Bennelongia Environmental Consultants

Subsea 7 Pipeline Fabrication Facility: Stygofauna Survey

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Final Report

Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Subsea 7 Pipeline Fabrication Facility: Stygofauna Survey

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EXECUTIVE SUMMARY

Subsea 7 plans to construct a pipeline fabrication facility (the project), located south of Learmonth on the western side of Exmouth Gulf and approximately 35 km south of the township of Exmouth. The project includes the construction of a fabrication shed, a storage area and two 10 km long bundle tracks which lead to a bundle launchway. The bundle launchway will span 380 m across the beach into the nearshore subtidal area where each bundle will be launched upon completion.

Desktop studies of the project site were conducted to assess the possibility of the presence of subterranean fauna within the project area of the Learmonth pipeline fabrication facility. Owing to a lack of identified suitable habitat, it was considered that in general troglofauna are unlikely to occur at the project east of Minilya-Exmouth road (although a depauperate community may occur near the fabrication facility, and possibly some troglofauna occur nearby in outcropping calcrete). More pertinently, it was considered that project development would not remove troglofaunal habitat even if troglofauna are present. In contrast, it was considered that suitable habitat for stygofauna is present and that two activities might impact any stygofauna species present. These are: 1) water drawdown west of the Exmouth-Minilya road as a result of groundwater abstraction, and 2) infiltration of nutrients and freshwater when treated greywater is released at a specifically designed sprayfield.

In summary, it was considered that the desktop study found sufficient information to conclude the project will not threaten the conservation status of troglofauna species but that field survey of stygofauna was needed to assess the potential impact of the project on this group of animals.

Twenty bores distributed across the proposed project envelope were sampled three times each for stygofauna, in November 2018, January 2019 and April 2019. A total of 180 specimens belonging to 11 species were collected. Of the 11 species, three were collected from the proposed borefield west of the Exmouth-Minilya road, with one also collected from the project envelope east of the road. These species also occur in other parts of the Cape Range Peninsula. Eight species were collected within, or adjacent to, the project envelope but all eight species were found close to the coast in supratidal habitat. No species were collected from the sandplain area covering most of the project envelope and in which the spray field is located. Two of the coastal species occur in other parts of Cape Range peninsula and elsewhere.

Four species collected near the coast are of scientific interest and their stygofauna status is uncertain. These are the copepods *Ameira* 'BHA250', *Ectinosoma* `BHA244`, *Apodopsyllus* `BHA255` and *Speleophria* `BCA002` (the latter species has many anchialine relatives).

Given the small depth of drawdown associated with borefield operations and the widespread distributions of the stygofauna species collected in the borefield, it is concluded that borefield operations will not adversely affect stygofauna. Given the lack of stygofauna species on the sand plain, the small size of the spray field and small volume of water being disposed of, with various factors likely to minimise changes to groundwater conditions resulting from this addition of nutrients fresh water, it is concluded that disposal of greywater will also not adversely affect stygofauna.

Accordingly, it is considered the Subsea 7 Pipeline Fabrication Facility poses no significant threat to either troglofauna or stygofauna species.

CONTENTS

Executive Summary iii
1. Introduction 1
2. The Cape Range Peninsula 1
2.1. Geology and Hydrologeology 3
2.2. Stygofauna on the Cape Range Peninsula 3
2.3. Troglofauna on the Cape Range Peninsula 3
3. Impacts on Stygofauna 4
4. ASSESSMENT Framework 6
5. SAMPLING FOR STYGOFAUNA 7
5.1. Sampling effort and methods 7
5.2. Sampling in Relation to Project Impacts 7
5.3. Personnel 8
6. SAMPLING Results 8
6.1. Groundwater Conditions 8
6.2. Stygofauna 9
6.3. Nationally Important Wetland 9
6.4. Species of Scientific Interest 9
6.4.1. Other Species of Note 14
7. Discussion 14
8. Conclusions 15
9. References 16
Appendix 1. Surface geology of the area surrounding the project 18
Appendix 2. Bores sampled during three phases of the stygofauna survey and their locations 19
Appendix 3. Salinity (TDS mg/L), pH, dissolved oxygen (DO, %) and depth to groundwater (m) at bores in the three phases of sampling. 21
Appendix 4. Results of stygofauna sampling. 22

LIST OF FIGURES

Figure 1. Location Map of the Project with regards to the townships of Exmouth and Carnarvon, highlighting the Development Footprint. 2
Figure 2. 10 year drawdown contours and sampled bores with respect to the development footprint, project envelope and the Cape Range Subterranean Waterways. 5
Figure 3. Stygofauna species accumulation curve based on sampling results and ICE estimate of the actual number of species present (using EstimateS, Colwell 2013). 11
Figure 4. Location of species identified from within the modelled water draw down contours (modelled by GHD) at the water abstraction site. 12
Figure 5. Location of species that may be impacted by nutrient and freshwater plume from spray field. 13

LIST OF TABLES

Table 1. Sampling effort for stygofauna in different parts of the project. 7
Table 2. Qualifications and experience of staff. 8
Table 3. Stygofauna species collected during three rounds of sampling. 10

1. INTRODUCTION

Subsea 7 plans to construct a pipeline fabrication facility (the project) south of Learmonth on the western side of Exmouth Gulf and approximately 35 km south of the township of Exmouth. The project includes construction of a fabrication shed, a storage area and two 10 km long bundle tracks that lead to a bundle launchway for the bundles of pipes being manufactured (Figure 1). The bundle launchway will span 380 m across the beach into the nearshore subtidal area where each bundle will be launched upon completion.

The project will require abstraction of groundwater for a potable water supply and for hydrotesting of the bundles. Groundwater will be sourced from up to three wells located west of the Minilya-Exmouth road (the other infrastructure is east of the road) and treated to make it potable. The greywater generated will be disposed of on-site, after treatment to reduce nutrients, in a small spray field (up to 1.5 ha) that irrigates vegetation. This report is designed to assess the significance of any impact that project construction and operations may have on subterranean fauna.

Subterranean fauna can be divided into two distinct groups: stygofauna and troglofauna. Troglofauna are air-breathing animals that live below the land surface, usually at depth greater than 2-3 m, with a distribution that extends down to the water table. Stygofauna are aquatic animals that live in groundwater. The vast majority of subterranean fauna in Western Australia are invertebrates, although stygofaunal fish and troglofaunal reptiles have been recorded (Aplin 1998; Whitley 1945). Subterranean fauna usually show morphological modifications to life underground that include loss (or reduction) of eyes and skin pigmentation, elongation of appendages and sensory setae, and development of a vermiform body shape.

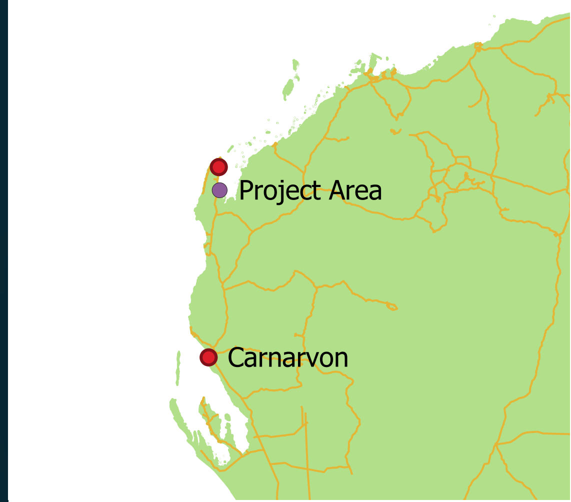
Many coastal sections of the Cape Range Peninsula are known to support rich stygofauna communities, while Cape Range itself and the associated foothills, which runs north-south along the centre of the peninsula, are known to support a rich troglofauna community (Eberhard *et al.* 2005; Hamilton-Smith *et al.* 1998; Harvey *et al.* 1993). The occurrence and distribution of subterranean fauna is closely related to geology. Both stygofauna and troglofauna inhabit subterranean spaces that comprise interstices, voids, vugs, cavities or fissures. Geologies that contain many such spaces represent potential habitat. Both vertical and lateral connectivity of spaces are factors that contribute to determining the distribution of subterranean fauna. In Western Australia, karst, calcretes and shallow alluvial aquifers are prospective habitat for stygofauna, while air-breathing troglofauna are particularly common in karst and some iron formations.

2. THE CAPE RANGE PENINSULA

The Cape Range Peninsula contains a diverse set of land uses, including Cape Range National Park and Ningaloo Marine Park (which together form the Ningaloo World Heritage Area), as well as pastoral stations, a defence base and various recreational and commercial areas.

A small part of the large nationally important wetland 'Cape Range Subterranean Waterways' occurs within the Project area (Figure 2). The wetland as a whole was listed because of its known or potential values for subterranean fauna. Nomination of the area was principally justified by faunal data from Bundera Sinkhole and the belief that the wetland was karstic (which is known to be the case where there are sinkholes and caves) (Lane *et al.* 1996).

