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SUPPLIERS NAME	360 Environmental Pty Ltd
PURCHASE ORDER NO:	4300233403
DOCUMENT TITLE	Desktop Assessment of Subterranean Fauna for the Learmonth Bundle Project, Cape Range, Western Australia
TOTAL NO OF PAGES	52
SUPPLIERS ORDER NO:	

SUPPLIERS OWN DOCUMENT NUMBER	SUPPLIERS REVISION	DATE	SUPPLIERS APPROVAL SIGNATURE
APFAC017-233403-HSE-00002	2	10.08.2017	

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PACKAGE DESCRIPTION	Environmental Baseline Surveys			
SAP NO	PURCHASE ORDER NUMBER	SEQUENCE NUMBER	REV NO	
APFAC017	233403	HSE	00007	02

Desktop Assessment of Subterranean Fauna for the Learmonth Bundle Project, Cape Range, Western Australia



Report by Invertebrate Solutions for
Subsea7 Australia Contracting Ltd on
behalf of 360 Environmental Pty Ltd

August 2017

Dr Timothy Moulds
Director and Principal Ecologist
Invertebrate Solutions
PO Box 14
Victoria Park, WA 6979
Australia
tim@invertebratesolutions.com
www.invertebratesolutions.com

Invertebrate Solutions. (2017). Desktop assessment of subterranean fauna for the Learmonth Bundle Project, Cape Range, Western Australia. Unpublished report to 360 Environmental, August 2017.

Report Number 2016ISJ09_F04_20170810

Prepared for: SubSea7 Contracting Ltd, on behalf of 360 Environmental Pty Ltd

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Executive Summary

Subsea7 is currently undertaking investigations for the proposed Learmonth Bundle project (the Project). The proposed site is located approximately 2 km south-east of the Learmonth Airport on the Cape Range, Western Australia. Due to the potential for impacts to the subsurface environment, including groundwater and the potential for subsequent impacts to subterranean fauna, 360 Environmental Pty Ltd (360 Environmental) has requested Invertebrate Solutions to undertake a desktop review of subterranean fauna (stygo fauna and troglo fauna) and preliminary impact risk assessment for the proposed development.

The presence of the Cape Range Subterranean Waterways both within and immediately adjacent to the Project area indicates that stygo fauna habitat is present and there is also a High to Very High likelihood of stygo fauna occurrence. These stygo fauna potentially include two stygobitic fish (*Milyeringa veritas* and *Ophisternon candidum*) that are listed as Vulnerable under both the WC and EPBC acts.

The immediate Project area contains minimal identified troglo fauna habitat, however, substantial troglo fauna habitat and a significant troglo fauna community is present in the region. Local variation in mapped geological units may reveal potential habitat for troglo fauna within the Project area following geotechnical and other site surveys.

The potential for impacts to subterranean fauna, if present, are currently considered Moderate from a Tier 1 Development, and Moderate/High for a Tier 2 or 3 development, although the final impact will be dependent upon the specifics of the final development.

The Bundera cenote is on the opposite side of the Range and so will not be influenced by the Learmonth Bundle Project in any way. Cameron's Cave TEC is located near Exmouth Townsite and will not be affected by the Learmonth Bundle Project in any way.

The following recommendations are made with regard to the potential development of the Learmonth Bundle Project:

- Subsea7 should comprehensively ground truth the development area for the presence of caves, voids and other karst features as part of a geotechnical/site assessment. This survey should be undertaken by suitably competent persons with experience in karst landscapes.
- All holes drilled as part of any geotechnical program should be cased and be suitable for the potential sampling of stygo fauna (if required).
- If any geological units that are more likely to provide habitat for subterranean fauna are identified through geotechnical surveys (i.e. limestone conglomerate, thick gravel sequences and others noted in Section 3.3) then additional risk assessment and/or field surveys may be required for subterranean fauna.
- The surface clearing footprint and positioning of infrastructure should be tailored to minimise clearing within and adjacent to any identified subterranean fauna habitat. The impacts to this habitat should be assessed in a detailed manner following finalisation of the surface footprint of the Project.

- If any subsurface voids or caves are encountered during construction then work should be halted until they can be assessed by a person competent in karst and potential for subterranean fauna.
- The storage of hydrocarbons on site should be limited and all storage areas fully bunded.

1. Introduction

Subsea7 Australia Contracting Ltd (Subsea7) is currently undertaking investigations for the proposed Learmonth Bundle project (the Project). The proposed site is located approximately 2 km south-east of the Learmonth Airport on the Cape Range, Western Australia. Three development levels (or Tiers) are being considered. These three development options are shown below:

- **Tier 1 – Basic:** The Basic site type is a small, temporary facility with minimum infrastructure requirements. Water supply utilising a standard water standpipe to fill holding tanks or imported to site by means of water tankers. Power from diesel generators.
- **Tier 2 – Medium:** The Medium site type is an extended version of the Basic site. Mains water and diesel generators for power.
- **Tier 3 – Advanced:** The Advanced Site type is a large permanent facility with advanced infrastructure requirements. Mains water and power.

Subterranean fauna are comprised of stygofauna (aquatic subterranean dependent species) and troglofauna (air breathing subterranean dependent species) which are known to be relatively diverse on a worldwide scale in Western Australia. Many species of subterranean fauna have highly restricted ranges, due to habitat connectivity issues and evolutionary history. Stygofauna and troglofauna are known to occur widely in much of Western Australia with many locally endemic species present.

The high degrees of local endemism and lack of habitat connectivity make subterranean fauna susceptible to impacts from sometimes localised projects, with species' extinction a real possibility if they are not adequately considered during project planning phases.

The Cape Range in Western Australia contains extensive limestone caves and karstic geologies from the coastal plateau to the Range itself. The caves on the range and surrounding coastal plain are known to contain a diverse relictual rainforest fauna with over 55 species of subterranean adapted species known, making it significant in the world as a site for subterranean biodiversity (EPA 2016). Along the coastal plain the seawater intrudes below the fresh groundwater forming an anchialine ecosystem that contains many endemic aquatic species, some with their closest related species found in similar anchialine habitats in the Atlantic Ocean. The Cape Range is also the type locality and primary habitat for two of Australia's four obligate subterranean vertebrate species; the Blind Gudgeon (*Milyeringa veritas*), and the Blind Eel (*Ophisternon candidum*). Many of the aquatic species, and several troglobitic species, associated with the Cape Range karst are protected under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), as well as the *Western Australian Wildlife Conservation Act 1950* (WC Act).

Due to the potential for impacts to the subsurface environment, including groundwater and the potential for subsequent impacts to subterranean fauna in the Project area, 360 Environmental Pty Ltd (360 Environmental) has requested Invertebrate Solutions to undertake a desktop review of subterranean fauna (stygofauna and troglofauna) and preliminary impact risk assessment for the proposed development.

