Bennelongia Environmental Consultants

Valhalla Gas Exploration and Appraisal Program Subterranean Fauna Desktop Assessment

Prepared for:

Bennett Resources Pty Ltd

November 2023

Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Valhalla Gas Exploration and Appraisal Program Subterranean 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: 627

EXECUTIVE SUMMARY

Bennett Energy Pty Ltd proposes to develop the Valhalla Gas Exploration and Appraisal Program (hereafter the Project) approximately 55 km west of Fitzroy Crossing, Western Australia. The focus of the Project is to extract hydrocarbons from 2,000-4,000 metres below ground level (mbgl). However, some abstraction of groundwater will be required for construction and other purposes from two shallow wells (or bores) at each of the 10 drill pads where deep wells will be installed. Bennett Energy commissioned Bennelongia Environmental Consultants to undertake desktop assessment of subterranean fauna values around the Project in relation to this abstraction of groundwater.

The databases of the Western Australian Museum and Bennelongia, as well as environmental reports for nearby mining projects and scientific literature, were searched for records of subterranean fauna within a 100 x 100 km square around the Project.

Although there has been little sampling of subterranean fauna in the desktop search area, up to 21 species of stygofauna and at least seven species of troglofauna have been collected. Many of the records have been from limestone caves north of the Project but stygofauna has been recorded in geologies similar to that of the Project area. Stygofauna occurs in the surficial aquifers of the Fitzroy Trough, quite likely in richer communities than current data suggest. More generally, the Kimberley is known to support moderate stygofauna communities, while to the south communities in the Pilbara are rich. Little is known about troglofauna in the Kimberley.

The Project proposes to abstract a maximum volume of 33,400 kL per well over a six-month period. Modelled drawdown in the shallow aquifer is small, being less than 1 m beyond 56 m from each bore. Thus, it is unlikely that drawdown will have negative impacts on stygofauna conservation values. Drawdown would also have no negative impact on troglofauna, if these animals are present.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Bennett Energy Pty Ltd proposes to develop the Valhalla Gas Exploration and Appraisal Program (hereafter the Project) approximately 55 km west of Fitzroy Crossing, Western Australia (Figure 1). The unconventional drilling program proposes drilling up to 20 wells across 10 well sites within a previously explored area of Petroleum Exploration Permit EP 371 in the Canning Basin (Bennett Resources 2020). The Development Envelope encompasses 109 ha and the target hydrocarbons lie 2,000-4,000 metres below ground level (mbgl). Pumping of 33,400 kL per well over 6 months has been modelled, with drawdown of 1 m at a distance of 56 m from each well; recovery is expected within weeks following the cessation of pumping (Rockwater 2016).

Recognising the potential for Project development to affect subterranean communities, Bennett Energy commissioned Bennelongia Environmental Consultants to undertake desktop assessment of subterranean fauna values around the Project. In accordance with established guidelines (EPA 2016, 2021), the objectives of this report are:

- To collate records of subterranean animals from the proposal area and surrounds to determine the types of subterranean fauna present;
- To determine the conservation status of the subterranean species recorded and the known distribution of any conservation-significant species; and
- To estimate the likely impact of mining activities on subterranean fauna based on groundwater flow, direction, connectivity, and drawdown.

1.1. Climate, Geology, and Hydrogeology

The climate at the Project is tropical, with hot wet summers and warm dry winters. The nearest weather station (Ellendale, BOM site number 003008; 17.93°S, 124.81°E) reports an annual mean rainfall of 614.8 mm concentrated in January (168.2 mm) and February (155.7 mm), although annual rainfall ranges from 211.7 mm to 1,409 mm (Bureau of Meteorology 2023). Monthly maximum temperatures at Fitzroy Crossing (18.18°S, 125.56°E; data not available for Ellendale) are highest in November (40.9°C) and lowest in Jun (30.6°C). Evaporation exceeds rainfall (Rockwater 2016).

The Canning Basin is the second largest groundwater source by volume in Australia, following the Great Artesian Basin (Rockwater 2016). It spans 430,000 km^2 and its yield is estimated at 615,000-827,000 ML/yr. Geologically the basin is early Ordovician to early Cretaceous in age.

The proposed wellfield falls within the Fitzroy Trough, a north-west trending graben constituting a major subdivision of the Canning Basin. The Fitzroy Trough is approximately 110 km wide and is bounded by the Beagle Bay fault on the north-east and the Fenton Fault on the south-west. Geology in the trough is characterised by strata of aquifers and/or aquitards, beginning with the siltstone, shale, and sandstone Liveringa Formation at the surface and progressing through shale, sandstone, and siltstone aquifers/aquitards to the Laurel Formation; permeability and porosity decrease with depth. The surficial Liveringa Formation is middle-to-late Permian in age and exposed at the surface around the Project. The Laurel Formation hosts the target hydrocarbons and comprises limestone, shale, siltstone, and sandstone; it is a minor aquifer or aquitard 2,000-4,000 mbgl (Rockwater 2016).

