Appendix C Database Searches

Australian Government
Department of the Environment and Energy

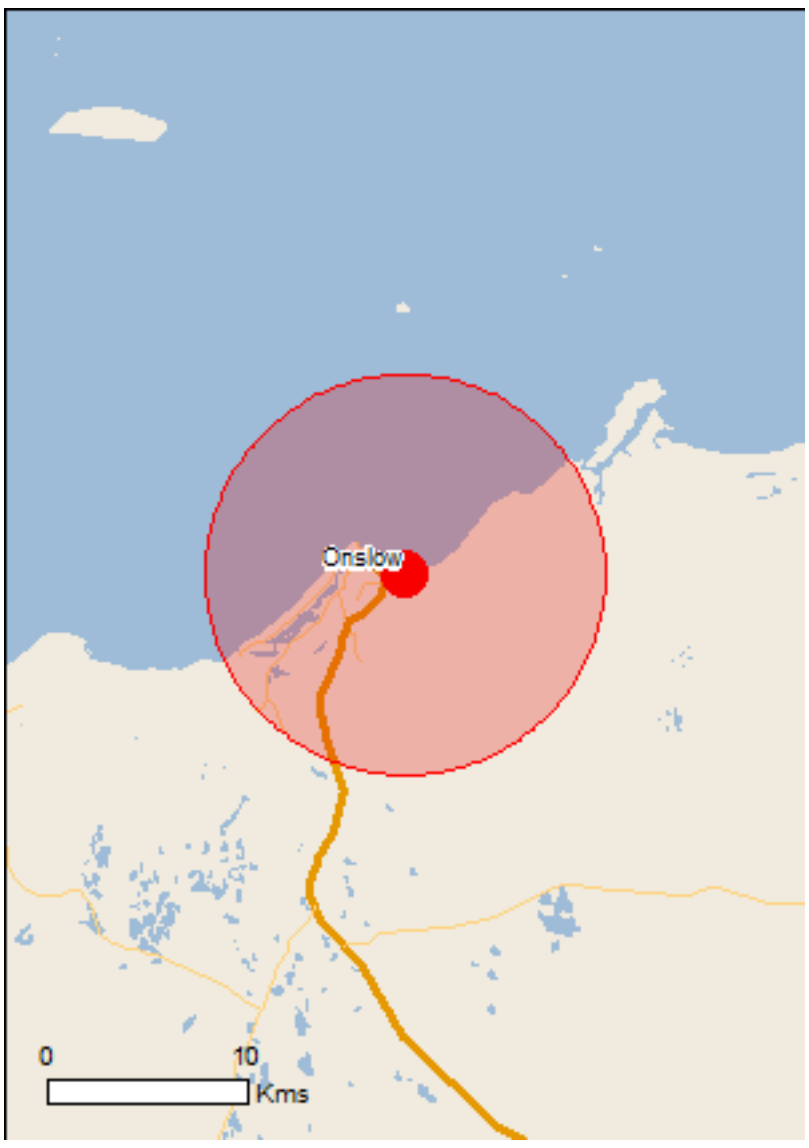
EPBC Act Protected Matters Report

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: 02/05/17 11:10:04



Coordinates
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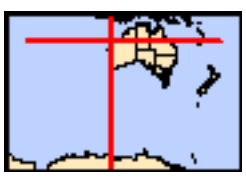

Summary

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:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	24
Listed Migratory Species:	37

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	70
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	8
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
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
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Reptiles		

Name	Status	Type of Presence
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus angusticeps Airlie Island Ctenotus [25937]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	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
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may 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		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat 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	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat 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 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 likely 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
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
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		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
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
[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		
[Actitis hypoleucos](#)		
Common Sandpiper [59309]		Species or species habitat known to occur within area
[Calidris acuminata](#)		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
[Calidris canutus](#)		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
[Calidris ferruginea](#)		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
[Calidris melanotos](#)		
Pectoral Sandpiper [858]		Species or species habitat likely 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
[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 -

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		
[Actitis hypoleucos](#)		
Common Sandpiper [59309]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to 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 likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may 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

Name	Threatened	Type of Presence
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
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
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 suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
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 Ribboned Pipehorse, Ribboned 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		Species or species

Name	Threatened	Type of Presence
[66234]		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
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
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]		Species or species habitat 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 likely 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

Name	Threatened	Type of Presence
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	Species or species habitat 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	Breeding likely 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 habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may 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 edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
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 may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		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

Extra Information

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
Mammals		
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
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
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
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
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area

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.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

-21.64556 115.13103

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
-Department of Land and Resource Management, Northern Territory
-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, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-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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Appendix D Likelihood of Occurrence: Fauna

An assessment was undertaken of the likelihood of occurrence for threatened species identified through the desktop review. The DOE and DPAW do not have prescriptive likelihood of occurrence guidelines within their policies but rather clarify the scale of assessment required to determine the level of impact (e.g. level of assessment, previous record searches, and distribution maps). The below criteria have been developed with the aim of considering this scale of assessment to identify the likelihood of occurrence for threatened species:

- **Low potential to occur** – the species has not been recorded in the region (no records from desktop searches) and/or current known distribution does not encompass project area and/or suitable habitat is generally lacking from the project area.
- **Moderate potential to occur** – the species has been recorded in the region (desktop searches) however suitable habitat is generally lacking from the project area or species has not been recorded in the region (no records from desktop searches) however potentially suitable habitat occurs at the project area.
- **High potential to occur** – the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area.
- **Known to occur** – the species has been recorded on-site in the recent past (i.e. last 5-10 years) and the site provides suitable habitat for it.

Codes used in the following likelihood of occurrence tables:

- EPBC Act (species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*): Ex = Extinct, CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, MM = Migratory Marine, MT = Migratory Terrestrial, MW = Migratory Wetlands, Ma = Listed Marine
- WC Act (species listed under the Western Australian *Wildlife Conservation Act 1950*):
    - Threatened Species: EX = Presumed Extinct, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, IA = Migratory birds protected under an International Agreement, CD = Conservation Dependent, OS = Other Specially Protected
    - Priority Species: P1 = Priority 1, P2 = Priority 2, P3 = Priority 3, P4 = Priority 4
- IUCN (species listed under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species): EX = Extinct, EW = Extinct in the Wild, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern

Birds

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
Calidris canutus Red Knot, Knot	E, MW, Ma	IA (& VU at subsp. level)	LC	Found in flocks on large, sheltered intertidal sand and mudflats during the austral summer. Feed on bivalves, crustaceans and other invertebrates at the receding tide. Rarely encountered inland. Northern Arnhem Land coast is important land during the non-breeding season (Garnett, S.T., Szabo, J.K., and Dutson, 2011)	**Moderate potential to occur** the species not been recorded in the region (no records from desktop searches) however potentially suitable habitat occurs at the project area
Calidris ferruginea Curlew Sandpiper	CE, MW, Ma	VU & IA	LC	Mainly occur in both fresh and brackish waters on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms but are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand (Higgins & Davies, 1996). Curlew Sandpipers forage on mudflats and nearby shallow water and generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh (Higgins & Davies, 1996).	Record 2013 **High potential to occur** the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Calidris tenuirostris Great Knot	CE, M, Ma	VU & IA	EN	Inhabit the same habitat as, and are often found in flocks with, the Red Knot (see above)(Garnett, S.T., Szabo, J.K., and Dutson, 2011)	Bamford (2009) **High potential to occur** the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Charadrius leschenaultii Greater Sand Plover	V, M, Ma	IA (& VU at subsp. level)	LC	Only seen in Australia from July-December, with an influx of individuals into the Top End of the NT during October. Inhabit littoral and estuarine habitats, mainly on sheltered beaches with large sand or mudflats, though observations have been made in estuary lagoons, inshore reefs, small rocky islands and sand cays on coral reefs. Occasionally sighted on near-coastal salt lakes and brackish swamps. Roosting generally takes place on sand-spits and banks on beaches or in tidal lagoons, higher up the beach than other waders (can be well above the high tide mark) (Department of the Environment, 2016a)	Record 2016 **High potential to occur** the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Charadrius mongolus Lesser Sand Plover	E, M, Ma	EN & IA	LC	Recorded along most of the coastline of the NT, in particular the North Arnhem coast, Mud Blue Bay, coast between Anson Bay and Murgenella creek and the Port McArthur area (Chatto, 2003). Inhabits mud and sandflats in sheltered bays, estuaries, harbours, and occasionally rocky outcrops, sandy beaches and coral reefs. Roosting occurs near foraging areas (Department of the Environment, 2016b)	Record 2016 **High potential to occur**

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
					the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Elanus scriptus Letter-winged kite	-	P4	NT	Grasslands with trees and tree-lined watercourses. Typically breeds in a loose colony, often in coolibahs on inland watercourses and mostly in spring but whenever food is abundant. Generally rare. (G. Pizzey & Knight, 2012)	Record 1979 **Low potential to occur** the species was only recorded once in the region in 1979, suitable habitat is generally lacking from the project area
Falco peregrinus Peregrine Falcon	-	OS	LC	An Australia-wide species including some offshore islands, but could be absent from most deserts and the Nullabor Plain (Johnstone and Storr 1998). This striking falcon is sedentary; it roosts and nests on inaccessible cliffs; also known to nest on ledges on tall city buildings and abandoned mine pits (personal observations). An extremely agile and fast hunter it feeds on a wide range of birds including pigeons and ducks. Most frequently observed near cliffs along the coast and ranges of the interior, also along wooded water courses and lakes	Biota (2010) **High potential to occur** Three species recorded in the region and suitable habitat is present at the project area
Limosa lapponica Bar-tailed Godwit	Ma, M V (*Limosa lapponica baueri*) CE (*Limosa lapponica menzbieri*)	IA (& VU at subsp. level)	NT	Inhabits mainly in coastal areas such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays, around beds of seagrass, saltmarsh, coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. Rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips (Department of the Environment, 2015; Morcombe, 2003).	Record 2016 **High potential to occur** the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Macronectes giganteus Southern Giant- Petrel	E, MM, Ma	IA	LC	Marine bird that occurs in Antarctic to subtropical waters. It is widespread throughout the southern ocean. It occurs in both pelagic and inshore waters and is attracted to land at sewage outfalls (Department of the Environment, 2015).	**Low potential to occur** The distribution for this species occurs significantly south of the survey area.
Numenius madagascariensis Eastern Curlew	CE, M, Ma	VU & IA	EN	Associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats (Morcombe, 2003).	Record 2016 **High potential to occur** the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
Pezoporus occidentalis Night Parrot	E	CR	EN	The current distribution of the night parrot is not known. Accepted historical records are from remote arid and semi-arid inland regions of Western Australia, Northern Territory, South Australia and Queensland. Most habitat records are of *Triodia* grasslands and/or chenopod shrublands in the arid and semi-arid zones. Roosting and nesting sites are consistently reported as clumps of dense vegetation, primarily old and large Spinifex clumps, but sometimes other vegetation types. (Threatened Species Scientific Committee, 2016)	Record 1967 **Low potential to occur** the species was only recorded once in the region in 1967, suitable habitat is generally lacking from the project area
Sterna nereis nereis Australian fairy tern	V	VU	VU	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The species roosts on beaches at night and breeds on sheltered mainland coastlines and close islands, usually on sandy beaches above the high tide line but below where vegetation occurs. (BirdLife International, 2017; Department of the Environment, 2017b)	Record 2011 **Low potential to occur** the only record for the species in the region on Bessieres Island in 1947.
Tringa brevipes Grey-tailed Tattler	M	IA & P4	NT	This species breeds in north-central and north-eastern Siberia in the Putorana mountains but spends the northern winter in Australia and other countries associated with the East Asian-Australasian Flyway. Within Australia, the Grey-tailed Tattler has a primarily northern coastal distribution and is found in most coastal regions. It is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats or at intertidal rocky, coral or stony reefs or platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves. It usually forages in shallow water, on hard intertidal substrates, such as reefs and rock platforms, in rock pools and among rocks and coral rubble, over which water may surge but has been recorded foraging on exposed intertidal mudflats, especially with mangroves and possibly seagrass nearby. Occasionally it forages on intertidal sandflats, around banks of seaweed or protruding rocks or lumps of coral. It usually roosts in the branches of mangroves or, rarely, in dense stands of other shrubs, or on snags or driftwood. Where mangroves are not present, it roosts on rocks that are sometimes partly submerged. (BirdLife International, 2016; Department of the Environment, 2016c)	Record 2016 **High potential to occur** the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area

Mammals

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
Balaenoptera musculus Blue Whale	E, MM	EN	EN	The blue whale is a cosmopolitan species, found in all oceans except the Arctic, but absent from some regional seas such as the Mediterranean, Okhotsk and Bering seas. Blue whales feed almost exclusively on krill, with a variety of species being taken by different blue whale populations. They feed both at the surface and also at depth, following the diurnal vertical migrations of their prey to at least 100 m. The migration patterns of blue whales are not well understood, but appear to be highly diverse. (Reilly et al., 2008)	**Low potential to occur** The species has not been recorded in depths of <10 m and is only located in deep waters of the continental slope
Dasyurus hallucatus Northern Quoll	E	EN	EN	The Northern Quoll occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. Northern Quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Rocky habitats are usually of high relief, often rugged and dissected but can also include tor fields or caves in low lying areas such as in Western Australia. Eucalypt forest or woodland habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes. Dens are made in rock crevices, tree holes or occasionally termite mounds (Department of the Environment, 2014).	Record 2012 **Moderate potential to occur** the species has been recorded in the region (desktop searches) however suitable habitat is generally lacking from the project area
Dugong dugon Dugong	MM, Ma	OS	VU	Dugongs undertake long-distance movements, which means Australia shares populations with other neighbouring countries. In Australia, dugongs occur in the shallow coastal waters of northern Australia from the Queensland/New South Wales border in the east to Shark Bay on the Western Australian coast. They are also found in other parts of the Indian and Pacific Oceans in warm shallow seas in areas where seagrass is found.	Record 2014 **High potential to occur** the species has been recorded in the region throughout the year (desktop searches) during aerial surveys.
Eubalaena australis Southern Right Whale	E, MM	VU	LC	In Australian coastal waters, southern right whales occur along the southern coastline including Tasmania, generally as far north as Sydney (33°53'S, 151°13'E) on the east coast and Perth (31°55'S, 115°50'E) on the west coast. There are occasional occurrences further north, with the extremities of their range recorded as Hervey Bay (25°00'S, 152°50'E) and Exmouth (22°23'S, 114°07'E).	**Low potential to occur** The distribution for this species occurs significantly south of the survey area.
Leggadina lakedownensis Lakeland Downs mouse, kerakenga	-	P4	LC	This species is endemic to northern Australia with a discontinuous distribution from Cape York Peninsula in the east to the Pilbara in the West. The species is nocturnal and found in areas of open tussock and hummock grassland, acacia shrubland, and savanna woodland, on alluvial clay or sandy soils. (Aplin, Burbidge, Morrison, & Woinarski, 2016)	Record 2003 **High potential to occur**

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
					the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Megaptera novaeangliae Humpback Whale	V, MM	CD	LC	Humpback whales utilising Australian waters currently have tropical calving grounds along the mid and northern parts of the east and west coasts of Australia, and feeding grounds in the Southern Ocean. The majority of humpbacks in Australian waters migrate north to tropical calving grounds from June to August, and south to the Southern Ocean feeding areas from September to November.	Record 2014 **High potential to occur** The species has been recorded in the region (desktop searches). Typically occur further offshore (>35 km) during migratory routes, although some whales recorded in <10m during southern migration (i.e. September).
Mormopterus loriae cobourgensis Little Northern Freetail-bat	-	1	LC	Distribution from Exmouth Gulf to Derby on WA coast. The Little Northern Freetail Bat is a DEC Priority 1 species which inhabits mangrove communities, roosting in crevices and sprouts of the dead upper branches of the mangrove *Avicennia marina* (van Dyck and Strahan 2008).	Biota (2010b) **High potential to occur** Species recorded via echolocation call during surveys undertaken for the Wheatstone Project
Orcaella heinsohni Australian snubfin dolphin	M	P4	NT	Stranding and museum specimen records indicate that Australian Snubfin Dolphins occur only in waters off the northern half of Australia, from approximately Broome (17° 57′ S) on the west coast to the Brisbane River (27° 32′ S) on the east coast. Aerial and boat-based surveys indicate that Australian Snubfin Dolphins occur mostly in protected shallow waters close to the coast, and close to river and creek mouths.	Record 2014 **Moderate potential to occur** Occasionally sighted in Pilbara coastal waters presumed to be an occasional visitor from the Kimberley region.
Pseudomys chapmani Western Pebble-mound Mouse	-	4	LC	Confined to the central and eastern Pilbara. Found on stony hillsides with hummock grasslands & is common to very common in suitable habitat within Hammersley and Chichester Pilbara subregions. Well known for constructing extensive mounds of small stones on spurs and gentle slopes.	Biota (2010) **Low potential to occur** An abandoned mound was recorded during surveys undertaken for the Wheatstone Project although lack of suitable stony substrate required for mound building in OMSB Project area
Sousa sahulensis Australian humpback dolphin	M	P4		In Australia, Indo-Pacific Humpback Dolphins are known to occur along the northern coastline, extending to Exmouth Gulf on the west coast (25° S), and the Queensland/NSW border region on the east coast (34° S) (Corkeron et al. 1997). There are few records between the Gulf of Carpentaria in the north and Exmouth Gulf in the west, this is probably due to a lack of research effort and the remoteness of the area (Bannister et al. 1996; Parra et al. 2002).	Record 2015 **High potential to occur** The species has been recorded in the region (desktop searches) and suitable habitat is present at the project area

Reptiles

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
Aipysurus apraefrontalis Short-nosed Seasnake	CE, Ma	CR	CR	The Short-nosed Seasnake is endemic to Western Australia, and has been recorded from Exmouth Gulf, Western Australia (Storr et al. 2002) to the reefs of the Sahul Shelf, in the eastern Indian Ocean. The species prefers the reef flats or shallow waters along the outer reef edge in water depths to 10 m (Cogger 2000; Guinea 1993, 1995; McCosker 1975).	**Moderate potential to occur** The species has not been recorded in the region (desktop searches) although within the known distribution and suitable habitat is present in the project area
Caretta caretta loggerhead turtle	E, MM, Ma	EN	EN	In Australia, Loggerhead Turtles nest on open, sandy beaches. They live at or near the surface of the ocean and move with the ocean currents, choosing a wide variety of tidal and sub-tidal habitat as feeding areas and showing fidelity to both their foraging and breeding areas. (Department of the Environment, 2015)	Record 2015 **Moderate potential to occur** The species has been recorded in the region (desktop searches) although not near the Project area. Suitable habitat is present at the project area
Chelonia mydas green turtle	V, MM, Ma	VU	EN	Green Turtles nest, forage and migrate across tropical northern Australia. They usually occur between the 20°C isotherms (Marquez 1990), although individuals can stray into temperate waters (Cogger et al. 1993). In Australia, the key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) occur on offshore Islands off Onslow (DEH 2005a; DEWHA 2008b).	Record 2015 **High potential to occur** The species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Ctenotus angusticeps Airlie Island Ctenotus	V	VU	-	This species inhabits Airlie Island, in north-western Western Australia and has also been recorded on the mainland near Roebuck Bay, south of Broome. However, the genetic status of the offshore and mainland populations is unknown. On Airlie Island, the species is found in a range of different habitat types, including tussock grass on the western end of the island and low open *Acacia coriacea* shrubland with coastal Spinifex species in the littoral zone. It prefers the tussock grass habitat, which is the less dominant vegetation type of the island. At Roebuck Bay, the species has been found on coastal mudflats vegetated with Samphire. (Threatened Species Scientific Committee, 2010)	**Low potential to occur** the species has not been recorded in the region (no records from desktop searches)
Dermochelys coriacea leatherback turtle	V	E	VU	The Leatherback Turtle is a pelagic feeder, found in tropical, subtropical and temperate waters throughout the world (Marquez 1990). Large body size, high metabolism, a thick adipose tissue layer and regulation of blood flow (Spotila et al.1997) allow them to utilise cold water foraging areas unlike other sea turtle species. For this reason this species is regularly found in the high latitudes of all oceans including the South Pacific	**Low potential to occur** the species has not been recorded in the region (no records from desktop searches)

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
				Ocean in the waters offshore from NSW, Victoria, Tasmania and Western Australia (Benson et al. 2011; Limpus & MacLachlan 1979, 1994).	
Eretmochelys imbricata Hawksbill Turtle	V, MM, Ma	VU	CR	Hawksbill Turtles are found in tropical, subtropical and temperate waters in all the oceans of the world. In Australia, the key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) occur on offshore Islands off Onslow (DEH 2005a; DEWHA 2008b). Reefs from Cape Preston to Onslow are considered important feeding grounds.	Record 2013 **Moderate potential to occur** The species has been recorded in the region (desktop searches) although not in the Project area. Suitable habitat is present at the project area
Lerista planiventralis subsp. Maryani Keeled Slider (NW coast Onslow to Barradale)	-	P1	-	Found in the upper west coast of Western Australia between Onslow and Barradale in coastal consolidated dunes and low shrubland. Burrowing and usually found in loose soil or sand where they feed on ants, termites and other small insects. Emerge at night to feed at the surface but immediately dive into loose sandy substrate when disturbed. (Cogger, 2014)	Biota (2010) **Moderate potential to occur** the species has been recorded in the region however suitable habitat is generally lacking from the project area
Liasis olivaceus barroni Pilbara Olive Python	V	VU	-	The Olive Python (Pilbara subspecies) is restricted to ranges within the Pilbara region. It is known to occur at 17 locations within the inland Pilbara (Pearson 1993) and the site of the proposed Pardoo iron ore shipping facility, in the Pilbara, approximately 70 km east of Port Hedland (Enesar Consulting 2007). Typically prefers escarpments, gorges and water holes in the ranges, though occasionally found in spinifex grasslands of the Pilbara region (Pearson 1993; Wilson & Swan 2003), usually in close proximity to water and rock outcrops that attract suitable sized prey species (Pearson 2003).	**Low Potential to Occur** One record from the Ashburton River (Ellis, 2012). Lack of typical habitat in the Project area and not listed on desktop database searches.
Natator depressus flatback turtle	V, MM, Ma	VU	DD	The Flatback Turtle is found only in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya (Spring 1982; Zangerl et al. 1988) and is one of only two species of sea turtle without a global distribution. On the North-West Shelf, the major rookeries are on the mid-eastern coast of Barrow Island and at Mundabullangana Station near Cape Thouin on the mainland (Prince 1994a,b). These turtles are known to occur in the Onslow region during all sensitive life-history phases (mating, nesting and inter-nesting).	Record 2015 **High Potential to Occur** The species has been recorded in the region (desktop searches) and suitable habitat is present at the project area
Crocodylus porosus Salt-water Crocodile	M, Ma	OS	LR/lc	The Salt-water Crocodile is found in Australian coastal waters, estuaries, lakes, inland swamps and marshes from Rockhampton in Queensland, throughout coastal Northern Territory to King Sound (near Broome) in Western Australia. There have been isolated records in rivers of the Pilbara region, around Derby near Broome and as far south as Carnarvon on the mid-west coast (Department of the Environment, 2017a).	Record 2014 **Moderate Potential to Occur** The species has been recorded in the region (desktop searches) although presumed to be an occasional visitor from the Kimberley region.

