Bennelongia Environmental Consultants

Arrowsmith Hydrogen Project SRE Desktop Assessment

Prepared for:

Infinite Blue Energy

August 2021
Final Report

Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Arrowsmith Hydrogen Project SRE Desktop Assessment

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EXECUTIVE SUMMARY

Infinite Blue Energy (IBE) proposes to develop the Arrowsmith Hydrogen Project (AHP) 30 km south of Dongara, Western Australia. The proposed AHP is located within Lots 3, 4, 100 and 6110 at Arrowsmith, within a 1,929 ha development envelope. The AHP is expected to produce 45 tonnes of green hydrogen a day by electrolysis using solar, wind energy and groundwater at the site. Hydrogen will be transported offsite by road as cryogenic liquid.

The purpose of this desktop assessment is to determine the likelihood of conservation significant and SRE invertebrate fauna occurring in the AHP area. The assessment is based on the habitat types present at the Project, as well as previous records of terrestrial invertebrates within a search area around the AHP.

The Project area contains a range of habitat types, with the main habitats being mallee woodland or shrubland habitat with areas of *Eucalyptus* woodland. These vegetation types could contain a range of microhabitats prospective for short-range endemic (SRE) invertebrate species; indeed, despite relatively little sampling in the region, similar habitats on the Geraldton Sandplains have yielded species from SRE Groups including mygalomorph spiders, scorpions, pseudoscorpions, isopods, millipedes and snails. The term SRE Groups refers to various taxonomic groups of invertebrates that are mostly ground-dwelling and frequently have ranges <10,000 km^2.

A database search found records of 21 species belonging to SRE Groups in a 100 x 100 km area centred on the AHP. These included six species of trapdoor spider, one species of harvestmen, two species of pseudoscorpion, one species of scorpion, one species of snail, two species of slater, six species of millipede and two species of centipede. The desktop search also returned records of four conservation-listed species, including the Priority 1 trapdoor spider *Idiosoma kwongan*, the Priority 3 bee *Hylaeus globuliferus*, the Priority 1 land snail *Bothriembryon perobesus*, and the land snail *B. whitleyi*, which is currently classified as extinct, although recent evidence suggests it may be extant.

This desktop assessment indicates that a moderately rich community of SRE Group invertebrates is likely to occur at the AHP, including trapdoor spiders, millipedes, and slaters. It is likely that some SRE species occur at the AHP, although exactly which species cannot be identified without field survey. In addition, some listed species may occur within the AHP, especially the snail *B. perobesus*.

Currently, there is no proposed development within the northeastern portion of the AHP near the lakes, which are associated with the only vegetation type at the AHP that has limited distribution regionally. IBE intends to minimize impacts to the higher quality vegetation in the south and southeast of the AHP and to maximize the use of existing cleared areas. While the Project will result in the destruction of some habitat in which SRE species may occur, the loss will in all cases be minimal in relation to the regional extent of these habitats.

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1. INTRODUCTION

Infinite Blue Energy (IBE) proposes to develop the Arrowsmith Hydrogen Project (AHP) at a site 30 km south of Dongara, Western Australia. The proposed AHP is located within Lots 3, 4, 100 and 6110 in Arrowsmith, with a 1929 ha development envelope (Figure 1). The AHP will produce 45 tonnes of green hydrogen a day by electrolysis using water, as well as solar and wind energy, at the site. Hydrogen will be transported offsite by road as cryogenic liquid.

When constructed and operating, the AHP will involve:

- solar farm (140 MW);
- wind turbines (22 x 6 MW);
- water supply (groundwater);
- processing plant (45 tonnes per day hydrogen); and
- storage and offloading.

The proposed site is former agricultural land and has been grazed by cattle and goats, and the AHP layout has been arranged to avoid wetlands, caves and Carnaby's Black Cockatoo (*Zanda latirostris*) habitat on the property. Site preparation is planned to commence in 2022 for hydrogen production to commence in late 2023, subject to approvals and availability of equipment.

Bennelongia has been requested to conduct a desktop review to assess the current knowledge of SRE fauna values at the AHP with a view to determining the significance of any species and communities present.