More generally, the occurrence of globally important subterranean fauna values in parts of the Cape Range Peninsula were among the reasons the peninsula was nominated as part of the Ningaloo World Heritage site (DEWHA 2010)



Legend

Development Footprint

Project Envelope

Roads

Figure 1: Location Map of the Project with regards to the townships of Exmouth and Carnarvon, highlighting the Development Footprint

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Map constructed using QGIS version 3.4

2.1. Geology and Hydrologeology

The geology and hydrogeology of the Cape Range Peninsula have been described by Allen (1993).

The project lies almost entirely within areas that Allen categorised as sand sheet and coastal plain deposits. However, finer scale surface geological mapping recognises areas of calcarenite, sandstone, sandplain with linear dunes, alluvium, calcrete and supratidal flats in the vicinity of the project (Appendix 1). Drill logs show that the main geologies at depth in both the proposed project envelope and borefield are Exmouth sandstone and Bundera calacarenite (Appendix 2).

Depth to the watertable varies from approximately 20-30 m in the proposed borefield, where the sandplains meet surface expressions of calcarenite and sandstone and groundwater salinities are mostly <2000 mg/L TDS. In the sandplains around the proposed fabrication facility, at the western end of the project envelope, depth to the watertable is 12-18 m and groundwater salinities are approximately 30,000 mg/L. In the areas of project envelope in sandplain closer to the coast or supratidal flats the depth to the watertable is <4 m and groundwater salinities are approximately 40,000-50,000 mg/L (Appendix 3). However, there also appears to be fresher groundwater that is slightly fresher than seawater, which suggests there is some flow of relatively fresh groundwater from Cape Range to the coast.

2.2. Stygofauna on the Cape Range Peninsula

There have been many studies of stygofauna on the Cape Range Peninsula (e.g. Humphreys and Adams 1991; Knott 1993; Page *et al.* 2016; Page *et al.* 2008), as well as intensive monitoring of the stygofauna in the Exmouth water supply borefield (e.g. Goater 2009; Tang 2006). It has been shown that the coastal plain habitats are rich in stygofauna. Perhaps the most significant site for stygofauna is Bundera Sinkhole, on the western side of the peninsula, which supports a well described anchialine community (e.g. Black *et al.* 2001; Humphreys 1999). The term anchialine refers to coastal systems where fresh or brackish water overlays marine water in a stratified system. Where anchialine systems occur in limestone caves, such as at Bundera Sinkhole, the fauna often contains relictual or otherwise interesting crustaceans (e.g. Jaume *et al.* 2001; Yager and Humphreys 1996).

While the stygofauna community of the eastern coastal plain of the peninsula does not have the scientific interest of the community at Bundera Sinkhole in the west, it is nevertheless quite rich with more than 30 species recorded from spatially limited sampling (Tang 2006; Bennelongia 2008, 2018).

2.3. Troglofauna on the Cape Range Peninsula

Many species of troglofauna have been collected from caves in Cape Range and its foothills (Gray and Thompson 2001; Harvey 1998; Humphreys and Adams 1991), whereas few species have been collected from the surrounding coastal plain.

The occurrence of troglofauna east of the Exmouth-Minilya road, where most of the project is located (Figure 2), is possible in the more inland sandplain comprising a dune network of quartz sand, with occasional small patches of nodular calcrete (Appendix 1). It is unlikely in the silt and clay-dominated areas closer to the coast. Depth to groundwater is up to 20 m near the road but is reduced to 4 m at bore S01 midway along the bundle track and is about 2 m near the coast. Soils are saline in the sandplain because they receive large amounts of aerosol salts from Exmouth Gulf, and even saltier near the shore because of past marine inundation as well as aerosol salts.

In general, troglofauna are considered to be most abundant in karstic and fractured rock habitats, including situations where voids are the result of weathering or chemical processes. The patches of outcropping nodular calcrete seen adjacent to the western end of the project envelope (Appendix 1) may possibly support troglofauna species because depth to the watertable is great enough to ensure at least a moderate amount of habitat will persist long-term. However, the small size of the calcrete patches make it unlikely many troglofauna species are present. Closer to the coast, where the watertable is shallow, any troglofauna in calcrete or the geologies underlying the sandplain are likely to be outcompeted by soil fauna. In relation to calcrete, which is considered to be a prospective geology, it should be noted that the documented occurrences of troglofauna fauna in Western Australia calcrete have involved groundwater, rather than the pedogenic, calcretes that occur on the Cape Range Peninsula. The structural suitability of these small pedogenic calcretes for troglofauna is unclear.

Sandplain is considered in general to have low prospectivity for troglofauna. The sand of the dunes and swales probably has pore spaces that are too small for most species. However, where the depth to the watertable is large enough to make it unlikely that soil fauna will occur throughout the vadose zone, troglofauna may occur if the deeper substrates are suitable. Both Exmouth sandstone and Bundera calcarenite occur at depth at the western end of the project envelope, and the limited information available from drill logs suggests that they at least sometimes provide suitable habitat (Appendix 2).

The occurrence of troglofauna is highly unlikely in supratidal flats near the coast because the silt/clay substrate does not have large enough pore spaces and the depth to groundwater is only a few metres. The shallow watertable means troglofauna will also be absent from areas of sandplain near the coast, irrespective of underlying geology. An additional constraint on the occurrence of troglofauna is that these animals essentially have the physiology of freshwater invertebrates and become desiccated if high concentrations of salt are present (see Howarth and Moldovan 2018). This constraint is also likely to be expressed in the nodular calcrete.

On the basis of the information above, it is considered unlikely that a significant troglofauna community occurs within the project envelope, although some potential troglofaunal habitat occurs around the fabrication facility at the western end. More favourable habitat for troglofauna occurs in the borefield, where the depth to groundwater is 20-30 m and there is some karstic habitat present (Invertebrate Solutions 2018; Appendix 2) but operation of the borefield will not remove any troglofauna habitat. Troglofauna may also occur in the small areas of nodular calcrete around the project where the depth to groundwater is deeper but there will be no disturbance of this habitat and hence no impact on troglofauna.

In summary, while there may be a small number of troglofauna species in and around the project, it is highly unlikely any troglofauna species will be threatened by the project. The limited excavation within the project envelope will not exceed 1 m in depth (this is discussed further in Section 3). Such shallow excavation of this depth is highly unlikely to affect the persistence of troglofauna and, accordingly, troglofauna survey was considered to be unnecessary.

3. IMPACTS ON STYGOFAUNA

Development projects may potentially impact subterranean fauna in two ways. These are by removal of habitat through ground excavation or removal of groundwater and by reducing the quality (or carrying capacity) of habitat. Habitat removal is a direct impact and is more likely to result in the complete loss of animals from an area than loss of habitat quality. The latter is often called an indirect impact and result from reduced recharge and energy input as a result of project developments. The effects of polluting events, such as petroleum spills, salinisation and nutrient release, are usually treated as indirect impacts although, in extreme cases, they may result in total loss of habitat for some species. It is useful to consider construction and operations of the pipeline fabrication facility separately when identifying potential impacts of the project on subterranean fauna:

1) Construction will cause surface disturbance in limited areas in the form of road construction (up to 6.9 ha), bundle track construction (35 ha), erection of buildings and staff facilities etc (8 ha), spray field (1.5 ha), drainage sump and hydrotesting pond (1 ha), groundwater borefield and supply pipeline