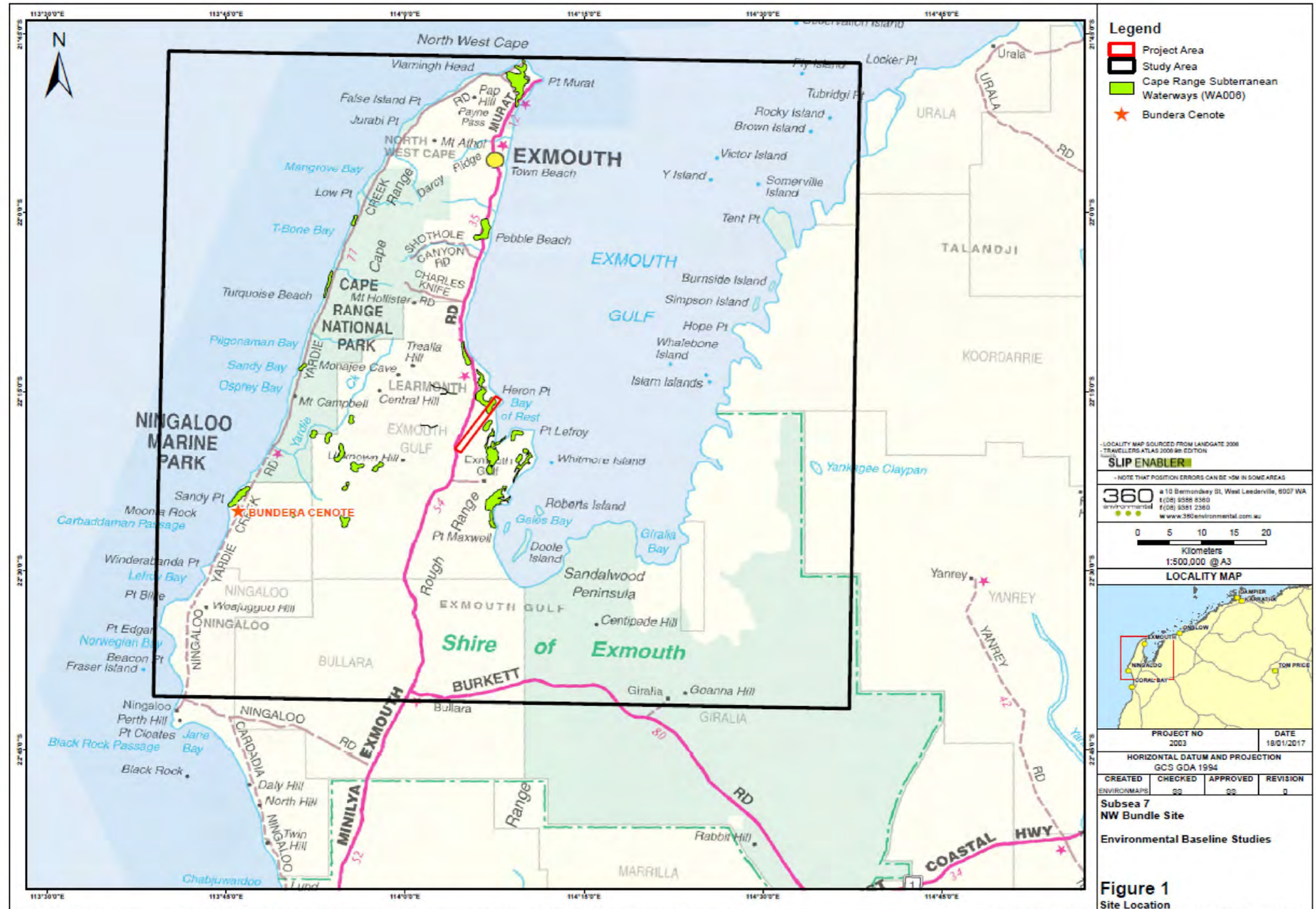


Figure 1 Learmonth Bundle Project subterranean fauna desktop study area.

1.1. Purpose of this report

360 Environmental has requested Invertebrate Solutions to undertake the following scope of works for the Learmonth Bundle Project area, Cape Range, Western Australia:

- Undertake a desktop review for stygofauna and troglifauna presence.
- Undertake a risk assessment for impacts to stygofauna and troglifauna from the proposed development.
- Provide recommendations to minimise potential impacts and any suggested requirements for further work to comply with relevant legislation.
- Provide a written report containing the above items.

1.2. Study Area

The desktop study area includes a 100 km sided rectangle centred on the Learmonth Bundle Project area. The Project area is defined by a 500 m wide corridor on either side of a transect running from the shoreline at -22.2592058°S 114.1302957°E and the inland termination at -22.3325504°S 114.0737961°E. The desktop study area boundary and the Project area is shown in Figure 1.

1.3. Documents examined

The Yanrey-Ningaloo 1:250,000 Geological Map (Geological Survey of Western Australia 1980) was examined in the compilation of this report, along with other referenced scientific papers used to provide general background.

This report has been prepared with regard to the Technical Guidance – subterranean fauna survey (EPA2016a), Technical Guidance – sampling methods for subterranean fauna (EPA2016b), and the Environmental Factor Guideline – Subterranean Fauna (EPA 2016c).

1.4. Conservation Legislation and Guidance Statements

Subterranean fauna and terrestrial Short Range Endemic (SRE) species are protected under state legislation via the *Wildlife Conservation Act (1950)*, the *Environmental Protection Act (1986)* and federally under the *Environmental Protection and Biodiversity Conservation Act (1999)*. The assessment of subterranean fauna for environmental impact assessment (EIA) is undertaken in Western Australia with regard to the Technical Guidance – subterranean fauna survey (EPA2016a), Technical Guidance – sampling methods for subterranean fauna (EPA2016b), and the Environmental Factor Guideline – Subterranean Fauna (EPA 2016c).

At the state level the WC Act provides a list of species that have special protection as species listed under the Wildlife Conservation (Specially Protected Fauna) Notice 2015 (DPaW 2015). This notice is updated periodically by the Department of Parks and Wildlife (DPaW) and the current list (November 2015) includes numerous subterranean species, mainly from the Cape Range and Pilbara regions, including crustaceans, arachnids and myriapods that are considered to be “rare or likely to become extinct, as critically endangered fauna, or declared to be fauna that is in need of special protection” (DPaW 2015). In addition to the specially protected fauna DPaW also maintains a list of

Priority fauna that are considered to be of conservation significance but do not meet the criteria for formal listing under the WC Act as Scheduled species. The Priority fauna list is irregularly updated by DPaW and although it offers no formal legislative protection these species are generally considered in the EIA process.

There is no current ability for the state government of Western Australia to formally list Threatened or Priority Ecological Communities (TECs/PECs), however, a list of such communities is maintained by DPaW and overseen by the Minister for the Environment. Several subterranean ecological communities are recognised as Threatened including the Bundera Cenote Anchialine community on Cape Range, Cameron's Cave near the townsite of Exmouth on Cape Range, stygal root mat communities in both the Yanchep and Margaret River regions and stygobionts in the Ethel Gorge aquifer in the Pilbara. Communities that are not considered by DPaW to be threatened but may be vulnerable to future impacts are classed as Priority ecological communities, and include numerous calcrete aquifers in the Yilgarn region where each calcrete has been shown to contain an endemic stygal community.

The WC Act is expected to be imminently replaced by the new Biodiversity Conservation Act that has yet to be enacted into law. This new act has been passed by the lower house of the State parliament and will be capable of protecting both species and ecological communities under legislation.

The federal EPBC Act protects both species and ecological communities. The most relevant listings for subterranean fauna include the Bundera Cenote on the western side of the Cape Range which contains a unique anchialine ecosystem including the stygal Cape Range Remipede *Kumonga exleyi* that is listed as Vulnerable. The Cape Range Gudgeon, *Milyeringa veritas* and the Cape Range blind eel *Ophisternon candidum* are also listed as Vulnerable species from subterranean habitats on the Cape Range.

1.5. Classifications of subterranean dependence

Subterranean fauna is a collective term that refers to both troglofauna (terrestrial subterranean fauna inhabiting air voids) and stygofauna (aquatic subterranean fauna) (Humphreys 2000). Extensive amounts of jargon has historically been associated with subterranean fauna and multiple forms of classification have been used through time (Sket 2008). The most commonly accepted and used terms divide troglofauna into categories that describe a particular species' degree of dependence upon the subterranean environment. Due to the reliance upon ecological information to determine if a species is a troglobite, the concept of troglomorphy (Christiansen 1962), specific morphological adaptations to the subterranean environment, is used to define obligate subterranean species. The term troglomorphy, initially confined to morphology has since been used to describe both morphological or behavioural adaptations (Howarth 1973). This combination provides a practical system, easily applied in the field and with minimum of detailed ecological study required (Sket 2008). The level of subterranean dependency for different ecological groupings is described below:

- Troglobiont: animals that are obligate subterranean species, and mostly show morphological adaptation to subterranean habitats (troglomorphisms) including depigmentation, loss or reduction of eyes, elongation of appendages, flightlessness or wing reduction, and extra sensory hairs.