Sharks and Rays

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
Carcharias taurus Grey Nurse Shark	V	VU	VU	The Grey Nurse Shark (west coast population) has a broad inshore distribution, primarily in sub-tropical to cool temperate waters (Last & Stevens 1994). The population of Grey Nurse Shark (west coast population) is predominantly found in the south-west coastal waters of Western Australia (Environment Australia 2002a) and has been recorded as far north as the North West Shelf (Stevens 1999; Pogonoski et al. 2002).	**Low potential to occur** the species has not been recorded in the region (no records from desktop searches). Has been found to Muiron Islands although predominantly found in cooler coastal waters further south.
Carcharodon carcharias White Shark	V, MM	VU	VU	In Australia, Great White Sharks have been recorded from central Queensland around the south coast to north-west Western Australia, but may occur further north on both coasts (Bonfil et al. 2005; Bruce et al. 2006; Last & Stevens 2009; Paterson 1990). They inhabit inshore waters around rocky reefs, surf beaches and shallow coastal bays; waters on the outer continental shelf and slope; and the open ocean. These sharks most commonly live in depths above 100 m.	**Moderate potential to occur** the species has not been recorded in the region (no records from desktop searches). Has been found to Muiron Islands although predominantly found in cooler coastal waters further south.
Pristis clavata Dwarf Sawfish, Queensland Sawfish	V, MM	P1	EN	The species' Australian distribution has previously been considered to extend north from Cairns around the Cape York Peninsula in Queensland, across northern Australian waters to the Pilbara coast in Western Australia (Last & Stevens 1994; McAuley et al. 2005; Stevens et al. 2008). The Dwarf Sawfish usually inhabits shallow (2–3 m) coastal waters and estuarine habitats.	**Moderate potential to occur** the species has not been recorded in the region (no records from desktop searches). The western extent of this species range has not been fully resolved, and this species may therefore also occur
Pristis pristis (Pristis microdon) Freshwater (Largetooth) Sawfish	V, M	P3	CR	The Freshwater Sawfish may potentially occur in all large rivers of northern Australia from the Fitzroy River, Western Australia, to the western side of Cape York Peninsula, Queensland. It is mainly confined to the main channels of large rivers. Recorded within Ashburton River from the Onslow area during recent survey (pers comms Dr David Morgan).	**Low potential to occur** Predominantly found in warmer coastal waters further north and suitable habitat (large river) is not present at the project area.
Pristis zijsron Green Sawfish	V, MM	VU	CR	The green sawfish inhabit shallow coastal marine and estuarine waters of northern Australia, from about Eighty Mile Beach, Western Australia, to the Cairns region, Queensland. It has been occasionally been caught as far south as Sydney (OzFishNet, 2016). In the Onslow area, green sawfish are known to be pupped near the Ashburton River mouth and utilise the estuary and nearby mangrove creeks, before moving offshore to mature at a length of about 3 m (pers comms Dr David Morgan)	Record 2011 **High potential to occur** The species has been recorded in the region (desktop searches), Beadon Creek offers limited suitable habitat in comparison to nearby creeks. However, the species may be found moving through the project area

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
Rhincodon typus Whale Shark	V, MM	OS	VU	Found worldwide in tropical and subtropical oceans.(OzFishNet, 2016). Ningaloo Reef, off the Western Australian coast, is the main known aggregation site of Whale Sharks in Australian waters.	**Moderate potential to occur** the species has been recorded in deeper waters than the Project area although no records from desktop searches.
Rhynchobatus australiae Whitespotted Guitarfish	-	-	VU	Fremantle, Western Australia, around the tropical north to Crowdy Head, northern New South Wales. Elsewhere, the species occurs in the tropical, east-Indo-west Pacific. Inhabits inshore waters, occurring on soft bottoms near reefs.	**Moderate potential to occur** the species has been recorded in deeper waters than the Project area although no records from desktop searches.

Migratory/Marine species & Whales & Cetaceans

Class	Species	Common Name	EPBC Act Status	WC Act Status	IUCN	Record in searches
Bird	*Actitis hypoleucos*	Common Sandpiper	MW, Ma	IA	LC	Y
Bird	*Anous stolidus*	Common Noddy	MM, Ma	IA	LC	
Bird	*Apus pacificus*	Fork-tailed Swift	MM, Ma	IA	LC	Y
Bird	*Ardea alba*	Great Egret, White Egret	Ma		LC	
Bird	*Ardea ibis*	Cattle Egret	M, Ma	IA	LC	
Bird	*Ardea modesta*	Eastern Great Egret	M	IA	LC	Y
Bird	*Arenaria interpres*	Ruddy Turnstone	M, Ma	IA	LC	Y
Bird	*Calidris acuminata*	Sharp-tailed Sandpiper	MW, Ma	IA	LC	Y
Bird	*Calidris alba*	Sanderling	M, Ma	IA	LC	Y
Bird	*Calidris melanotos*	Pectoral Sandpiper	MW, Ma	IA	LC	
Bird	*Calidris ruficollis*	Red-necked Stint	M, Ma	IA	LC	Y
Bird	*Calidris subminuta*	Long-toed Stint	M, Ma	IA	LC	
Bird	*Charadrius veredus*	Oriental Plover, Oriental Dotterel	MW, Ma	IA	LC	

Bird	*Chlidonias leucopterus*	white-winged black tern, white-winged tern	M, Ma	IA	LC	Y
Bird	*Egretta sarca*	Easter reef Egret	M, Ma	-	LC	Y
Bird	*Fregata ariel*	Lesser Frigatebird, Least Frigatebird	MM, Ma	IA	LC	
Bird	*Gallinago stenura*	Pin-tailed Snipe	M, Ma	IA	LC	
Bird	*Gelochelidon nilotica*	Gull-billed Tern	M	IA	LC	Y
Bird	*Glareola maldivarum*	Oriental Pratincole	MW, Ma	IA	LC	Y
Bird	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	Ma		LC	Y
Bird	*Hirundo rustica*	Barn Swallow	MT, Ma	IA	LC	
Bird	*Hydroprogne caspia*	Caspian Tern	M, Ma	IA	LC	Y
Bird	*Limicola falcinellus*	Broad-billed Sandpiper	M, Ma	IA	LC	
Bird	*Limosa limosa*	Black-tailed Godwit	M, Ma	IA	LC	
Bird	*Merops ornatus*	Rainbow Bee-eater	M, Ma	IA	LC	Y
Bird	*Motacilla cinerea*	Grey Wagtail	MT, Ma	IA	LC	
Bird	*Motacilla flava*	Yellow Wagtail	MT, Ma	IA	LC	
Bird	*Numenius minutus*	Little Curlew	M, Ma	IA	LC	Y
Bird	*Numenius phaeopus*	Whimbrel	M, Ma	IA	LC	Y
Bird	*Oceanites oceanicus*	Wilson's Storm Petrel	M, Ma	IA	LC	Y
Bird	*Pandion haliaetus*	Osprey (includes *Pandion cristatus* Eastern Osprey)	MW, Ma		LC	Y
Bird	*Plegadis falcinellus*	Glossy Ibis	M, Ma	IA	LC	
Bird	*Pluvialis fulva*	Pacific Golden Plover	M, Ma	IA	LC	Y
Bird	*Pluvialis squatarola*	Grey Plover	M, Ma	IA	LC	Y
Bird	*Puffinus pacificus*	Wedge-tailed Shearwater	M, Ma	IA	LC	Y
Bird	*Sterna albifrons*	Little Tern	-	IA	LC	Y
Bird	*Sterna bengalensis*	Lesser Crested Tern	Ma		LC	Y
Bird	*Sterna bergii*	Crested Tern	-	-	LC	Y

Bird	*Sterna dougallii*	Roseate Tern	M, Ma	IA	LC	Y
Bird	*Sterna hirundo*	Common Tern	M, Ma	IA	LC	Y
Bird	*Tringa cinereus*	Terek Sandpiper	M, Ma	IA	LC	
Bird	*Tringa glareola*	Wood Sandpiper	M	IA	LC	Y
Bird	*Tringa hypoleucos*	Common Sandpiper	M, Ma	IA	LC	Y
Bird	*Tringa nebularia*	Common Greenshank, Greenshank	MW, Ma	IA	LC	Y
Bird	*Tringa stagnatilis*	Marsh Sandpiper	M, Ma	IA	LC	
Fish	*Bulbonaricus brauni*	Braun's Pughead Pipefish, Pug-headed Pipefish	Ma			
Fish	*Campichthys tricarinatus*	Three-keel Pipefish	Ma			
Fish	*Choeroichthys brachysoma*	Pacific Short-bodied Pipefish, Short-bodied Pipefish	Ma		LC	
Fish	*Choeroichthys suillus*	Pig-snouted Pipefish	Ma			
Fish	*Doryrhamphus janssi*	Cleaner Pipefish, Janss' Pipefish	Ma		LC	
Fish	*Doryrhamphus negrosensis*	Flagtail Pipefish, Masthead Island Pipefish	Ma			
Fish	*Festucalex scalaris*	Ladder Pipefish	Ma			
Fish	*Filicampus tigris*	Tiger Pipefish	Ma			
Fish	*Halicampus brocki*	Brock's Pipefish	Ma			
Fish	*Halicampus grayi*	Mud Pipefish, Gray's Pipefish	Ma			
Fish	*Halicampus nitidus*	Glittering Pipefish	Ma			
Fish	*Halicampus spinirostris*	Spiny-snout Pipefish	Ma			
Fish	*Haliichthys taeniophorus*	Ribboned Pipehorse, Ribboned Seadragon	Ma			
Fish	*Hippichthys penicillus*	Beady Pipefish, Steep-nosed Pipefish	Ma		LC	
Fish	*Hippocampus alatus*	Winged Seahorse	Ma		DD	Y
Fish	*Hippocampus angustus*	Western Spiny Seahorse, Narrow-bellied Seahorse	Ma		DD	Y
Fish	*Hippocampus histrix*	Spiny Seahorse, Thorny Seahorse	Ma			
Fish	*Hippocampus kuda*	Spotted Seahorse, Yellow Seahorse	Ma		VU	

Fish	*Hippocampus planifrons*	Flat-face Seahorse	Ma			Y
Fish	*Hippocampus trimaculatus*	Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse	Ma		VU	
Fish	*Hippocampus zebra*	Zebra seahorse	Ma		DD	Y
Fish	*Micrognathus micronotopterus*	Tidepool Pipefish	Ma			
Fish	*Solegnathus hardwickii*	Pallid Pipehorse, Hardwick's Pipehorse	Ma		DD	
Fish	*Solegnathus lettiensis*	Gunther's Pipehorse, Indonesian Pipefish	Ma		DD	
Fish	*Solenostomus cyanopterus*	Robust Ghostpipefish, Blue-finned Ghost Pipefish,	Ma			
Fish	*Solenostomus paegnius*	Rough-snout Ghost Pipefish	Ma			
Fish	*Syngnathoides biaculeatus*	Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish	Ma		DD	
Fish	*Trachyrhamphus bicoarctatus*	Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish	Ma			
Fish	*Trachyrhamphus longirostris*	Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish	Ma			
Mammal	*Balaenoptera acutorostrata*	Minke Whale	Ma			
Mammal	*Balaenoptera edeni*	Bryde's Whale	MM		DD	
Mammal	*Delphinus delphis*	Common Dophin, Short-beaked Common Dolphin	Ma			
Mammal	*Grampus griseus*	Risso's Dolphin, Grampus	Ma			
Mammal	*Orcinus orca*	Killer Whale, Orca	MM		DD	
Mammal	*Sousa chinensis*	Indo-Pacific Humpback Dolphin	MM		NT	
Mammal	*Stenella attenuata*	Spotted Dolphin, Pantropical Spotted Dolphin	Ma			
Mammal	*Tursiops aduncus*	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	MM		DD	
Mammal	*Tursiops truncatus s. str.*	Bottlenose Dolphin	Ma			
Reptile	*Acalyptophis peronii*	Horned Seasnake	Ma		LC	
Reptile	*Aipysurus duboisii*	Dubois' Seasnake	Ma		LC	
Reptile	*Aipysurus eydouxii*	Spine-tailed Seasnake	Ma		LC	
Reptile	*Aipysurus laevis*	Olive Seasnake	Ma		LC	Y
Reptile	*Astrotia stokesii*	Stokes' Seasnake	Ma			

Reptile	*Disteira kingii*	Spectacled Seasnake	Ma			
Reptile	*Disteira major*	Olive-headed Seasnake	Ma			
Reptile	*Emydocephalus annulatus*	Turtle-headed Seasnake	Ma		LC	
Reptile	*Ephalophis greyi*	North-western Mangrove Seasnake	Ma			
Reptile	*Hydrophis czeblukovi*	Fine-spined Seasnake	Ma		DD	
Reptile	*Hydrophis elegans*	Elegant Seasnake	Ma		LC	
Reptile	*Hydrophis ornatus*	Spotted Seasnake, Ornate Reef Seasnake	Ma			Y
Reptile	*Pelamis platurus*	Yellow-bellied Seasnake	Ma			
Shark	*Anoxypristis cuspidata*	Narrow Sawfish	M		EN	
Shark	Manta alfredi	Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray	MM		VU	Y
Shark	Manta birostris	Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray	MM		VU	Y

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Appendix E Likelihood of Occurrence: Flora

An assessment was undertaken of the likelihood of occurrence for threatened species identified through the desktop review. The DOE and DPAW do not have prescriptive likelihood of occurrence guidelines within their policies but rather clarify the scale of assessment required to determine the level of impact (e.g. level of assessment, previous record searches, and distribution maps). The below criteria have been developed with the aim of considering this scale of assessment to identify the likelihood of occurrence for threatened species:

- **Low potential to occur** – the species has not been recorded in the region (no records from desktop searches) and/or current known distribution does not encompass project area and/or suitable habitat is generally lacking from the project area.
- **Moderate potential to occur** – the species has been recorded in the region (desktop searches) however suitable habitat is generally lacking from the project area or species has not been recorded in the region (no records from desktop searches) however potentially suitable habitat occurs at the project area.
- **High potential to occur** – the species has been recorded in the region (desktop searches) and suitable habitat is present at the project area.
- **Known to occur** – the species has been recorded on-site in the recent past (i.e. last 5-10 years) and the site provides suitable habitat for it.

Codes used in the following likelihood of occurrence tables:

- EPBC Act (species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*): - = CE = Critically Endangered, E = Endangered, V = Vulnerable, CD = Conservation Dependent, OSP = Other Specially Protected.
- WC Act (species listed under the Western Australian *Wildlife Conservation Act 1950*):
    - Priority Species: 1 = Priority 1, 3 = Priority 3
- IUCN (species listed under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species): - = has not been assessed for the IUCN Red List

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
Abutilon sp. Onslow (F. Smith s.n. 10/9/61)	-	1	-	The species is currently undescribed and very little is known about its biology. The distribution includes the Cape Range, Hamersley and Roebourne IBRA subregions (Western Australian Herbarium, 2017). Habitat described as loamy plain supporting shrubland of *Acacia synchronicia* and *A. bivenosa* over an open hummock grassland of *Triodia epactia* (Biota 2013).	**Low potential to occur** Known to occur from three (3) locations near Onslow approximately 26 km southwest from OMSB Project area. Suitable habitat is lacking from the project area (Biota 2013).
Atriplex flabelliformis Saltbush	-	3	LC	Records associated with samphire and grassland vegetation on clayey plains in the Wheatstone Area (C3 & CP1). Typically known to occur further inland (i.e. nearest record 430 km south-east of Onslow in the Fortescue Marsh.	**Low potential to occur** Recorded from southern Wheatstone plant study area. Subsequent targeted searches for this species have failed to

Species Name	EPBC Act Status	WC Act Status	IUCN Status	Habitat Preference	Likelihood of Occurrence
					locate any further records closer to the OMSB Project area (Biota 2013).
Eleocharis papillosa Dwarf Desert Spike Rush	V	3		Distribution from north and south Australia including SA, NT & WA. The Dwarf Desert Spike Rush prefers ephemeral wetlands, clay pans and open silty-clay flats. It can also be observed growing along the edge of drainage lines.Has been recorded in Onslow region within claypan with samphire shrubland vegetation from tidally influenced creeks, 16 km south of the Project area.	**Moderate potential to occur** the species has not been recorded in the Project area, although is known to occur at the Wheatstone site. A very small area of "degraded" potentially suitable habitat (creek open drain) occurs at the project area
Eremophila forrestii subsp. *viridis*	-	3	-	The distribution includes the Cape Range, Mackay, Roebourne IBRA subregions (Western Australian Herbarium, 2017). Surveys in the Ashburton North revealed this species prefers inland red sand dune habitats composed of *Grevillea* tall open shrubland over *Crotalaria* over *Triodia* hummock grassland (ID1, ID2: Biota 2013).	**Low potential to occur** the species not recorded in the OMSB Project area, although is known to occur at the Wheatstone site. Suitable habitat (vegetation units ID1, ID2) do not occur within the Project area
Indigofera roseola	-	1	-	Records for the species are from sand dunes and ridges of red sand or red sandy loam. The species has been found in association with *Grevillea*, *Verticordia*, *Plectrachne*, *Tephrosia*, *Triodia*, *Salsola*, *Ptilotus* and *Acacia* species. (Council of Heads of Australasian Herbaria, 2014)	**Low potential to occur** the species has not been recorded in the region (no records from desktop searches) and current known distribution does not encompass project area
Solanum leopoldense	-	3	-	The distribution includes the Mitchell, Mount Eliza and Pentecost IBRA subregions (Western Australian Herbarium, 2017).	**Low potential to occur** the species has not been recorded in the region (no records from desktop searches) and current known distribution does not encompass project area
Tephrosia rosea var. Port Hedland (A.S. George 1114)	-	1	-	The distribution includes the Chichester and Roebourne IBRA subregions (Western Australian Herbarium, 2017). Records for the species are from coastal dune sands or low rocky ridges (Council of Heads of Australasian Herbaria, 2014).	**Low potential to occur** the species has not been recorded in the region (no records from desktop searches) and current known distribution does not encompass project area
Triumfetta echinata	-	3	-	The distribution includes the Ashburton, Cape Range and Roebourne IBRA subregions (Western Australian Herbarium, 2017). Found scattered around the Ashburton North region along the crest of dune ridges and preferring red sandy soils and sand dune habitats composed of *Grevillea* tall open shrubland over *Crotalaria* over *Triodia* hummock grassland (ID1, ID2: Biota 2013).	**Low potential to occur** the species not recorded in the OMSB Project area, although is known to occur at the Wheatstone site. Suitable habitat (vegetation units ID1, ID2) does not occur within the project area

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Appendix F Assessing the Potential Impacts on Sawfish

Technical Memorandum

DATE:	15th July 2017	**REFERENCE:**	17WAU-0008/1702023
TO:	Andrew Natta	**EMAIL:**	andrew.natta@omsb.com.au
FROM:	Travis Hurley	**EMAIL:**	Travis.Hurley@o2marine.com.au
SUBJECT:	**OMSB Project Stage 2 Capital Dredging: Assessing potential impacts to Sawfish**		

1. Background

This technical memorandum presents the environmental impact assessment on Sawfish associated with construction activities for Stage 2 of the Onslow Marine Support Base Project (OMSB Project). The potential impact to Sawfish from OMSB Project activities was raised as an item to address during a pre-referral meeting held with the Environmental Protection Authority (EPA). Sawfish are listed as *Vulnerable* under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999), are protected under the *Fish Resources Management Act 1994* (FRMA 1994), and Green Sawfish (*Pristis zijsron*) are listed as Schedule 3 (rare or likely to become extinct) under the *Wildlife Conservation Act 1950* (WCA 1950). Therefore, the objective of the assessment is to determine whether the OMSB Project is likely to have a significant impact on populations of Sawfish in north-west Australia.