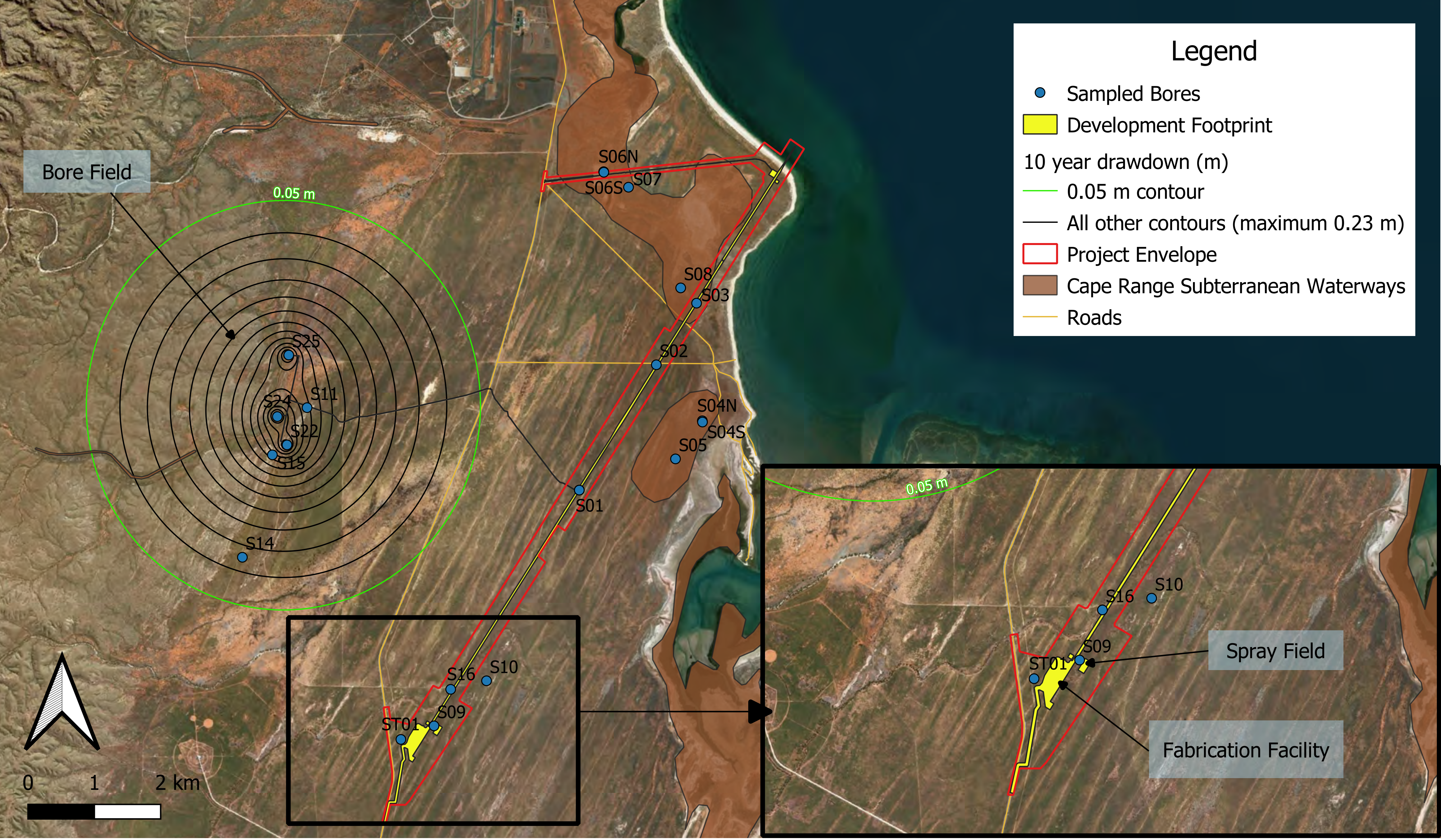

Figure 2: 10 year drawdown contours and sampled bores with respect to the development footprint, project envelope and the Cape Range Subterranean Waterways.

Map Constructed with QGIS version 3.4

(2.6 ha) and miscellaneous drains, access tracks and earthworks area (120 ha) (Figure 2). Excavations will not exceed 1 m in depth (note that surface species exclude troglofauna from such shallow habitat). Petroleum products and other chemicals will be used in construction.

2) Operations will include managing a borefield to supply hydrotesting water and a potable water supply to support staff (12 ML/annum), disposal of greywater from staff facilities (2.4ML/annum), and the storage and use of hydrocarbons and other chemicals used for bundle manufacture, transport etc. In addition, there will be on-going reduction of infiltration of rainwater and plant matter (carbon for energy) as a result of the creation of hard surfaces (roads, building etc) in the project area.

The most likely impacts, other than a hydrocarbon or chemical spill, on stygofauna will be:

1) Loss of habitat - groundwater abstraction to provide water for bundle pipe testing and amenities at the fabrication site will lower the watertable and reduce the volume of stygofauna habitat available.

Water is required for onsite potable water use in kitchens, showers and washbasins, as well as for hydro-testing of the constructed bundle pipes. This water requirement is anticipated to be no more than 12 ML/annum. Water will be sourced from three bores located to the west of the Exmouth-Minilya road (Figure 2) and will be treated to make it potable. The drawdown associated with 10 years of abstraction has been modelled by GHD (2019a). Most assessments in Western Australia assume that drawdowns of <2 m do not affect stygofauna significantly and, on this basis, there is essentially no drawdown impact associated with the borefield.

2) Altered groundwater conditions – disposing of treated greywater is likely to increase nutrient concentrations and decrease salinity of groundwater.

Greywater generated on site through showers, washbasins etc will be treated on site and disposed of in a small vegetated spray field. Some of the sprayed water will evaporate and a substantial proportion of the nutrients in it will be taken up by plants or will adhere to soil particles above the watertable (GHD 2019b). The remaining water, salt and nutrients will recharge groundwater. The expected increase in nutrients (mainly nitrogen) in groundwater as a result of spray field operation is expected to be small and occur over a limited area; the expected freshening of groundwater is also expected to be localised.

As described above, it is anticipated that only very minor loss, or deleterious change, in habitat will occur as a result of project operations. However, owing to the known richness and scientific importance of stygofauna communities occurring on the coastal plain of Exmouth peninsula, stygofauna surveys were conducted to document the stygofauna species present, or likely to occur, within the project area and to assess the likely impact of the project on stygofauna conservation values.

4. ASSESSMENT FRAMEWORK

The environmental impact assessment process in relation to state government approvals in Western Australia is largely managed under the *Environmental Protection Act 1986* (EP Act). The Environmental Protection Authority (EPA), which administers the EP Act has put out a position statement '*Environmental Protection of the Cape Range Province*' on the Exmouth peninsula area that identifies stygofauna and troglofauna as a major value of the Cape Range area and laid out policies to underpin environmental assessment and decision-making in the area (EPA 1999). More recently, they provided a framework for the assessment of subterranean fauna. These are: EPA (2016b) that describes how subterranean fauna should be treated as a factor in assessment, and EPA (2016a, 2016c) that provide technical guidance on survey design and sampling methods.

The proposed pipeline fabrication facility is currently being reviewed by the EPA under Part IV of the EP Act at a public environmental review (PER) level of assessment. Subterranean Fauna is deemed to be a preliminary key environmental factor in the assessment. This report provides the results of a field survey of stygofauna in the vicinity of the project and provides an assessment of the likely impact of the project on subterranean fauna.

5. SAMPLING FOR STYGOFAUNA

A three-phase survey program was conducted to assess the presence of stygofauna near the project. The sampling plan was presented to EPA Services on 9 July 2018 and surveys were conducted in accordance with EPA technical guidance for survey and sampling methods (2016a, 2016c).

5.1. Sampling effort and methods

Twenty bores distributed across the proposed project envelope were sampled, with each bore being sampled three times. The locations of bores are shown in Figure 2 and a list of bores is provided in Appendix 2.

Bores were sampled with modified plankton nets of either 32 or 90 mm diameter, depending on the diameter of the bore (Invertebrate Solutions 2019). Each bore was hauled six times (three times with a 50 µm mesh net and three times with a 150 µm mesh net). Nets were lowered to the base of the bore and agitated at the bottom to mix sediment into the water column to increase likelihood of capturing benthic species. The nets were then hauled through the entire water column of the bore. Samples were transferred into polycarbonate vials containing 100 % ethanol and kept in a cool environment (esky with ice bricks or refrigerator) for preservation purposes. Samples that contained large volumes of sediment were elutriated prior to sample preservation. Nets were washed in decontamination solution between each site to avoid cross-contamination. Depth to water table, depth to end of hole, temperature, dissolved oxygen, electrical conductivity, pH and oxygen-reduction potential were recorded using a Hanna HI 9298194 water quality meter.

5.2. Sampling in Relation to Project Impacts

The sampling design had two objectives: 1) to compile a list of species that occur, or are likely to occur, within the borefield and project envelope, and 2) to assess the conservation significance of any possible changes in stygofauna communities associated with the potential project impacts on stygofauna habitat (albeit these impacts will be small). As such, sampling occurred in two distinct areas, the freshwater drawdown area associated with abstraction and the saline/coastal area that is potentially influenced by infrastructure development and operations, including by the potential spread of a nutrient and freshwater plume from the treated greywater spray field (although this impact is likely to be very small).

At the time of sampling, the exact location of the spray field and extent of the borefield were not known and sites were selected to maximise the likelihood of identifying species that occur within the general areas of the borefield and project envelope (including adjacent areas that reflect conditions inside the envelope). The spray field site has now been selected (see Figure 1). Sample effort is assigned to general areas in Table 1, with more detail about locations given in Appendix 2.

Representative specimens of the species collected are currently being lodged in the Western Australian Museum.

Table 1. Sampling effort for stygofauna in different parts of the project.

Location	No of bores	No. of samples
Borefield	6	18
Project envelope	10	30
Outside envelope	4	12
Total	**20**	**60**

5.3. Personnel

Field work and sample sorting was conducted by Timothy Moulds of Invertebrate Solutions. Samples were sorted by Jane McRae, and Melita Pennifold and animals identified by Jane McRae, with advice on some copepod identifications from Prof. Tomislav Karanovic (University of Tyumen, South Korea). The report was written by Huon Clark and reviewed by Stuart Halse. Staff competencies are summarised in Table 2.