- Troglaphiles: animals that can complete their entire lifecycle within a cave but possess no specific adaptations to the cave environment. These species are capable of living outside caves in suitably dark and moist epigeal habitats.
- Troglaxenes: animals that use the subterranean environment, but require surface environments to complete part of their lifecycle (generally either feeding or breeding). Common troglaxenes are cave dwelling bats, cave swiftlets and cave crickets that leave subterranean habitats to feed.

The terms above refer to stygofauna when the prefix is altered to stygo (Humphreys 2000).

Species which inhabit the deep soil habitat (Edaphophiles) often exhibit convergent morphological adaptations to those animals found exclusively within caves, such as eyelessness, body flattening, loss of pigmentation etc. Soil dwelling species commonly do not show highly restricted distributions as they are less easily isolated in evolutionary timeframes, thus only true troglotic animals are the focus of surveys for subterranean fauna. Taxa discussed in this study were assessed upon their combination of loss/reduction of eyes, and reduction in pigmentation, wing development, and elongation of appendages to assess if a taxa was an edaphophile or truly reliant upon the subterranean habitat (Troglont).

1.6. Report Limitations and Exclusions

This study was limited to the written scope provided to the client by Invertebrate Solutions (11th November 2016) and in Section 0. This study was limited to the extent of information made available to Invertebrate Solutions at the time of undertaking the work. Information not made available to this study, or which subsequently becomes available may alter the conclusions made herein.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Invertebrate Solutions has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by Invertebrate Solutions described in this report (this section and throughout this report). Invertebrate Solutions disclaims liability arising from any of the assumptions being incorrect.

Invertebrate Solutions has prepared this report on the basis of information provided by 360 Environmental on behalf of Subsea7 and others (including Government authorities), which Invertebrate Solutions has not independently verified or checked beyond the agreed scope of work. Invertebrate Solutions does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.7. Assumptions

Invertebrate Solutions has made the following assumptions in the writing of this report and its subsequent conclusions:

- The potential impacts identified and assessed in Section 4 are not necessarily exhaustive and may change with additional detail regarding the potential development.
- No groundwater will be abstracted within the Project area for construction or other purposes.
- The impacts to subterranean fauna may require additional investigation following finalisation of the development plan.

2. Desktop Methods

The subterranean fauna desktop review comprises of two distinct sections:

- An assessment of the likelihood that subterranean species are present in the habitats located within the study area.
- Consideration of the potential impacts to subterranean species that may occur as a result of the proposal.

2.1 Likelihood of Subterranean fauna occurrence

The likelihood of stygofauna and troglifauna species occurring in the study area was assessed using a combination of regional information, geological, hydrogeological and database searches including:

- Analysis of published and unpublished reports concerning subterranean fauna from the region.
- Available geological maps.
- Geological, geotechnical and hydrogeological information available for the Study area.
- Results of a Protected Matters Search from the Federal Government's Department of the Environment and Energy website.
- Records of fauna held by the Western Australian Museum.

Based on the analysis of all available information the study area was assigned a level of likelihood to support subterranean fauna of either 'Low', 'Moderate', 'High', or 'Definite'.

2.2 Potential Impacts to Subterranean Fauna

The potential impacts of the installation of infrastructure and general construction activities on subterranean fauna may be categorised as being either direct or indirect impacts.

Direct impacts are the obvious and unavoidable destruction or degradation of habitat that occurs in excavation for footings and other subsurface excavations, including associated aquifer dewatering. Indirect impacts are generally gradational, and more difficult to predict and manage because they may occur at moderate to large distances from the project footprint. These impacts may be expressed some time after development has been undertaken.

Some examples include changes to hydrology, nutrient and microclimate regimes, contamination, reduced habitat area, water quality, and population viability. The zone of influence for indirect impacts may be considerably larger than the immediate area of the disturbance area. Potential indirect impacts of development include:

- Alteration of surface hydrology that affects groundwater recharge regimes, sedimentation, and water quality (e.g. under and adjacent to infrastructure areas, roads and hard packed surfaces).
- Reduction in organic inputs beneath areas cleared of vegetation and sealed surfaces.
- Vibration disturbance from construction and operational activities.
- Surface and groundwater contamination from plant equipment and infrastructure (e.g. chemical pollutants, hydrocarbons or waste water of lower quality).

- Changes to subterranean microclimate in rock masses surrounding clearing areas (exposure of subterranean habitat to desiccation).
- Risk of species extinction from reduction and/or fragmentation in habitat.
- Cumulative impacts from nearby developments

The Project aspects were reviewed to assess the potential severity of impact to potential subterranean habitats. In evaluating the relevance of these factors to the Project, consideration was given to the magnitude, duration and spatial extent of the impacts, where known. This assessment has taken the approach of considering these broad categories of potential impacts and evaluating their occurrence and relative severity. The impacts were then assigned a level of either 'Low', 'Moderate', or 'High'. Where an impact is designated as 'Low' no further consideration to this factor is required if all assumptions made throughout this report are correct.

3. Desktop Subterranean Fauna Review

3.1 Subterranean fauna of Cape Range

The Cape Range in Western Australia is a significant world hotspot for subterranean biodiversity contained within the extensive limestone caves and karstic geologies from the coastal plateau to the range itself (Humphreys 2000b, 2004, 2008). The western side of the Cape Range is part of the Cape Range National Park and also listed as a World Heritage Area. The caves on the central range and surrounding coastal plain are known to contain a diverse relictual rainforest fauna with over 55 species of subterranean adapted species known, making it significant in the world as a site for subterranean biodiversity.

The Cape Range contains two of Australia's four stygobitic vertebrate species; the Blind Gudgeon (*Milyeringa veritas*), and the Blind Eel (*Ophisternon candidum*). Both these species are listed as Vulnerable under the EPBC act (1999). Many of the aquatic species, and several of troglitic species, associated with the Cape Range karst are protected under the EPBC Act, as well as the WC Act. The Bundera Cenote on the western side of the range is the type locality of many of these species including the remipede crustacean (*kumonga exleyi*) that is the only known species of the class Remipedia in the southern hemisphere and with the species' closest related species found in similar anchialine habitats in the Caribbean area and the island of Lanzarote (Yager and Humphreys 1996)

The Bundera Cenote or sinkhole is an anchialine system, with an indirect connection to marine waters and is semi-tidal and is the only such anchialine system known on continental Australia. The cenote contains a distinct physiochemical stratification with the endemic fauna living below a thermohalocline and hydrogen sulphide layers that provide conditions low in oxygen and supporting chemoautotrophic bacteria (Humphreys 2004). This rare ecosystem contains numerous endemic stygofauna species many with Tethyan origins, relating to the breakup of the continent of Gondwana during the Triassic period approximately 250 ma. Some of the endemic species are the ostracod *Welesina kornickeri* that is the sister group of all other ostracod species, *Liagoceradocus branchialis* a species of hadziid amphipod, three species of cycloid copepods (*Metacyclops mortoni*, *Microcyclus varicans*, and *Apocyclops dengizicus*), the bristleworm *Prionospio thalangi*, three species of melitid amphipod, the cirrolanid isopod *Haptolana pholeta* (the genus is known from Barrow Island, Somalia and Cuba), and the thermosbaenacean *Halosbaena tulki* (genus is known from Barrow Island, Lanzarote and the Caribbean) (Humphreys 1994; Humphreys & Feinburg 1995; Pesce et al. 1996).

Two species of blind shrimps are listed as rare, *Stygiocaris lancifera*, *S. stylifera* (Atyidae) and occur in various caves and wells from Bundera Cenote up the western side of the coastal plain and around the northern tip of Cape Range (Page et al. 2008).

The caves located on the upper elevations to the coastal plains also contain a diverse and largely endemic troglifauna. The most commonly encountered species are the ubiquitous troglomorphic millipedes, *Stygiochiropus communis* (Shear and Humphreys 1993) and the schizomids *Draculoides vinei* (Harvey 1988) and *D. brooksi* (Harvey 2001) found in numerous caves throughout the range. There are also several troglomorphic spiders found in the caves including *Bengalla bertmaini* (Gray

and Thompson 2001), *Chthiononetes tenuis* (Milledge 1993), and *Trichocyclus septentrionalis* (Deeleman-Reinhold 1993) recorded from various caves along the range.