2. CONSERVATION FRAMEWORK

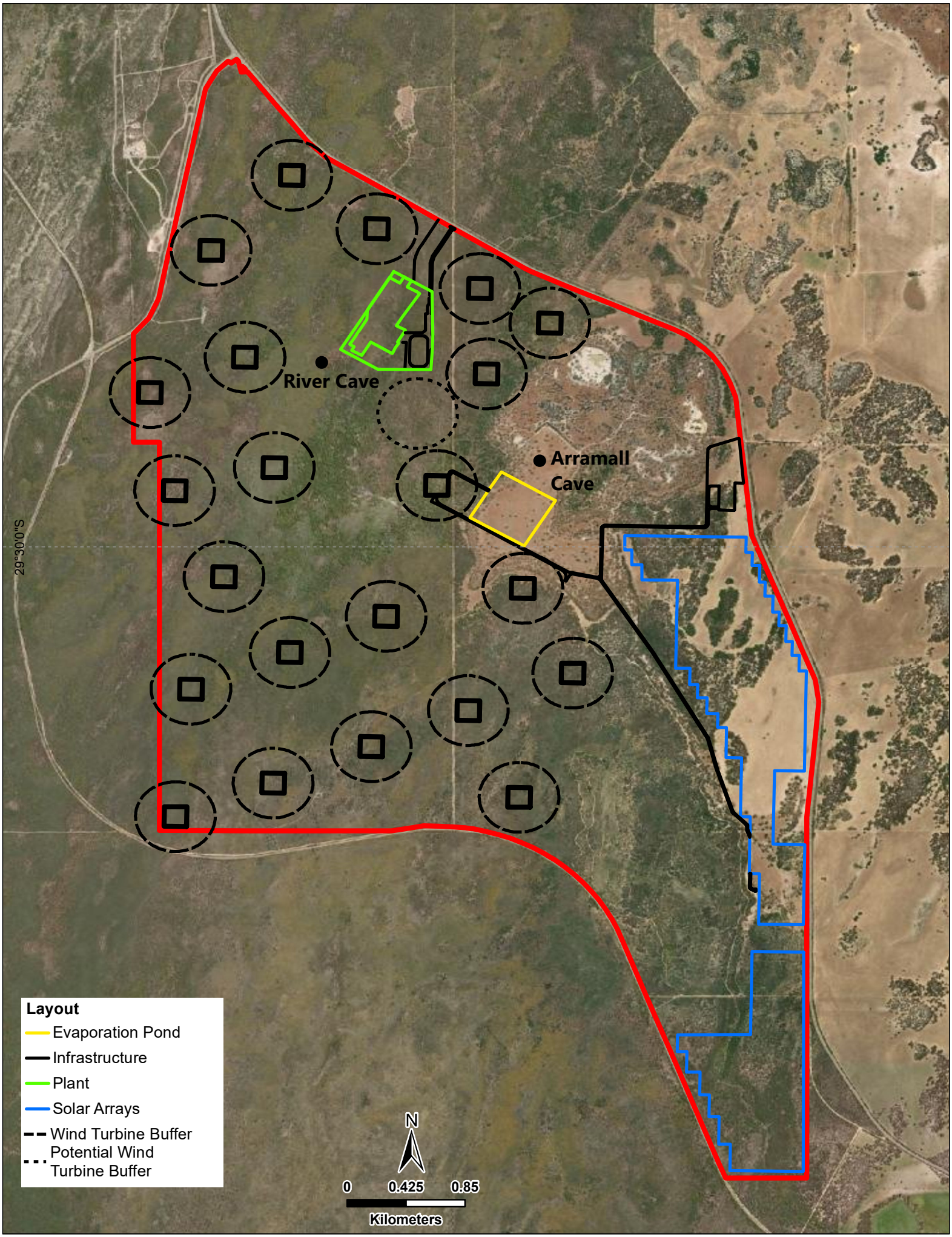
2.1. Listing of Threatened Terrestrial Invertebrates

The listing of species for special protection is governed at the federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and at the state level under the *Biodiversity Conservation Act 2016* (BC Act). The state-level listing of Threatened species (Critically Endangered, Endangered and Vulnerable species) 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.

2.2. SRE Terrestrial Invertebrates

In addition to formal listing of Threatened and Priority fauna, the assessment of 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 known to contain high proportions of species with these characteristics. In southwestern Australia, these 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, due to high vagility, ecological plasticity or xeric adaptation (Framenau *et al.* 2008; Rix *et al.* 2015). Second, and conversely, many species belonging to SRE Groups



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AHP boundary

Figure 1. Arrowsmith Hydrogen Project (AHP) area with proposed infrastructure layout.

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.