Table 2. Qualifications and experience of staff.

	Qualification	Main role	Experience
Huon Clark	BSc PhD	Reporting	6 years consulting in NT and WA on vertebrates, water quality and subterranean fauna, 6 scientific publications
Stuart Halse	BSc PhD	Reporting and review	19 years subterranean fauna research and consulting, more than 40 years wetland survey experience across WA. Written or coordinated over 350 reports; author of 120 scientific publications with 20 on subterranean fauna and 22 on taxonomy, editor of recently published Spring Nature book *Cave Ecology*. Recognised by Environmental Consultants association as providing Specialist Service for subterranean fauna
Tim Moulds	BSc PhD	Fieldwork	20 years of ecological and subterranean fauna surveys. Written over 80 reports, author of 10 scientific publications with 6 on subterranean fauna
Jane McRae	-	Identifications	19 years subterranean fauna identifications, 30 years of invertebrate identification experience. Author of 20 scientific publications, with 12 describing new species
Melita Pennifold	BSc (Hons)	Sorting	21 years aquatic invertebrate sorting and identification
Tomislav Karanovic	MSc PhD	Identification advice	Author of following books: *Subterranean copepods from arid Western Australia, 2004* *Subterranean copepods from the Pilbara region in Western Australia, 2006* *Marine interstitial Poecilostomatoida and Cyclopoida of Australia, 2008*

6. SAMPLING RESULTS

6.1. Groundwater Conditions

Salinity of groundwater in the top metre or so of the watertable varied across the project, being fresh in the borefield (approximately 800-1,200 mg/L) and of marine salinity or more, in the project envelope (Appendix 3). Salinity in the vicinity of the spray field was 30,000-34,000 mg/L and this may represent the salinity of the upper layer of groundwater across most of the sandplain until the supralittoral, although the salinity in bore S04 in the middle of the plain was approximately 43,000 mg/L. Salinity in the S06 bores (assumed to be on the seaward edge of the sandplain) was about 50,000 mg/L. These higher salinities, as well as the lower salinity of approximately 34,000 mg/L at bore S02 in the supralittoral flats, probably reflect fine-scale spatial variation in groundwater salinity as a result of variable rates of groundwater flow, evaporation and recharge from the surface. Salinity in supralittoral flats near the coast was mostly 48,000-52,000 mg/L. No salinity profiling was undertaken.

There was less than one unit of variation in pH across all bores in the three phases of sampling (6.42-7.35), with values at individual bores varying by no more than half a unit. Dissolved oxygen showed more variation, ranging from 1.8% at ST01 in January 2019 to 71.4% at S06N in November 2018. While some low DO values were recorded, none was likely to be limiting to stygofauna distributions (2% DO represents 0.15 mg/L oxygen; the threshold for survival is about 0.01 mg/L – Malard and Hervant 1999). Halse *et al*. (2014) found no relationship between stygofauna richness and DO in the Pilbara.

Groundwater conditions were similar in November 2018 and January 2019, although DO declined in January (mean salinity across bores 30,220 vs 30,220 mg/L TDS; pH 7.03 vs 6.9; DO 28.0 vs 20.6, Appendix 3). As a result of rainfall, salinity was lower in April 2019 and there was substantial further decline in DO (mean salinity across bores 25366 mg/L TDS, pH 6.9, DO 11.1%).

6.2. Stygofauna

A total of 180 specimens belonging to 11 species were collected during the three phases of stygofauna survey. All species collected are crustaceans and comprise two amphipods and nine copepods (Table 3). Eight species were collected from the project envelope and its surrounds east of the Minilya-Exmouth road, while three species were collected from the borefield. Six of the eight species east of the road are known only from the project envelope or its immediate vicinity. The exceptions are the widespread copepod *Stygoridgwayia trispinosa*, which is found widely in the Pilbara (Tang *et al.* 2008), and the copepod *Phyllopodopsyllus wellsi*, which occurs elsewhere on the Cape Range Peninsula and on Barrow Island. In contrast to the situation east of the road, all animals identified within the borefield are known to occur in other parts of the Cape Range Peninsula or further afield.

Six of the eight species collected from the project envelope and close surrounds were represented by only one individual even though three phases of sampling occurred (Table 3). Despite the high proportion of species collected as single animals, the species estimating algorithms (see Colwell 2013) suggest that approximately 70% of stygofauna species at the project have been documented (Figure 3). This is at the lower end, but within the range, of the efficiency of most subterranean fauna assessments.

Stygofauna were not collected from any of the bores in the sandplain. In contrast, 66% of the borefield bores (4 of 6 sampled, Figure 4) and 75% of the bores in supralittoral flats yielded stygofauna (3 of 4 sampled, Figure 5). This suggests the sandplain at the project (and its underlying geologies) does not provide suitable habitat for stygofauna, although a general habitat analysis considered it to be prospective (Invertebrate Solutions 2017; see also Appendix 2). It is noted that stygofauna have been collected 40 km north at Exmouth at similar groundwater depths and salinities to those of the sandplain. The proposed project borefield, which yielded stygofauna, has the same geologies underlie the sandplain although groundwater is fresher.

6.3. Nationally Important Wetland

Three of the eight bores sampled within the nationally important wetland WA006 (Cape Range Subterranean Waterways) are also within the project envelope (Figure 2). These are bore S03, which yielded six species, and bores S06N and S06S, which did not yield any stygofauna. Two of the bores outside the project envelope but within WA006 also yielded stygofauna (S04N 1 species, S08 2 species).

Results of the sampling reported here suggest the supratidal areas closer to the ocean represent the most prospective part of the wetland for stygofauna and these areas appear to be the target geology in the listing of WA006, although it contains a mix of geologies and the target geology is not specified.

6.4. Species of Scientific Interest

While none of the stygofauna species collected during sampling is considered likely to be impacted by project development or operations, four of the species are of scientific interest.

Ameira `BHA250`

Five individuals of *Ameira* 'BHA250' were identified in bore S03, which is located 7.5 km from the spray field (Figure 5). The nearest record of an *Ameira* is from Lake MacLeod, just to the south of the Cape Range Peninsula. It is currently not possible to state whether these two species are the same or how closely they are related.

Table 3. Stygofauna species collected during three rounds of sampling.
Blue highlighting indicates high order identifications that of species that are probably already listed in the table. Grey highlighting indicated the species is known only from the project envelope.

Higher Order Identification	Lowest Identification	Number of Specimens	Located within drawdown impact zone	Located within sprayfield impact zone	Located outside of impact zones	Comment
Arthropoda						
Crustacea						
Malacostraca						
Eumalacostraca						
Amphipoda						
Eriopisidae	Nedsia `sculptilis Cape Range`	1	Yes	No	Yes	Elsewhere on Exmouth peninsula
	Nedsia sp.	1	NA	NA	NA	Only a partial animal found, probably N. 'sculptilis'.
Decapoda						
Atyidae	Stygiocaris stylifera	19	Yes	No	Yes	Also located at the northern end of Cape Range Peninsula
Maxillopoda						
Copepoda						
Calanoida						
Ridgewayiidae	Stygoridgewayia trispinosa	1	No	Unlikely	Yes	Widespread throughout the Pilbara
Cyclopoida						
Cyclopidae	Diacyclops humphreysi s.s.	6	Yes	No	Yes	Occurs elsewhere on Exmouth peninsula
	Neocyclops `BCY058`	20	No	Unlikely	Probably	Known from S08 outside project
	Neocyclops sp.	1	NA	NA	NA	From S03, probably N. 'BCY060'
Harpacticoida						
Ameiridae	Ameira `BHA250`	5	No	Unlikely	Probably	Known from S03 in project envelope
	Nitokra `BHA251`	123	No	Unlikely	Probably	Known from S08 outside project
Ectinosomatidae	Ectinosoma `BHA244`	1	No	Unlikely	Probably	Known from S03 in project envelope
Paramesochridae	Apodopsyllus `BHA255`	2	No	Unlikely	Probably	Known from S04 outside project
Tetragonicipitidae	Phyllopodopsyllus wellsi	1	No	Unlikely	Yes	Occurs elsewhere on Exmouth peninsula and Barrow Island
Misophrioida						
Speleophriidae	Speleophria `BCA002`	3	No	Unlikely	Probably	Known from S03 in project envelope
Grand Total		**184**				