Cameron's Cave located near the Exmouth Townsite contains a Threatened Ecological Community comprising of various highly troglomorphic fauna including the pseudoscorpion *Indohya damocles* (Harvey 1993), the harvestman *Glennhuntia glennhunti* (Shear 2001), and the millipede *Stygiochiropus peculiaris* (Shear and Humphreys 1996). All these species are known only from this single cave located on the coastal plain.

Long term monitoring of bores within the Exmouth Limestone leases to the north of the Learmonth Airport have revealed a diverse and distinctly different troglofauna community to that previously identified in the caves enterable by humans. Multiple species new to science have been recorded, many of which are highly troglomorphic including the spiders *Prethopalpus alexanderi* (Baehr and Harvey 2012), and *P. infernalis* (Harvey and Edward 2007), a schizomid *Bamazomus subsolanus*, and undescribed species of a harvestmen, a polyxenid millipede, a cryptopid centipede and an unidentified *Indohya* pseudoscorpion (WAM 2016b). The presence of these species that are unknown from the natural cave ecosystems indicates that additional subterranean diversity remains to be recorded from other parts of the Cape Range where human enterable caves are not present.

3.2 Conservation Significant Fauna and Habitats

A list of conservation significant fauna for the Study Area was compiled from the DPaW Wildlife Conservation (Specially Protected Fauna) Notice 2015 (DPaW 2015) and the Protected Matters Search Tool (PMST) of the Australian Government's Department of the Environment and Energy (DEE). Subterranean species that are listed under the WC Act and/or the EPBC Act and are likely to occur or have known habitat within the Study Area are shown in Table 1 along with their conservation code. A full description of the WC and DPaW conservation codes are shown in Appendix 1. The full list of species obtained from the PMST search is shown in Appendix 2.

Many of the species that appear in the Study Area are highly restricted and known only from single locations such as Bundera Cenote on the Western side of the Range or from Cameron's Cave near Exmouth Townsite. The desktop study area also contains several nationally important wetlands related to the subterranean environment (Table 2, Appendix 2, DEE 2016).

The Bundera Cenote is a very important subterranean wetland site with numerous endemic stygobitic species present (refer Figure 1, Table 1 and Table 4). This site is an anchialine system, with an indirect connection to marine waters and is semi-tidal (**Error! Reference source not found.**). The cenote contains a distinct physiochemical stratification with the endemic fauna living below a thermohalocline and hydrogen sulphide layers that provide conditions low in oxygen and supporting chemoautotrophic bacteria (Humphreys 2004).

The "Cape Range Subterranean Waterways" is part of the Nationally Important Wetlands (Table 2) and includes a wide variety of naturally occurring caves and artificial wells found across the entire Cape Range including the Learmonth Bundle Project area (Figure 1, Table 2). This ecosystem contains numerous species that have either been newly discovered or had their known range extended through the drilling of artificial wells and bores where the absence of natural cave entrances has previously precluded the sampling of subterranean fauna. This indicates that habitat for

subterranean fauna extends far beyond the extent of cavernous limestone units in the central part of Cape Range. The presence of the Cape Range Subterranean Waterways habitat indicates definite habitat for stygofauna within and immediately adjacent to the Project area.

The Learmonth Air Weapons Range - Saline Coastal Flats ecosystem mapping extends over the northeastern portion of the Learmonth Bundle Project Area (Table 2, Appendix 2, DEE 2016). This is primarily a surface wetland system containing a distinctive floristic community, however, the results of the detailed flora and vegetation survey (360 Environmental, 2017) has shown that this ecosystem is not present within the project area and is therefore not considered further in this report.

Table 1 Conservation significant species that may occur in the Study Area.

Name	Common Name	WC Act/DPAW Status	EPBC Act Status	Presence
<i>Milyeringa veritas</i>	Blind Gudgeon	VU	Vulnerable	Species or habitat known to occur in the area
<i>Ophisternon candidum</i>	Blind Eel	VU	Vulnerable	Species or habitat known to occur in the area
<i>Bamazomus subsolanus</i>	eastern Cape Range bamazomus	EN	-	Species or habitat known to occur in the area
<i>Bamazomus vespertinus</i>	western Cape Range bamazomus	EN	-	Only known from the western side of the range
<i>Bunderia misophaga</i>	a copepod	CR	-	Only known from Bundera Cenote
<i>Draculoides brooksi</i>	northern Cape Range draculoides	EN	-	Only known from the northern end of the range
<i>Draculoides julianneae</i>	western Cape Range draculoides	EN	-	Only known from the western side of the range
<i>Draculoides vinei</i>	Cape Range Draculoides	P4	-	Species or habitat known to occur in the area
<i>Indohya damocles</i>	Cameron's Cave pseudoscorpion	CR	-	Only known from Cameron's Cave
<i>Kumonga exleyi</i>	Cape Range remipede	CR	Vulnerable	Only known from Bundera Cenote
<i>Liagoceradocus branchialis</i>	Cape Range liagoceradocus amphipod	EN	-	Only known from Bundera Cenote
<i>Nocticola flabella</i>	Cape Range blind cockroach	P2	-	Various caves
<i>Prionospio thalanji</i>	a bristle worm	CR	-	Only known from Bundera Cenote
<i>Speleophria bunderae</i>	a copepod	CR	-	Only known from Bundera Cenote
<i>Stygiocaris lancifera</i>	lance-beaked cave shrimp	VU	-	Western side of Cape Range (Page et al. 2008)
<i>Stygiocaris stylifera</i>	spear-beaked cave shrimp	P4	-	Northern end of Cape Range and Barrow Island (Page et al. 2008)
<i>Stygiochiropus isolatus</i>	a millipede	VU	-	Only known from Loop Cave C-222
<i>Stygiochiropus peculiaris</i>	Cameron's Cave millipede	CR	-	Only known from Cameron's Cave
<i>Stygiochiropus sympatricus</i>	a millipede	VU	-	Only known from Breakdown Maze Cave C-111
<i>Stygocyclopia australis</i>	a copepod	CR	-	Only known from Bundera Cenote
<i>Welesina kornickeri</i>	an ostracod	CR	-	Only known from Bundera Cenote

Table 2 Nationally important wetlands relevant to the subterranean environment within the Study Area.

Name	Description
Bundera Sinkhole (Cenote)	Located on the western side of the Cape Range Peninsula, and part of the Cape Range Subterranean Waterways. The cenote has a single entrance that is flooded from the near surface and a passage that extends about 70 m. Divers have access to the area to a depth of 30 m. The main cave extends towards the west but there are minor easterly passages in line with a gorge entering the coastal plain 2.8 km to the east. The water level of the sinkhole is influenced by semi-diurnal marine tides of the area. The cenote contains numerous endemic stygofauna including remipedes and thaumatoctypridid ostracods that are priority listed and/or declared rare and endangered fauna.
Cape Range Subterranean Waterways	The site is the subterranean waterways, sinkholes, general groundwater and artificial wells (notably Billy, Five Mile, Jarvis, Kubara, Kudumurra, Milyering, Mowbowra, Pilgramunna, Tantabiddi and Tulki Wells, Tantabiddi and Wobiri Rockholes, Bundera Sinkhole, and caves C-23, C-215, C-452, C-495) of the coastal plain and foothills of Cape Range north of a line between Norwegian Bay, at the foot of the peninsula on the west coast, and the Bay of Rest in Exmouth Gulf. Threatened Species: The Blind Cave Eel <i>Ophisternon candidum</i> (V) and the Blind Gudgeon <i>Milyeringa veritas</i> (V) are known from 11 and 18 locations respectively, mostly outside Cape Range National Park. Both species occur in wells, sinkholes and caves and possibly occur widely in the groundwater. There is a diverse endemic stygofauna. Many belong to genera known from similar habitats bordering the former Tethys Sea, especially Lanzarote in the Canary Islands and the Caribbean region.
Learmonth Air Weapons Range - Saline Coastal Flats WA	Typical saline coastal flats subject to inundation and ponding. This vegetation type typically has low species richness, but its floristic composition and structure is highly distinctive and supports habitat specific fauna.