In this desktop assessment, the SRE status of each species in the search area was determined using a modified version of the Western Australian Museum's (WAM) SRE classification system. 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, species recorded in the search area were assigned to the following categories: *widespread (not an SRE), confirmed SRE*, *likely potential SRE,* or *unlikely potential SRE*. Species were considered *widespread* if they have a known distribution >10,000 km^2. If species have a well-known taxonomy and known distributions of <10,000 km^2 based on extensive sampling, they were considered to be *confirmed SREs*. For species with known distributions of <10,000 km^2 that are taxonomically uncertain or are associated with patchy sampling effort, we assign them as either *likely* or *unlikely potential SREs* based on the following information (if available):

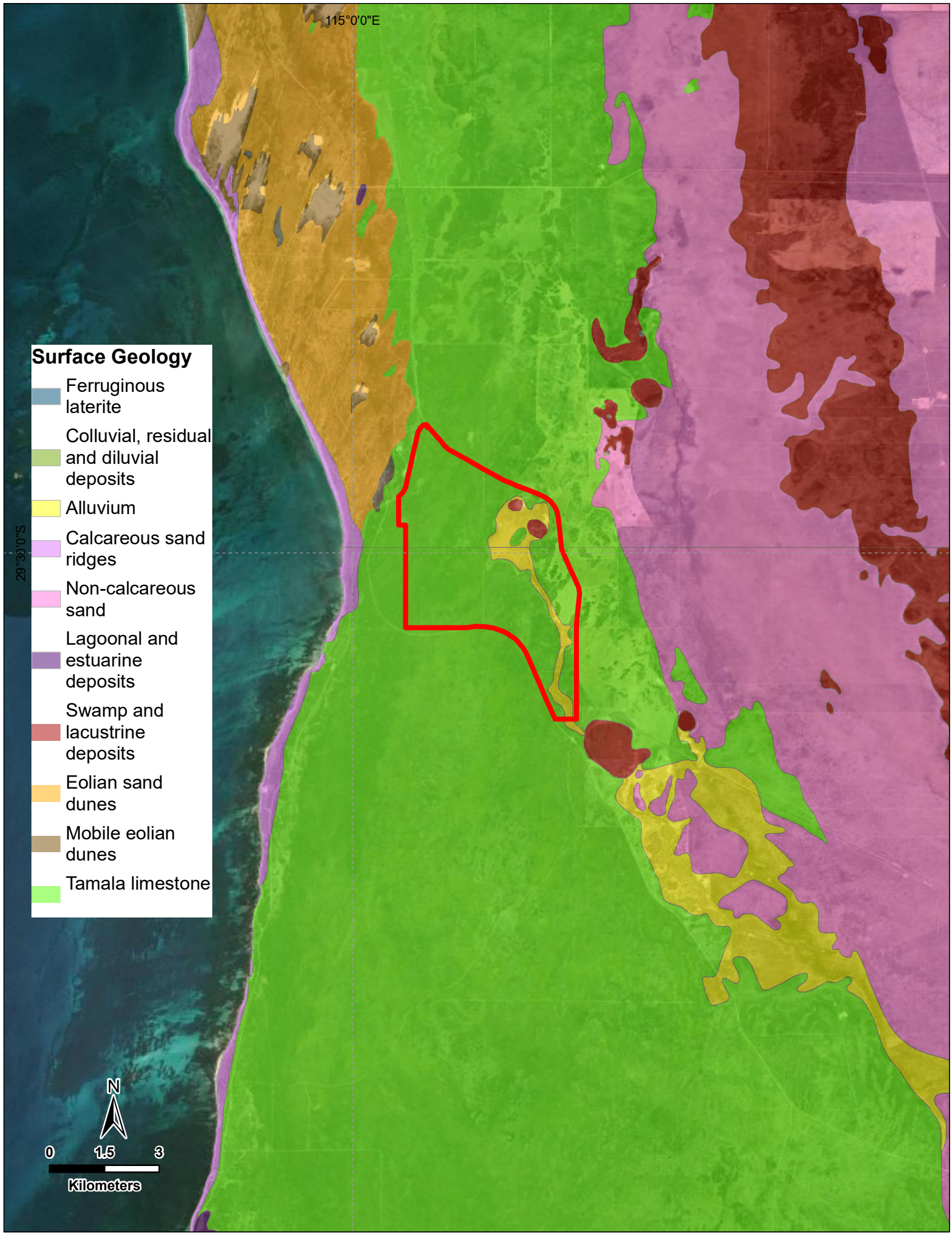
- Habitat indicators and degree of habitat specialisation (e.g. occur in one or multiple habitats);
- Research and expertise (e.g. expert information of the biology and ecology of related species); and/or
- Molecular evidence regarding the genetic variability within sampling areas.

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

3. HABITAT ASSESSMENT

3.1. Regional Setting

The Project is located within the Lesueur Sandplains subregion, one of 419 Australian sub-regions recognised by the Interim Biogeographic Regionalisation of Australia (IBRA). The Lesueur Sandplains comprise the southern half of the Geraldton Sandplain Region, covering coastal areas south of Geraldton to Jurien Bay. The underlying geology of the subregion is characterised by Permian to Cretaceous sedimentary basins, with extensive undulating sandplains at the surface that include limestones, siltstones, sandstones and drainage-associated alluvials (Figure 2; Desmond and Chant 2002). The region has a dry, warm Mediterranean climate, with the majority of precipitation falling in the winter months. Flora communities of the Lesueur Sandplains are mainly proteaceous scrub-heath of *Banksia*, *Melaleuca*, *Eucalyptus* and *Acacia*, characteristic of the Kwongan vegetation type of south-western Australia (Mucina *et al.* 2014). The sub-region is notable by both national and international standards for its high levels of floristic species richness and endemism (Desmond and Chant 2002).