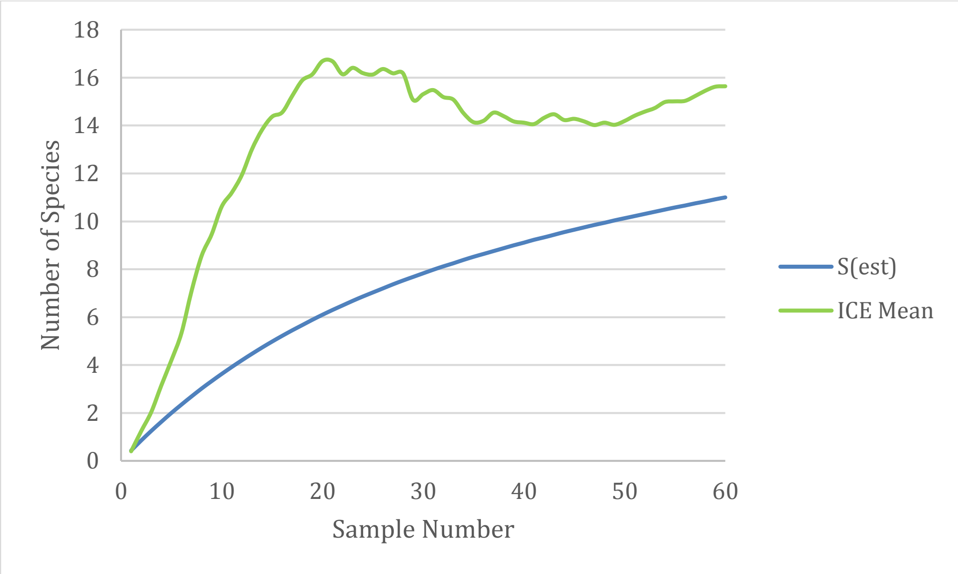

Figure 3. Stygofauna species accumulation curve based on sampling results and ICE estimate of the actual number of species present (using EstimateS, Colwell 2013).

It should also be noted that the subterranean status of *Ameira* 'BHA250' is unclear. The family Ameiridae has a marine origin but has successfully colonised fresh water, especially in subterranean habitats (Conroy-Dalton and Huys 1996) and Ameira 'BHA250' may be an inland record of a marine species or may be a stygofaunal species adapted to saline coastal areas. Whichever is the case, the availability of apparently suitable supratidal habitat north and south of the project, and the distance of this species from the spray field, mean that its conservation status is unlikely to be affected by the project.

Ectinosoma `BHA244`

Only one individual of *Ectinosoma* 'BHA244' was collected from bore S03 (Figure 5). *Ectinosoma* is predominantly a marine genus, although it has been collected from wells in Florida (Bruno *et al.* 2005). As with *Ameira* "BHA250', its status as stygofauna is uncertain. However, owing to the availability of apparently suitable habitat north and south of the project, and the distance of this species from the spray field, its conservation status is unlikely to be affected by the project.

Apodopsyllus `BHA255`

Two individuals of *Apodopsyllus* 'BHA255' were identified in Bore S04 North, which is located 6.1 km from the spray field and outside the project envelope. *Apodopsyllus* 'BHA255' is likely to be an interstitial marine species. Similar *Apodopsyllus* species have been found throughout Western Australia and are linked to interstitial marine environments (Tomislav Karanovic, pers. comm, May 2019). However, stygobiont species of *Apodopsyllus* occur in Italy (Pesce 1985). Whether *Apodopsyllus* 'BHA255' is an interstitial species of the upper shore, or stygofauna, it is not expected to be significantly affected by project development and operations.

Speleophria `BCA002`

Three individuals of *Speleophria* 'BCA002' were collected from bore S03 in the third phase of sampling after quite heavy rainfall. This species is closely related to the critically endangered *Speleophria bunderae*, which is known from the Bundara Sinkhole on the western side of the Exmouth peninsula (Jaume *et al.* 2001). Other species of *Speleophria* were collected on Barrow Island in 2012 (Jane McRae, pers. comm., May 2019) and in the Nullarbor Plain caves (Karanovic and Eberhard 2009). *Speleophria* species usually occur in anchialine habitats – closed pools located near the coast that have fresh water overlying seawater. The ecological significance of the record of *Speleophria* 'BCA002' at bore S03 is unclear, although it suggests that perhaps some copepod species utilise the fresh and saline water interface of groundwater along the coast of the southern part of Exmouth Gulf. This may mean the other copepods

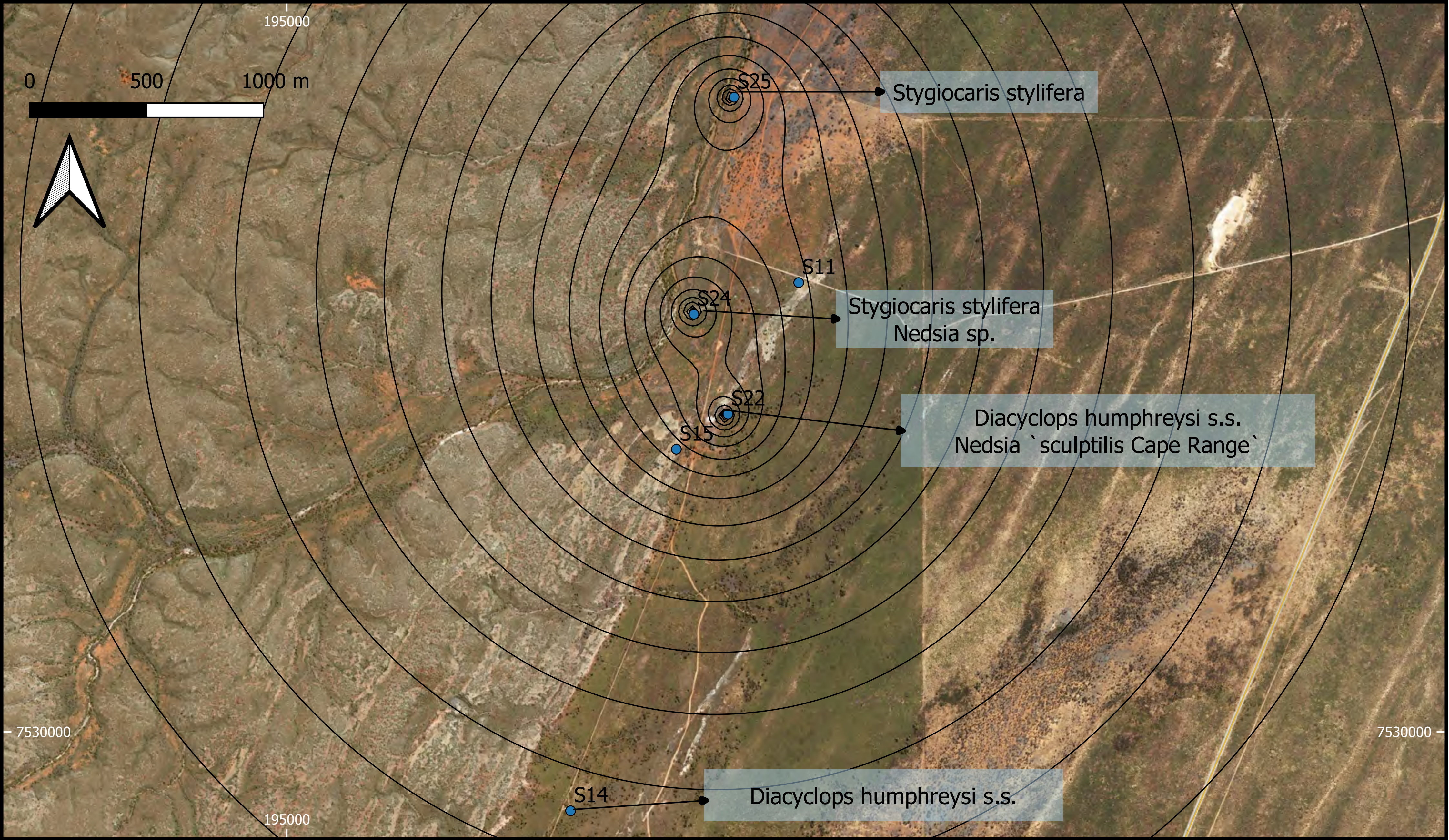

Figure 4: Location of species identified from within the modelled water draw down contours (modelled by GHD) at the water abstraction site

Legend

Sampled Bores

10 year drawdown (m)