3.3 Subterranean Fauna Habitat in the Desktop Study Area

The Desktop Study area that encompasses much of the Cape Range peninsula contains extensive habitat for subterranean fauna within the many caves and other subterranean voids formed within the highly karstic Trealla, Tulki and Mandu Limestone units that form the central elevated range (Allen 1993 **Error! Reference source not found.**).

The Cape Range Subterranean Waterways habitat shown in Figure 1 shows some areas of high value stygofauna habitat, although it is by no means the only existing stygofauna habitat known from the Cape Range.

3.4 Subterranean Fauna Habitat in the Project Area

Through much of the Project area the depth to water is approximately 1-2 metres (Allen 1993) which limits the potential habitat for troglofauna. The areas closest to the ocean (Coastal dunes and beaches; Supratidal flats) have a low likelihood for troglofauna as they are composed of fine grained units with pore spaces too small to provide habitat for troglofauna. The Bundera Calcarenite and Exmouth Sandstone are the most likely to potentially contain troglofauna habitat especially within limestone conglomerate and pebble conglomerate horizons respectively. These units have a Medium to High likelihood for containing suitable troglofauna habitat, if they occur within the Project area. The overlaying dune systems have a very low likelihood for troglofauna as the pore spaces are generally too small in well sorted dunes, however, if coarse gravel beds within colluvium are present then these will provide a Medium likelihood for troglofauna if in the unsaturated zone.

There is a low likelihood for stygofauna habitat within the coastal dunes and beaches and the supratidal flats as they are unlikely to contain large enough pore spaces for stygofauna, however,

the presence of the Cape Range Subterranean Waterways both within and immediately adjacent to the Project area indicates that stygofauna habitat is present. This karstic habitat likely lies beneath the superficial sand cover and so was not originally mapped as part of the Yanrey-Ningaloo 1:250,000 Geological Map (Geological Survey of Western Australia 1980). It should be noted that some caves and karst features are known to occur in the area south of the Learmonth Airport, although their exact locations are not made publically available (D Brooks, Western Australian Speleological Group, pers. comm. December 2016).

The other potential stygofauna habitat within the Project area is most likely to be the Bundera Calcarenite and Exmouth Sandstone especially within limestone conglomerate and pebble conglomerate horizons respectively. These units have a Medium to High likelihood for containing suitable stygofauna habitat, if they occur within the Project area. The overlaying dune systems have a Low likelihood for stygofauna but depending upon the depth of the dune systems underlying strata could be more conducive to stygofauna habitat. The Colluvium units, especially if they contain coarse gravel beds will provide a Medium likelihood for stygofauna if in the saturated zone.

The draft geotechnical assessment (GHD 2017) was also reviewed, although it provided no additional confirmation of the absence of karstic subterranean geologies beneath the superficial sand cover within the Project area.

Table 3 Geological units in the Project Area and Subterranean fauna habitat potential.

Unit	Description / Remarks	Subterranean Fauna Suitability
Coastal dunes and beaches	Quartzose calcarenite	Low for troglofauna and stygofauna.
Supratidal flats	Calcareous clay, silt and sand with authigenic gypsum and salt	Low for troglofauna and stygofauna.
Bundera Calcarenite	Calcarenite with various beds of limestone conglomerate and coral reef deposits	Medium/High for troglofauna and stygofauna especially in limestone conglomerate areas.
Exmouth Sandstone	Milyering member; crossbedded quartzose calcarenite, minor pebble conglomerate	Medium/Low for troglofauna. Medium/Low for Stygofauna
Colluvium	Poorly sorted clay, silt sand and gravel	Medium/Low for troglofauna in gravel areas. High for stygofauna in saturated gravels and coarse sand areas.

3.5 Likelihood of stygofauna presence

A search was undertaken of the Western Australian Museum databases for Crustaceans (WAM 2016a) and Arachnids/Myriapods (WAM 2016b). The searches were undertaken as a 100 km x 100 km rectangle centred on the inland termination point of the Project area (-22.3325504°S 114.0737961°E). The results of these filtered for subterranean stygofauna species are shown in Table 4. No stygofauna has previously been recorded from the Project area (WAM 2016a and 2016b), however, no sampling within the immediate Project area has occurred. The subterranean waters of the Cape Range are highly likely to contain stygobitic fauna if suitable voids are present in the subsurface.

The presence of the Cape Range Subterranean Waterways both within and immediately adjacent to the Project area indicates that stygofauna have a High to Very High likelihood of occurrence. While many of the species in the WAM databases are from single localities it should be noted that several undescribed species have been recorded during surveys of artificial wells drilled away from known surface karstic features and so the absence of records in some areas of the Cape Range could be more related to an absence of sampling access (and effort) rather than an absence of fauna, where subterranean habitat is present.

Table 4 Stygofauna in WAM databases recorded from within the Desktop Study Area.

Order	Family	Genus and Species	Notes
Pisces (Fish)	Eleotridae	<i>Milyeringa veritas</i>	Species or habitat known to occur in the area (DEE 2016)
	Synbranchidae	<i>Ophisternon candidum</i>	Species or habitat known to occur in the area (DEE 2016)
Amphipoda	Eriopisidae	<i>Nedsia sp.</i>	MB30 Exmouth Wellfield.
		<i>Nedsia douglasi</i>	Exmouth Well
		<i>Norcapensis mandibulis</i>	Various caves/ wells
	Hadziidae	<i>Liagoceradocus branchialis</i>	Bundera Cenote
	Neoniphargidae	<i>Wesniphargus sp.</i>	Bundera Cenote
Bathynellaceae	Parabathynellidae	<i>Hexabathynella sp.</i>	Exmouth Wellfield
Copepoda	Epacteriscidae	<i>Bunderia misophaga</i>	Bundera Cenote
	Pseudocyclopidae	<i>Stygocyclopia australis</i>	Bundera Cenote
	Cyclopidae	<i>Diacyclops humphreysi</i>	Widespread
<i>Halicyclops longifurcatus</i>		Bundera Cenote	
<i>Halicyclops spinifer</i>		Various caves/ wells	
<i>Metacyclops mortoni</i>		Various caves/ wells	
Decapoda	Atyidae	<i>Stygiocaris lancifera</i>	Various caves/ wells on western side of Cape Range
		<i>Stygiocaris stylifera</i>	Various caves/ wells on the northern end of Cape Range and Barrow Island
Halocyprida	Thaumatocyprididae	<i>Welesina kornickeri</i>	Bundera Cenote
Isopoda (Slaters)	Undetermined	<i>Undetermined</i>	Not identified adequately to consider further
Misophrioida	Speleophriidae	<i>Speleophria bunderae</i>	Bundera Cenote
Nectiopoda	Kumongidae	<i>Kumonga exleyi</i>	Bundera Cenote
Thermosbaenacea	Halosbaenidae	<i>Halosbaena tulki</i>	C215

3.6 Likelihood of troglifauna presence

A search was undertaken of the Western Australian Museum databases for Crustaceans (WAM 2016a) and Arachnids/Myriapods (WAM 2016b). The searches were undertaken as a 100 km x 100 km rectangle centred on the inland termination point of the Project area (-22.3325504°S 114.0737961°E). The results of these filtered for subterranean stygofauna species are shown in Table 5. The troglifauna recorded from the desktop Study area is diverse and significant on a world scale (Refer to Section 3.1 and references therein) and desktop occurrences are shown in Table 5.