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Project Area

Figure 2: Surface geology in the AHP vicinity.

3.2. Local Habitat

Vegetation surveys were conducted by Ecoscape (2021), which resulted in the definition of eight broad vegetation types. These are (see Table 1 for condition definitions):

Near-coastal limestone uplands:
- **EeLW**; *Eucalyptus erythrocorys* low woodland: Good to Degraded-Completely Degraded
- **McArGaTS**; *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland – this vegetation type has emergent mallees, in patches (i.e. as a mosaic) sufficient to form an upper stratum: Very Good-Good

Karst:
- **ArMrTS**; *Acacia rostellifera* and *Melaleuca rhaphiophylla* tall shrubland: Degraded-Completely Degraded

Sandplain (with limestone pavement):
- **LcBsJhMOS**; *Labichea cassioides*, *Banksia sessilis* var. *cygnorum* and *Jacksonia hakeoides* mid open shrubland – this vegetation type has patches of mallees and, in deeper sands, patches of *Banksia prionotes*: Excellent (67%), Very Good-Good

Riparian areas and floodplain:
- **EcArMW**; *Eucalyptus camaldulensis* subsp. *obtusa* and *Acacia rostellifera* mid woodland

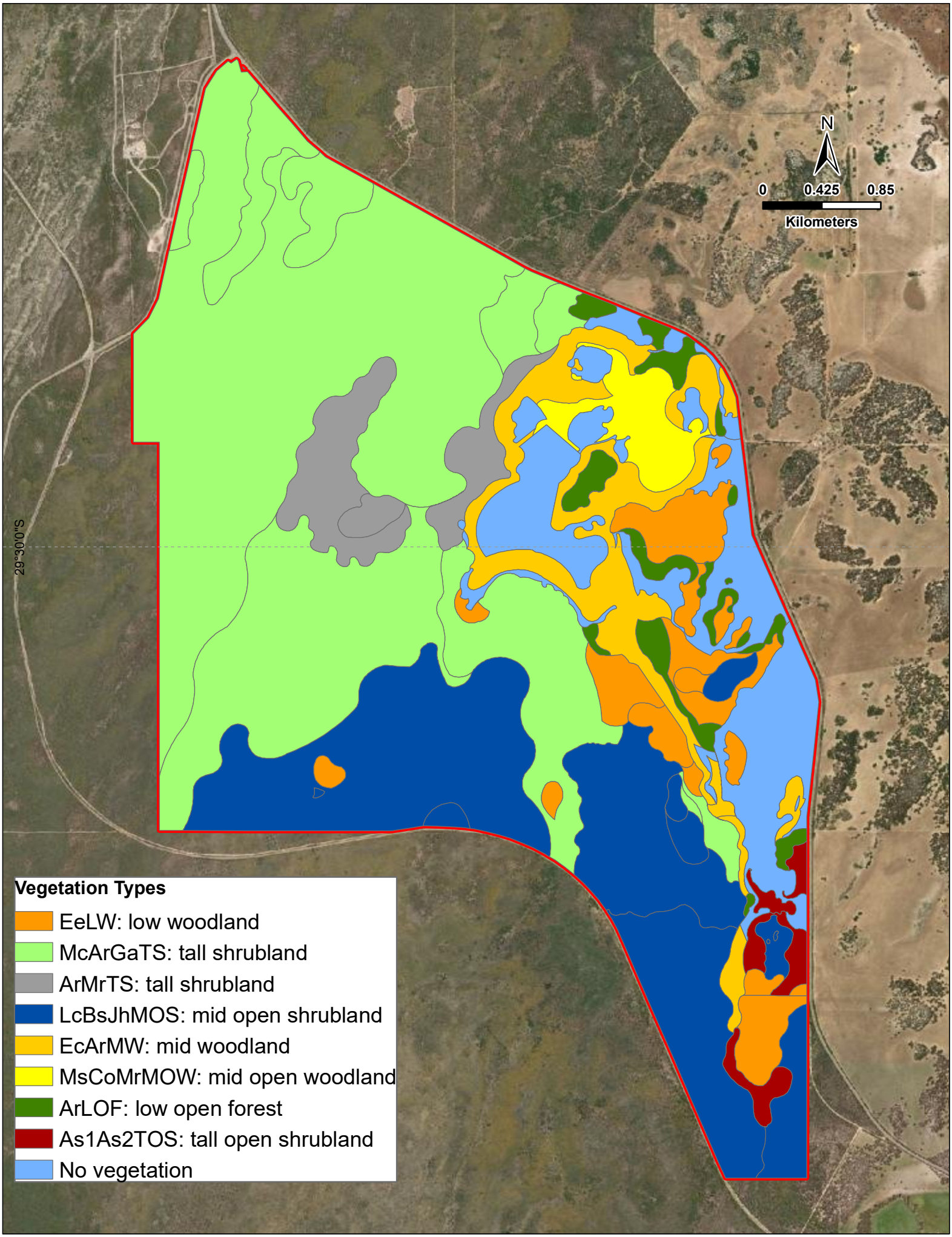
Lakes and floodplain (flat) areas:
- **MsCoMrMOW**; *Melaleuca strobophylla*, *Casuarina obesa* and *Melaleuca rhaphiophylla* mid open woodland: Completely Degraded