Depth to the water table ranges from 30-36 m. This is a depth at which the richness of stygofauna communities usually declines substantially as a result of reduced inputs of nutrients and cardon from the surface. Groundwater in the more surficial formations is recharged by rainfall, a process slowed by fine-grained sediments throughout the Fitzroy Trough. Groundwater flow is westerly with discharge into the Fitzroy River (102 ML/d; INTERA 2023); the flow travels approximately 3 km in 500 years (Rockwater 2016). Groundwater is fresh (200 mg/L TDS) to brackish (1,000 mg/L TDS) in the surficial formations, but increasingly saline from 1,500 mbgl, and >70,000 mg/L TDS in the lowermost formations

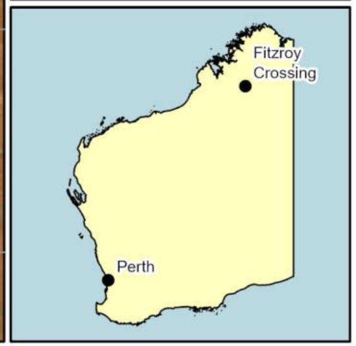
Bennelongia Environmental Consultants

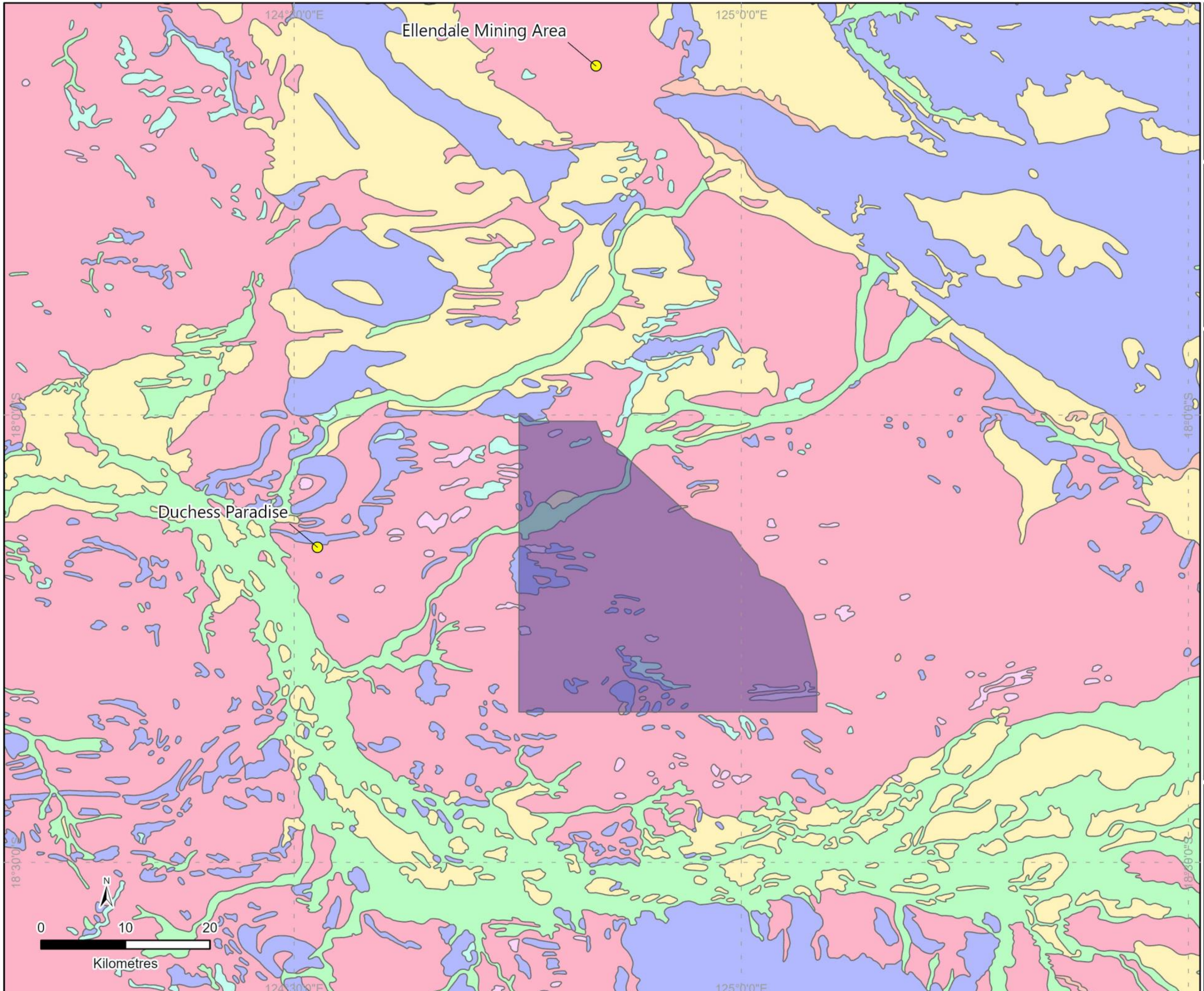
GCS GDA 1994
Author: Rhare
Date: 20/11/2023

Figure 1. General location of the Project and approximate locations of nearby survey sites.