No troglifauna has previously been recorded from the Project area (WAM 2016a and 2016b), however, no sampling within the immediate Project area has occurred. Troglifauna are known to occur within void spaces or fractured geological units, especially where transmissivity is high such as in karst. Where subterranean voids are present in the unsaturated zone of the Project area then

they are highly likely to contain subterranean fauna due to the propensity for subterranean fauna within the Cape Range region. The surveys of artificial wells and bore holes have revealed substantial additional diversity of unrecorded species (Table 5) that would indicate that the absence of records in areas of the Cape range is more related to an absence of sampling access (and effort) rather than an absence of fauna, where subterranean habitat is present.

Table 5 Troglifauna in WAM Arachnida and Crustacea databases recorded from within the Desktop Study Area.

Order	Family	Genus and Species	Notes
Isopoda (Slaters)	Undetermined	undetermined	Learmonth Limestone troglifauna trap. Not identified adequately to consider further
Acari (Mites)	Acaridae; Galumnidae; Haplozetidae; Laelapidae; Lohmanniidae; Oppiidae; Pediculochelidae; Penthaleidae; Xylobatidae	undetermined	Cosmopolitan families / Not identified adequately to consider further
Araneomorphae (Spiders)	Ctenidae	<i>Bengalla bertmaini</i>	Troglobiont; various caves
	Filistatidae	<i>Wandella waldockae</i>	Widespread species
		<i>Yardiella humphreysi</i>	Various caves
	Linyphiidae	<i>Chthiononetes tenuis</i>	Various caves (Milledge 1993)
		<i>Dunedinia occidentalis</i>	C106 (Milledge 1993), possibly not a true troglobiont
	Oonopidae	<i>Prethopalpus alexanderi</i>	Troglobiont; Exmouth Limestone, 9.4 km S. of Exmouth
		<i>Prethopalpus infernalis</i>	Troglobiont; Cape Range, Learmonth Limestone, bore #LL 11
	Pholcidae	<i>Trichocycclus septentrionalis</i>	Various caves (Deeleman-Reinhold 1993)
	Symphytognathidae	<i>Anapistula troglobia</i>	
	Pseudoscorpiones (False Scorpions)	Chthoniidae	<i>Austrochthonius easti</i>
<i>Tyrannochthonius brooksi</i>			C21, C111, C107
Hyidae		<i>Tyrannochthonius butleri</i>	Various Caves and bores
		<i>Indohya damocles</i>	Cameron's Cave C452
		<i>Indohya humphreysi</i>	C15, C103
		<i>Indohya`sp. indet. (juvenile)`</i>	Exmouth Limestone
Syarinidae		<i>Ideoblothrus papillon</i>	Papillon Cave C15
		<i>Ideoblothrus woodi</i>	Cave C167
Schizmoida (Micro-whip scorpions)	Hubbardiidae	sp. Indet.	Learmonth Limestone
		<i>Bamazomus subsolanus</i>	Learmonth Limestone; C168
		<i>Bamazomus vespertinus</i>	C215
		<i>Draculoides sp. indet.</i>	Learmonth Limestone
		<i>Draculoides brooksi</i>	Various Caves
		<i>Draculoides julianneae</i>	C215
		<i>Draculoides vinei</i>	Various caves

Order	Family	Genus and Species	Notes
Opiliones (Harvestmen)	Assamiidae	<i>Dampetrus isolatus</i>	
	Phalangodidae	<i>Glennhuntia glennhunti</i>	Cameron's Cave C452
	`Phalangodidae?`	sp.	Exmouth Limestone
Chilopoda (Centipedes)	Cryptopidae	<i>Cryptops</i> sp. indet.	Various caves; Learmonth Limestone
	Scutigerae	<i>Thereuopoda lesueurii</i>	Various caves
	Geophilida	<i>Mecistocephalidae</i> sp.	Various caves
	Lithobiida	sp. indet.	Various caves
Diplopoda (Millipedes)	Paradoxosomatidae	<i>Antichiropus humphreysi</i>	
		<i>Stygiochiropus peculiaris</i>	Cameron's Cave C452
		<i>Stygiochiropus communis</i>	Various caves; Learmonth Limestone
		<i>Stygiochiropus isolatus</i>	Loop Cave, Cave C-222
		<i>Stygiochiropus sympatricus</i>	C-111, Breakdown Maze
	Polyxenidae	sp. Indet.	Learmonth Limestone; various caves

4. Subterranean Fauna Risk Assessment

This preliminary risk assessment considers each of the three development options for the proposed Project (refer Section 1). The anticipated activities at the Learmonth Bundle Project area include land clearing, construction of buildings and surface access roads, storage of hydrocarbons and minor excavation for the purposes of building footings. The extent of these activities will be dependent upon the level of development that is selected by Subsea7.

The final extent and impact of the proposed development will be unknown until the completion of more detailed development proposal by Subsea7. This preliminary risk assessment does not account for onsite water abstraction to provide construction water.

4.1 Conservation Significant Fauna and Habitat Preliminary Risk Assessment

The conservation significant fauna identified in the Desktop Study Area are mostly species endemic to single locations on the Cape Range such as Bundera Cenote on the western side of the range or Cameron's Cave located near Exmouth Townsite. After these species with highly restricted ranges have been excluded five conservation significant species need to be considered (Table 6).

Table 6 Conservation significant species that may occur within the Project Area.

Name	Common Name	WC Act/DPaW Status	EPBC Act Status	Likelihood of occurrence in the Project Area
<i>Milyeringa veritas</i>	Blind Gudgeon	VU	Vulnerable	Moderate
<i>Ophisternon candidum</i>	Blind Eel	VU	Vulnerable	Moderate
<i>Bamazomus subsolanus</i>	eastern Cape Range bamazomus	EN	-	Low
<i>Draculooides vinei</i>	Cape Range Draculooides	P4	-	Low
<i>Nocticola flabella</i>	Cape Range blind cockroach	P2	-	Low

The two stygobitic fish (*Milyeringa veritas* and *Ophisternon candidum*) are known to occur in various caves and artificial wells on the eastern side of Cape Range. These species have a Moderate to High likelihood of occurring within the Project area due to the presence of the Cape Range Subterranean waterways habitat both within and immediately adjacent to the Project area.

The remaining conservation significant troglifauna species have a low likelihood of occurring within the project area as they are mainly known from limestone caves (*Draculooides vineii* and *Nocticola flabella*), although their distributions extend to the southern extent of the main Range, approximately 9 km to the west of the Project Area (WAM 2016b).

The Eastern Cape Range Bamozomus schizomid (*Bamazomus subsolanus*) has a low likelihood of occurring within the Project area. This species has primarily been recorded from artificial bores approximately 9 km to the northwest of the Project Area on the slopes of the Range.

The Bundera cenote is located within similar geological units to the Learmonth Bundle Project area and so the absence of limestone units at the surface does not necessarily exclude the presence of

subterranean habitat being present. The Bundera cenote is, however, on the opposite side of the Range and so itself will not be influenced by the Learmonth Bundle Project in any way.

The Cape Range Subterranean Waterways occurs both within and immediately adjacent to the Project Area (Figure 1) and could potentially be subject to localised impacts from the development.

The Learmonth Air Weapons Range - Saline Coastal Flats ecosystem does not occur within the Learmonth Bundle Project Area according to the flora and vegetation survey undertaken by 360 Environmental botanists and so will not be impacted by the Learmonth Bundle Project in any way (360 Environmental, 2017).

4.2 Subterranean Fauna Preliminary Risk Assessment

The clearing of native vegetation on the surface is considered to be the most significant impact from the Learmonth Bundle Project. Clearing is anticipated to have a Moderate to High impact upon any local subterranean fauna community (Table 7). This is based upon the clearing footprint extending across the majority of the Project area, however, a reduced clearing footprint will reduce this impact to Low or Moderate. The impact will be mitigated to a small degree if the clearing is only temporary although it will still likely lead to increased sedimentation in the subsurface environment. Clearing will reduce the amount of organic carbon that enters the subterranean environment and acts as a primary energy source for the subterranean environment. This impact will be mitigated by the potential for cyclonic events to wash vegetative material from outside any cleared portion of the Project area

The alteration of surface and subsurface hydrology is the second most significant impact to any local subterranean fauna community and relates to the construction of roads, buildings and other hard stand areas that will restrict the infiltration of water into the subterranean environment. These impacts are likely to be moderate to high depending upon the tier of development chosen by Subsea7.