Uplands (disturbed):
- **ArLOF**; *Acacia rostellifera* low open forest: Degraded-Completely Degraded
- **As1As2TOS**; *Acacia saligna* and *Acacia scirpifolia* tall open shrubland: Good to Degraded-Completely Degraded

Vegetation condition was mostly influenced by weed cover and the lack of native ground stratum species. Most of the AHP area is characterized by mallee woodland or shrubland habitat, especially in the western and southwestern parts of the AHP (Figure 3), and approximately 10% of the area has been cleared for farming. A significant proportion (28%) of the vegetation of the AHP is considered Degraded-Completely Degraded (Table 1), mostly adjacent to the cleared areas. The most common vegetation type in the AHP is the McArGaTS tall shrubland community (45%), which was primarily in Good or Very Good condition and is a common local vegetation type. In general, the vegetation of the west, south and southeast was assessed as Good to Excellent, especially type LcBsJhMOS, which historically was largely fenced off from livestock grazing. The only regionally significant vegetation type at the AHP was MsCoMrMOW, due primarily to its association with the wetland features and being at the northern extent of the range of a key species (*Melaleuca strobophylla*). All other vegetation types are well represented at locations outside of the development envelope, and/or were Completely Degraded, representing commonly occurring disturbed areas of the region (Ecoscape 2021).

Table 1: Vegetation condition (Ecoscape 2021).

Vegetation Condition	Extent (ha)	Proportion
Pristine	-	-
Excellent	276.27	14.32%
Very Good	824.59	42.73%
Good	91.23	4.73%
Degraded	254.81	13.20%
Completely Degraded	286.12	14.83%
Not Vegetated	196.65	10.19%



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AHP boundary

Figure 3. Vegetation types as identified by Ecoscape

A tributary of the Arrowsmith River intersects the eastern portion of the AHP, ending in a series of ephemeral lakes, including Lake Arramall. The vegetation associated with these features (MsCoMrMOW), although regionally significant as a type, is completely degraded as a result of historical livestock grazing, which has facilitated weed invasion (Ecoscape 2021). IBE intends to minimize developments in the northeast AHP area associated with wetland features (Figure 1).

Ignoring condition, probably all vegetation communities of the AHP have the potential to hold SRE species, especially in microhabitats with higher moisture content than surrounding areas, which can be important for relict species (Main 1996).

4. DESKTOP ASSESSMENT

Sampling of invertebrates of the Geraldton Sandplains bioregion has been historically sparse, with few studies of SRE fauna, though the region is known to have a high diversity of *Bungulla* and other idiopid trapdoor spiders (Rix *et al.* 2018a; Rix *et al.* 2018b; Rix *et al.* 2019). In addition, species of SRE groups such as snails, millipedes, centipedes, snails, pseudoscorpions, scorpions and isopods have been recorded from the region (ecologia 2010; Harvey *et al.* 2000; Whisson 2019).

The databases of the Western Australian Museum (WAM), Atlas of Living Australia (ALA) and Bennelongia were used to collate existing records, within a search area of 100km X 100km centred on the AHP, of listed invertebrate species and species belonging to the SRE Groups. These records were supplemented by records in published taxonomic literature. Many of the records in the databases were higher order identifications for which the species had not been determined; these were retained in the final species list for the search area only if there were no other species-level identifications within the same taxonomic group.

4.1. SRE Species Results

The desktop search found records of 21 species belonging to the SRE Groups within the search area (Table 2). These included six species of trapdoor spider, one species of harvestmen, two species of pseudoscorpion, one species of scorpion, one species of snail, two species of slater, six species of millipede and two species of centipede. Two species were classified as confirmed SREs and 18 were classified as likely potential SREs owing to a deficiency of data, primarily because higher level identifications (mostly only to genus level) made any assessment of range impossible. There was one widespread species.