Bennelongia Environmental Consultants

Map constructed using QGIS version 3.4

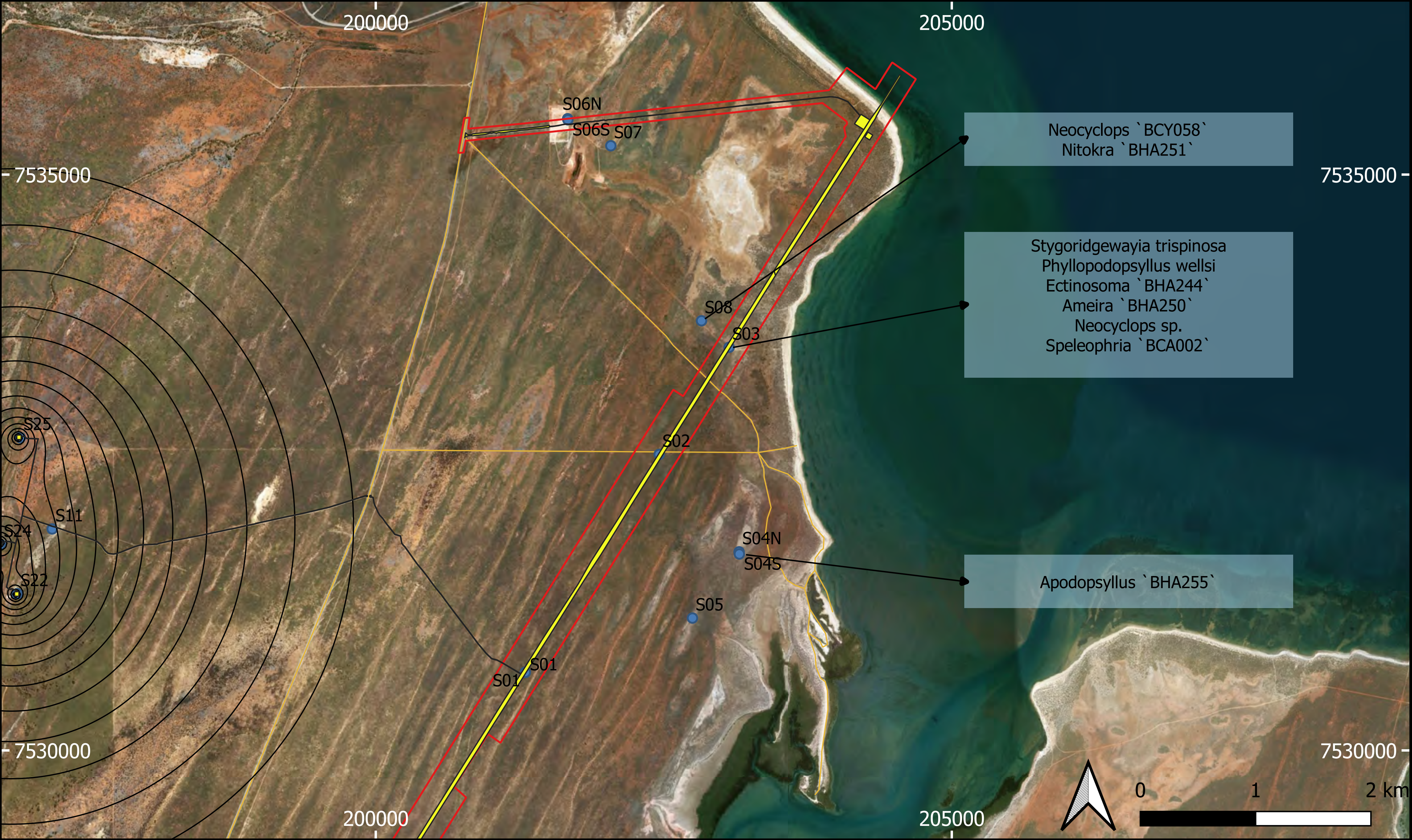

Figure 5: Location of species that may be impacted by nutrient and freshwater plume from spray field

Legend

- Sampled Bores
- Development Footprint
- 10 year drawdown (m)
- Project Envelope
- Roads

Bennelongia Environmental Consultants

Map constructed using QGIS version 3.4

discussed above are also best regarded as stygofauna. It may also mean their ranges are relatively restricted, although the availability of apparently suitable habitat north and south of the project means that project development and operations are unlikely to threaten any species.

6.4.1. Other Species of Note

Stygiocaris stylifera

A total of 19 specimens of *Stygiocaris stylifera* were collected over the three field surveys conducted at the project. These all came from two bores (S24, S25) within the drawdown area of the borefield. This species has also been found further afield on Cape Range and on Barrow Island (Page *et al.*, 2008). While collections of *Stygiocaris stylifera* demonstrate that the borefield contains suitable habitat for larger species of stygofauna, the wider range of *Stygiocaris stylifera* means borefield operations will not have significant detrimental impact on the species, whatever the pattern of drawdown. In reality, drawdown will be minor and unlikely to have even local impact on the species.

Ophisternon candidum and Milyeringa veritas

Both the blind cave eel and the blind gudgeon are listed as vulnerable by both the Western Australian and Federal Governments. Based on known salinity levels within the project, it is not expected that the blind cave eel and blind gudgeon will be present in saline areas east of the Minilya-Exmouth road.

It remains possible that both species occur in the fresher water in and around the borefield. The observed occurrence of karst on the surface in the borefield and vugs in some drill logs, as well as the presence of *Stygiocaris stylifera* in the area, suggest suitable habitat for the gudgeon and eel may be present. Net hauling is a relatively inefficient method of capturing large, mobile species within bores (they can leave the bore as the net enters), although it has yielded eels several times at in the Robe River catchment (Moore et al. 2018). Thus, the failure to collect either species provides some evidence that they are absent from the borefield, although the size of bore slotting was smaller than ideal for these species. Perhaps more significantly, neither the gudgeon nor eel has been collected during all the historical sampling on the east coast south of Exmouth. This is interpreted as further evidence that the species probably do not occur in the borefield (Humphreys and Adams 1991).

7. DISCUSSION

No subterranean species will be directly threatened by habitat loss as a result of the project.

The project is located on the coastal plain. While Cape Range itself is known to support a rich troglofauna community, few species have been collected from the surrounding coastal plain. Furthermore, even if troglofauna are present in the project envelope, their occurrence will be below the shallow excavations planned (up to 1 m) because soil invertebrates exclude troglofauna to depths of about 2 m through competition (see Price and Benham 1977; Rendos et al. 2012). Thus, there will be very little, if any, impact on troglofauna within the project envelope. Bore operation and the concomitant small reduction in watertable (<20 cm) is also highly unlikely to impact troglofauna species in any way.

Stygofauna surveys were conducted in the borefield because, in the initial stages of project design, the likely extent of groundwater drawdown associated the borefield was unknown. Modelling showed there will be a small reduction in groundwater habitat as a result of lowering the watertable by <20 cm. This is highly unlikely to be biologically meaningful for stygofauna, given that annual fluctuations in the watertable are much greater.

Indirect impacts on stygofauna in the project envelope and its surrounds through the reduction of habitat quality, as a result of sprey field operation and increased nutrient concentrations or freshening of groundwater, are also unlikely. The likelihood of any impact is further reduced by the fact no stygofauna species were recorded in the vicinity of the spray field. The species recorded in the supratidal flats are 6-7 km from the spray field and unlikely to be in the path of any plume (which would be expected to dissipate within a short distance because of the relatively small quantities of water and nutrients being sprayed).

The lack of threat from nutrients is highlighted by comparing existing groundwater concentrations with those expected in greywater. Nitrogen levels in a range of bores ranged from 0.2-2.4 mg/L. Treated grey water released at the spray field will have a nitrogen concentration of 7 mg/L (GHD 2019b). Phosphorus concentrations in groundwater at the project site ranged between <0.01 mg/L and 0.08 mg/L. Treated greywater will be released at the spray field at concentrations of 1 mg/L (GHD 2019b). The nutrient levels in treated greywater are comparable to those from wastewater treatment plants designed to achieve a high level of nutrient reduction (GHD 2019b). The treated greywater will be sprayed over an appropriately designed and vegetated area and it is possible that most of the nutrients to be bound by soil or taken up by the vegetation and converted to plant biomass (GHD 2019b). Groundwater concentrations under the spray field will be further reduced as groundwater flows through the area.

The extent to which greywater freshens the groundwater below and downstream of the spray field will be influenced by the volume of greywater, the amount of evaporation and groundwater flow rates. In theory, impacts on stygofauna may also be dependent on the extent of salinity stratification in the groundwater aquifer and whether this is altered by spray field operation. However, given that the sprayfield will occupy no more than 1.5 ha, the likelihood of changes in groundwater conditions extending over distances of more than a few hundred metres are probably low. It is highly unlikely that any stygofauna species in a uniform sand plain environment, without strong barriers, would have a range this small (Halse *et al*. 2014). As stated above, currently no stygofauna species are known to occur in the vicinity of the spray field.

8. CONCLUSIONS

Desktop studies of the project site were conducted to assess the possibility of the presence of subterranean fauna within the project area of the Learmonth pipeline fabrication facility. Owing to a lack of identified suitable habitat, it was considered that in general troglofauna are unlikely to occur at the project east of Minilya-Exmouth road (although a depauperate community may occur near the fabrication facility, and possibly some troglofauna occur nearby in outcropping calcrete). More pertinently, it was considered that project development would not remove troglofaunal habitat even if troglofauna are present. In contrast, it was considered that suitable habitat for stygofauna is present and that two activities might impact any stygofauna species present. These are: 1) water drawdown west of the Exmouth-Minilya road as a result of groundwater abstraction, and 2) infiltration of nutrients and freshwater when treated greywater is released at a specifically designed sprayfield.