The storage of hydrocarbons on site should be limited and all storage areas fully bunded. The risk of hydrocarbon contamination to subterranean fauna is anticipated to be Low, however, should a major spill occur then the impacts would be significant. This impact will be largely mitigated in the Tier 3 development option as power will be supplied by a mains connection and there will no regular reliance upon diesel generators for power.

The final impact for subterranean fauna cannot currently be accurately assessed with the currently available information.

Table 7 Risk of impact to subterranean fauna from the proposed Project

Development level	Subterranean fauna presence	Disturbance mechanism	Risk of Impact to Subterranean Fauna Community (if present)
Tier 1 Basic	Moderate inland/ low toward the coast	Vegetation clearing and increased sedimentation	Low/Moderate
		Alteration of surface and subsurface hydrology	Moderate
Tier 2 Medium	Moderate inland/ low toward the coast	Hydrocarbon spills	Moderate/High
		Vegetation clearing and increased sedimentation	Moderate
		Alteration of surface and subsurface hydrology	Moderate/High
Tier 3 Advanced	Moderate inland/ low toward the coast	Hydrocarbon spills	Moderate/High
		Vegetation clearing and increased sedimentation	Moderate/High
		Alteration of surface and subsurface hydrology	Moderate/High
		Hydrocarbon spills	Low/Moderate

4.3 Cumulative impacts

Cumulative impacts in the local region are expected to be minimal with the only other major impacts being the Learmonth airport and associated Department of Defence facility and the coastal highway. The primary cumulative impacts from these developments are land clearance and altered hydrology, however, these are relatively small in the scale of the eastern side of the Cape Range and the area of uncleared and unaltered land. It is anticipated that the Learmonth Bundle Project will not add significantly to the cumulative impacts to subterranean fauna in the local area.

5. Conclusions and Recommendations

The presence of the “Cape Range Subterranean Waterways” as part of the Nationally Important Wetlands (EPA 2017) both within and immediately adjacent to the Project area indicates that stygofauna have a High to Very High likelihood of occurrence. These stygofauna potentially include two stygobitic fish (*Milyeringa veritas* and *Ophisternon candidum*) that are listed as Vulnerable under both the WC Act and EPBC Acts.

The immediate Project area contains minimal identified troglofauna habitat, however, substantial troglofauna habitat and a significant troglofauna community is present in the region. Local variation in mapped geological units may reveal potential habitat for troglofauna within the Project area following geotechnical and other site surveys. Desktop and preliminary geotechnical field assessments (GHD 2017) have not provided any additional clarification as to the presence or absence of karstic voids within the Project area. No previously known subterranean fauna are known from within the Learmonth Bundle Project area, however, no sampling for any of these groups has previously occurred within the Project area.

The potential impacts to subterranean fauna, if present, are currently Moderate from a Tier 1 Development, and Moderate/High for a Tier 2 or Tier 3 development option, although the final impact will be dependent upon the specifics of the final development.

The Bundera cenote is on the opposite side of the Range and so will not be influenced by the Learmonth Bundle Project in any way. Cameron’s Cave TEC is located near Exmouth Townsite and will not be affected by the Learmonth Bundle Project in any way.

The Learmonth Air Weapons Range - Saline Coastal Flats ecosystem does not occur within the Learmonth Bundle Project Area according to the detailed flora and vegetation survey undertaken by 360 Environmental botanists and so will not be impacted by the Learmonth Bundle Project in any way (360 Environmental, 2017).

While many of the species in the WAM databases are from single localities it should be noted that several undescribed species have been recorded during surveys of artificial wells drilled away from known surface karstic features and so the absence of records in some areas of the Cape Range could be more related to an absence of sampling access (and effort) rather than an absence of fauna, where subterranean habitat is present.

The currently available information on the project is insufficient to allow more than a preliminary analysis of impacts to stygofauna and troglofauna and impacts will need to be fully assessed when the final development proposal is available, including the placement of all surface infrastructure.

5.1 Recommendations

The following recommendations are made with regard to the potential development of the Learmonth Bundle Project:

- Subsea7 should comprehensively ground truth the development area for the presence of caves, voids and other karst features as part of a geotechnical/site assessment. This survey should be undertaken by suitably competent persons with experience in karst landscapes.
- All holes drilled as part of any geotechnical program should be cased and be suitable for the potential sampling of stygofauna (if required).
- If any geological units that are more likely to provide habitat for subterranean fauna are identified through geotechnical surveys (i.e. limestone conglomerate, thick gravel sequences and others noted in Section 3.3) then additional risk assessment and/or field surveys may be required for subterranean fauna.
- The surface clearing footprint and positioning of infrastructure should be tailored to minimise clearing within and adjacent to any identified subterranean fauna habitat. The impacts to this habitat should be assessed in a detailed manner following finalisation of the surface footprint of the Project.
- If any subsurface voids or caves are encountered during construction then work should be halted until they can be assessed by a person competent in karst and potential for subterranean fauna.
- The storage of hydrocarbons on site should be limited and all storage areas fully bunded.

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Appendix 1

Department of Parks and Wildlife Conservation Codes (November 2015)



CONSERVATION CODES

For Western Australian Flora and Fauna

Specially protected fauna or flora are species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Categories of specially protected fauna and flora are:

T Threatened species

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Appendix 2

Protected Matters Search Results



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 11/11/16 14:13:12

[Summary](#)

[Details](#)

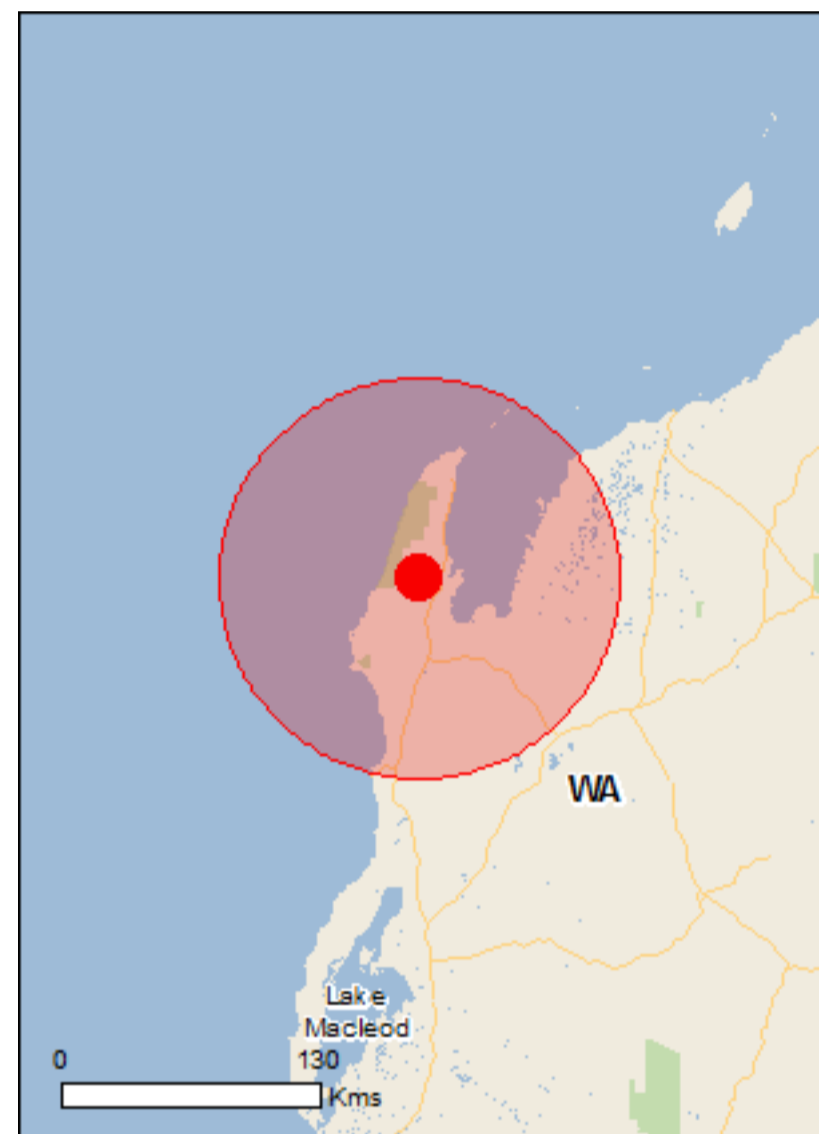
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

