI/UBS1, DIP082/DIP172`	Likely potential SRE
	Antichiropus `janine, DIP022`	Likely potential SRE
	Antichiropus `nadia, DIP170`	Likely potential SRE
	Antichiropus `Norman Road 1, DIP112`	Likely potential SRE
	Antichiropus `rottnest, DIP172`	Likely potential SRE
	Antichiropus `susannah, DIP168`	Likely potential SRE
	Antichiropus `UBS1/GI, DIP141`	Likely potential SRE
	Antichiropus `UBS2, disgregus, DIP126`	Likely potential SRE
	Antichiropus `UBS2, disgregus, DIP126`+DIP078	Likely potential SRE
	Antichiropus `UBS2`UBS2, disgregus, DIP126`	Likely potential SRE
	Antichiropus `UBS3, DIP127`	Likely potential SRE
	Antichiropus `woodvale, DIP167`	Likely potential SRE
	Antichiropus accinctus DIP126`	Likely potential SRE
Polyzoniida		
Siphonotidae	`Genus indet.` `sp.`	Likely potential SRE
Spirostreptida		
Iulomorphidae	*Dinocambala ingens*	Likely potential SRE
	Podykipus collinus	Likely potential SRE
Mollusca		
Gastropoda		

Higher Classification	Lowest dentification	SRE category
Heterobranchia		
Stylommatophora		
Bothriembryontidae	*Bothriembryon cf. bulla*	Likely potential SRE
	Bothriembryon kendricki	Likely potential SRE
Charopidae	*Epinicium restifer*	Likely potential SRE
	Luinodiscus sublesta	Likely potential SRE
Punctidae	*Westralaoma sp.*	Likely potential SRE*
Succineidae	*Succinea cf. contenta*	Likely potential SRE