Table 2: Potential SRE species returned from the desktop search.

Higher order	Lowest identification	SRE status
Gastropoda		
Stylommatophora		
Succineidae	*Succinea* sp.	Likely potential SRE*
Arachnida		
Araneae		
Mygalomorphae		
Actinopodidae	*Missulena* `Bisevac sp. 1`	Likely potential SRE*
	Missulena `Bisevac sp. 2`	Likely potential SRE*
Anamidae	*Aname* `MYG633`	Likely potential SRE*
Euagridae	*Cethegus* `sp.`	Likely potential SRE*
Idiopidae	*Bungulla banksia*	Confirmed SRE
	Euoplos mcmillani	Confirmed SRE
Opiliones		
Neopilionidae	*Megalopsalis* `sp. indet.`	Likely potential SRE*

Higher order	Lowest identification	SRE status
Pseudoscorpiones		
Panctenata		
Olpiidae	*Beierolpium* `sp.`	Likely potential SRE*
Chthoniidae	*Austrochthonius* `lesueuri`	Likely potential SRE*
Scorpiones		
Urodacidae	*Urodacus* `SCO016, Mingenew`	Likely potential SRE*
Malacostraca		
Isopoda		
Ligiamorpha		
Armadillidae	*Buddelundia lateralis*	Widespread
Stenetriidae	*Stenetrium* sp.	Likely potential SRE*
Diplopoda		
Polydesmida		
Paradoxosomatidae	*Antichiropus* `DIP057, cooljarloo`	Likely potential SRE*
	Antichiropus `DIP076, ensiculus`	Likely potential SRE*
	Antichiropus `DIP076, houstoni`	Likely potential SRE*
	Antichiropus `DIP078, Eneabba 1`	Likely potential SRE*
	Antichiropus sulcatus	Likely potential SRE
Spirostreptida		
Iulomorphidae	*Podykipus* `sp.`	Likely potential SRE*
Chilopoda		
Lithobiida		
Henicopidae	*Lamyctes* `sp.`	Likely potential SRE*
Scutigerida		
Thereuopodina	Thereuopodina `sp.`	Likely potential SRE*

*Species considered *Likely potential SRE* due to data deficiency.

4.1.1. Comments on SRE Species Records

The two confirmed SREs were the trapdoor spiders *Bungulla banksia* and *Euoplos mcmillani*. *Bungulla banksia* is endmic to kwongan heathlands of the Geraldton Sandplains bioregion, though no additional information is known about the biology of this species. The genus *Bungulla* was relatively unknown until surveys beginning in the 1990s greatly expanded knowledge of its diversity and distribution, with over 90% of species appearing to have small ranges (Rix *et al.* 2018b).

Euoplos mcmillani occurs in kwongan on white sand. The species has a known range of <5,000 km^2 and it is known to date only from active or proposed mining tenements. It has rare occurrence (Rix *et al.* 2019).

One species was classified as widespread. The slater *Buddelundia lateralis* is known from across Australia (ALA). It occurs at two sites in the search area approximately 50km north-east of the AHP. Some *Buddelundia* species have small ranges (Judd 2004), and it is possible that genetic investigation would show *B. lateralis* is more restricted than ALA records suggest but is unlikely to be an SRE species. Its occurrence in the search area was in a habitat not present within the AHP.

The millipede *Antichiropus sulcatus* was recently collected from mineral sand sites near Eneabba, with historical collections from Guildford; however, Car *et al.* (2013) considers the Guildford records to be mislabelled and no additional specimens have been collected from there or the intermediate area.

Additional collections are likely required to further clarify this species' SRE status, though members of this genus are typically poor dispersers with small ranges (Car *et al.* 2013). It is classified as a likely potential SRE and this terminology reflects its status accurately.

For the other 17 species classified as likely potential SREs there is inadequate information on which to base classification of SRE status.

4.2. Listed Threatened and Priority Species

The desktop search returned records of four species under the BC Act or informal DBCA processes (Table 2). These include the Priority 1 trapdoor spider *Idiosoma kwongan*, the Priority 3 bee *Hylaeus globuliferus*, the Priority 1 land snail *Bothriembryon perobesus*, and finally the land snail *B. whitleyi*, which is currently listed as a Schedule 4 threatened species (i.e. likely to be extinct). However, as discussed below, recent evidence suggests it may be extant. There were no records of species listed under the EPBC Act.

Table 3: Listed Threatened and Priority terrestrial invertebrates in the search area.