In summary, it was considered that the desktop study found sufficient information to conclude the project will not threaten the conservation status of troglofauna species but that field survey of stygofauna was needed to assess the potential impact of the project on this group of animals.

A total of 180 specimens belonging to 11 species were collected during the stygofauna survey. Of the 11 species identified, three were collected from the proposed borefield west of the Exmouth-Minilya road or the project envelope east of the road. They also occur in other parts of the Cape Range Peninsula. Eight species were collected within, or adjacent to, the project envelope but all eight species were found close to the coast in supratidal habitat. No species were collected from the sandplain area covering most of the project envelope and in which the spray field is located. Two of the coastal species occur in other parts of Cape Range peninsula and elsewhere.

Four species collected near the coast are of scientific interest and their stygofauna status is uncertain. These are the copepods *Ameira* 'BHA250', *Ectinosoma* `BHA244`, *Apodopsyllus* `BHA255` and *Speleophria* `BCA002` (the latter species has many anchialine relatives).

Given the small depth of drawdown associated with borefield operations and the widespread distributions of the stygofauna species collected in the borefield, it is concluded that borefield operations will not adversely affect stygofauna. Given the lack of stygofauna species on the sand plain, the small size of the spray field and small volume of water being disposed of, with various factors likely to minimise changes to groundwater conditions resulting from this addition of nutrients fresh water, it is concluded that disposal of greywater will also not adversely affect stygofauna.

Accordingly, it is considered the Subsea 7 Pipeline Fabrication Facility poses no significant threat to either troglofauna or stygofauna species.

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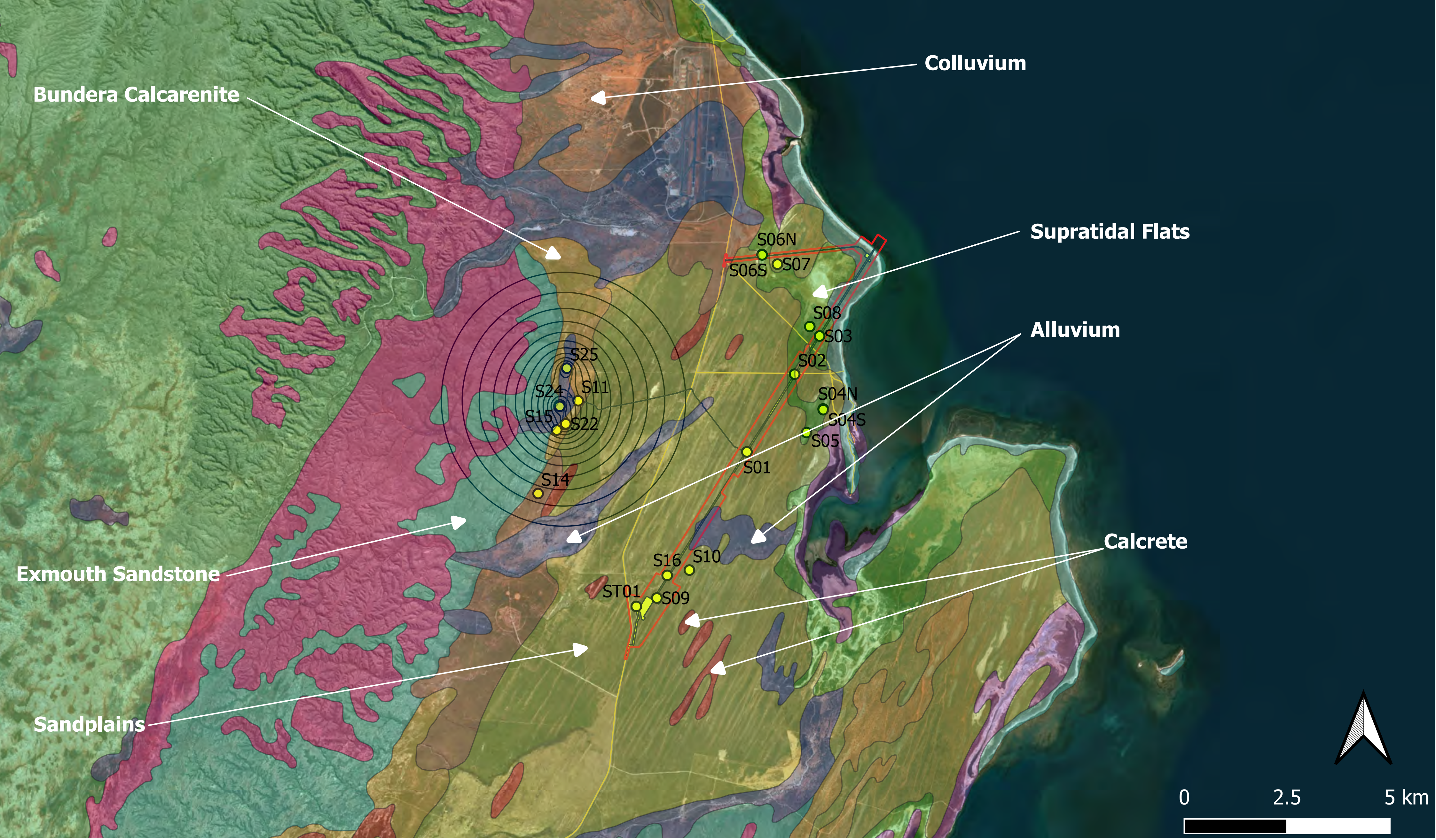

Appendix 1: Surface geology of the area surrounding the Project

GSWA 250k Yanrey-Ningaloo 2003
Author: Huon Clark
Date: 04/09/2019

Legend

Development Footprint
Project Envelope
10 year drawdown (m)

Bennelongia Environmental Consultants

Appendix 2. Bores sampled during three phases of the stygofauna survey and their locations

Date, date of completion of drilling; WNI, Wetland of National Importance. Whether site is within the WA006 boundary or outside is indicated.
Slot D, approximate depth (m) below watertable at which slotting begins, slotting extends to end of casing, slot size = 1 mm.
Sites considered prospective for stygofauna in the project envelope are highlighted orange; those in the borefield are highlighted blue.

Code	Location	Latitude	Longitude	Date	WNI	Slot D	Hydrogeological comment
S01	Bundle track	22.30379	114.10085		Outside	-5	Above watertable: dune sand, Exmouth sandstone (non-prospective) Below watertable: Exmouth sandstone (non prospective because of clay?)
S02	Bundle track	22.28692	114.11247	15/09/18	Outside	-0.7	Above watertable: dune sand, Bundera calcarenite (non-prospective because 3 m to water) Below watertable: Bundera calcarenite (prospective)
S03	Bundle track	22.27863	114.11853	16/09/18	Inside	-0.8	Above watertable: dune sand, Exmouth sandstone (non-prospective) Below watertable: Exmouth sandstone, Bundera calcarenite (prospective)
S04N	Near coast, outside project envelope	22.29467	114.11904	13/09/18	Inside	-0.3	Above watertable: dune sand (non-prospective, <2 m m to watertable) Below watertable: dune sand, Bundera calcarenite (prospective)
S04S	Near coast, outside project envelope	22.29484	114.11906	13/09/18	Inside	0	Above watertable: dune sand (non-prospective, <2 m m to watertable) Below watertable: dune sand, Bundera calcarenite (prospective)
S05	Near coast, outside project envelope	22.29979	114.11501	14/09/18	Inside	-0.5	Above watertable: dune sand (non-prospective, 1.5 m to watertable) Below watertable: dune sand, Exmouth sandstone (non prospective?)
S06N	Access road, important wetland area	22.26048	114.10531	15/09/18	Inside	0	Above watertable: dune sand, Exmouth sandstone (non-prospective, 1.5 m to watertable) Below watertable: Exmouth sandstone (prospective because vuggy)
S06S	Access road, important wetland area	22.26056	114.10533	15/09/18	Inside	-1.3	Above watertable: dune sand, Exmouth sandstone (non-prospective, 1.5 m to watertable) Below watertable: Exmouth sandstone (prospective because vuggy)
S07	Near important wetland area	22.26266	114.1089	15/09/18	Inside	-1.5	Above watertable: dune sand, Exmouth sandstone (non-prospective, 3.5 m to watertable) Below watertable: Exmouth sandstone, limited calcrete (prospective)
S08	Near bundle track, outside project envelope	22.27651	114.11625	16/09/18	Inside	-0.8	Above watertable: dune sand (non-prospective because 1.5 m to water) Below watertable: Exmouth sandstone (prospective because interbedded with calcrete)
S09	Near spray field	22.33552	114.07893	1/09/18	Outside	-3	Above watertable: sand, Exmouth sandstone (non-prospective) Below watertable: Exmouth sandstone (non-prospective)