Legend

- Development envelope
- Desktop search area
- Other survey sites





Bennelongia Environmental Consultants

GCS GDA 1994
Author: Rhare
Date: 20/11/2023

Figure 2. Regolith in the Project area.

Legend

Development envelope
Other survey sites
TYPE
Alluvium
Calcrete
Colluvium
Exposed
Lacustrine
Residual
Sandplain

(Rockwater 2016). In general stygofauna communities can be rich in salinities up to 25,000 mg/L, although few species in north-western Australia occur in water >10,000 mg/L (Halse 2018).

1.2. Subterranean Fauna Framework

The term subterranean fauna refers to animals living essentially full-time underground. Subterranean animals are divided into two types: stygofauna are aquatic animals that live below ground in water, while troglofauna are air-breathing animals that live underground and require very high humidity (Gibson *et al.* 2019). Stygofauna inhabit vugs, fissures, and interstitial spaces in groundwater aquifers, especially those in alluvium and calcretes. Troglofauna inhabit similar spaces above the water table but with more emphasis on vugs, fissures, and relatively large interstitial spaces.

Subterranean species share several convergent adaptations to life underground where it is dark and resources are limited. These include worm-shaped bodies, elongated chemosensory apparatus, loss of wings, transition towards K-selected breeding strategies, and the loss of skin colouration and eyes (Gibert and Deharveng 2002). Western Australia supports a particularly rich subterranean fauna outside caves (Humphreys 2000; UNESCO World Heritage Centre 2022), with estimates of over 4,000 species, 90% of which remain to be described (Guzik *et al.* 2011; Halse 2018a). Almost all subterranean animals in Western Australia are invertebrates, but fishes (Whitely 1945) and one snake (Aplin 1998) have also been recorded. Most subterranean species are inconspicuous, but contribute substantially to biodiversity and other values, for example by moderating groundwater quality (Hose and Stumpp 2019).

The distribution of subterranean animals is largely determined by prevailing lithology. In Western Australia, subterranean animals probably mostly occupy spaces only a few millimetres in width (Halse 2018a, b; Halse *et al.* 2018) but the key characteristics of their habitat(s) is that it is rich in such spaces (e.g. interstices in alluvium, screen, and voids; vugs, cavities, and fissures in consolidated geologies) and that the spaces are well connected laterally and vertically. Lateral connectivity facilitates dispersal of animals, while vertical connectivity ultimately to the surface is crucial for delivering carbon and other nutrients to subterranean ecosystems (Korbel and Hose 2011). Connectivity may be disrupted by a range of factors, including dykes, major landscape features, and chemical barriers.

Subterranean animals tend to have limited distributions. Most stygofauna species exhibit short range endemism (SRE), having substantially smaller ranges than Harvey's (2002) SRE criterion of 10,000 km^2 (Cooper *et al.* 2007; Cooper *et al.* 2002; Eberhard *et al.* 2009). The ranges of troglofauna have yet to be investigated in detail but are mostly even more restricted than those of stygofauna, with many species having linear ranges less than 10 km (Halse and Pearson 2014; Lamoreux 2004). Given that species with small ranges are more vulnerable to extinction following habitat degradation than wider ranging species, it follows that subterranean taxa are highly susceptible to anthropogenic threats, particularly large-scale excavation and groundwater abstraction (Halse 2018a; Ponder and Colgan 2002).

Stygofauna

Most stygofauna species in Western Australia are crustaceans, particularly ostracods and copepods, although other groups such as worms and beetles are sometimes abundant (DEC 2009; DPAW 2022; Matthews *et al.* 2019). The most productive known stygofauna habitats are saturated alluvial and calcrete aquifers associated with palaeochannel deposits, but stygofauna also inhabit karstic limestones, hyporheic zones, groundwater-fed springs, and aquifers in some iron formations, especially channel iron (Halse 2018b; Hyde *et al.* 2018). Stygofauna are rarely abundant where depth to the water table is more than 30 m below ground level (Halse 2018a; Halse and Pearson 2014). Aquifers with higher transmissivity are more likely to host stygofauna than aquifers with lower transmissivity (Maurice and Bloomfield 2012). Stygofauna mostly occur in fresh to hyposaline water (Halse *et al.* 2014; Humphreys *et al.* 2009), but can occur in higher salinities (Bennelongia 2016; Reeves *et al.* 2007; Watts and Humphreys 2006).