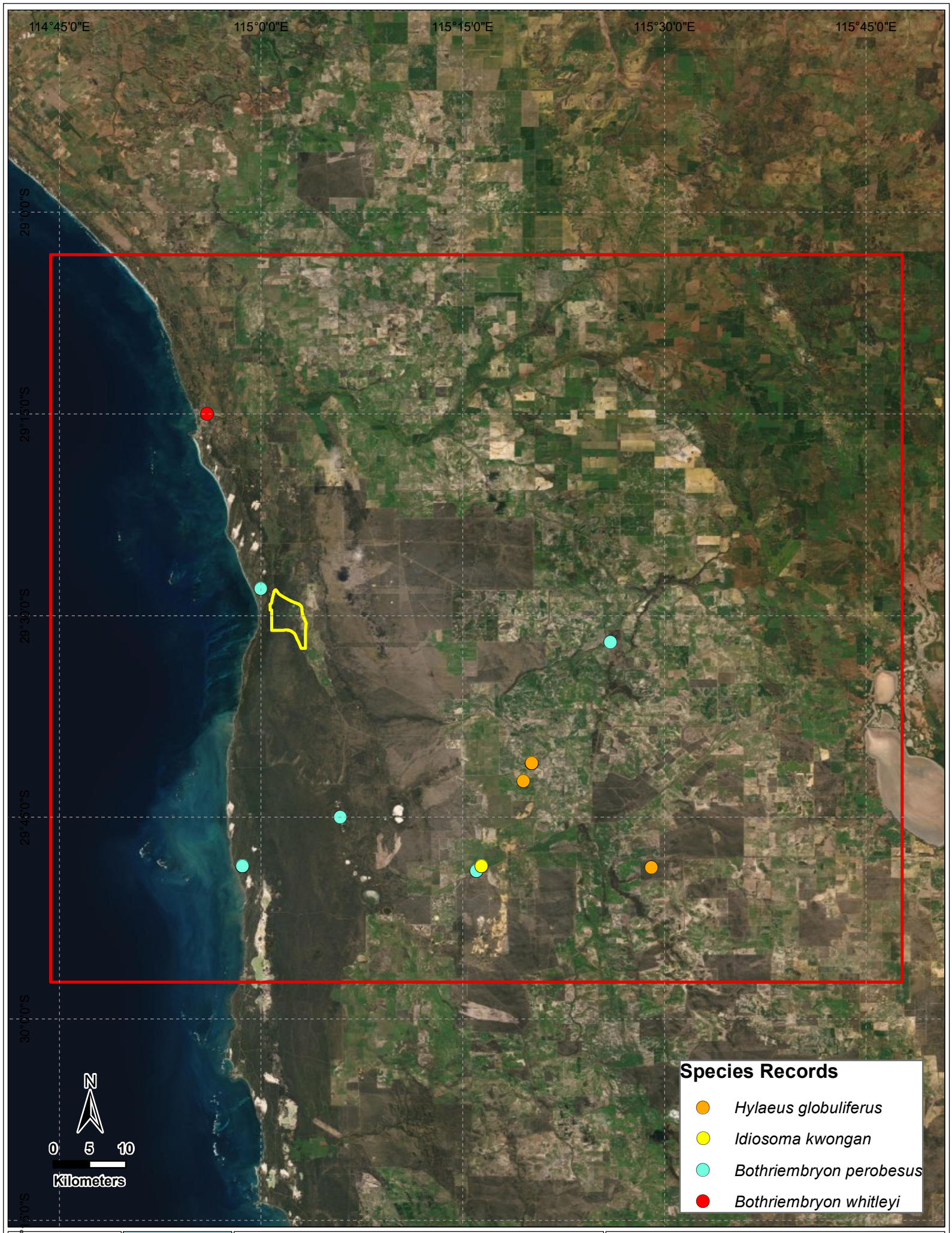
Higher classification	Lowest Identification	WA status (BCA)
Gastropoda		
Stylommatophora		
Bothriembryontidae	*Bothriembryon perobesus*	P1
	Bothriembryon whitleyi	Extinct
Arachnida		
Araneae		
Mygalomorphae		
Idiopidae	*Idiosoma kwongan*	P1
Hexapoda		
Insecta		
Hymenoptera		
Colletidae	*Hylaeus globuliferus*	P3

The land snail *B. perobesus* is listed as a Priority 1 species by DBCA. There are also records of this species from Moore Rive, Leeman and the south coast of Western Australia (ALA; Whisson 2019). The snails were collected from sandy soils among *Banksia* and eucalypt woodland at Moore River and a limestone escarpment at Leeman. Given the proximity of Leeman to the AHP (Figure 4), *B. perobesus* is considered likely to occur there.

The snail *B. whitleyi* is currently classified as extinct, though shells collected recently indicate this species may still persist (Craig 2017). The species potentially occurs in sandy coastal dune systems with *Acacia* spp. and other medium to tall shrubs over *Spinifex longifolius* (Whisson 2019). This is not habitat present at the AHP and, therefore, the likelihood of *B. whitleyi* occurring in the AHP is very low.