Code	Location	Latitude	Longitude	Date	WNI	Slot D	Hydrogeological comment
S10	?downstream of spray field	22.32952	114.08674	3/09/18	Outside	-1	Above watertable: sand, Exmouth sandstone (prospective?) Below watertable: Exmouth sandstone (prospective?)
S11	Borefield	22.29184	114.06126	11/09/18		-3	Above watertable: sand, Exmouth sandstone, Bundera calcarenite with calcrete (prospective) Below watertable: Exmouth sandstone, Bundera calcarenite (prospective)
S14	Borefield	22.31205	114.05137	7/09/18		-7	Above watertable: sand, Exmouth sandstone (vuggy), Bundera calcarenite (prospective) Below watertable: Bundera calcarenite, possible aquitard, Bundera calcarenite (prospective if aquitard incomplete or not present)
S15	Borefield	22.29818	114.05605	7/09/18	Outside	-8	Above watertable: reef deposit, Exmouth sandstone, Bundera calcarenite (prospective) Below watertable: aquitard?, Exmouth sandstone with calcrete (prospective if aquitard incomplete or not present)
S16	Bundle track	22.33059	114.08147	2/09/19	Outside	-2	Above watertable: sand, Bundera calcarenite, Exmouth sandstone (non-prospective?) Below watertable: Exmouth sandstone, Bundera calcarenite, Ex. sandstone (prospective?)
S22	Borefield	22.29686	114.05822	5/09/18		-9	Above watertable: sand, Exmouth sandstone, Bundera calcarenite, Exmouth sandstone (prospective?) Below watertable: Bundera calcarenite (prospective?)
S24	Borefield	22.29298	114.05689	4/09/18		-14	Above watertable: sand, Bundera calcarenite (prospective) Below watertable: Bundera calcarenite (prospective)
S25	Borefield	22.28463	114.05873	12/09/18		-9	Above watertable: sand, Exmouth sandstone, Bundera calcarenite (prospective) Below watertable: Bundera calcarenite with calcrete (prospective)
ST01	Near fabrication site	22.33728	114.07404	31/08/18	Outside	-1	Above watertable: sand, Exmouth sandstone, Bundera calcarenite (some vugs, prospective) Below watertable: Bundera calcarenite (possibly prospective)

Appendix 3. Salinity (TDS mg/L), pH, dissolved oxygen (DO, %) and depth to groundwater (m) at bores in the three phases of sampling.

Highlighted TDS values in April reflect recent rainfall and either recharge or rainfall leakage around bore.
TDS values are calculated from electrical conductivity using the conversion of Williams (1986).
**, error in reading or transcription, values on order of magnitude high.
Note that watertables in S14 were c. 7 m lower in November 2018 than drilling data suggest and there was a chemical smell in S22, S24 and S25; this was still present in January 2019 at S24 and S25 and at S25 in April 2019 (Invertebrate Solutions 2019). The potential source of the smell is unknown but the holes yielded stygofauna.

Bore	October 2018				January 2019				April 2019				No. of species
	TDS	pH	DO	Depth	TDS	pH	DO	Depth	TDS	pH	DO	Depth	
S01	42300	7.08	18.6	3.6	42300	6.9	13.2	4.2	42500	6.83	2.9	4.2	
S02	33500	6.83	32.7	4.2	33500	7.15	11.3	4.2	35700	6.7	10.2	3.0	
S03	49600	7.1	48.3	1.8	49600	7.1	48.2	1.8	48800	6.99	2.0	2.4	6
S04N	50700	6.97	9.9	1.8	50700	6.85	**	1.8	51300	6.91	3.7	1.8	1
S04S	52700	6.99	34.4	1.8	52700	6.89	**	1.8	48600	6.79	4.2	1.8	
S05	44500	6.98	11.2	1.8	44500	6.78	**	2.4	**18800**	6.8	2.5	1.8	
S06N	50700	7.03	71.4	1.8	50700	6.94	48.2	1.8	46700	6.87	18.3	1.8	
S06S	52600	6.89	58.3	1.8	52600	7.0	27.7	1.8	43200	6.76	15.4	1.8	
S07	41300	6.99	15.4	3.0	41300	6.8	31.2	3.0	36500	6.76	2.0	3.6	
S08	51300	6.95	42.6	1.8	51300	7.1	37.	1.8	51900	6.88	13.6	1.8	2
S09	34500	6.83	15.6	12.6	34500	6.51	3.1	15.0	**16800**	6.61	12.2	14.4	
S10	33800	7.08	26.9	13.2	33800	6.63	18.5	13.2	**16800**	6.56	20.2	12.0	
S11	2222	7.07	19.2	25.8	2222	6.93	7.3	24.0	2576	7.09	4.9	23.4	
S14	1241	7.03	25.5	32.3	1241	6.94	32.6	32.4	1016	7.24	24.3	31.2	1
S15	911	7.34	25.1	28.5	911	7.32	20.3	28.2	352	7.72	28.9	28.2	
S16	30600	7.02	18.4	12.0	30600	6.59	6.3	12.6	**14500**	6.75	8.7	12	
S22	939	7.3	33.6	24.0	939	7.24	18.5	25.2	985	7.35	9.6	25.2	2
S24	1004	7.02	20.1	27.6	1004	7.19	13.2	28.2	958	7.15	6.6	25.8	2
S25	788	7.02	15.8	22.2	788	7.17	11.0	22.2	843	7.1	19.9	21.6	1
ST01	29200	7.07	16.0	18.6	29200	6.12	1.8	18.6	28500	6.42	11.9	18.0	

Appendix 4. Results of stygofauna sampling.

Bore	Sample Date	Species	No. of animals
S01	22/10/2018	No species	-
S01	9/01/2019	No species	-
S01	10/04/2019	No species	-
S02	22/10/2018	No species	-
S02	19/01/2019	No species	-
S02	10/04/2019	No species	-
S03	22/10/2018	Stygoridgewayia trispinosa	1
S03	22/10/2018	Phyllopodopsyllus wellsi	1
S03	22/10/2018	Ectinosoma `BHA244`	1
S03	22/10/2018	Ameira `BHA250`	1
S03	9/01/2019	Ameira `BHA250`	2
S03	10/04/2019	Ameira `BHA250`	2
S03	10/04/2019	Neocyclops sp.	1
S03	10/04/2019	Speleophria `BCA002`	3
S04 North	22/10/2018	No species	-
S04 North	9/01/2019	No species	-
S04 North	8/04/2019	Apodopsyllus `BHA255`	2
S04 South	22/10/2018	No species	-
S04 South	9/01/2019	No species	-
S04 South	10/04/2019	No species	-
S05	22/10/2018	No species	-
S05	9/01/2019	No species	-
S05	10/04/2019	No species	-
S06 North	22/10/2018	No species	-
S06 North	9/01/2019	No species	-
S06 North	10/04/2019	No species	-
S06 South	22/10/2018	No species	-
S06 South	9/01/2019	No species	-
S06 South	10/04/2019	No species	-
S07	22/10/2018	No species	-
S07	9/01/2019	No species	-
S07	10/04/2019	No species	-
S08	22/10/2018	Neocyclops `BCY058`	5
S08	22/10/2018	Nitokra `BHA251`	100
S08	9/01/2019	Neocyclops `BCY058`	3
S08	9/01/2019	Nitokra `BHA251`	17
S08	10/04/2019	Neocyclops `BCY058`	12
S08	10/04/2019	Nitokra `BHA251`	6
S09	22/10/2018	No species	-
S09	9/01/2019	No species	-
S09	10/04/2019	No species	-
S10	22/10/2018	No species	-

Bore	Sample Date	Species	No. of animals
S10	9/01/2019	No species	-
S10	10/04/2019	No species	-
S14	22/10/2018	No species	-
S14	8/01/2019	Diacyclops humphreysi s.s.	1
S14	9/04/2019	Diacyclops humphreysi s.s.	4
S15	22/10/2018	No species	-
S15	9/01/2019	No species	-
S15	10/04/2019	No species	-
S16	22/10/2018	No species	-
S16	9/01/2019	No species	-
S16	10/04/2019	No species	-
S22	24/10/2018	Nedsia `sculptilis Cape Range`	1
S22	9/01/2019	No species	-
S22	9/04/2019	Diacyclops humphreysi s.s.	1
S24	23/10/2018	Stygiocaris stylifera	4
S24	8/01/2019	Stygiocaris stylifera	1
S24	8/01/2019	Nedsia sp.	1
S24	9/04/2019	Stygiocaris stylifera	7
S25	23/10/2018	Stygiocaris stylifera	3
S25	8/01/2019	Stygiocaris stylifera	2
S25	9/04/2019	Stygiocaris stylifera	2
ST01	22/10/2018	No species	-
ST01	9/01/2019	No species	-
ST01	10/04/2019	No species	-