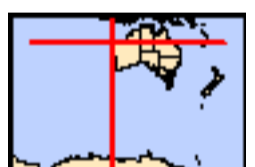
[Acknowledgements](#)



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[Coordinates](#)

[Buffer: 100.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	32
Listed Migratory Species:	44

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	9
Commonwealth Heritage Places:	2
Listed Marine Species:	76
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	2

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	14
Regional Forest Agreements:	None
Invasive Species:	14
Nationally Important Wetlands:	4
Key Ecological Features (Marine)	4

Details

Matters of National Environmental Significance

World Heritage Properties [\[Resource Information \]](#)

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [\[Resource Information \]](#)

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place

Commonwealth Marine Area [\[Resource Information \]](#)

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name

EEZ and Territorial Sea

Marine Regions [\[Resource Information \]](#)

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name

[North-west](#)

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [331]	Endangered	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fieldi Shark Bay Mouse, Djoongari, Alice Springs Mouse [113]	Vulnerable	Species or species habitat likely to occur within area
Rhinonictoris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Other		
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Name	Status	Type of Presence
<i>Eretmochelys imbricata</i> Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
<i>Natator depressus</i> Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
<i>Carcharias taurus</i> (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
<i>Carcharodon carcharias</i> White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
<i>Pristis clavata</i> Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
<i>Pristis zijsron</i> Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
<i>Rhincodon typus</i> Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
<i>Apus pacificus</i> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<i>Macronectes giganteus</i> Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
<i>Puffinus carneipes</i> Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
<i>Puffinus pacificus</i> Wedge-tailed Shearwater [1027]		Breeding known to occur within area
<i>Sterna caspia</i> Caspian Tern [59467]		Breeding known to occur within area
<i>Sterna dougalli</i> Roseate Tern [817]		Breeding known to occur within area
<i>Thalassarche impavida</i> Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area

Migratory Marine Species

<i>Balaenoptera bonaerensis</i> Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat may occur within area
<i>Balaenoptera borealis</i> Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<i>Balaenoptera edeni</i> Bryde's Whale [35]		Species or species habitat may occur within area
<i>Balaenoptera musculus</i> Blue Whale [36]	Endangered	Migration route known to

Name	Threatened	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	occur within area Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - EXMOUTH ADMIN & HF TRANSMITTING Defence - EXMOUTH NAVAL HF RECEIVING STATION (H/F Receiving Station, Learmonth, WA) Defence - EXMOUTH VLF TRANSMITTER STATION Defence - LEARMONTH - AIR WEAPONS RANGE Defence - LEARMONTH - RAAF BASE

Name
Defence - LEARMONTH RADAR SITE - TWIN TANKS EXMOUTH
Defence - LEARMONTH RADAR SITE - VLAMING HEAD EXMOUTH
Defence - LEARMONTH TRANSMITTING STATION

Commonwealth Heritage Places		[Resource Information]
Name	State	Status
Natural		
Learmonth Air Weapons Range Facility	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur

Name	Threatened	Type of Presence within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribbioned Pipehorse, Ribbioned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species

Name	Threatened	Type of Presence
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	habitat may occur within area Breeding known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

[Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species

Name	Status	Type of Presence
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		habitat may occur within area Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Commonwealth Reserves Marine

[[Resource Information](#)]

Name	Label
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Name	Label
Gascoyne	Multiple Use Zone (IUCN VI)
Ningaloo	Recreational Use Zone (IUCN II)

Extra Information

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Bundegi Coastal Park	WA
Burnside And Simpson Island	WA
Cape Range	WA
Giralia	WA
Gnandaroo Island	WA
Jurabi Coastal Park	WA
Muiron Islands	WA
Rocky Island	WA
Tent Island	WA
Unnamed WA37500	WA
Victor Island	WA
Whalebone Island	WA
Whitmore,Roberts,Doole Islands And Sandalwood Landing	WA
Y Island	WA

Invasive Species [\[Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area

Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name	State	
Bundera Sinkhole	WA	
Cape Range Subterranean Waterways	WA	
Exmouth Gulf East	WA	
Learmonth Air Weapons Range - Saline Coastal Flats	WA	

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Cuvier Abyssal Plain and the Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-22.3317 113.97693

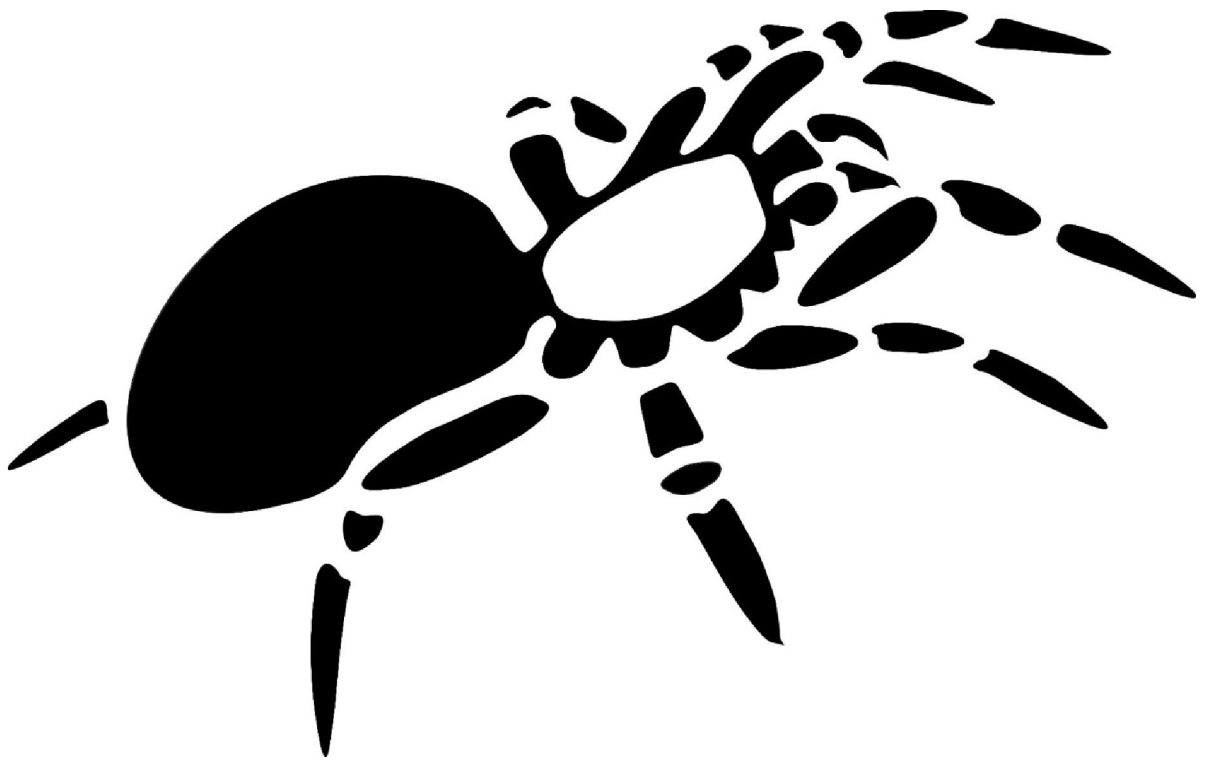
Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Parks and Wildlife Commission NT, Northern Territory Government](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.



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