The Priority 1 trapdoor spider *I. kwongan* has a known distribution restricted to the Geraldton Sandplains bioregion south of the AHP. Little else of its biology is currently understood (Rix *et al.* 2018a). The single record within the search area is the most northern known occurrence (Figure 4). According to Rix *et al.* (2018a), however, the known range of 500km^2 is likely an underestimate, due to the low survey effort and additional suitable habitat present in the region, and the species may possibly occur in the AHP.

The Priority 3 bee *H. globuliferus* has a distribution throughout southwestern Australia, and all of the records from the search area were collected from flowers of *Adenanthos cygnorum*. Though this species was not identified at the AHP, *H. globuliferus* appears to be a Proteaceae specialist, including *Banksia* spp. and other native plants (Houston 2018) which occur at the Project. There is moderate potential for this species to occur in the AHP.



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AHP Boundary

Desktop Search Area

Figure 4: Listed Priority species records identified in the search area.

5. CONCLUSIONS

Vegetation surveys resulted in the definition of eight broad vegetation types in the AHP. Most of the area is characterized by mallee woodland or shrubland habitat, especially in the western and southwestern areas, and approximately 10% of the area has been cleared for farming. A significant proportion (28%) of the vegetation of the AHP is considered Degraded-Completely Degraded, mostly adjacent to the cleared areas. In general, the vegetation of the west, south and southeast was assessed Good to Excellent.

The database search found 21 species belonging to SRE Groups in the search area. These included six species of trapdoor spider, one species of harvestmen, two species of pseudoscorpion, one species of scorpion, one species of snail, two species of slater, six species of millipede and two species of centipede. In particular, trapdoor spiders, lands snails and millipedes are known to inhabit habitats of the Geraldton Sandplains similar to the AHP area and potentially occur there, but species such as centipedes, pseudoscorpions, scorpions, and isopods have also been collected in the region.

In addition to two SRE species, one well documented likely potential SRE species and 17 data deficient likely SRE species, the desktop assessment identified four Priority listed terrestrial invertebrate species within the search area. These are the land snails *Bothriembryon perobesus* and *B. whitleyi,* the trapdoor spider *Idiosoma kwongan* and the bee *Hylaeus globuliferus*. *Bothriembryon perobesus* has been collected from *Banksia* woodlands and low shrubland on white sandy soils in multiple locations surrounding the AHP and is likely to also occur within the AHP. *I. kwongan* and *H. globuliferus* were collected at locations between 20 and 50 km south of the AHP, again in habitats similar to those found in the AHP. *H. globuliferus* is a specialist of Proteaceae flowers and is considered to have a moderate likelihood of occurring at the Project. The record of *I. kwongan* is at the northern edge of its known range but this species also may occur at the AHP. *B. whitleyi* is considered to have very low probability of occurring in the AHP.

Two types of impacts on invertebrate fauna communities are typically associated with development projects: *primary impacts*, through activities (mainly land clearing) that result in complete loss of habitat; and *secondary impacts*, that result in degradation of habitat rather than complete loss, for example through vehicle movements (and associated vibrations and/or dust), weed encroachment, and clearing of small areas and infrastructure corridors (causing fragmentation and edge effects). Primary impacts may cause extinction of a local population restricted to the development envelope, or species extinction if the entire range of the species lies within the development envelope. Secondary impacts are unlikely to cause extinction of either local or species populations, however they can cause reductions in population size.

The overall threat to SRE conservation values posed by development projects is determined by a combination of the likelihood of occurrence of significant species, their known ranges relative to project envelopes, and the likely consequences of potential impacts. The results of the desktop search suggest that several, and perhaps many, SRE species are likely to occur in the AHP. However, impacts from development are likely to be minor because the habitats in which the SRE species occur extend outside the AHP. It is considered that SRE species are unlikely to occur in the one habitat (MsCoMrMOW) that is not well connected to similar habitat outside the project area. Threat to any SRE species in this wetland habitat will be low because no development will occur there.

In conclusion, this desktop assessment indicates that a moderately rich community of SRE Group invertebrates occurs in the vicinity of the AHP. It is likely some SRE species occur within the AHP, although exactly which species cannot be identified without field survey within the AHP. In addition, three Priority species may occur within the AHP, especially the snail *B. perobesus*. Currently, there is no proposed development within the northeastern portion of the AHP near the lakes, which are associated with the only regionally significant vegetation type, and IBE intends to minimize impacts to the areas of

higher quality vegetation in the south and southeast of the AHP. While development will result in the destruction of some habitat in which SRE species may occur, the loss will in all cases be minimal in relation to the regional extent of these habitats.

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