The Centre for Fish and Fisheries Research recently undertook a research project for Chevron that investigated Sawfish populations to establish baseline distributional area data for different species in the Onslow region and examined the population demographics and movement patterns of the resident species (Morgan et al. 2012). The study was undertaken in the Ashburton River, Hooleys Creek and Four Mile Creek to the west of Beadon Creek and involved setting gill nets to capture Sawfish, fitting them with an acoustic tag and recording transmissions from the tags within the detection limits of the acoustic receivers positioned at various locations inside and outside the creeks. Independent technical advice for the OMSB Project was sought from Dr Dave Morgan from the Centre for Fish and Fisheries Research, Murdoch University, to provide advice on what is known about the population of Sawfish that occur in the Onslow area and recommendations to mitigate potential impacts on Sawfish from OMSB Project activities. The review of the potential impacts to Sawfish from Dr Dave Morgan is provided in **Attachment 1**.

The EPA also recommended to discuss the potential impacts of the project with the Department of Fisheries (DoF). O2 Marine met with Dr Rory McCauley, Elasmobranch Research Scientist from the DoF, on 6 June 2017 to discuss the project, provide an overview of information and recommendations provided by from Dr Morgan, and allow initial consideration for the potential impacts on Sawfish from the OMSB Project. The impact assessment was provided in greater detail in this memorandum for further consideration for Dr McCauley.

Note: Consultation was undertaken with Dr McCauley to address specific concerns from the EPA regarding the potential impacts on Sawfish. The environment branch from the DoF were also consulted and offered an opportunity to provide comment separately on other potential OMSB Project environmental risks.

2. Project Description

2.1. Project History

The Beadon Creek Maritime Facility was developed in 1964 and is managed by the Department of Transport (DoT). The facility is used as a harbour for both recreational and commercial activities, although has recently transformed from a small facility supporting local and charter fishing activities to a significant facility supporting the myriad of industrial and commercial activities associated with the growing offshore oil and gas industry in the region. The Beadon Creek Maritime Facility covers an area of 15.29 ha and includes ~260 m wharf face, mooring berths, cyclone moorings, public service wharf, dual public boat ramp, diesel fuelling facilities, public car park and fish cleaning facilities (Figure 1).

Beadon Creek is located approximately 2 km East of the town of Onslow in the Pilbara, within the Shire of Ashburton. Onslow is located 1386 kms north of Perth and 360 kms south of Karratha. The township is 80 km west off the North West Coastal Highway. It is ideally located to service offshore locations including the Mackerel Islands, Barrow Island (Gorgon LNG Plant), Exmouth Gulf, and the Carnarvon Basin (oil and gas reserves) as well as in-land mines including Rio Tinto's Mesa A site and Pannawonica.

The broader Project area is largely undeveloped except for a solar salt field with offshore loadout facilities to the West of Onslow, the Roller oilfield in shallow coastal waters to the West of Onslow and the Liquified Natural Gas (LNG) plants, Wheatstone and Macedon, with offshore jetty and materials offloading facility (MOF), at Ashburton North Strategic Industrial Area (ANSIA) approximately 12 km southwest of Onslow.

Figure 1 Beadon Creek Maritime Facility (shaded blue), including OMSB Stage 1 project footprint (shaded red) (Source: BMT Oceanica 2015)

2.2. OMSB Project – Stage 2

OMSB is planning to modify and extend the harbour approach channel, turning circle and berth pocket as part of Stage 2 of the Onslow Marine Support Base Project (herein the OMSB Project). The proposed capital dredging will enable offshore supply vessels to access the newly constructed OMSB land-backed wharf infrastructure within the Beadon Creek Maritime Facility.

Capital dredging proposed includes a turning basin and channel to a declared depth of - 6.0 m CD and a berth pocket to -8.0mCD. The total volume of dredging is anticipated to be ~930,000 cubic metres and it is

expected that dredging will be undertaken using a medium-sized cutter suction dredge over a period of approximately eight (8) months.

Dredge material will be disposed of onshore in the area between the industrial areas adjacent to Beadon Creek Rd extending south towards the airport. During dredging, the dredge spoil area will be dewatered to the intertidal flats between the disposal site and Beadon Creek. The proposed concept plan for Stage 2 of the OMSB Project is presented in **Figure 2** and the key characteristics of the project are summarised in **Table 1**.

The OMSB Project (Stage 2) will be referred to the EPA in early August 2017.

Table 1 Key characteristics of the OMSB Project (Stage 2)

Element	Location	Proposed Extent
Physical Elements		
Approach Channel	Figure 2	Harbour approach channel (HAC) dredge area of 32 ha, with a target depth of -6.0 m CD, width of 55 metres (m) and length of 2 km. Direct removal of 11 ha of nearshore subtidal benthic communities and habitat (BCH) from within the HAC dredge area.
Turning Basin	Figure 2	Turning basin dredge area of 2 ha, with a target depth of -6.0 m CD and a diameter of 143 m.
Berth Pocket	Figure 2	Berth pocket dredge area of 3 ha, with a target depth of -8.0 m CD.
Dredge Material Management Area (DMMA)	Figure 2	Onshore spoil disposal area of 35.6ha. Clearing of no more than 15.8 ha of native vegetation within the onshore spoil disposal area.
Channel Navigation Markers	Unspecified.	Floating (i.e. moored) channel navigation markers (approximately 15) will be installed within the development areas as required. No removal of BCH is required.
Dredge Material Disposal Pipeline	Figure 2 (Two Options Proposed)	Two pipeline route options are proposed: Pipeline Route Option A – 450 mm diameter pipeline installed within a 50 m wide pipeline route corridor. Pipeline confined to existing tracks and road reserve. Clearing of <0.3 ha of native vegetation is expected within the pipeline corridor. Pipeline Route Option B – 450 mm diameter pipeline installed within a 50 m wide pipeline route corridor. Pipeline confined to Beadon Creek and intertidal flats adjacent to Beadon Creek. Clearing of <0.1 ha of native vegetation is expected within the pipeline corridor. Potential direct loss of <0.1 ha of BCH within the pipeline corridor.
Operational Elements		
Capital Dredging – Approach Channel	Figure 2	Capital dredging of 758,000 m^3 of marine sediment from within the harbour approach channel dredge area to target depth of -6.0 m CD.
Capital Dredging – Turning Basin	Figure 2	Capital dredging of 86,500 m^3 of marine sediment from within the turning basin dredge area to target depth of -6.0 m CD.
Capital Dredging – Berth Pocket	Figure 2	Capital dredging of 85,500 m^3 of marine sediment from within the

Element	Location	Proposed Extent
		berth pocket dredge area to target depth of -8.0 m CD.
Dredge Material Disposal Pipeline	Figure 2	Two pipeline route options are proposed: Pipeline Route Option A – Temporary installation of 450 mm diameter onshore pipeline and booster stations within the pipeline corridor to transport dredge material from floating pipeline to disposal area. Pipeline Route Option B – Temporary installation of 450 mm diameter floating pipeline and booster stations within the pipeline corridor to transport dredge material to an onshore pipeline connection and subsequently to the DMMA.
Onshore Spoil Disposal to DMMA	Figure 2	Disposal of approximately 930,000 m3 of clean, uncontaminated marine sediment to the DMMA.
Onshore Spoil Disposal Dewatering	Figure 2	Controlled discharge of approximately 21 megalitres (ML) per day of dredge spoil return water to the adjacent intertidal catchment of Beadon Creek.
Channel Navigation Markers	Unspecified	Floating (i.e. moored) channel navigation markers will be installed within the development areas as required.
Vessel Operations	Figure 2	Increase in vessel traffic up to approximately 700 vessels per annum to/from the existing OMSB land-backed wharf within the Beadon Creek Maritime Facility, via the HAC, turning basin and berth pocket.

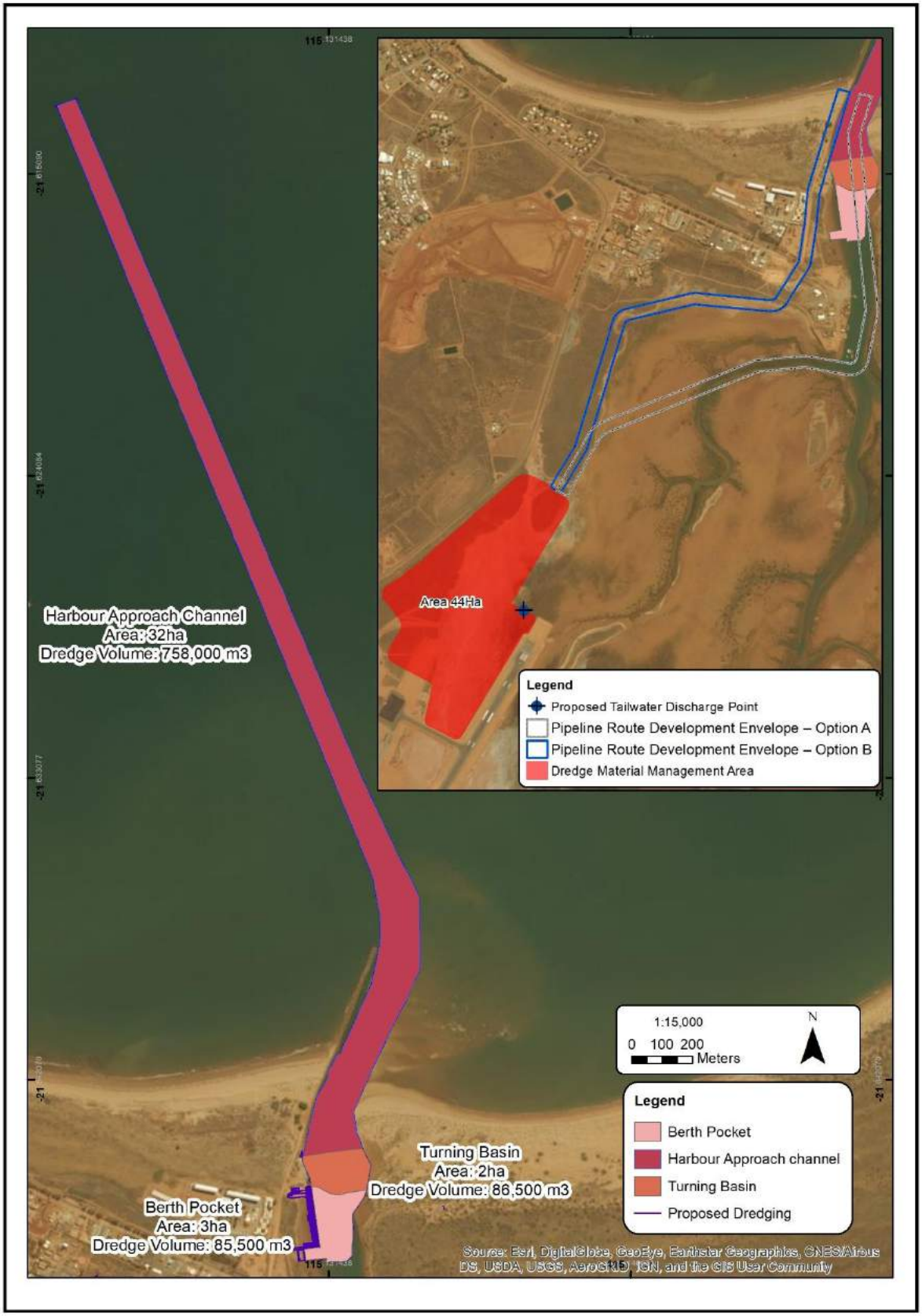

Figure 2 OMSB Stage 2 project area, including proposed capital dredging area and spoil disposal locations

3. Sawfish Risk Assessment

The risk assessment was undertaken for specific project activities (i.e. 'Stressors'). The risk assessment utilised the Risk Matrix[1] shown in **Figure 3**. This matrix evaluates the risk rating as a combination of the consequence of an impact, and the likelihood of that consequence occurring. It is important to note consequences have been evaluated on a Sawfish population basis for consideration of environmental risk. The risk evaluation includes identification and description of the project specific stressors, description of the potential impact on Sawfish, review of what is known and identification of proposed management and mitigation. The risk evaluation then considers what management and monitoring may be applied to mitigate the risk and the residual risk is ranked.

Review of the potential impacts to Sawfish and discussions with Dr Morgan identified the following project risks to Sawfish:

- Turbidity generated from dredging activities;
- Injury or mortality of Sawfish by cutter head during dredging;
- Underwater noise generated from dredging or piling;
- Direct loss of critical habitat;
- Indirect loss of critical habitat; and
- Pollution.

The risk assessment is presented in **Table 2**.

3.1. Risk Assessment Summary

The risk assessment enabled potential risks to be categorised in terms of their relative importance or concern and identification of priorities for monitoring, management and reporting. The risks of the OMSB Project activities to Sawfish populations in the north-west of Western Australia were determined to be low. Research has not previously been undertaken on the presence of Sawfish in Beadon Creek. Whilst the review suggests Sawfish are likely to be present, the preference of juvenile Green Sawfish for extremely shallow water habitat at the mouth of creeks suggests Beadon Creek is not likely to provide ideal habitat due to the historically modified nature of the mouth of the creek for use as harbour facilities when comparing the potential Sawfish populations in Beadon Creek to those recorded during recent investigations within adjacent creeks to the west. It is also likely that the distribution of Sawfish is not limited to this area and may opt preference for more suitable habitat within additional creeks to the east and further west. Consideration was also given to there being no records of negative impacts to Sawfish during previous dredging operations undertaken within Beadon Creek. Project risks to Sawfish are typically likely to be temporary during dredging activities, of which Sawfish are likely to avoid, and critical habitat is widely distributed in adjacent creeks along the West Pilbara coast for refuge during this time. The consequence was typically classified as minor or insignificant based on the likely impact to populations of Sawfish in the north-west of Australia.

Mitigation measures to prevent impacts to Sawfish are limited due to not being able to observe their presence and implement exclusion zones as is typically applied to protect other marine megafauna during construction projects. However, the risks are perceived to be relatively minor due to the small to moderate size of the cutter suction dredge, which is similar to dredgers previously used by the DoT for historical dredging programs in Beadon Creek.

[1] Risk matrix adapted from Pilbara Ports Authority Hazard Management Procedure (PPA 2016)

Turbidity

Sawfish, including Green Sawfish, live in naturally turbid (i.e. creek/rivers) or low light (i.e. below the photic zone) environments and have sensory adaptations for detecting and capturing prey. Reference to Sawfish leaving the Ashburton River during flood events in the review describes periods when turbidity levels were 3,300 NTU, and during periods between these events turbidity remains relatively stable and low describes concentrations less than 200 NTU (URS 2010). Therefore, these environments are naturally turbid. As alluded to in the review, it is also more than likely that tolerance to low salinity levels is the primary influential physical change that causes movement of Sawfish from the rivers and creeks during flood events. It is anticipated that Sawfish can actively avoid plumes generated from dredging activity if it is likely to reduce their success when hunting.

Cutter-Head Injury or Mortality

There are no known records of previous dredging undertaken within Beadon Creek to cause injury or mortality to Sawfish. It is anticipated that Sawfish will actively avoid a noisy-slow moving dredge. However, a soft start-up procedure has been recommended for each new or re-start operation which will involve running the dredge for a few minutes to haze Sawfish from the area prior to the commencement of dredging. The construction crew should be trained in the identification of Sawfish in the event of an encounter the cutter head so they can report any impacts to the Department of Parks and Wildlife and DoF.

Underwater Noise

The potential effects of pile driving underwater noise risks on Sawfish for the OMSB Project have effectively been eliminated through the selection of preference to use anchored navigation markers for the harbour entrance channel. This eliminates the highest noise risks to Sawfish for the OMSB Project. CEDA (2011) reviewed expected impacts of dredging on marine fauna and concluded that it is very unlikely that underwater sound from dredging operations can cause injury. Casper (2006) identified that while elasmobranchs can detect sounds, they do not have sensitive hearing compared to other marine animals or the ability to detect most natural sounds they encounter in the far field. As behavioural impacts from underwater noise would be temporary and only occur at close range to the dredge operations the potential unmitigated impacts on Sawfish are therefore likely to be negligible. As described above, a soft start-up procedure would assist to haze Sawfish from the area prior to the commencement of dredging.

Direct Habitat Loss

The proposal for the OMSB Project includes plans for deepening and widening the channel, turning circle and berth pocket. The berth pocket already occurs on the modified western bank of the creek, although the east bank and the mouth of the creek are planned to be dredged to create a larger turning circle and the channel will be widened. There is potential that the removal of shallow water habitat may result in loss of a continuum of critical juvenile Sawfish habitat that currently exists. Dr Morgan provided a recommendation to undertake an assessment of the existing and proposed shallow water habitats within Beadon Creek. An image of the existing shallow water habitat for juvenile Sawfish within Beadon Creek is provided in **Figure 4**. The Figure shows that due to historical dredging of Beadon Creek the only remaining existing shallow water habitat for juvenile Sawfish is a very narrow strip along the edge of the east bank. Therefore, critical shallow water habitats near the mouth of the creek have already been removed from Beadon Creek. The proposed design for the slope of the channel also leaves a narrow strip along the edge of the east bank from the turning circle to the mouth of the creek (**Attachment B)**. Therefore, there are no major changes to the continuity of existing shallow water habitat for juvenile Sawfish within the mouth of Beadon Creek from the proposed design. Standard techniques for dredging accuracy such as dredge positioning technology and hydrographic surveys will be applied to ensure the dredging program is implemented as designed.

Indirect Habitat Loss

Depth of the channel will be modified near the mouth of Beadon Creek and a tidal lagoon will be modified to create the turning circle. These modifications to the bathymetry and creek width have the potential to change hydrodynamic regimes and water level or water residence times further upstream, resulting in loss of key mangrove habitats. Comprehensive hydrodynamic modelling of the proposed design for Beadon

Creek has been investigated and the study estimates that there will be negligible changes to water level submergence times and current velocities in the upper parts of Beadon Creek. Modelling indicates current velocities will reduce significantly through the entrance channel from deepening and widening the channel (Baird 2017). Therefore, there is unlikely to be any change in tidal inundation of intertidal areas upstream or subsequent shifts in shallow mangrove communities, and erosion of the east bank and subsequent loss of mangrove habitat in this area is not expected (O2 Marine 2017). Any changes to the creek banks and loss of mangrove habitats will be detectable in future aerial survey photographs which are collected regularly by the DoT and Shire of Ashburton.

Pollution

With the use of various hydrocarbons on site, including fuel, oil and lubricants for the dredge and support vessels, there will be a risk of hydrocarbon spillage to the marine environment. Release of waste material can adversely impact on the Sawfish through toxic effects, entanglement, suffocation and ingestion of wastes. These wastes may include solid wastes, hazardous wastes and sewage and grey water.

All hazardous substances on site must be appropriately stored such that they do not pose a threat to the health and safety of personnel and the environment. All necessary material for mitigation of accidental spillage of hydrocarbons should be kept onsite at all times. All Contractors will work to the required refuelling management plans reviewed and approved by DoT, and in accordance with the refuelling policy for DoT maritime facilities. In the event of accidental spillage, the Contractor should cease work immediately and ensure contamination is cleaned up prior to recommencing. A comprehensive environmental incident report will then be completed and provided to the DoT.

Waste management will be implemented in accordance with contractor management plans. Wastes will be segregated and secured to avoid the potential for wind-blown wastes entering the marine environment or terrestrial areas of Beadon Creek.