Troglofauna
Western Australia appears to be almost unique for its diverse and widespread troglofauna inhabiting small spaces in the vadose zone (Halse and Pearson 2014). The Western Australian troglofauna comprises mostly arthropods, with a variety of isopods, insects, spiders, pseudoscorpions, and millipedes, centipedes, and their allies represented. Troglofauna are particularly likely to occur in weathered or mineralised iron formations, alluvium or colluvium in valley-fill areas (including areas of karstic calcrete), and fractured sandstone (Halse 2018a). Troglofauna typically require relative humidity close to 100% (Howarth 1983).

1.2.1. Conservation legislation
Native flora and fauna in Western Australia are protected at both State and Commonwealth levels. At the state level, the *Biodiversity Conservation Act 2016* (BC Act) provides a legal framework for protection of species, particularly for species listed by the Minister for the Environment as threatened. In addition to the formal list of threatened species under the BC Act, the Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a list of priority fauna species that are of conservation importance but, for various reasons, do not meet the criteria for listing as threatened. At the national level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna and ecological communities.

Both the EPBC and BC Acts provide frameworks for the protection of threatened ecological communities (TECs), where an ecological community is defined as a naturally occurring group of plants, animals, and other organisms interacting in unique habitat (with the unique habitat created by the combination of the species and their landscape setting; DEC 2013). Communities occupying a small or threatened habitat are classified as threatened ecological communities (TECs) under the BC Act and the EPBC Act. Within Western Australia, DBCA also informally recognises communities of potential conservation concern, but for which there is little information, as priority ecological communities (PECs). The list of TECs recognised under the BC Act is larger than the EPBC Act list and has much greater focus on subterranean communities.

2. METHODS
The desktop assessment combined three sources of information using GIS mapping:

- Boundary information and description of Project activity was supplied by Bennett Energy.
- Records of subterranean animal occurrence in the vicinity of the project were obtained from the Western Australia Museum and Bennelongia databases, as well as relevant environment reports from other mines in the region and scientific literature.
- Boundaries of the subterranean fauna TECs and PECs were provided by DBCA and the Department of Mines, Industry Regulation, and Safety.
- Geological mapping to provide information about occurrence of likely subterranean fauna habitat.

Database searches covered two degree area centred on the Project (Figure 1). Analysis and mapping were undertaken using ArcGIS Pro v2.9.

3. SEARCH RESULTS

There has been little sampling of subterranean fauna in the desktop search area. No TECs or PECs are listed in the vicinity of the Project. However, up to 21 species of stygofauna have been collected in the desktop search area (Table 1, Figure 3).

Table1. Subterranean fauna surveys in desktop search area and results.

Group	Species	Comments
Stygofauna		
Ellendale Diamond Mine, MBS Environmental/Brenton Knott 2010		
Acarina	Unidentified species	Possible stygofauna
Ostracoda	*Strandesia kimberleyensis*	Identified by Halse from photos in MBS report
	?*Candonopsis kimberleyi*	
Copepoda	Cyclopidae sp. 1	
	Cyclopidae sp. 2	
	3 unknown species	Inferred from Rockwater 2016
Isopoda	*Tainisopus* sp.	
MBS Environmental 2011, Duchess Paradise Project		
Nematoda	Unidentified species	Not assessed (EPA 2016)
Oligochaeta	Enchytraeidae sp.	Unknown habit and range
Copepoda	*Mesocyclops notius*	Widespread
Ostracoda	?*Reticypris* sp.	Uncertain identification (Halse)
Western Australian Museum database		
Acarina	*Limnohalacarus australis*	Collected from sink hole
Ostracoda	Unidentified species	
Decapoda	*Austrothelphusa transversa*	Caves, also surface occurrence
	Caridina spelunca	Caves
Isopoda	*Tainisopus napierensis*	Caves
	Tainisopus ?*fontinalis*	Caves
	Kimberleydillo waldockae	Cave
Troglofauna		
Western Australian Museum database		
Araneomorphae	*Heteropoda cavernicola*	No habitat information
Araneae	*Wandella infernalis*	Cave
Schizomida	Apozomus eberhardi	Cave
	Bamazomus hunti	Cave
Pseudoscorpiones	Indohya napierensis	Vadose tube
	Cheiridium sp. nov.	Cave
Diplopoda	?*Stygochiropus* sp.	Cave

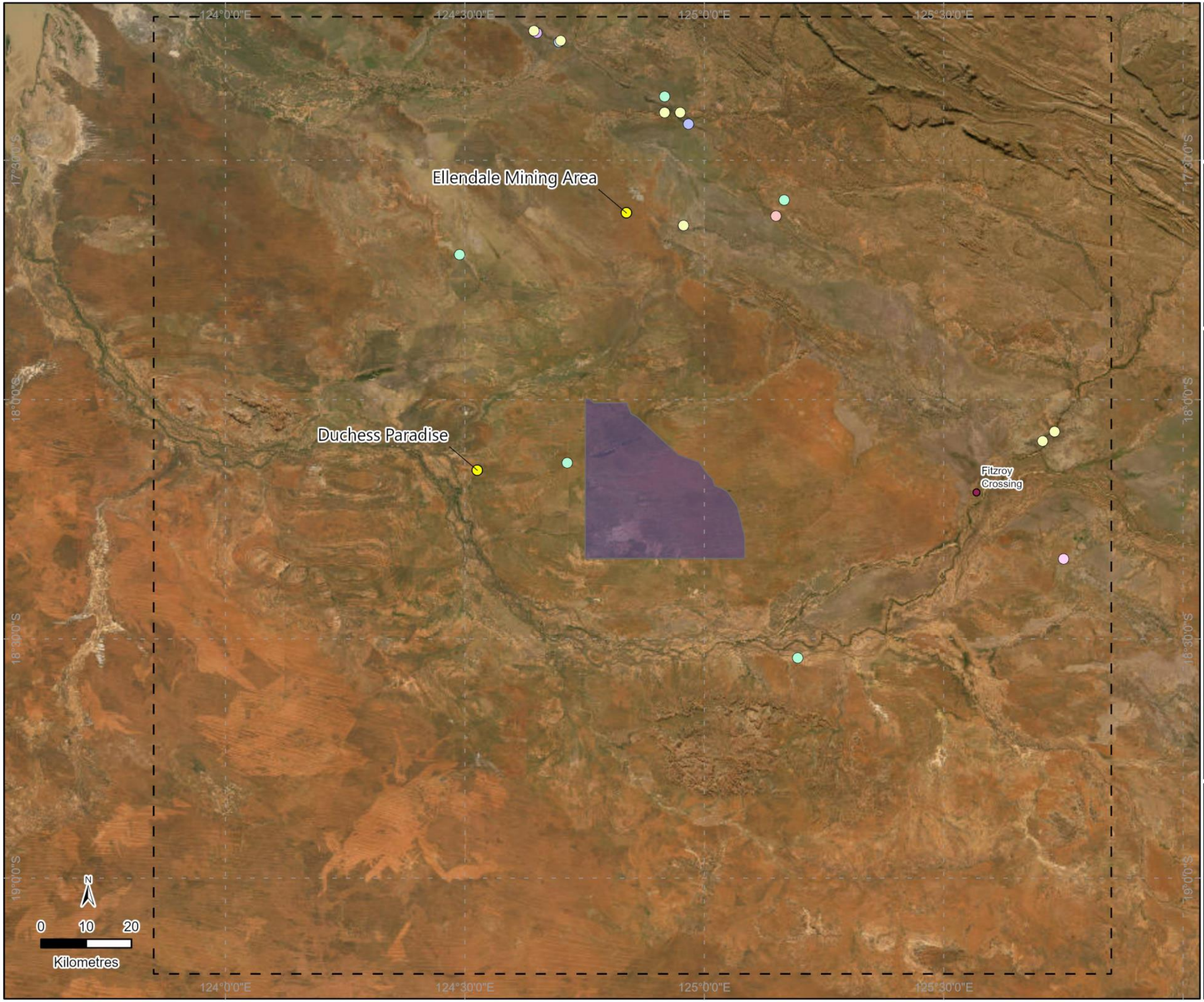
According to Rockwater (2016), nine stygofauna species have been collected from boreholes and a cave at the Ellendale Diamond Mine about 45 km north of the Project but one of the species (an ostracod) appears to be a surface species, based on photographs in MBS (2010), and another (a mite) cannot be identified with enough resolution to determine whether it is stygofaunal. Four species of stygofauna have been collected from about 30 west of the Project at the Duchess Paradise Project in geology similar to that of the Project. According to Museum records, a further seven species have been collected from caves and a sink hole in limestone ranges north and west of the Project (Table 1, Figure 2).

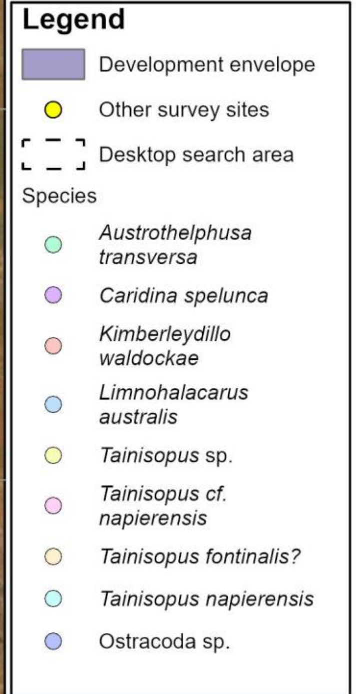
Museum records also show that at least seven species of troglofauna have been collected from caves north and west of the Project (Table 1, Figure 4). This includes two species belonging to the iconic troglofaunal group Schizomida. Rockwater (2016) points out that both schizomid species have eyespots and may be troglophiles rather than troglobites (the former are found in the twilight zone of caves; the latter in dark zones) but the key issue is that use subterranean habitats. Higher level records and records

Bennelongia Environmental Consultants

GCS GDA 1994
Author: Rhare
Date: 20/11/2023

Figure 3. Stygofauna records in the desktop search area.