Environmental Impacts		CONSEQUENCE				
		Insignificant	Minor	Moderate	Major	Catastrophic
		Negligible impact to biota and ecosystems (less than 1 year). Negligible impact to cultural features	Minor impact (up to 1 year) to biota and ecosystems. Minor / repairable impacts to cultural features. Regulatory notice	Moderate impact (up to 2 years) to biota & ecosystems.Moderate impact to cultural features of low significance. Regulatory notice and investigation.	Major impacts (up to 10 years) to biota, ecosystems or environmental harm. Extensive impacts to cultural features of significance. Regulatory fine/prosecution and/or warning.	Significant impacts to biota, ecosystems or environmental harm - Impact Persistence >10 years. Impacts resulting in significant or total loss of cultural features of high significance and/or items of National Heritage Value. Loss of licence/prosecution and/or fine
LIKELIHOOD	**Almost Certain** Has occurred frequently at the location and in the Company. Almost certain to occur during the next year	MOD	HIGH	HIGH	EXT	EXT
	Likely Has occurred frequently in the Company. Likely to occur in the next 2 years	MOD	MOD	HIGH	HIGH	EXT
	Possible Has occurred once or twice in the Company. May occur within 5 years	LOW	MOD	HIGH	HIGH	HIGH
	Unlikely Has occurred in Industry but not in the Company. May occur within the next 10 to 20 years.	LOW	LOW	MOD	MOD	HIGH
	Rare Almost unheard of in the Industry. May occur within the next 20 to 50 years	LOW	LOW	MOD	MOD	HIGH

Figure 3 Risk matrix[2] used for a risk-based approach to identification and significance of the potential risks to Sawfish for the OMSB Project

[2] Risk matrix adapted from Pilbara Ports Authority Hazard Management Procedure (PPA 2016)

Table 2 Risk assessment of the potential OMSB Project impacts on Sawfish

Stressor	Activity	Sawfish Impact	What is known	Risk Rating			Management	Monitoring	Residual Risk Rating		
				Likelihood	Consequence	Risk Rating			Likelihood	Consequence	Risk Rating
Turbidity	Dredging	Altered distribution of Sawfish due to avoidance of area (Temporary)	Green Sawfish least adapted species to sensory feeding Live in naturally turbid or dark waters. Avoid Ashburton River during periods of runoff discharge & low salinity /high turbidity	Possible	Insignificant	**Low**	Small to moderate size dredge		Possible	Insignificant	**Low**
Dredging	Dredging	Cutter head injury or mortality to individuals	Green Sawfish are likely to be most abundant at the mouth of the creek during high tides in shallow waters	Unlikely	Moderate	**Moderate**	Small to moderate size dredge; Soft start-up	Construction crew trained in Sawfish identification Report evidence of injured/deceased Sawfish to DPAW & DoF	Unlikely	Minor	**Low**
Noise	Dredging/ Pile Driving	Altered distribution of Sawfish due to avoidance of area (Temporary)	Elasmobranchs have narrow hearing ranges and are known to be sensitive to very low frequencies, which overlaps with anthropogenic sound produced by dredging.	Possible	Insignificant	**Moderate**	Small to moderate size dredge Soft start-up Industry standards Replace 'piled' for 'anchored' navigation markers	Regular maintenance	Unlikely	Insignificant	**Low**

Stressor	Activity	Sawfish Impact	What is known	Risk Rating			Management	Monitoring	Residual Risk Rating		
				Likelihood	Consequence	Risk Rating			Likelihood	Consequence	Risk Rating
Habitat loss (Direct)	Dredging	Permanent reduction in critical habitat/ shift in Sawfish presence in creek	Sawfish <1 year of age occupy extremely shallow water (<1 m) >95% of the time near mouth of creek Beadon Creek modified habitat Widespread habitat availability in area	Likely	Minor	**Moderate**	Channel design retains shallow water habitat along east bank of creek Dredge positioning systems	Hydrographic surveys to assess the reduction in shallow water habitat	Unlikely	Minor	**Low**
Habitat loss (Indirect)	Dredging	Changes to creek bathymetry/ hydrology & erosion of upstream habitats/ shift in Sawfish presence in creek	Sawfish <1 year of age occupy extremely shallow water (<1 m) >95% of the time near mouth of creek Beadon Creek modified habitat Widespread habitat availability in area	Possible	Minor	**Moderate**	Channel design to minimise potential for upstream erosion. Model changes to creek hydrology & upstream water levels	Future aerial surveys of Beadon Creek (DoT/Shire)	Rare	Minor	**Low**
Pollution	Refueling/ solid waste disposal	Injury or mortality from chemicals and waste	Toxic effects of pollution, migration of habitat, possible entanglement, suffocation, and ingestion of wastes	Unlikely	Moderate	**Moderate**	Contractor management plans/ OMSB Information Handbook Spill kits	DoT Compliance	Rare	Minor	**Low**

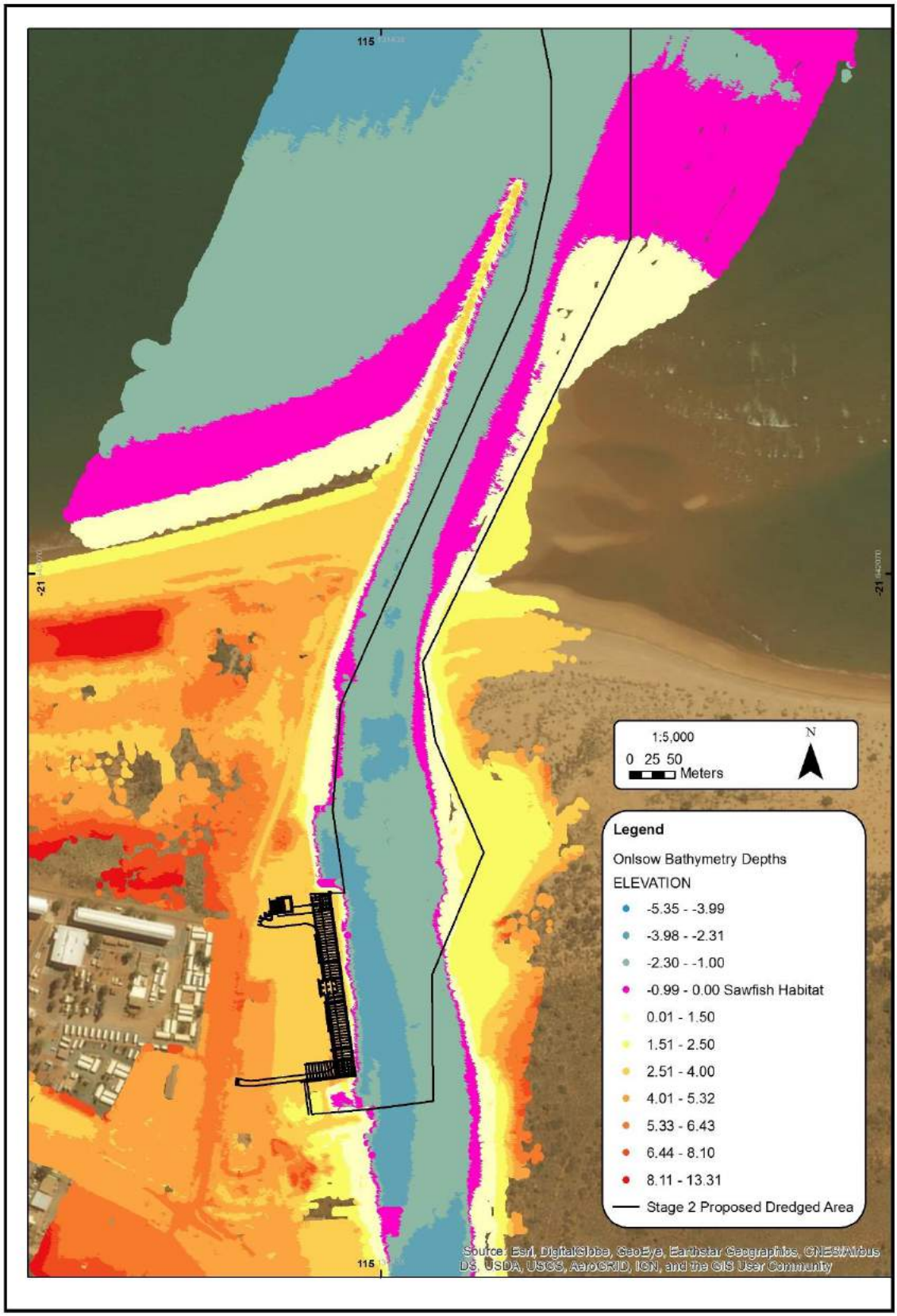

Figure 4 Existing shallow water habitat near the mouth of Beadon Creek preferred by juvenile Sawfish

4. Conclusion

All risks to Sawfish evaluated from OMSB Project activities, with considered management and monitoring mitigations introduced to reduce either the likelihood or the consequence of that risk, have been allocated a risk rating of 'Low'. It is therefore considered that the OMSB Project is unlikely to have a significant impact on protected Sawfish. Based on the findings of this evaluation, it is proposed that approval from the Australian Government Minister for the Environment under the EPBC Act (1999), the Minister of Fisheries under the FRMA (1994), or the State Government Minister for Environment under the WCA (1950), is not required.

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Attachment 1 Independent Review: Potential Impacts to Sawfish

Onslow Marine Support Base Project

Potential Impacts to sawfish

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April 2017

Centre for Fish and Fisheries Research

Murdoch UNIVERSITY

Background

The Onslow Marine Support Base Pty Ltd (OMSB) is planning to modify and extend the harbour approach channel, turning circle and berth pockets as part of Stage 2 of the Onslow Marine Support Base Project (herein the OMSB Project). The proposed capital dredging includes a berth pocket to -8.0 m CD, and turning basin and channel to -6 m CD. The total volume of dredging is anticipated to be 1.06 Million cubic metres and it is expected that dredging will be undertaken using a medium sized cutter suction dredge.

During a pre-referral meeting with the Environmental Protection Authority (EPA) for the OMSB Project the EPA requested an assessment of the potential impacts on sawfish species to be included with a referral submission. Northern Australia boasts four of the world's five sawfish species, and each is listed as either *Critically Endangered* or *Endangered* at the international level (IUCN Red List), with each having a population trend that is decreasing (see Dulvy *et al.* 2016). Within Australian waters, the three species that belong to the genus *Pristis* are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) as *Vulnerable*, while all species are fully protected in Western Australian waters under the *Fish Resources Management Act 1994*, with the Green Sawfish (*Pristis zijsron*) listed as Schedule 3 (Fauna that is rare or likely to become extinct as vulnerable fauna) under the *Wildlife Conservation Act 1950.*

Sawfish in the vicinity of Onslow

Three species of sawfish are known from the Onslow area, including the Green Sawfish (*P. zijsron*), the Freshwater Sawfish (*Pristis pristis*) and the Narrow Sawfish (*Anoxypristis cuspidata*). The first two species were detected during targeted sawfish sampling in 2011, and the latter via the presence of rostra (saws) in collections in the town (Morgan *et al*. 2012, 2015). Until recently, the life-cycles of each were unknown. Freshwater Sawfish are essentially diadromous, with the pups born in the estuary and migrating into freshwaters where they remain for about 5 years before leaving the river to attain maturity (Morgan *et al*. 2011). Data on Green Sawfish are limited, but in the Onslow area, they are known to be pupped near the Ashburton River mouth, where they have a high site fidelity for at least 3 to 6 months (Morgan *et al*. 2015). Older juveniles utilise the Ashburton River estuary and nearby mangrove creeks, before moving offshore to mature at a length of about 3 m. Limited data is available for the Narrow Sawfish in WA waters. Phillips *et al*. (2016) suggested that male and female gene flow of Green Sawfish is restricted at large spatial scales in Australian waters, with those of the west coast significantly different to those elsewhere.

Sawfish Susceptibility to Pressures

Sawfish are arguably the most threatened of all fish (Dulvy *et al*. 2016), due to their low intrinsic rates of population increase owing to their late age at maturity and low fecundity, their susceptibility and high catchability in fisheries, high value of fins and their rostra are taken as curios. Their unique rostrum (or saw) renders them highly susceptible to entanglement in fishing nets, and they occupy shallow coastal habitats where interactions with humans and habitat loss is high (Whitty *et al.* 2014; *Dulvy et al*. 2016). Although the size at birth of all species is around 60-80 cm, the maximum length of at least two species (Green Sawfish and Freshwater Sawfish) is believed to be over 6 m, with these two species living for up to 50 years. The third species in the Onslow area, the Narrow Sawfish is thought to have a maximum size of around 3.5 m and is relatively short-lived (<10 years). All species are impacted by gill net fisheries, one of the major reasons for the global decline in extent of occurrence of between 30 and 60% for Green, Freshwater and Narrow Sawfish.

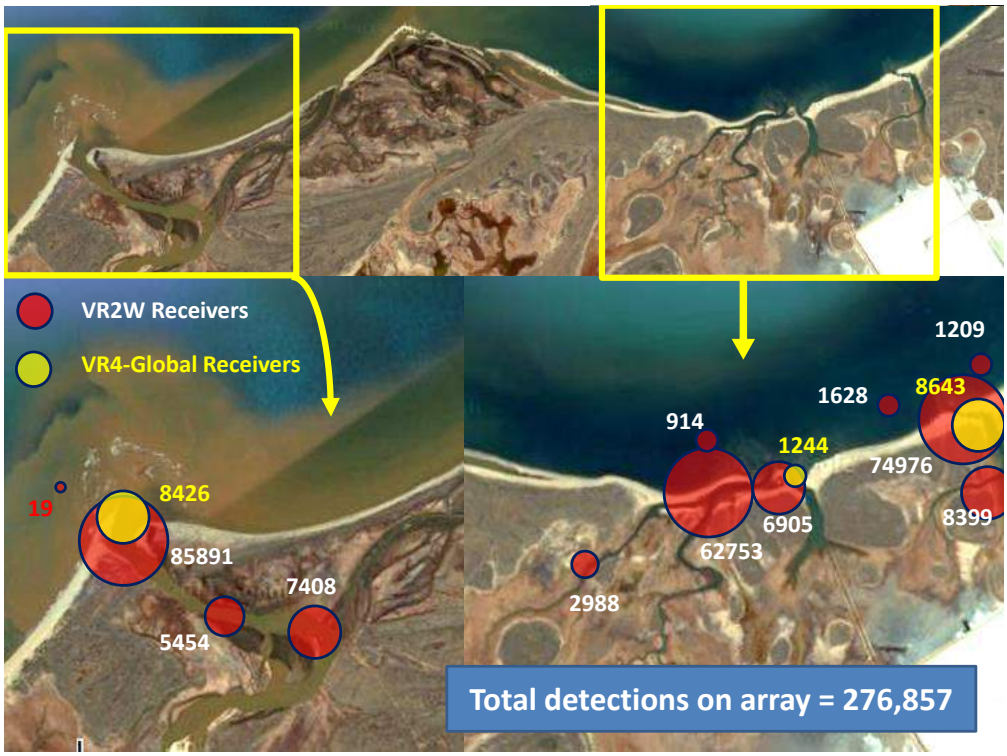
(Top left), Green Sawfish and Narrow Sawfish rostra in collections in Onslow; (top right), a Freshwater Sawfish captured in the Ashburton River mouth; (bottom), a Green Sawfish captured in the Ashburton River mouth.

Habitat use and abundance of sawfish in the Onslow area

A recent study demonstrated that sawfish habitat use in the Onslow area is comparatively high, particularly with regard to Green Sawfish (Morgan *et al*. 2015). The Ashburton River Delta is a known pupping site for Green Sawfish, where pups spend at least their first few months of life, before utilising other coastal mangrove-lined tidal creeks, such as Hooleys Creek and Four Mile Creek. A study of 37 acoustically tagged Green Sawfish (total length between 77 and 293 cm), monitored via a series of acoustic receivers, revealed that home range increases with age/size, and that the above habitats are utilised by individuals up to 3 m in total length (Morgan *et al*. 2012, unpublished data). The receivers in the mouths of each of these sites had the highest number of detections compared to nearshore habitats and upstream habitats. Some individuals were recorded to use these habitats for up to 344 continuous days. These 37 tagged Green Sawfish were detected on almost 300,000 occasions over a period of 514 days. Of these individuals, 29, 14 and 9 were detected in the Ashburton River mouth, Hooleys Creek and Four Mile Creek, respectively. Further, two Freshwater Sawfish were captured in the Ashburton River mouth during high discharge periods.

There has been no targeted sampling for sawfish in Beadon Creek. During the above study, a recently removed Green Sawfish rostrum was found at Beadon Creek, suggesting that the individual was captured there. Based on the results of the acoustic study, it is also suggested that the mouth of

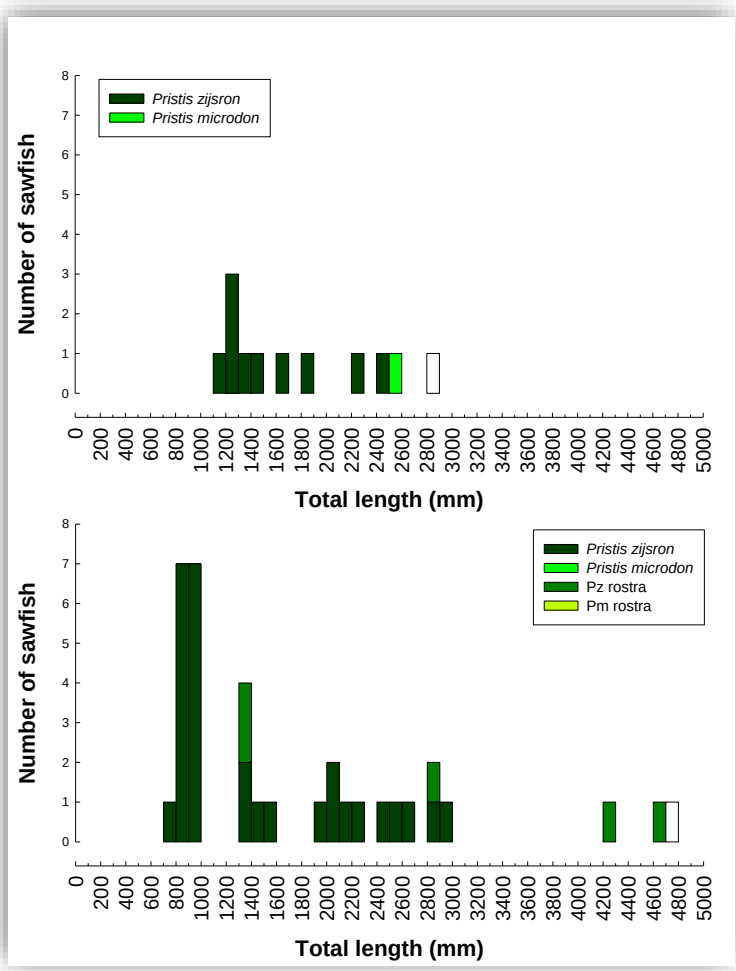
Beadon Creek is likely to be visited by larger (1+ year old) individual Green Sawfish on a regular basis, particularly during periods of high freshwater discharge, when Green Sawfish leave and are absent from the Ashburton River mouth. For example, Morgan *et al*. (2012) detected acoustically-tagged Green Sawfish moving along the coast north of Four Mile Creek on 1209 occasions between April 2011 and April 2013 using an acoustic array, and it is thus perceivable that at least some of these individuals may have passed Beadon Creek, or perhaps entered the mouth of the creek.



Number of detections of sawfish throughout the Onslow area using passive acoustic telemetry; left – Ashburton River, right – Hooleys Creek and Four Mile Creek (from Morgan et al. 2012)

Behavioural characteristics of sawfish in the Onslow region

Previous research on sawfish movements in the Onslow area strongly suggest that their movement is driven by tide and time of the day. For example, movement was generally in the direction of tidal flow, with >90% of detections between two receivers in the direction of tidal flow in Four Mile Creek, and >60% of movements to and from Hooleys Creek in the direction of tidal flow. The greatest number of detections of Green Sawfish in these locations occurred between 18:00 and 08:59 h. The number of Green Sawfish detections were highest outside of the mouths of these creeks during low tides than high tides; and detections inside the mouths of these creeks were highest during high tides. The increased activity around and just after dusk is likely to be representative of an increase in foraging. There is some ontogenetic depth partitioning of Green Sawfish in the Onslow region (Four Mile Creek, Hooley Creek, Ashburton delta), with neonates occupying the extreme shallows, and deeper habitats are utilised with increasing size.



Size of two species of sawfish captured in the Onslow coastal habitats during 2011 (from Morgan et al. 2011); including rostra in private collections in the town, whereby the total lengths were extrapolated from known relationships between the size of the rostrum compared to the total length of the species

Potential impacts of dredging and re-alignment of littoral zones

Although sawfish have not been recorded in Beadon Creek, the study by Morgan *et al*. (2012) detected acoustically-tagged Green Sawfish moving along the coast north of Four Mile Creek on 1209 occasions between April 2011 and April 2013 using an acoustic array. It is therefore more than possible that at least some of these individuals continued past, or into, Beadon Creek. The exact nature and extent of the potential impacts that dredging will have on sawfish populations in this area are speculative as there is no sawfish data available for Beadon Creek and there have been no previous studies on the impact of increased turbidity or dredging on any sawfish species. The potential impacts on sawfish for the duration of the dredging program include disruption of migration routes and movement patterns through avoidance of areas of increased turbidity, changes in prey availability, reduced success of foraging and hunting behaviour of resident sawfish. There is increasing literature to suggest that habitat loss and degradation from port developments and diffuse pollution can impact sawfish and dredging may temporarily impact or alter sawfish habitats (Minerals Management Service 2003). The impact of commercial fishing is likely to be the key cause

of the global decline of sawfish (Dulvy *et al*. 2016), but loss of coastal habitats is another factor. Increased turbidity has the potential to alter prey and impact visible hunting techniques; although sawfish sensory capability of the rostrum for detecting and capturing prey varies between species (Wueringer et al. 2011a, b). The cessation of detections of Green Sawfish in the Ashburton River during high freshwater discharge was likely to be a result of the movement of individuals out of the estuary and into nearshore marine waters, suggesting that the low salinity waters do not provide favourable conditions for the species. However following flooding, the river and estuary experiences very high short-term turbidity, conversely, in the periods between flow events, the waters are characterised by comparably low turbidity (Chevron Australia Pty Ltd 2010). Elasmobranchs rely on a number of senses while foraging, from early prey detection, tracking, orientation to, and capture of the prey (Gardiner et al. 2014). Preliminary data suggest that Green Sawfish possess the least intricate lateral line system (used for mechanoreception of prey, orientation and predator avoidance) of all four Australian sawfishes (Wueringer *et al*. 2011a). Green Sawfish have a much lower number of ampullae of Lorenzini (a close range sensory system) on both the ventral and dorsal surface of the head compared to Freshwater Sawfish, which is an electroreception specialist in turbid estuaries and freshwaters (Wueringer et al. 2011b). Thus, the absence of acoustic detections from the Ashburton River estuary and Hooley Creek during flooding, may have been an avoidance of the highly turbid waters, which may have reduced feeding efficiency, and increased predation risk.