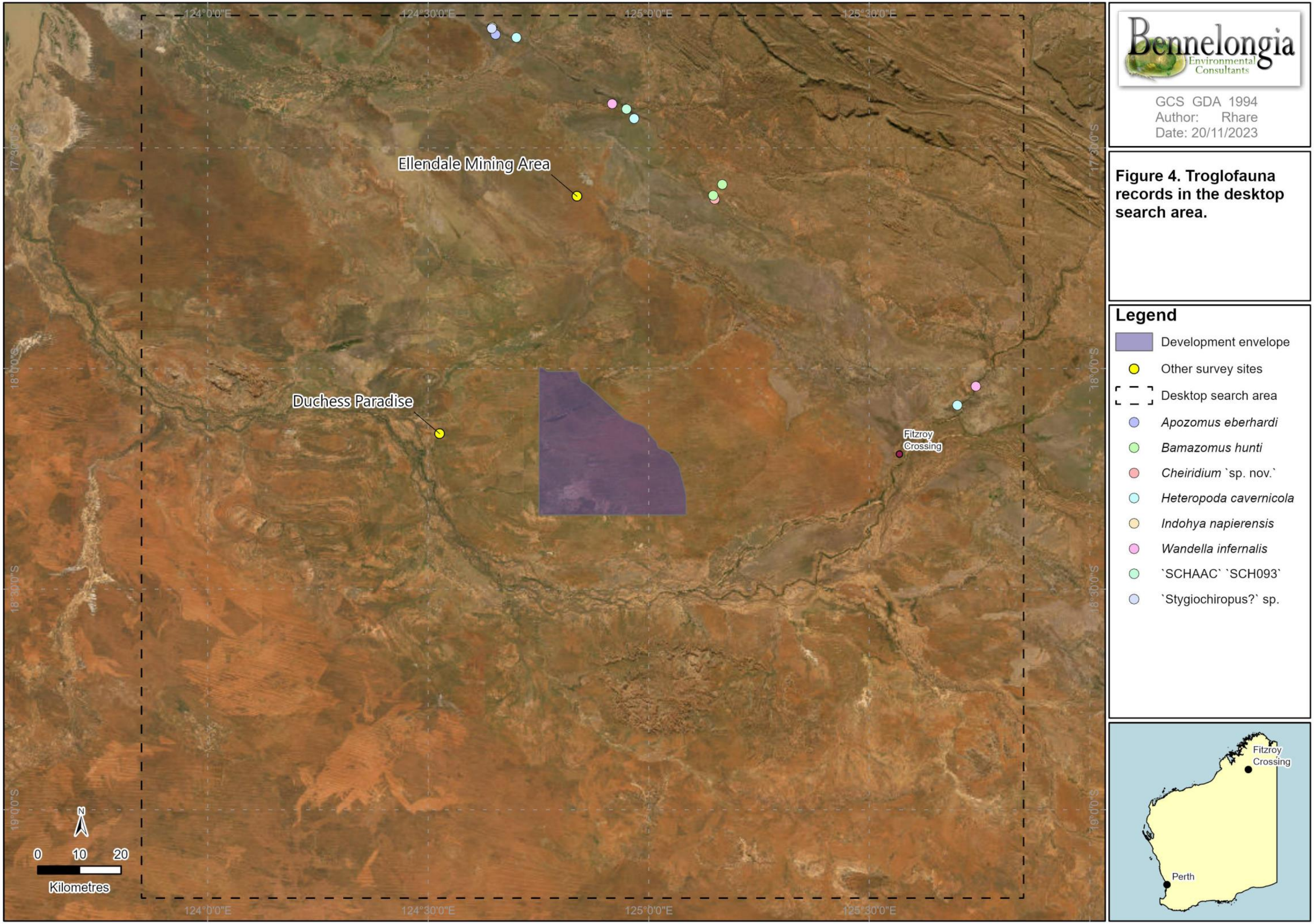


Figure 4. Troglofauna records in the desktop search area.

without specific habitat information have not been included in Table 1 but it is likely that several other species recorded in the desktop search area, especially pseudoscorpions, represent troglofauna.