Noise from piling is known to cause behavioural disturbance in marine fauna, and is likely to cause stress to fishes and impact predator-prey relationships (Bailey *et al*. 2010, Slabbekoorn *et al*. 2010).

Recommendations for dredging program

Review of recent studies undertaken in the Onslow region indicate sawfish are likely to occur within Beadon Creek or in adjacent coastal waters. Therefore, the following management/mitigation measures are recommended:

- Use small to moderate size dredge to reduce the broad dispersion of very high turbidity and limit the potential for maceration of sawfish. However, sawfish are likely to move away from the site during dredging.
- Underwater noise from piling activities should be managed through a soft start-up approach with progressively increasing hammer energy to alert sawfish of impending noise increase. Optimal periods for piling activities would be during daylight hours when sawfish activity is lowest.
- Undertake an assessment of the connectivity of shallow water habitat along eastern bank of Beadon Creek to compare the continuity of existing habitat for juvenile sawfish to validate habitat will be present in the proposed design.

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Attachment 2 Shallow Water Habitat of the Proposed Channel Design

LEGEND

- 0-1m WATER DEPTH @ LAT (0.09mCD)
- 0-1m WATER DEPTH @ MLWS (0.65mCD)
- 0-1m WATER DEPTH @ MSL (1.57mCD)

DATUM COMPARISON

	CD	AHD
HAT	+3.07m	+1.58m
MHWS	+2.48m	+0.99m
MHWN	+1.84m	+0.35m
MSL	+1.57m	+0.08m
AHD	+1.47m	+0.00m
MLWN	+1.29m	-0.20m
MLWS	+0.65m	-0.84m
LAT	+0.09m	-1.40m

CHECK PRINT: DATE: CHECKED:

PLAN

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SCALE BAR (m)

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

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ONSLOW MARINE SUPPORT BASE (OMSB)

BEADON CREEK, ONSLOW

CAPITAL DREDGE & NAV AIDS

0-1m WATER DEPTH (SAWFISH)

A1

DRAWING NUMBER

Job Number APH170162 Sheet No. SK-08 Rev. A

Design WB Drawn WB

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Appendix G Earth Stewardship Level 2 Flora and Vegetation Survey

Earth Stewardship

Onslow Marine Support Base:

Dredge Material Management Area and Pipeline – Botanical Survey

October 2017

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Document Status

Revision	Author(s)	Reviewer	Date	Approved for Issue	Distributed To	Date
A – Draft	J Foster	K Foster	26/10/2017			

Contents

1 Project Background - Onslow Marine Support Base

Onslow Marine Support Base Pty Ltd (the Proponent) is proposing to modify and extend the Beadon Creek harbour approach channel, Turning Basin and Berth Pocket as part of Stage 2 of the Onslow Marine Support Base (OMSB) Proposal. The proposed capital dredging will enable offshore supply vessels to access the newly-constructed OMSB land-backed wharf facility within the Department of Transport (DoT) managed Beadon Creek Maritime Facility. Dredge material will be disposed of onshore (via a pipeline) to a 44 hectare (ha) Dredge Material Management Area (DMMA) adjacent to the Onslow Airport and owned by the Shire of Ashburton. The material is proposed for future reuse to develop and extend the Light Industrial Area in Onslow. Dredge spoil return water will be released to the intertidal flats between the DMMA and the western tributary of Beadon Creek.

1.1 Purpose of the Report

As part of the development proposal a Public Environmental Review was completed by WA Marine Pty Ltd (hereby referred to as O2 Marine) (O2 Marine, 2017) and submitted to the Environmental Protection Authority (EPA) for review. As a result of the review, the EPA requested additional clarification as follows:

> "Further information on flora and vegetation is required to enable the assessment of the potential impacts of the proposal. This would include Level 2 flora and vegetation surveys in accordance with the standards of Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, December 2016). A detailed description and figure(s) of the proposed clearing and impacts associated with the proposal, details of proposed management measures, and identification of any residual impacts from the proposal on flora and vegetation, both direct and indirect, after considering and applying avoidance and minimisation measures would be required." (C. Lane, pers. comm. 17 October 2017))

1.2 Scope of Works

Earth Stewardship was engaged to provide additional information to support a response to the EPA's request for additional clarification on the vegetation and flora of the DMMA and associated pipeline route. Collectively, these areas comprise the study area. The scope of works undertaken included:

- Desktop reviews of existing information;
- Site visit comprising:
  - Vegetation (type and condition) surveys of the proposed impact area and associated pipelines;
  - Targeted surveys for conservation significant flora (e.g. Priority 3 *Eleocharis papillosa*);
  - Opportunistic flora surveys; and
- Production of a short report detailing outcomes of desktop reviews, botanical surveys and recommendations.

2 Methodology

2.1 Desktop Review

Prior to the commencement of the field survey, a desktop review was undertaken to identity botanical information relevant to the study area and to assist in survey design. This included a review of:

- The Department of the Environment and Energy (DotEE) Protected Matters Search Tool (PMST) to identify communities and flora taxa listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the study area (DotEE, 2017) (Appendix A);
- The *NatureMap* database records within 20 km of the study area for listed Threatened and Priority Ecological Communities, vegetation associations recorded, and conservation significant flora taxa comprising:
    - Populations listed on the Threatened (Rare) and Priority Flora (TPFL) database; and
    - Specimens of Threatened and Priority flora previously collected, lodged and databased within the Department of Biodiversity, Conservation and Attractions' (DBCA) Western Australian Herbarium (Appendix A); and
- Existing reports (where available) to provide background information on the variability of the environment, likely vegetation units and to identify areas with potential to contain significant communities and taxa.

2.2 Field Survey

A single season comprehensive vegetation and flora assessment of the survey area was conducted by botanist Joshua Foster (SL012114) from the 19 – 21 October 2017. The field survey was undertaken to ground-truth the results of the desktop review, identify and describe the dominant vegetation units, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant flora taxa were also undertaken.

The survey methodology employed for the survey was undertaken with reference to the EPA (2016) *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* and the EPA (2004) *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*.

2.2.1 Collection of Data

Survey methods involved the sampling of quadrats located in identified vegetation units, wandering transects, and relevés. The study area was traversed on foot. Three quadrats were described within the study area, supplemented by two wandering transects, and seven relevés. The location of quadrats was based on the aerial photography, with transects and relevés selected *in situ*, based on observations of vegetation types during the field assessment.

Non-permanent quadrats (measuring 30 m x 30 m) were located within the larger identified vegetation type. Where the ecotone was narrow (less than five metres wide), wandering transects were used to describe the vegetation. Field data for each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Quadrat data are provided in Appendix B.

Table 1: Data collected during the field surveys

Aspect	Measurement
Collection Attributes	Personnel/recorder; survey date, quadrat dimensions, photograph of the quadrat.
Physical Features	Aspect, soil attributes, ground surface cover, leaf and wood litter.
Location	Co-ordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.
Vegetation Condition	Vegetation condition was assessed using the condition rating scale as adopted by the EPA (2016).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora Taxa	List of dominant flora from each structural layer. List of all species within the quadrat including average height and cover (using a modified Braun-Blanquet scale).

2.2.2 Vegetation Types

Vegetation types were identified and boundaries delineated using a combination of aerial photography, topographical features and field observations.

Vegetation types were described based on structure, dominant taxa and cover characteristics as defined by quadrat, wandering transect and relevé observations. Vegetation type descriptions follow the National Vegetation Inventory System (NVIS) and are consistent with NVIS Level V (Association). At Level V, three (or occasionally more) taxa per stratum are used to describe the association (ESCAVI, 2003). The mapping of vegetation types has been undertaken at a scale suitable for this project.

2.2.3 Vegetation Condition

The vegetation condition of the study area was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean Botanical Provinces (EPA, 2016). The scale recognises the intactness of vegetation and consists of six rating levels.

2.2.4 Flora Identification and Nomenclature

A flora inventory was compiled from taxa recorded in the quadrats, wandering transects, relevés and from opportunistic records made throughout the study area.

Flora taxa well known to the botanist were identified in the field. Other taxa were collected and assigned a unique collection number to facilitate tracking, where required. All plant specimens collected during the field assessment were dried and processed in accordance with the requirements of the Western Australian Herbarium. Specimens collected were identified by the use of taxonomic literature, electronic keys and online electronic databases. Where necessary, plant taxonomists considered to be authorities on particular plant groups were consulted.

The conservation status of all recorded flora taxa was compared against the current lists available on *FloraBase* (DBCA, 2017), the Government Gazette: Wildlife Conservation (Rare Flora Notice) (Government of Western Australia, 2017) and the EPBC Act List of Threatened Flora (DotEE, 2017). Nomenclature used in this report follows that used by the Western Australian Herbarium.

2.2.5 Surveys for Conservation Significant Flora

Prior to the field survey, information from the desktop review was assessed determine the potential for conservation significant flora taxa to be present within the study area. The EPA request for additional information included a request to search for the Priority 3 *Eleocharis papillosa* (C. Lane 17 October 2017, pers. comm.), known to occur approximately 16 km south of the study area.

Habitat with the potential to support conservation significant flora were searched. Locations within the study area with differing hydrology, fire or disturbance history to the surrounding areas were also searched, where identified.

When any known or potential conservation significant flora was located, the following data was collected: GPS location, height, estimate of number of plants and corresponding area of population, reproductive state and plant condition. This information is supplied in the DBCA's Threatened and Priority Reporting Form (Appendix C).

2.3 Limitations

The services undertaken by Earth Stewardship in connection with preparing this report were limited to those specifically detailed in the report and are subject to the limitations set out in the report. 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 (including flora taxa listings).

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of conservation significant taxa. As such, this may not represent actual records of the taxa within the study area. The records from *NatureMap* (including the TPFL and Western Australian Herbarium databases) provide more accurate information for the study area and surrounds. However, some of these collections or records may not be accurately dated and may misrepresent the current range of significant taxa.

The EPA (2016) Technical Guide states that vegetation and reports in Western Australia should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 2.

Table 2: Survey Limitations

Aspect	Constraint	Comment
Sources of desktop information and availability of additional broader scale information	Minor	Adequate information is available for the study area and surrounding locale, this includes and is summarised in: • O2 Marine (2017) Onslow Marine Support Base: Stage 2: Capital Dredging – Environmental Review Document (and associated appendices).
Scope of survey (i.e. what life forms were sampled)	Nil	Vascular flora taxa were sampled during the survey. Non-vascular flora taxa were not assessed as part of survey.

Aspect	Constraint	Comment
Proportion of flora collected and identified (based on sampling, timing and intensity).	Minor	The vegetation and flora survey was undertaken from 19 to 21 October 2017. The flora taxa recorded from the field survey is examined further and a full flora list is provided in Appendix B. Flora identification was undertaken by Joshua Foster in the field and utilising specimen records of the Western Australian Herbarium. Two taxa could only be identified to genus due to lack of flowering and fruiting material required for identification. These taxa showed no resemblance to any conservation significant flora identified in the desktop assessment. Some species, particularly annual flora, may have been overlooked due to lack of material. This may have resulted in a lower than expected inventory of flora. The results of the survey indicate that there are unlikely to be any taxa of conservation significance present (beyond that recorded during the survey) within the study area.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed).	Nil	The study area was traversed extensively on foot. Information gained from the survey was extrapolated across those small sections of the study area not traversed to assist with determining the vegetation types for the entire study area. Habitats considered to support conservation significant flora were considered to be adequately surveyed. The average flora taxa richness of 15.3 taxa per quadrat ± 1.15 is considered to be comparable to the surveys completed by ENV (2011) as part of the Onslow Townsite Strategy. The average richness in ENV's surveys was 17.7 taxa per quadrat ± 6.8. This survey occurred out of season (so fewer annuals were recorded), there has been historical disturbance and there is a high presence of introduced species, all of which are considered to have reduced the floristic diversity within the study area.
Mapping reliability	Nil	High resolution aerial imagery was available. Data was recorded in the field using hand-held GPS tools (Garmin GPS). Some atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are considered accurate to within ±5 m on average. Therefore, the data points consisting of coordinates recorded from the GPS may contain inaccuracies.

Aspect	Constraint	Comment
Timing/weather/season/cycle	Moderate	The field survey was conducted in October (Spring). In the three months preceding the field survey (July to September), rainfall recorded at the adjacent Onslow Airport was 2.2 millimetres (mm) which is below the long-term average (LTA) of 30.3 mm over the same months (Bureau of Meteorology (BoM), 2017). The EPA (2016) preference for surveys in the Eremaean botanical province is 6 to 8 weeks post-wet season (i.e. March to June). The botanist conducting the survey has previously surveyed a portion of the study area (a 200 m corridor east of the old Onslow Road alignment) in April 2011 (GHD, 2011). No flora taxa of conservation significance were recorded during the 2011 survey within that area.
Disturbances (e.g. fire, flood, accidental human intervention)	Minor	The majority of the study area has been impacted to some degree by past and current disturbances including clearing, removal of gravel materials, grazing livestock, weed infestation, rubbish dumping, infrastructure development (roads, airport), and off-road vehicular activities. The mudflats are tidal and subject to natural inundation. Cyclonic events have scoured drainage lines and shifted debris.
Intensity and resources (in retrospect, was the intensity adequate)	Nil	The vascular flora of the study area was sampled with reference to the EPA (2016) Technical Guide. The survey was considered to be comprehensive due to the large number of previous surveys occurring within the local Onslow area, which allow for adequate comparison between surveys over a number of different years and seasons. In addition, the botanist has previously surveyed a portion of the study area (April 2011) (GHD, 2011). The study area was sufficiently covered by the botanist (and an assistant) during the survey. Adequate resources were employed during the field survey. The personnel spent two and a half days completing the survey.
Access restrictions	Nil	No access problems were encountered during the survey. The Shire of Ashburton readily provided access to the study area. The study area was readily accessed on foot.
Experience levels	Nil	Joshua Foster (Scientific Flora Collection licence SL012114), is suitably qualified and has over five years' experience conducting surveys in the local Onslow area. He has over 19 years' experience in undertaking ecological surveys within Western Australia.

3 Desktop Review

The O2 Marine (2017) PER includes a detailed and adequate desktop assessment examining:

- Interim Biogeographic Regionalisation of Australia (IBRA) database notes;
- National Vegetation Inventory System (NVIS) mapping;
- EPBC Act Protected Matters Searches;
- Review of DBCA TPFL and Western Australian Herbarium databases for the presence of conservation significant flora; and
- A review of existing local biological surveys that occurred within or adjacent to the study area (where known) to provide local contextual information.

Large-scale regional resource development projects and associated upgrades to Onslow infrastructure (road, electrical and water services) have resulted in a large number of site-specific biological surveys occurring in the Onslow region over the last nine years. These have been reviewed by Biota (2013) and O2 Marine (2017).

Results of database searches and reviews of local botanical surveys have been used to inform this study.

3.1 Vegetation

An updated EPBC Act Protected Matters Search in October 2017 (PMST_9JJPW4) confirmed the assessment that no Commonwealth-listed TECs were reported as occurring or likely to occur within the study area.

Two pre-European vegetation associations are mapped within the study area:

- 127: Bare areas; mudflats
- 676: Succulent steppe; samphire

An area of ocean is also mapped (incorrectly) within the study area.

The current extents (Government of Western Australia (GoWA), 2017) of Association 127 and Association 676 are greater than 95% of the pre-European extent at all scales (e.g. State, IBRA Bioregion, IBRA Sub-region and Local Government Area-LGA) (Table 3). These are both above the 30 per cent threshold level[1].

[1] The 30 per cent threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (EPA, 2000).

Table 3: Vegetation Association extent

Vegetation Association	Scale	Pre-European Extent (ha)	Current Extent (ha)	% Remaining
Carnarvon IBRA Bioregion		8,382,890.36	8,360,801.46	99.74
Cape Range IBRA Sub-region		2,368,970.05	2,356,438.09	99.47
127	State (WA)	737,724.05	697,871.39	94.60
	Carnarvon	102,780.92	101,489.55	98.74
	Cape Range	100,987.52	99,790.74	98.81
	LGA (Shire of Ashburton)	95,314.48	93,097.99	97.67
676	State (WA)	2,063,413.94	1,963,859.13	95.18
	Carnarvon	51,983.51	51,232.57	98.56
	Cape Range	29,193.60	28,442.66	97.43
	LGA (Shire of Ashburton)	45,155.52	44,695.18	98.98

3.2 Flora

The EPBC Act Protected Matters Search in October 2017 (PMST_9JJPW4) confirmed that no Commonwealth-listed conservation significant flora species were reported as occurring or likely to occur within the study area.

Results of TPFL and Western Australian Herbarium database searches (O2 Marine, 2017) indicated that six flora taxa of conservation significance potentially occur within the study area. An additional two taxa were indicated by an interrogation of *NatureMap* to potentially occur within the study area (Table 4).

The EPA requested an assessment of the potential presence of the EPBC Act-listed Vulnerable and DBCA-listed Priority 3 *Eleocharis papillosa* within the study area (C. Lane 17 October 2017, pers. comm.). *Eleocharis papillosa* is known from in a location 16 km south of the study area in a seasonally-wet samphire shrubland. This differs to the tidally-influenced samphire shrublands area present within the study area. As this taxon occurs in seasonally (or episodically) wet marshes and lakes - locations where freshwater pools following rainfall runoff, rather than a tidally-influenced area, this taxon is considered unlikely to occur in the study area, due to a lack of preferred habitat. This taxon was not recorded during the field survey.

NatureMap indicates a possible record of the Priority 1 *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) three kilometres south-east of the study area. The study area supports suitable habitat for this taxon and occurs within the known range of this taxon, and as such it is considered possible that this taxon may be present. The location is considered unreliable as: the record is pre-GPS; and the location is described as "1 km south of Onslow" when Australia only formally adopted the metric system in 1974 (the specimen was collected in 1963). This taxon was not recorded during the field survey.

Table 4: Likelihood of Occurrence Assessment of Conservation Significant Flora Taxa

Taxon Name	Status		Source	Description[1, 2]	Preferred Habitat	Preferred Flowering Time	*NatureMap* Counts	Nearest Record	Within Known Range	Within Known Habitat	Likelihood
	EPBC	DBCA									
Abutilon sp. Onslow (F. Smith s.n. 10/9/61) [was *A. uncinatum*]		P1	O2 Marine (2017)	Prostrate to semi-prostrate shrub to 1 m with dense hairs. Leaves petiolate and orbicular.	Sandplains in grassland of *Triodia lanigera* with *Acacia xiphophylla* overstorey	Fl. Yellow, May to September	11	24 km S of the study area	No	No	Unlikely - Survey Areas outside known range and preferred habitat.
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)		P1	NatureMap	Large shrub to 3 m tall with white appressed stellate hairs. Leaves narrowly ovate to ovate c.50 x 35 mm. Flowers dioecious.	Coastal and near coastal sand dunes, margins of estuaries and coastal plains. Red sand or clay	Fl. Yellow, June to Nov.	41	3.2 km SE of the study area	Yes	Yes	Possible. Record near Onslow is from 1963 and location information may be unreliable.
Indigofera roseola		P1	O2 Marine (2017)	Erect shrub to 1.3 m high, with pinnate leaves 3-5(-7) leaflets with the terminal leaflet sessile.	Red sandy loams of the upper part of sand dunes	Fl. Pink	No records on NatureMap 4 records (Wilson and Rowe, 2015)	120 km S of the study area	No	No	Unlikely - Survey Areas outside known range and preferred habitat.

Taxon Name	Status		Source	Description[1, 2]	Preferred Habitat	Preferred Flowering Time	*NatureMap* Counts	Nearest Record	Within Known Range	Within Known Habitat	Likelihood
	EPBC	DBCA									
Tephrosia rosea var. Port Hedland (A.S. George 1114)		P1	O2 Marine (2017)	Sprawling to upright shrub to 1.7 m, leaves pinnate with 5-7 leaflets.	Coastal. Occurring in sandy areas and along ephemeral sandy rivers, but also from loams in *Triodia* sp. Hummock grasslands and *Acacia stellaticeps* woodland.	Fl. Maroon-purple or pink. August to October	160	15 km N of study area (offshore islands)	Unknown	Yes	Possible - Survey Areas may support suitable habitat. Widespread on offshore islands (after *NatureMap*)
Eleocharis papillosa	Vu	P3	Biota (2013) in O2 Marine (2017)	Annual, herb.	Red clay over granite, open clay flats. Claypans.	Fl. brown, Nov.	10	16 km S of the study area	Yes	No. Biota (2013) indicates that this species occurs in a habitat comprised of samphire shrubland vegetation. The vegetation is seasonally (episodically) inundated lakes and marshes, and not associated with tidal creeks.	Unlikely. Within known range, but preferred habitat is not present in study area.

Taxon Name	Status		Source	Description[1, 2]	Preferred Habitat	Preferred Flowering Time	*NatureMap* Counts	Nearest Record	Within Known Range	Within Known Habitat	Likelihood
	EPBC	DBCA									
Eremophila forrestii subsp. *viridis*		P3	O2 Marine (2017)	Much-branched shrub, up to 2 m high. Leaves oblanceolate, ovate, obovate to orbiculate, 6-35 x 4.2-20 mm long, sparsely clothed in glandular hairs. Leaves deep green.	Variable. Skeletal soils to heavy clays.	Fl. Pale pink-cream, Aug	6	14 km S of the study area	No	No	Unlikely - Survey Areas outside known range and preferred habitat.
Solanum leopoldense		P3	O2 Marine (2017)	Intricate, spreading shrub, 0.5-1 m high.	Sandstone. Rocky gullies and creeklines.	Fl. blue-purple, May to Aug.	35	>1000 km E of study area	No	No	Extremely unlikely – known from Kimberley Region
Stackhousia clementii		P3	*NatureMap*	Dense broom-like perennial, herb, to 0.45 m high.	Sand, cracking clay, gibber plains and gilgai, often associated with limestone flats and ridges	Fl. green/yellow/brown.	133	2.4 km S of study area	Yes	Yes	Recorded – recorded 50 m east of proposed pipeline route. Widespread on offshore islands (after *NatureMap*).
Triumfetta echinata		P3	O2 Marine (2017)	Prostrate shrub, to 0.3 m high.	Red sandy soils. Sand dunes.	Fl. Aug.	7	12.5 km S of study area	Yes	No	Unlikely - Study Area does not support preferred habitat

Where: 1 = FloraBase, 2 = Rare and Priority Plants of the Pilbara (application)

3.3 Previous Surveys

One previous survey not examined by O2 Marine (2017) covers a portion of the study area. This report is not publicly available in its entirety:

- GHD Pty Ltd (2011). Report for Onslow Road: Vegetation and Flora Survey. Prepared for Main Roads Western Australia, September 2011.

The field survey covered a corridor 400 m corridor (200 m either side of the centreline) of the Onslow Road from Beadon Creek Road in the north, to the North West Coastal Highway intersection in the south. As such, a 200 m wide portion of the study area was covered by this assessment.

No conservation significant flora taxa were recorded within the vicinity of the study area from this assessment. The Priority 3 taxa: *Triumfetta echinata* and *Eremophila forrestii* subsp. *forrestii* were recorded at known locations approximately 14 km south of the study area.

4 Field Survey

4.1 Vegetation

Vegetation within the study area is dominated by grasses: *Triodia epactia* and **Cenchrus ciliaris* on the coastal plain and dunes, and *Tecticornia* spp. (samphires) on the tidal mudflats and adjacent beach. Six vegetation types were recorded from the study area (Table 5, Figure 1). Vegetation condition ranged from *Very Good* to *Completely Degraded* across the study area (Figure 2). Cleared and degraded areas were dominated by **Cenchrus ciliaris*. The majority of the study area is covered by the Coastal Plains vegetation type. Bare areas, classified as Tidal Mudflats were predominantly (naturally) free of vegetation.

The vegetation types identified within the study area are considered to be well represented in the local and regional area. A review of the aerial photography indicates that there is representation of the defined vegetation types outside the study areas. The vegetation is also consistent with vegetation associations identified in the vegetation mapping for the area (see Section 3.1).

Within the DMMA portion of the study area, the extent of vegetation is:

- Samphire Shrublands – Beach: 2.1 ha;
- Coastal Plains: 13.4 ha;
- Tidal Mudflat: 24.5 ha; and
- Cleared/Degraded: 4.0 ha.

The narrow corridor of the Pipeline route precludes areal extent of vegetation types being calculated. However, the Pipeline route intersects:

- Coastal Dune;
- Samphire Shrubland – Beach;
- Samphire Shrubland – Flats;
- Coastal Plains; and
- Cleared/Degraded vegetation.

The pipeline route intersected vegetation ranging in condition from *Completely Degraded* to *Very Good*. Within the DMMA portion of the study area, the extent of each vegetation condition is:

- *Very Good*: 24.1 ha – majority on Coastal Plains (and Tidal Mudflats);
- *Good*: 4.6 ha – majority within Coastal Plains and Samphire Shrublands – Beach;
- *Poor*: 11.1 ha – majority within Coastal Plains;
- *Degraded*: 0.2 ha – majority near airport infrastructure
- *Completely Degraded*: 4.0 ha – majority near airport.

Comparison with previous surveys indicates a large overlap of the Coastal Plains and Coastal Dune vegetation types with previous surveys (GHD, 2011; ENV, 2011), and is well-represented in the local and regional area. The Samphire Shrubland vegetation types (Beach and Flats) have not been surveyed as much. The Samphire Shrubland – Beach is a narrow strip between the Flats and Coastal Plains and may not have necessarily been separately examined in previous surveys.

local and regional area. The Samphire Shrubland vegetation types (Beach and Flats) have not been surveyed as much. The Samphire Shrubland – Beach is a narrow strip between the Flats and Coastal Plains and may not have necessarily been separately examined in previous surveys.

4.1.1 Conservation Significant Ecological Communities

The vegetation associations identified within the survey area during the survey do not align with any known Commonwealth or State listed TECs or PECs.

4.1.2 Other Significant Vegetation

O2 Marine (2017) has indicated that the portion of Vegetation Type 3: Samphire Shrubland - Beach between the tidal island may be considered to be consistent with the Biota (2013) "claypan" vegetation unit, and therefore hold a high conservation significance. This study does not recognise this area as a claypan as it is continuous with the areas influenced by tidal action. However, this study concurs with the review by O2 Marine (2017) indicating that this portion of the study area is *Degraded* to *Completely Degraded* in condition due to the presence of current off-road vehicular tracks, historical rubbish dumping, and the use of the area as a storm drain for water management.

Table 5: Study Area Vegetation Types

Type	Short Description	NVIS Level V Association Description	NVIS code	Photo	Sample Sites	Vegetation Condition	Survey Area
1	Coastal Dune	*Acacia coriacea* subsp. *coriacea* with *Hakea lorea*, tall isolated to isolated shrubs over *Indigofera monophylla* low sparse shrubland with *Trichodesma zeylanicum* tall isolated forbs over *Triodia epactia* sparse hummock grassland with **Cenchrus ciliaris* tussock grassland on sandy dune soils.	M^Indigofera monophylla,Acacia coriacea subsp. coriacea,Hakea lorea\^shrub\2\r;G+^Cenchrus ciliaris,Triodia epactia,Trichodesma zeylanicum^grass,forb\2\c		R14	Degraded	Pipeline
2	Samphire Shrublands - Flats	*Tecticornia halocnemoides* with *T. indica* subsp. *bidens, Muellerolimon salicorniaceum* low open samphire shrubland on mudflats.	M+^Tecticornia halocnemoides,T. indica subsp. bidens,Muellerolimon salicorniaceum\^shrubs\1\i		T3, R11	Good to Completely Degraded	Pipeline

Type	Short Description	NVIS Level V Association Description	NVIS code	Photo	Sample Sites	Vegetation Condition	Survey Area
3	Samphire Shrublands - Beach	*Tecticornia indica* subsp. *bidens, T. auriculata, halocnemoides* low open samphire shrubland over *Sprorobolus mitchellii, Eragrostis falcata* sparse hummock grassland on saline sandy beach.	M+^Tecticornia indica subsp. bidens,T. auriculata,T. halocnemoides\^shrubs\1\i;G^Sporobolus mitchellii,Eragrostis falcata\1\r		T1, R6, R8, R10, R12	Poor to Completely Degraded	DMMA, Pipeline

Type	Short Description	NVIS Level V Association Description	NVIS code	Photo	Sample Sites	Vegetation Condition	Survey Area
4	Coastal Plains	*Senna glutinosa* ssp. isolated shrubs over *Heliotropium pachyphyllum, Indigofera monophylla, Scaevola* spp. low open shrubland over *Triodia epactia* low closed to low hummock grassland with **Cenchrus ciliaris* low sparse to low grassland on sandy plains (with underlying limestone).	M^Heliotropium pachyphyllum,Indigofera monophylla,Scaevola spp.\^shrubs\2\i;G+Triodia epactia,Cenchrus ciliaris,Sporobolus mitchellii\2\d	 	Q1, Q2, Q3, R3, R5, T2, R7, R9, R13	Good to Poor	DMMA, Pipeline
5	Tidal Mudflat	*Tecticornia* spp. isolated shrubs	M+^Tecticornia spp.\^shrubs\1\bc		R1, R2	Good to Degraded	DMMA

Type	Short Description	NVIS Level V Association Description	NVIS code	Photo	Sample Sites	Vegetation Condition	Survey Area
6	Cleared / Degraded Areas	Previously / currently cleared areas dominated by introduced grasses with shrubs and herbs from adjacent vegetation. Includes roads, tracks, airstrip, etc.	n/a		n/a	Completely Degraded	DMMA, Pipeline

4.2 Flora

4.2.1 Recorded Flora

Sixty-six flora taxa from 23 families were recorded within the study area. Two taxa could not be adequately identified to species level due to lack of flowering or fruiting material. Considering the late season survey, and the relatively small size of the study area (44 ha), the diversity is considered to be acceptable. ENV (2011) recorded 109 flora taxa from 31 families within the adjacent 333 ha Onslow townsite survey area.

Average flora taxa richness was 15.3 taxa per quadrat ± 1.15 from a total of 3 quadrats. Quadrat data, including photographs are included in Appendix B. The taxa by site matrix and inventory (flora list) is presented in Appendix B.

The most frequently recorded families were:

- Fabaceae (wattles, peas) 12 taxa;
- Chenopodiaceae (chenopods, samphires) 8 taxa;
- Poaceae (grasses) 8 taxa; and
- Asteraceae (daisies) 6 taxa.

The most frequently recorded genera were: *Acacia* (six taxa); and *Tecticornia* (three taxa).

4.2.2 Conservation Significant Flora

No Threatened species pursuant to the EPBC Act were recorded during the survey of the study area.

No plant taxa gazetted as Threatened (Declared Rare) pursuant to the WC Act were recorded in the study area.

No Priority Flora taxa were recorded in the study area. The Priority 3 *Stackhousia clementii* was recorded 50 m east of the preferred pipeline route located in Samphire Shrubland – Beach vegetation type (Figure 3). One location with approximately 15 plants was recorded during the survey. Vegetation at this location was disturbed by off-road vehicle movements.

Plate 1: *Stackhousia clementii* (left) and habitat recorded (right)

This taxon has recently been recorded at another location within three kilometres of the study area in similar habitat. This taxon has also been recorded in large numbers near Wiluna (J. Foster, pers. obs.; GHD, 2014b), where up to 180 plants per 100 m^2 were recorded in suitable habitat. The relatively cryptic nature of the taxon (especially when not flowering) is considered likely to have resulted in an historical under-sampling. The recent *Expert Elicitation Data of Plants on Pilbara Islands* (Astron, 2015) has recorded over 100 locations on nearby offshore islands, indicating that this taxon is more widespread locally and regionally than previously noted.

The proposed pipeline route will not impact on the location of this taxon.

4.2.3 Other Significant Flora

No flora taxa exhibiting an extension to their known range, or at the current known limit of their range were recorded from the study area.

4.2.4 Weeds and Introduced Flora

Four weed species were recorded from the study area: **Aerva javanica* (Kapok); **Cenchrus ciliaris* (Buffel Grass); **Flaveria trinervia* (Speedy Weed); and **Tamarix aphylla* (Athel Tree). Buffel Grass (**Cenchrus ciliaris*) is widespread across the study area, within the Coastal Plain and Coastal Dune vegetation.

The Athel Tree (**Tamarix aphylla*) is listed as a Weed of National Significance, and as a Declared Pest pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007*. One Athel Tree is located adjacent to the Onslow Airport access road.

5 Consideration of Impacts

5.1 Vegetation

5.1.1 DMMA

Approximately 15.5 ha of native vegetation (excluding the bare areas of Tidal Mudflats as a vegetation type) is earmarked to be directly impacted as the DMMA by the disposal of dredged material. This will bury the DMMA vegetation types: Coastal Plain and Samphire Shrubland – Beach under dredged material. Both vegetation types are well-represented in the local and regional area.

The direct impact to this area of vegetation will be permanent. The clear demarcation of the boundaries of the DMMA area will ensure that accidental clearing does not occur.

There are few options available to consider the minimisation of direct impacts.

Indirect impacts include: spread of weeds due to disturbance activities; and cover of adjacent vegetation by wind-blown dust from vegetation-free areas. Mitigation of indirect impacts can occur through appropriate management actions, including: a consideration of timing of clearing; weed/hygiene management of vehicles within the DMMA; and progressive reuse of stored vegetation and/or topsoil.

As avoidance of impact cannot occur as part of this project within the DMMA, the reuse of vegetation and/or associated areas of topsoil classified as being in *Very Good* condition (Figure 1) for soil stabilisation (mulch), and/or as source of seed for a rehabilitation program may be considered as an impact mitigation option, e.g. stored on-site for rehabilitation of temporary works associated with the pipeline alignment.

Whether the vegetation is used on-site as part of landscaping, rehabilitation program or able to be reused in the local area by alternative projects is an option suggested to be explored further. In addition, the topsoil underneath the vegetation types classified as *Very Good* may also be considered for reuse in a rehabilitation program as a seedbank source. Any reuse of vegetation and/or topsoil within a site-specific rehabilitation program (on-site or offsite) will need to be examined and instigated prior to dredge material disposal commencement.

Vegetation types rated as *Good* or lower contain a large presence of weeds (particularly **Cenchrus ciliaris* – Buffel Grass) that reduces the suitability for reuse in a rehabilitation program.

5.1.2 Pipeline

O2 Marine (2017) have indicated that approximately 0.3 ha of vegetation will be disturbed as part of the proposed pipeline installation, with the pipeline to be placed on existing tracks and cleared areas, where possible. O2 Marine (2017) indicates that the disturbance will be limited to 0.3 ha within a nominated broader corridor of 50 m in width. Disturbance is indicated as "temporary", with the pipeline to be removed once the dredging program is completed and the DMMA area filled to capacity.

The proposed route provided by O2 Marine (as a shapefile) indicates a pipeline length of approximately 1.6 km between the DMMA and currently cleared portions of the Beadon Creek Road industrial area and existing port facilities. This project indicates that approximately 1.1 km is

vegetated. This would result in a clearing (disturbance) corridor within vegetation approaching the 0.3 ha stipulated by O2 Marine (2017). In addition, existing Cleared/Degraded areas (as off-road vehicle tracks) along the proposed pipeline alignment are relatively narrow. The clear demarcation of the corridor in these areas is considered to be crucial to ensure that accidental clearing of adjacent vegetation not occur.

As the proposed pipeline is considered to be temporary, the impacts caused by the installation and removal may be mitigated using appropriate management actions. These include: weed/hygiene management of all vehicles during installation and maintenance of the pipeline; development and implementation of a rehabilitation program designed to re-establish pre-disturbance vegetation following the removal of pipeline.

5.2 Flora

The Priority 3 species *Stackhousia clementii* was recorded 50 m east of the proposed pipeline alignment (Figure 3). This species and location will not be directly impacted by the proposed project.

To mitigate any indirect or potential impact to this species (and location), the following actions are suggested:

- Clear demarcation of the known location, with an appropriate buffer and signage along the Samphire Shrubland – Beach vegetation type in which the species is present;
- A consideration of fencing of the individual plants to prevent accidental disturbance;
- Discussions with the Shire of Ashburton to close the off-road vehicle access within the area. This will reduce the disturbance to the Samphire Shrubland – Beach vegetation type and allow protection of the habitat preferred by this species. If closure is not acceptable, or cannot be achieved, and the local community requests access to the tidal mudflats, a number of controlled access points should be considered; and
- Include information of the species and habitat in any staff site induction program developed as part of standard environmental inductions.

6 References

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Figures

Earth Stewardship

IDEAS | SOLUTIONS | APPLICATIONS

Onslow Marine Support Base

Figure 1 - Vegetation Type

A: Dredge Material Management Area

Legend – Vegetation Types
1: Coastal Dunes
2: Samphire Shrubland - Flats
3: Samphire Shrubland - Beach
4: Coastal Plain
5: Tidal Mudflats
6: Cleared/Degraded

0 100 200
50 150 250m

\ES2017_016_GIS_Figure 1 v1
Maps created using QGIS with imagery from Google Earth

Earth Stewardship

IDEAS | SOLUTIONS | APPLICATIONS

Onslow Marine Support Base

Figure 1 - Vegetation Type

B: Dredge Pipeline

Legend – Vegetation Types
1: Coastal Dunes
2: Samphire Shrubland - Flats
3: Samphire Shrubland - Beach
4: Coastal Plain
5: Tidal Mudflats
6: Cleared/Degraded

0 100 200
50 150 250m

\ES2017_016_GIS_Figure 1 v1
Maps created using QGIS with imagery from Google Earth

Earth Stewardship

IDEAS | SOLUTIONS | APPLICATIONS

Onslow Marine Support Base

Figure 2 - Vegetation Condition

A: Dredge Material Management Area

Legend – Vegetation Condition
VG: Very Good
G: Good
P: Poor
D: Degraded
CD: Completely Degraded

0 100 200
50 150 250m

\ES2017_016_GIS_Figure 2 v1

Maps created using QGIS with imagery from Google Earth

Earth Stewardship

IDEAS | SOLUTIONS | APPLICATIONS

Onslow Marine Support Base

Figure 2 - Vegetation Condition

B: Dredge Pipeline

Legend – Vegetation Condition
VG: Very Good
G: Good
P: Poor
D: Degraded
CD: Completely Degraded

0 100 200
50 150 250m

\ES2017_016_GIS_Figure 2 v1
Maps created using QGIS with imagery from Google Earth

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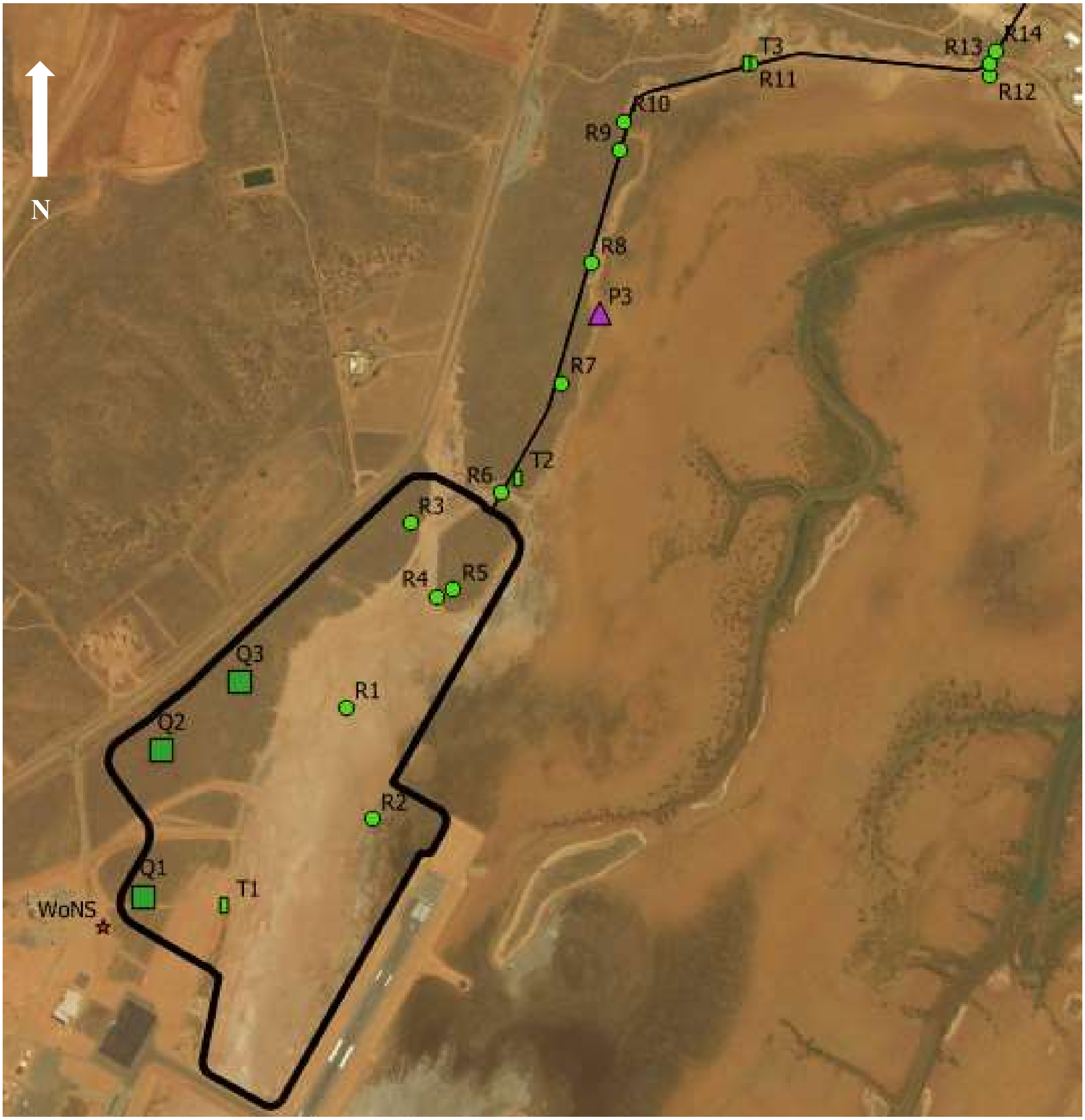

Earth Stewardship

IDEAS | SOLUTIONS | APPLICATIONS

ABN: 93 408 115 945

Onslow Marine Support Base

Figure 3 – Survey Locations

Legend – Location – Survey Points

- Quadrat
- Relevé
- Transect
- Priority Flora
- Weed of National Significance

0 100 200

50 150 250m

\ES2017_016_GIS_Figure 3 v1

Maps created using QGIS with imagery from Google Earth

Appendix A

Results of Database Searches

EPBC Act Protected Matters Search

NatureMap Search

Australian Government
Department of the Environment and Energy

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.