4. DISCUSSION

The lack of much subterranean fauna sampling of sampling in the Kimberley makes it difficult to assess the likely richness of subterranean fauna communities in the surficial aquifers of the Fitzroy Trough. Saccò *et al.* (2022) provide a summary of stygofauna richness patterns in the Kimberley that supports the picture, based on results of the desktop search, that stygofauna probably occur. While the depth to water table in the Project area suggests the community there will not be rich, more evidence from sampling is required to understand whether stygofauna occur at the Project and the nature of the community. Richness may be greater than current data suggest. Surficial aquifers in alluvium and in sediments below sand plain are potentially prospective for stygofauna (Halse 2018).

While the likelihood of stygofauna occurrence and the nature of any stygofauna community remains unclear, this has little relevance to an assessment of potential impacts of groundwater abstraction on stygofauna in the Project area because the maximum drawdown experienced at each bore is modelled to be only 1.2 m and to decline to 1 m at 56 m from the bore. The level of drawdown interpreted as having potential impact on stygoofauna is usually taken to be 2 m (EPA 2016). Both the very small spatial extent of drawdown, and the minimal drawdown itself at the Project, indicate the there is little likelihood of impact on stygofauna, irrespective of whether a stygofauna community is present.

As with stygofauna, the potential impact of the Project on troglofauna can be assessed by examining the potential impacts without reference to whether troglofauna occurs. The small modelled drawdown will have no impact on troglofauna. Ground disturbance will be limited to the drawdown associated with drilling and preparations for surface construction. These activities will have very little likelihood of impact on troglofauna, irrespective of whether a troglofauna community is present.

5. REFERENCES

Aplin, K.P. (1998) Three new blindsnakes (Squamata, Typhlopidae) from north western Australia. *Records of the Western Australian Museum* **19**: 1-12.

Bennelongia (2016) Gruyere Gold Project: Borefields Stygofauna Assessment. Bennelongia Pty Ltd, Report 2016/279, Jolimont, WA, 40 pp.

Bennett Resources (2020) Valhalla gas exploration and apprasial program. Section 38 referral - supporting information document. Bennett Resources Pty Ltd, Perth, 141 pp.

Bureau of Meteorology (2023) Bureau of Meteorology, Climate Statistics for Australian Locations. Commonwealth of Australia, retrieved 2023.

Cooper, S.J.B., Bradbury, J.H., Saint, K.M., Leys, R., Austin, A.D., and Humphreys, W.F. (2007) Subterranean archipelago in the Australian arid zone: mitochondrial DNA phylogeography of amphipods from central Western Australia. *Molecular Ecology* **16**: 1533-1544.

Cooper, S.J.B., Hinze, S., Leys, R., Watts, C.H.S., and Humphreys, W.F. (2002) Islands under the desert: molecular systematics and evolutionary origins of stygobitic water beetles (Coleoptera: Dytiscidae) from central Western Australia. *Invertebrate Systematics* **16**: 589-598.

DEC (2009) Priority Ecological Communities for Western Australia. Department of Environment and Conservation, Species and Communities Branch, 17 pp.

DEC (2013) Definitions, categories and criteria for threatened and priority ecological communities. Government of Western Australia, Perth.

DPAW (2022) Priority Ecological Communities for Western Australia Version 34 (21 December 2022). Species and Communities Program, Department of Biodiversity, Conservation and Attractions, https://www.dpaw.wa.gov.au/images/Priority%20Ecological%20Communities%20list.pdf, retrieved May 2023.

Eberhard, S.M., Halse, S.A., Williams, M.R., Scanlon, M.D., Cocking, J., and Barron, H.J. (2009) Exploring the relationship between sampling efficiency and short-range endemism for groundwater fauna in the Pilbara region, Western Australia. *Freshwater Biology* **54**: 885–901.

EPA (2016) Environmental Factor Guideline - Subterranean Fauna. Environmental Protection Authority, Perth, WA, 5 pp.

EPA (2021) Technical guidance - Subterranean fauna surveys for environmental impact assessment. Environmental Protection Authority, Perth, WA, 35 pp.

Gibert, J., and Deharveng, L. (2002) Subterranean ecosystems: a truncated functional biodiversity. *BioScience* **52**: 473-481.

Gibson, L., Humphreys, W.F., Harvey, M., Hyder, B., and Winzer, A. (2019) Shedding light on the hidden world of subterranean fauna: A transdisciplinary research approach. *Sci Total Environ* **684**: 381-389.

Guzik, M.T., Austin, A.D., Cooper, S.J.B., *et al.* (2011) Is the Australian subterranean fauna uniquely diverse? *Invertebrate Systematics* **24**(5): 407-418.

Halse, S.A., 2018a. Research in calcrete and other deep subterranean habitats outside caves. In: OT Moldovan, L Kovac and S Halse (Eds.), Cave ecology. Springer nature, Cham, Switzerland, pp. 415-434.

Halse, S.A., 2018b. Subterranean fauna of the arid zone. In: H Lambers (Ed.), On the ecology of Australia's arid zone. Springer Nature, Cham, Switzerland, pp. 388.