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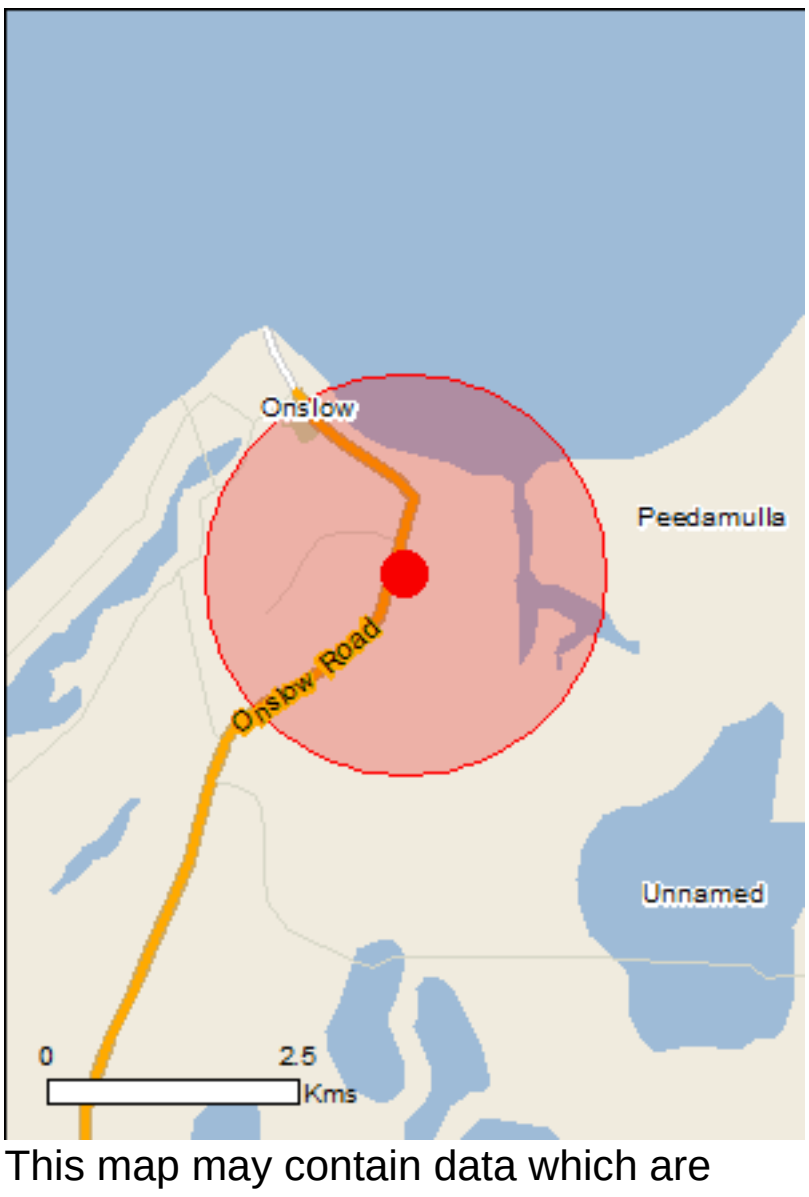

Coordinates

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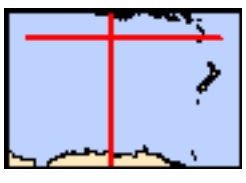

Summary

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:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	23
Listed Migratory Species:	38

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:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	71
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	8
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
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
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus angusticeps		
Airlie Island Ctenotus [25937]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	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	Breeding likely to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may 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		
Anous stolidus		
Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat may occur within area
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata		
Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat 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	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat 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
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	Breeding likely to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		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 known to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may 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
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

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		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to 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 likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may 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
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
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 suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
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 Ribboned Pipehorse, Ribboned 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

Name	Threatened	Type of Presence
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
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
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]		Species or species habitat 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 likely 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

Name	Threatened	Type of Presence
		area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat 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	Breeding likely 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 habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may 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 edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		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 known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

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
Mammals		
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
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
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

Name	Status	Type of Presence
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
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area

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.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

-21.65234 115.12142

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
-Department of Land and Resource Management, Northern Territory
-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, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-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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NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 26/10/2017

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 07' 00" E,21° 39' 37" S
Buffer 20km
Group By Family

Family	Species	Records
Acanthaceae	2	4
Aizoaceae	5	11
Amaranthaceae	14	22
Anadyomenaceae	1	2
Apocynaceae	1	3
Araliaceae	1	4
Arecaceae	1	1
Areschougiaceae	2	4
Asteraceae	25	43
Bonnemaisoniaceae	1	1
Boodleaceae	1	2
Boraginaceae	11	19
Brassicaceae	3	6
Capparaceae	1	3
Caryophyllaceae	1	1
Caulerpaceae	7	14
Celastraceae	2	7
Ceramiaceae	2	4
Chenopodiaceae	21	46
Cladophoraceae	2	4
Cleomaceae	1	1
Combretaceae	1	3
Convolvulaceae	9	16
Corallinaceae	3	7
Cucurbitaceae	1	3
Cymodoceaceae	2	2
Cyperaceae	5	6
Dasycladaceae	1	3
Elatinaceae	2	4
Euphorbiaceae	6	19
Fabaceae	44	110
Frankeniaceae	1	2
Galaxauraceae	3	7
Gentianaceae	1	1
Geraniaceae	1	1
Goodeniaceae	9	24
Gracilariaceae	1	3
Gyrostemonaceae	2	3
Halimedaceae	4	15
Haloragaceae	2	3
Hemerocallidaceae	2	3
Hydrocharitaceae	2	2
Juncaginaceae	1	2
Lamiaceae	2	6
Lauraceae	2	2
Liagoraceae	1	1
Lomentariaceae	2	2
Malvaceae	21	33
Marsileaceae	2	2
Molluginaceae	1	1
Montiaceae	1	1
Myrtaceae	5	8
Nyctaginaceae	1	1
Onagraceae	1	1
Orobanchaceae	1	1
Phrymaceae	1	3
Phyllanthaceae	3	4
Plantaginaceae	1	6
Plumbaginaceae	1	1
Poaceae	33	86
Polygalaceae	2	2
Primulaceae	1	3
Proteaceae	5	21
Restionaceae	1	3
Rhamnaceae	1	1
Rhizophyllidaceae	1	5
Rhodomelaceae	8	10
Rhodymeniaceae	1	1
Rubiaceae	1	2
Santalaceae	1	2
Sapindaceae	1	2
Schizymeniaceae	1	1
Scrophulariaceae	4	6
Siphonocladaceae	2	2
Solanaceae	4	8

Surianaceae	1	1
Thymelaeaceae	1	1
Udoteaceae	2	2
Valoniaceae	2	2
Zygophyllaceae	4	7
TOTAL	**331**	**682**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthaceae					
1.	6828	*Avicennia marina (White Mangrove)*			
2.	12088	*Rostellularia adscendens var. clementii*			
Aizoaceae					
3.		*Carpobrotus sp. subsp. Thevenard Island (M. White 050)*			
4.	2818	*Sesuvium portulacastrum*			
5.	44305	*Trianthema pilosum*			
6.	44362	*Trianthema triquetrum*			
7.	44360	*Trianthema turgidifolium*			
Amaranthaceae					
8.	2646	*Aerva javanica (Kapok Bush)*	Y		
9.	2652	*Alternanthera nodiflora (Common Joyweed)*			
10.	2686	*Gomphrena pusilla*		P2	
11.	11131	*Gomphrena sordida*			
12.	2694	*Ptilotus appendiculatus*			
13.	2695	*Ptilotus arthrolasius*			
14.	2699	*Ptilotus axillaris (Mat Mulla Mulla)*			
15.	2738	*Ptilotus latifolius (Tangled Mulla Mulla)*			
16.	2741	*Ptilotus macrocephalus (Featherheads)*			
17.	2745	*Ptilotus murrayi*			
18.	2746	*Ptilotus nobilis (Tall Mulla Mulla)*			
19.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
20.	2766	*Ptilotus villosiflorus*			
21.	43203	*Surreya diandra*			
Anadyomenaceae					
22.	35872	*Anadyomene plicata*			
Apocynaceae					
23.	12832	*Gymnanthera cunninghamii*		P3	
Araliaceae					
24.	19053	*Trachymene pilbarensis*			
Arecaceae					
25.	1042	*Phoenix dactylifera (Date Palm)*	Y		
Areschougiaceae					
26.	26503	*Betaphycus speciosum*			
27.	27230	*Sarconema filiforme*			
Asteraceae					
28.	7822	*Angianthus acrohyalinus (Hook-leaf Angianthus)*			
29.	7827	*Angianthus cunninghamii (Coast Angianthus)*			
30.	7832	*Angianthus milnei (Cone-spike Angianthus)*			
31.	7866	*Blumea tenella*			
32.	7958	*Decazesia hecatocephala*			
33.	35558	*Flaveria trinervia (Speedy Weed)*	Y		
34.	7988	*Gnephosis arachnoidea (Cobwebby-headed Gnephosis)*			
35.	8030	*Helichrysum oligochaetum*		P1	
36.		*Launaea sarmenstosa*			
37.	17925	*Myriocephalus oldfieldii*			
38.	8127	*Olearia axillaris (Coastal Daisybush)*			
39.	42024	*Olearia sp. Kennedy Range (G. Byrne 66)*			
40.	17817	*Pluchea dunlopii*			
41.	17816	*Pluchea ferdinandi-muelleri*			
42.	43944	*Pluchea longiseta*			
43.	8168	*Pluchea rubelliflora*			
44.	8192	*Pterocaulon sphacelatum (Apple Bush, Fruit Salad Plant)*			
45.	13297	*Rhodanthe psammophila*			
46.	13254	*Rhodanthe stricta*			
47.	45154	*Roebuckiella cheilocarpa var. cheilocarpa*			
48.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
49.	8237	*Streptoglossa decurrens*			
50.	8239	*Streptoglossa macrocephala*			
51.	8240	*Streptoglossa odora*			
52.	8252	*Tridax procumbens (Tridax, Tridax Daisy)*	Y		
Bonnemaisoniaceae					
53.	26486	*Asparagopsis taxiformis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Boodleaceae					
54.	26508	*Boodlea composita*			
Boraginaceae					
55.	14301	*Ehretia saligna var. saligna*			
56.	17301	*Heliotropium chrysocarpum*			
57.	6705	*Heliotropium crispatum*			
58.	6707	*Heliotropium curassavicum (Smooth Heliotrope)*			
59.	6708	*Heliotropium diversifolium*			
60.	6712	*Heliotropium heteranthum*			
61.	17309	*Heliotropium pachyphyllum*			
62.		*Heliotropium sp.*			
63.	17031	*Heliotropium transforme*			
64.	6727	*Trichodesma zeylanicum (Camel Bush, Kumbalin)*			
65.	13559	*Trichodesma zeylanicum var. grandiflorum*			
Brassicaceae					
66.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
67.	3032	*Lepidium muelleri-ferdinandii*			
68.	3039	*Lepidium platypetalum (Slender Peppercress)*			
Capparaceae					
69.	2982	*Capparis umbonata (Wild Orange, Nanggalu)*			
Caryophyllaceae					
70.	12075	*Polycarpaea corymbosa var. corymbosa*			
Caulerpaceae					
71.	35158	*Caulerpa corynephora*			
72.	42783	*Caulerpa delicatula*			
73.	26562	*Caulerpa fergusonii*			
74.	26568	*Caulerpa lentillifera*			
75.	26573	*Caulerpa racemosa*			
76.	26576	*Caulerpa serrulata*			
77.	26577	*Caulerpa sertularioides*			
Celastraceae					
78.	4729	*Stackhousia clementii*		P3	
79.	4736	*Stackhousia umbellata*		P3	
Ceramiaceae					
80.	26587	*Centroceras clavulatum*			
81.	27310	*Spyridia filamentosa*			
Chenopodiaceae					
82.	2451	*Atriplex bunburyana (Silver Saltbush)*			
83.	2453	*Atriplex codonocarpa (Flat-topped Saltbush)*			
84.	2476	*Atriplex semilunaris (Annual Saltbush)*			
85.	2504	*Dysphania plantaginella*			
86.	2547	*Maireana lanosa (Woolly Bluebush)*			
87.	2548	*Maireana lobiflora*			
88.	2573	*Neobassia astrocarpa*			
89.	2582	*Rhagodia eremaea (Thorny Saltbush)*			
90.	11240	*Rhagodia preissii subsp. obovata*			
91.	30434	*Salsola australis*			
92.	11650	*Sclerolaena bicornis var. bicornis (Goathead Burr)*			
93.	2633	*Sclerolaena uniflora (Two-spined Saltbush)*			
94.	2638	*Suaeda arbusculoides*			
95.	31616	*Tecticornia auriculata*			
96.	33236	*Tecticornia halocnemoides (Shrubby Samphire)*			
97.	33238	*Tecticornia halocnemoides subsp. tenuis*			
98.	33319	*Tecticornia indica subsp. bidens*			
99.	33318	*Tecticornia indica subsp. leiostachya (Samphire)*			
100.	33296	*Tecticornia pergranulata*			
101.	33220	*Tecticornia pterygosperma subsp. denticulata*			
102.	2644	*Threlkeldia diffusa (Coast Bonefruit)*			
Cladophoraceae					
103.	35865	*Cladophora catenata*			
104.	36316	*Cladophora herpestica*			
Cleomaceae					
105.	2988	*Cleome viscosa (Tickweed, Tjinduwadhu)*			
Combretaceae					

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
106.	5313	*Terminalia supranitifolia*		P3	
Convolvulaceae					
107.	6604	*Bonamia brevifolia*		P1	
108.	11167	*Bonamia erecta*			
109.	19565	*Cressa australis*			
110.	11200	*Evolvulus alsinoides var. villosicalyx*			
111.	6624	*Ipomoea costata (Rock Morning Glory, Kanti)*			
112.	6635	*Ipomoea pes-caprae*			
113.	11312	*Ipomoea pes-caprae subsp. brasiliensis*			
114.	6637	*Ipomoea polymorpha*			
115.	6638	*Ipomoea quamoclit (Cupid's Flower)*	Y		
Corallinaceae					
116.	26462	*Amphiroa fragilissima*			
117.	26983	*Jania adhaerens*			
118.	42222	*Jania ungulata*			Y
Cucurbitaceae					
119.		*Cucumis Barrow Island (D.W. Goodall 1264)*			
Cymodoceaceae					
120.	126	*Amphibolis antarctica (Sea Nymph)*			
121.	129	*Cymodocea serrulata*			
Cyperaceae					
122.	750	*Bulbostylis barbata*			
123.	808	*Cyperus pygmaeus*			
124.	809	*Cyperus rigidellus*			
125.	31017	*Eleocharis papillosa*		P3	
126.	48355	*Schoenoplectiella dissachantha*			
Dasycladaceae					
127.	26509	*Bornetella oligospora*			
Elatinaceae					
128.	5185	*Bergia perennis*			
129.	5186	*Bergia trimera*			
Euphorbiaceae					
130.	17422	*Adriana tomentosa var. tomentosa*			
131.	4623	*Euphorbia coghlanii (Namana)*			
132.	4629	*Euphorbia hirta (Asthma Plant)*	Y		
133.	4635	*Euphorbia myrtoides*			
134.	4647	*Euphorbia tannensis*			
135.	12097	*Euphorbia tannensis subsp. eremophila (Desert Spurge)*			
Fabaceae					
136.	3214	*Acacia ancistrocarpa (Fitzroy Wattle)*			
137.	3241	*Acacia bivenosa*			
138.	17013	*Acacia colei var. colei*			
139.	3270	*Acacia coriacea (Wirewood)*			
140.	13500	*Acacia coriacea subsp. coriacea*			
141.	14088	*Acacia cyperophylla var. cyperophylla*			
142.	3356	*Acacia gregorii (Gregory's Wattle)*			
143.	3419	*Acacia ligulata (Umbrella Bush, Watarka)*			
144.	3534	*Acacia sclerosperma (Limestone Wattle)*			
145.	13078	*Acacia sclerosperma subsp. sclerosperma*			
146.	20819	*Acacia sp. Ripon Hills (B.R. Maslin 8460)*			
147.	19456	*Acacia stellaticeps*			
148.	3577	*Acacia tetragonophylla (Kurara, Wakalpuka)*			
149.	3579	*Acacia trachycarpa (Minni Ritchi, Balgali)*			
150.	3603	*Acacia wiseana*			
151.	39780	*Aenictophyton reconditum subsp. reconditum*			
152.	3680	*Aeschynomene indica (Budda Pea)*			
153.	3774	*Crotalaria cunninghamii (Green Birdflower, Bilbun)*			
154.	20175	*Crotalaria cunninghamii subsp. sturtii*			
155.	20179	*Crotalaria medicaginea var. neglecta*			
156.	17436	*Cullen graveolens*			
157.	17116	*Cullen martinii*			
158.	3853	*Desmodium filiforme*			
159.	3973	*Indigofera colutea (Sticky Indigo)*			
160.	3974	*Indigofera georgei (Bovine Indigo)*			
161.	3980	*Indigofera linifolia*			
162.	3981	*Indigofera linnaei (Birdsville Indigo)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
163.	3982	*Indigofera monophylla*			
164.	3613	*Leucaena leucocephala (Leucaena)*	Y		
165.	4061	*Lotus cruentus (Redflower Lotus)*			
166.	20862	*Rhynchosia bungarensis*		P4	
167.	4191	*Rhynchosia minima (Rhynchosia)*			
168.	4196	*Sesbania cannabina (Sesbania Pea)*			
169.	4231	*Swainsona kingii*			
170.	4242	*Swainsona pterostylis*			
171.	41920	*Tephrosia rosea var. Port Hedland (A.S. George 1114)*		P1	
172.	19531	*Tephrosia rosea var. clementii*			
173.	15947	*Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)*			
174.	41815	*Tephrosia sp. Carnarvon (J.H. Ross 2681)*			
175.	42442	*Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)*			
176.	39422	*Tephrosia sp. Onslow (K.R. Newbey 10571)*			
177.	30716	*Vachellia farnesiana (Mimosa Bush)*	Y		
178.	31391	*Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)*			
179.	4326	*Zornia albiflora*			
Frankeniaceae					
180.	5188	*Frankenia ambita*			
Galaxauraceae					
181.	29615	*Dichotomaria obtusata*			
182.	26835	*Galaxaura rugosa*			
183.	27340	*Tricleocarpa cylindrica*			
Gentianaceae					
184.	41660	*Schenkia australis*			
Geraniaceae					
185.	4335	*Erodium cygnorum (Blue Heronsbill)*			
Goodeniaceae					
186.	7509	*Goodenia forrestii*			
187.	7526	*Goodenia microptera*			
188.	12571	*Goodenia pascua*			
189.	7588	*Lechenaultia subcymosa (Wide-branching Leschenaultia)*			
190.	7606	*Scaevola crassifolia (Thick-leaved Fan-flower)*			
191.	7608	*Scaevola cunninghamii*			
192.	12584	*Scaevola pulchella*			
193.	7643	*Scaevola sericophylla*			
194.	7644	*Scaevola spinescens (Currant Bush, Maroon)*			
Gracilariaceae					
195.	26873	*Gracilaria salicornia*			
Gyrostemonaceae					
196.	2778	*Codonocarpus cotinifolius (Native Poplar, Kundurangu)*			
197.	2784	*Gyrostemon ramulosus (Corkybark)*			
Halimedaceae					
198.	26891	*Halimeda cylindracea*			
199.	26892	*Halimeda discoidea*			
200.	26894	*Halimeda macroloba*			
201.	26898	*Halimeda velasquezii*			
Haloragaceae					
202.	6174	*Haloragis gossei*			
203.	23464	*Haloragis gossei var. inflata*			
Hemerocallidaceae					
204.	1284	*Corynotheca flexuosissima*			
205.	1286	*Corynotheca pungens*			
Hydrocharitaceae					
206.	164	*Halophila ovalis (Sea Wrack)*			
207.	165	*Halophila spinulosa*			
Juncaginaceae					
208.	145	*Triglochin hexagona (Six-point Arrowgrass)*			
Lamiaceae					
209.	41063	*Quoya loxocarpa*			
210.	41061	*Quoya paniculata*			
Lauraceae					
211.	12073	*Cassytha aurea var. aurea*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
212.	2949	*Cassytha capillaris*			
Liagoraceae					
213.	26837	*Ganonema farinosum*			
Lomentariaceae					
214.	26606	*Ceratodictyon spongiosum*			
215.	26845	*Gelidiopsis intricata*			
Malvaceae					
216.		*Abutilon Onslow (F. Smith s.n. 10/9/61)*			
217.	4895	*Abutilon lepidum*			
218.		*Abutilon sp.*			
219.	42920	*Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)*			
220.	43021	*Abutilon sp. Pritzelianum (S. van Leeuwen 5095)*		P1	
221.	4907	*Alyogyne pinoniana (Sand Hibiscus)*			
222.	18411	*Corchorus congener*		P3	
223.	18414	*Corchorus sidoides subsp. vermicularis*			
224.	4910	*Gossypium australe (Native Cotton)*			
225.	4913	*Gossypium hirsutum (Upland Cotton)*	Y		
226.	17782	*Hannafordia quadrivalvis subsp. recurva*			
227.	4922	*Hibiscus brachychlaenus*			
228.	4923	*Hibiscus brachysiphonius*			
229.	4942	*Hibiscus sturtii (Sturt's Hibiscus)*			
230.	4960	*Lawrencia viridigrisea*			
231.	4962	*Malvastrum americanum (Spiked Malvastrum)*	Y		
232.	5051	*Melhania oblongifolia*			
233.	31758	*Sida arsiniata*			
234.	4977	*Sida fibulifera (Silver Sida)*			
235.	18149	*Sida rohlenae subsp. rohlenae*			
236.	17524	*Triumfetta echinata*		P3	
Marsileaceae					
237.	75	*Marsilea exarata*			
238.		*Marsilea sp.*			
Molluginaceae					
239.	2835	*Glinus lotoides (Hairy Carpet Weed)*			
Montiaceae					
240.	2860	*Calandrinia polyandra (Parakeelya)*			
Myrtaceae					
241.	17093	*Corymbia hamersleyana*			
242.	17084	*Corymbia zygophylla*			
243.	14548	*Eucalyptus victrix*			
244.	15592	*Eucalyptus xerothermica*			
245.	6081	*Verticordia forrestii (Forrest's Featherflower)*			
Nyctaginaceae					
246.	2776	*Commicarpus australis (Perennial Tar Vine)*			
Onagraceae					
247.	16347	*Oenothera laciniata*	Y		
Orobanchaceae					
248.	7047	*Buchnera linearis (Blackrod)*			
Phrymaceae					
249.	7082	*Mimulus gracilis*			
Phyllanthaceae					
250.		*Breynia desorii*			
251.	17626	*Phyllanthus erwinii*			
252.	48206	*Synostemon rhytidospermus*			
Plantaginaceae					
253.	17295	*Stemodia sp. Onslow (A.A. Mitchell 76/148)*			
Plumbaginaceae					
254.	6490	*Muellerolimon salicorniaceum*			
Poaceae					
255.	12063	*Aristida holathera var. holathera*			
256.	233	*Avena barbata (Bearded Oat)*	Y		
257.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
258.	273	*Chrysopogon fallax (Golden Beard Grass)*			
259.	311	*Digitaria ciliaris (Summer Grass)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
			Y		
260.	48378	*Diplachne fusca subsp. fusca*			
261.	340	*Echinopogon ovatus (Hedgehog Grass)*			
262.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
263.	381	*Eragrostis falcata (Sickle Lovegrass)*			
264.	392	*Eragrostis pergracilis*			
265.	403	*Eriachne benthamii (Swamp Wanderrie)*			
266.	408	*Eriachne flaccida (Claypan Grass)*			
267.	409	*Eriachne gardneri*			
268.		*Eriachne sp.*			
269.	426	*Eriochloa pseudoacrotricha (Perennial Cupgrass)*			
270.	11011	*Eulalia aurea*			
271.	459	*Iseilema eremaeum*			
272.	465	*Iseilema vaginiflorum (Red Flinders Grass)*			
273.	503	*Panicum decompositum (Native Millet, Kaltu-kaltu)*			
274.	505	*Panicum laevinode*			
275.	11232	*Paractaenum novae-hollandiae subsp. novae-hollandiae*			
276.	514	*Paractaenum refractum*			
277.	619	*Sorghum plumosum (Plume Canegrass)*			
278.	625	*Spinifex longifolius (Beach Spinifex)*			
279.		*Sporobolus sp.*			
280.	635	*Sporobolus virginicus (Marine Couch)*			
281.	13131	*Triodia epactia*			
282.	17873	*Triodia schinzii*			
283.	43220	*Triodia sp. Peedamulla (A.A. Mitchell PRP 1636)*			
284.	706	*Triraphis mollis (Needle Grass)*			
285.	11321	*Urochloa holosericea subsp. velutina*			
286.	728	*Whiteochloa cymbiformis*			
287.	11894	*Yakirra australiensis var. australiensis*			
Polygalaceae					
288.	41365	*Polygala glaucifolia*			
289.	4572	*Polygala isingii*			
Primulaceae					
290.	14027	*Samolus sp. Millstream (M.I.H. Brooker 2076)*			
Proteaceae					
291.	2001	*Grevillea eriostachya (Flame Grevillea, Kaliny-kalinypa)*			
292.	19570	*Grevillea pyramidalis subsp. leucadendron*			
293.	2096	*Grevillea stenobotrya*			
294.	19137	*Hakea lorea subsp. lorea*			
295.	16897	*Hakea stenophylla subsp. stenophylla*			
Restionaceae					
296.	13775	*Lepidobolus quadratus*		P3	
Rhamnaceae					
297.	4847	*Ziziphus mauritiana (Zornia)*	Y		
Rhizophyllidaceae					
298.	27186	*Portieria hornemannii*			
Rhodomelaceae					
299.	26441	*Acanthophora spicifera*			
300.	35868	*Acrocystis nana*			
301.	26628	*Chondria armata*			
302.	26782	*Digenea simplex*			
303.	26998	*Laurencia brongniartii*			
304.	46834	*Osmundaria melvillii*			
305.	38021	*Palisada concreta*			Y
306.	27335	*Tolypiocladia calodictyon*			
Rhodymeniaceae					
307.	26686	*Coelarthrum opuntia*			
Rubiaceae					
308.	13339	*Synaptantha tillaeacea var. tillaeacea*			
Santalaceae					
309.	2357	*Santalum lanceolatum (Northern Sandalwood, Yarnguli)*			
Sapindaceae					
310.	4745	*Diplopeltis eriocarpa (Hairy Pepperflower)*			
Schizymeniaceae					