Halse, S.A., Curran, M.K., Carroll, T., and Barnett, B. (2018) What does sampling tell us about the ecology of troglofauna? *ARPHA Conference Abstracts* **1**.

Halse, S.A., and Pearson, G.B. (2014) Troglofauna in the vadose zone: comparison of scraping and trapping results and sampling adequacy. *Subterranean Biology* **13**: 17-34.

Halse, S.A., Scanlon, M.D., Cocking, J.S., Barron, H.J., Richardson, J.B., and Eberhard, S.M. (2014) Pilbara stygofauna: deep groundwater of an arid landscape contains globally significant radiation of biodiversity. *Records of the Western Australian Museum* **Supplement 78**: 443-483.

Harvey, M.S. (2002) Short-range endemism amongst the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* **16**(4): 555-570.

Hose, G.C., and Stumpp, C. (2019) Architects of the underworld: bioturbation by groundwater invertebrates influences aquifer hydraulic properties. *Aquatic Sciences* **81**(1): 20.

Howarth, F.G. (1983) Ecology of cave arthropods. *Annual Review of Entomology* **28**(1): 365-389.

Humphreys, W.F., 2000. The hypogean fauna of the Cape Range Peninsula and Barrow Island, northwestern Australia. In: H Wilkens, DC Culver and WF Humphreys (Eds.), Subterranean Ecosystems. Ecosystems of the World. Elsevier, Amsterdam, pp. 581-601.

Humphreys, W.F., Watts, C.H.S., Cooper, S.J.B., and Leijs, R. (2009) Groundwater estuaries of salt lakes: buried pools of endemic biodiversity on the western plateau, Australia. *Hydrobiologia* **626**(1): 79-95.

Hyde, J., Cooper, S.J.B., Humphreys, W.F., Austin, A.D., and Munguia, P. (2018) Diversity patterns of subterranean invertebrate fauna in calcretes of the Yilgarn Region, Western Australia. *Marine and Freshwater Research* **69**(1): 114-121.

INTERA (2023) Modelling of drawdown impacts from proposed rig supply bores in the Bennett Resources Valhalla Gas Development Project. INTERA Geosciences Pty Ltd, Perth, 16 pp.

Korbel, K., and Hose, G. (2011) A tiered framework for assessing groundwater ecosystem health. *Hydrobiologia* **661**(1): 329-349.

Lamoreux, J. (2004) Stygobites are more wide-ranging than troglobites. *Journal of Cave and Karst Studies* **66**: 18-19.

Matthews, E.F., Abrams, K.M., Cooper, S.J.B., Huey, J.A., Hillyer, M.J., Humphreys, W.F., Austin, A.D., and Guzik, M.T. (2019) Scratching the surface of subterranean biodiversity: molecular analysis reveals a diverse and previously unknown fauna of Parabathynellidae (Crustacea: Bathynellacea) from the Pilbara, Western Australia. *Molecular Phylogenetics and Evolution*: 106643.

Maurice, L., and Bloomfield, J. (2012) Stygobitic Invertebrates in Groundwater — A Review from a Hydrogeological Perspective. *Freshwater Reviews* **5**(1): 51-71.

Ponder, W.F., and Colgan, D.J. (2002) What makes a narrow-range taxon? Insights from Australian freshwater snails. *Invertebrate Systematics* **16**: 571-582.

Reeves, J.M., De Deckker, P., and Halse, S.A. (2007) Groundwater ostracods from the arid Pilbara region of northwestern Australia: distribution and water chemistry. *Hydrobiologia* **585**(1): 99-118.

Rockwater (2016) Hydrogeological assessment of Paradise-Valhalla-Asgard project areas. Report for Buru Energy. Rockwater Hydrogeological and Environmental Consultants, Jolimont, 166 pp.

Saccò, M., Blyth, A.J., Douglas, G., *et al.* (2022) Stygofaunal diversity and ecological sustainability of coastal groundwater ecosystems in a changing climate: The Australian paradigm. *Freshwater Biology* **67**(12): 2007-2023.

Subterranean Ecology (2012) Canning Basin Project: Stygofauna survey and assessment. Subterranean Ecology Pty Ltd, 2012\02, Stirling, WA, 28 pp.

UNESCO World Heritage Centre (2022) Ningaloo Coast. https://whc.unesco.org/en/list/1369, retrieved 11 July 2022.

Watts, C.H.S., and Humphreys, W.F. (2006) Twenty-six new Dytiscidae (Coleoptera) of the genera Limbodessus Guignot and Nirripirti Watts & Humphreys, from underground waters in Australia. *Transactions of the Royal Society of Australia* **130**(1): 123-185.

Whitely, P.G. (1945) New sharks and fishes from Western Australia. Part 2. *Australian Zoologist* **11**: 1-45.