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
311.	35182	*Titanophora pikeana*			
Scrophulariaceae					
312.	17177	*Eremophila forrestii subsp. viridis*		P3	
313.	16696	*Eremophila fraseri subsp. fraseri*			
314.	17175	*Eremophila glabra subsp. albicans*			
315.	17158	*Myoporum montanum (Native Myrtle)*			
Siphonocladaceae					
316.	26507	*Boergesenia forbesii*			
317.	26771	*Dictyosphaeria versluysii*			
Solanaceae					
318.	11856	*Nicotiana occidentalis subsp. occidentalis*			
319.	11734	*Nicotiana rosulata subsp. rosulata*			
320.	6994	*Solanum cataphractum*		P3	
321.	7018	*Solanum lasiophyllum (Flannel Bush, Mindjulu)*			
Surianaceae					
322.	3182	*Stylobasium spathulatum (Pebble Bush)*			
Thymelaeaceae					
323.	5230	*Pimelea ammocharis*			
Udoteaceae					
324.	27348	*Udotea argentea*			
325.	27349	*Udotea flabellum*			
Valoniaceae					
326.	46438	*Valonia ventricosa*			
327.	27357	*Valoniopsis pachynema*			
Zygophyllaceae					
328.	4377	*Tribulus hirsutus*			
329.	4378	*Tribulus hystrix*			
330.	4380	*Tribulus occidentalis (Perennial Caltrop)*			
331.	4386	*Zygophyllum aurantiacum (Shrubby Twinleaf)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix B

Field Survey Results

Quadrat Data

Flora Inventory

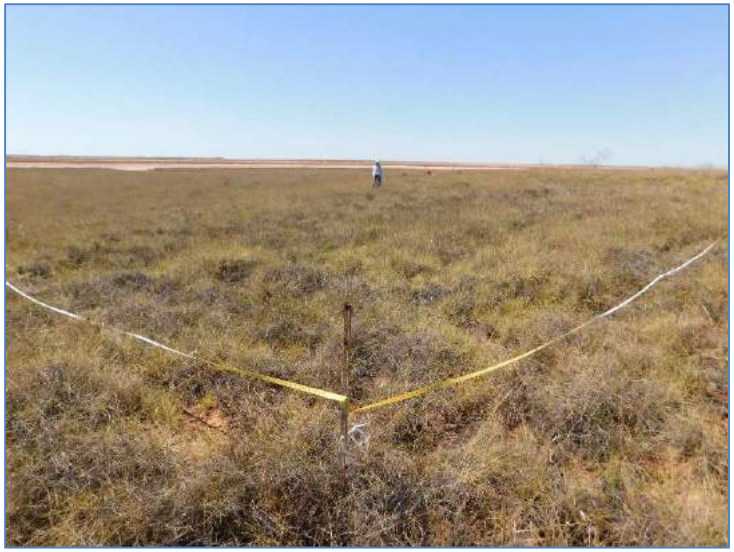
Vegetation Site Sheet: habitat information					**Date:**	20/10/2017	**Site#:**	Q1
Survey:	ES2017-016	Onslow Marine Support Base						
Observers:	JF, JF							
Location:	Onslow, airport							
MGA Zone:	50, GDA94	**Easting:**	304779		**Northing:**	7603221	Qo1	
Site Type:	Quadrat	**Dimensions:**	30x30	**Camera:**	**p320**	**From:**	NW	
Site Disturbance	**Frequency**		**Water or Wind Erosion Evidence**			**Field Vegetation Type**		
Mining/Infrastructure	Disturbs >10yr	Old tracks	No			spinifex steppe with some shrubs calcareous soils		
Exotic Weeds	Current Disturbance	Buffel Grass						
			Climate		**Vegetation Condition**		**Litter**	
			Dry, plants stress		Good			
			Site Drainage				**Leaf Litter:**	
			Good Drain				Sparse	
			Fire Frequency		**Fire Intensity**		**Wood Litter:**	
			Old >5yr		Not applicable		Negligible	
Surface Components		**Cover (if needed)**		**Soil**		**Landform**		
Loose Soil		20		Major Component		**Slope-Lower**		
Humus/Litter		15		Sand				
Cracked Clay		5						
Fine Rocks (2-6mm)		20		Minor		**Slope**		
Medium gravel/pebbles (6-20mm)				Loamy		Gentle		
Coarse gravel/pebbles (20-60mm)								
Cobbly Cobbles (60-200mm)				Soil Colour		**Slope Aspect**		
Stony/stones (200-600mm)			pink	Orange		East		
Surface Plates/boulders (>600mm)								

Growth Form Table									
Tree >10m		Tree 2-10m		Tree <2m			Tree Mallee		
Palm		Shrub >2m	M1	Shrub 1-2m		M2	Shrub >1m		M3
Cycads		Tussock Grass	G2	Hummock Grass		G1	Sedge		
Vine		Herbs		Other			Mallee Shrub		
Heath Shrub		Samphire Shrub		Chenopod			Rush		
Grass Tree		Other							
Stratum	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**	
%Cover				<2%	<2%	10-30%	70-100%	2-10%	
Ht range (m)				2.2	11-1.8	0.1-1.0	0.05-0.9	0.1-0.6	
Av ht (m)				2.2	1.1	0.5	0.7	0.6	

Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)
Boraginaceae	*Heliotropium*	*pachyphyllum*		M3	0.5	2-10%
Fabaceae	*Senna*	*glutinosa* subsp. *pruinosa*		M1	2.2	<2% Few than 10
Fabaceae	*Senna*	*glutinosa* subsp. *pruinosa*		M2	1.1	<2% Few than 10
Asteraceae	*Pterocaulon*	*sphacelatum*		M3	0.6	<2% Numerous

Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)
Poaceae	*Cenchrus*	*ciliaris*	*	G2	0.6	2-10%
Poaceae	*Triodia*	*epactia*		G1	0.8	70-100%
Solanaceae	*Solanum*	*lasiophyllum*		M3	0.5	<2% Numerous
Fabaceae	*Acacia*	*gregorii*		M3	0.7	2-10%
Fabaceae	*Indigofera*	*monophylla*		M3	0.5	10-30%
Lauraceae	*Cassytha*	sp. (insufficient material)		G2	climber	10-30%
Goodeniaceae	*Scaevola*	*sericophylla*		M3	0.6	<2% Few than 10
Zygophyllaceae	*Zygophyllum*	*aurantiacum*		M3	0.5	<2% Few than 10
Fabaceae	*Acacia*	*bivenosa*		M2	1.1	<2% Few than 10
Goodeniaceae	*Scaevola*	*acacioides*		M3	0.9	<2% Few than 10
Goodeniaceae	*Goodenia*	*microptera*		G2	0.3	<2% Few than 10

Vegetation Site Sheet: habitat information					**Date:**	20/10/2017	**Site#:**	Q2
Survey:	ES2017-016						Q2	
Observers:	JF, JF							
Location:	Onslow, airport							
MGA Zone:	50, gda 94	**Easting:**	304810		**Northing:**	7603489		
Site Type:	Quadrat	**Dimensions:**	30x30	**Camera:**	**p338**	**From:**	nw	
Site Disturbance	**Frequency**		**Water or Wind Erosion Evidence**			**Field Vegetation Type**		
Mining/Infrastructure	Disturbs >10yr	Old tracks	No			spinifex steppe with some shrubs calcareous soils		
Exotic Weeds	Current Disturbance	Buffel Grass						
			Climate		**Vegetation Condition**		**Litter**	
			Dry, plants stress		Good			
			Site Drainage				**Leaf Litter:**	
			Good Drain				Sparse	
			Fire Frequency		**Fire Intensity**		**Wood Litter:**	
			Old >5yr		Not applicable		Negligible	
Surface Components		**Cover (if needed)**		**Soil**		**Landform**		
Loose Soil		20		Major Component		**Slope-Lower**		
Humus/Litter		5		Sand				
Cracked Clay		5						
Fine Rocks (2-6mm)		20		Minor		**Slope**		
Medium gravel/pebbles (6-20mm)		15		Loamy		Gentle		
Coarse gravel/pebbles (20-60mm)								
Cobbly Cobbles (60-200mm)				Soil Colour		**Slope Aspect**		
Stony/stones (200-600mm)			pink	Orange		East		
Surface Plates/boulders (>600mm)		40	limestone					



Growth Form Table									
Tree >10m		Tree 2-10m		Tree <2m			Tree Mallee		
Palm		Shrub >2m	M1	Shrub 1-2m		M2	Shrub >1m		M3
Cycads		Tussock Grass	G2	Hummock Grass		G1	Sedge		
Vine		Herbs		Other			Mallee Shrub		
Heath Shrub		Samphire Shrub		Chenopod			Rush		
Grass Tree		Other							
Stratum	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**	
%Cover				<2%	<2%	30-70%	70-100%	<2%	
Ht range (m)				2.1	1.1-1.8	0.1-1.0	0.05-0.9	0.1-0.6	
Av ht (m)				2.2	1.3	0.5	0.7	0.6	

Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)
Boraginaceae	*Heliotropium*	*pachyphyllum*		M3	0.5	<2% Numerous
Fabaceae	*Senna*	*glutinosa* subsp. *x luersennii*		M1	2.1	<2% Few than 10
Fabaceae	*Senna*	*glutinosa* subsp. *x luersennii*		M2	1.1	<2% Few than 10
Poaceae	*Cenchrus*	*ciliaris*	*	G2	0.6	<2% Few than 10
Poaceae	*Triodia*	*epactia*		G1	0.8	70-100%
Solanaceae	*Solanum*	*lasiophyllum*		M3	0.5	<2% Few than 10

Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)
Fabaceae	*Acacia*	*gregorii*		M3	0.7	10-30%
Fabaceae	*Indigofera*	*monophylla*		M3	0.5	2-10%
Lauraceae	*Cassytha*	sp. (insufficient material)		G2	climber	<2% Few than 10
Goodeniaceae	*Scaevola*	*sericophylla*		M3	0.6	10-30%
Amaranthaceae	*Ptilotus*	*macrocephalus*		M3	0.4	<2% Few than 10
Fabaceae	*Acacia*	*bivenosa*		M2	1.1	<2% Few than 10
Goodeniaceae	*Scaevola*	*acacioides*		M3	0.9	<2% Few than 10
Malvaceae	*Corchorus*	*sidoides* subsp. *vermicularis*		M3	0.25	<2% Few than 10
Fabaceae	*Acacia*	*coriacea* subsp. *coriacea*		M2	1.1	<2% Few than 10
Asteraceae	*Pterocaulon*	*sphacelatum*		M2	0.8	<2% Few than 10
Poaceae	*Panicum*	*decompositum*		G2	0.6	<2% Few than 10

Vegetation Site Sheet: habitat information					**Date:**	20/10/2017	**Site#:**	Q3
Survey:	ES2017-016						Q3	
Observers:	JF, JF							
Location:	Onslow, airport							
MGA Zone:	50, gda 94	**Easting:**	304954		**Northing:**	7603616		
Site Type:	Quadrat	**Dimensions:**	30x30	**Camera:**	**p343**	**From:**	nw	
Site Disturbance	**Frequency**		**Water or Wind Erosion Evidence**			**Field Vegetation Type**		
Mining/Infrastructure	Disturbs >10yr	Old Tracks	No			spinifex steppe and buffel and sporobolus		
Exotic Weeds	Current Disturbance	Buffel Grass						
Flood	Disturbs >10yr?	Off Road drainage	**Climate**		**Vegetation Condition**		**Litter**	
			Dry, plants stress		Poor			
			Site Drainage				**Leaf Litter:**	
			Poor Drain				Negligible	
			Fire Frequency		**Fire Intensity**		**Wood Litter:**	
			Old >5yr		Not applicable		Negligible	
Surface Components		**Cover (if needed)**		**Soil**		**Landform**		
Loose Soil		20		Major Component		**Slope-Lower**		
Humus/Litter		5		Sand				
Cracked Clay		5						
Fine Rocks (2-6mm)		20		Minor		**Slope**		
Medium gravel/pebbles (6-20mm)				Loamy		Gentle		
Coarse gravel/pebbles (20-60mm)								
Cobbly Cobbles (60-200mm)				Soil Colour		**Slope Aspect**		
Stony/stones (200-600mm)			pink	Orange		East		
Surface Plates/boulders (>600mm)								

Growth Form Table									
Tree >10m		Tree 2-10m		Tree <2m			Tree Mallee		
Palm		Shrub >2m		Shrub 1-2m		M1	Shrub >1m		M2
Cycads		Tussock Grass	G2	Hummock Grass		G1	Sedge		
Vine		Herbs		Other			Mallee Shrub		
Heath Shrub		Samphire Shrub		Chenopod			Rush		
Grass Tree		Other							
Stratum	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**	
%Cover				<2%	2-10%		10-30%	30-70%	
Ht range (m)				1.8	0.1-1.0		0.05-0.9	0.1-0.6	
Av ht (m)				1.8	0.4		0.7	0.6	

Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)
Fabaceae	*Acacia*	*Synchronicia*		M1	1.8	<2% Few than 10
Asteraceae	*Pluchea*	*rubelliflora*		M2	0.4	2-10%
Plantaginaceae	*Stemodia*	sp. Onslow (A.A. Mitchell 76/148)		M2	0.9	<2% Few than 10
Poaceae	*Triodia*	*epactia*		G1	0.8	10-30%
Poaceae	*Cenchrus*	*ciliaris*	*	G2	0.8	30-70%
Poaceae	*Sporobolus*	*mitchellii*		G2	0.7	30-70%

Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)
Asteraceae	*Pluchea*	*dunlopii*		M3	0.5	2-10%
Poaceae	*Sorghum*	*plumosum*		G2	0.9	<2% Few than 10
Goodeniaceae	*Scaevola*	*acacioides*		M2	0.9	<2% Few than 10
Fabaceae	*Rhynchosia*	*minima*		M2	0.4	<2% Few than 10
Malvaceae	*Lawrencia*	*viridigrisea*		M2	0.4	<2% Few than 10
Fabaceae	*Indigofera*	*monophylla*		M2	0.4	<2% Few than 10
Chenopodiaceae	*Neobassia*	*astrocarpa*		M2	0.25	<2% Few than 10
Chenopodiaceae	*Tectocornia*	*indica* subsp. *bidens*		M2	0.4	<2% Few than 10
Frankeniaceae	*Frankenia*	*ambita*		M2	0.2	<2% Few than 10
Brassicaceae	*Lepidium*	sp. (insufficient material)		G2	0.1	<2% Few than 10

Onslow Marine Support Base – Dredge Management Area and Pipeline Route Flora Inventory

Family	Genus	Species	Status	DMMA	Pipeline	Q1	Q2	Q3	T1	R1	R2	R3	R4	R5	R6	T2	T3	R7	R8	R9	R10	R11	R12	R13	R14
Amaranthaceae	*Aerva*	*javanica*	*	x	x																				x
Amaranthaceae	*Ptilotus*	*macrocephalus*		x			x																		
Amaranthaceae	*Ptilotus*	*nobilis*		x	x																				
Amaranthaceae	*Surreya*	*diandra*		x	x				x						x										
Asteraceae	*Angianthus*	*acrohyalinus*		x																					
Asteraceae	*Flaveria*	*trinervia*	*	x	x																			x	x
Asteraceae	*Pluchea*	*dunlopii*		x	x			x								x									
Asteraceae	*Pluchea*	*rubelliflora*		x	x			x																x	x
Asteraceae	*Pterocaulon*	*sphacelatum*		x	x	x	x					x		x		x		x		x					
Asteraceae	*Streptoglossa*	*macrocephala*		x																					
Boraginaceae	*Heliotropium*	*cunninghamii*		x																					
Boraginaceae	*Heliotropium*	*pachyphyllum*		x	x	x	x									x		x		x					
Boraginaceae	*Trichodesma*	*zeylanicum*		x	x																				x
Brassicaceae	*Lepidium*	sp. (insufficient material)		x				x																	
Chenopodiaceae	*Atriplex*	*semilunaris*		x	x				x						x			x							
Chenopodiaceae	*Dysphania*	*plantaginella*		x																					
Chenopodiaceae	*Enchylaena*	*tomentosa*		x										x											
Chenopodiaceae	*Neobassia*	*astrocarpa*		x	x			x								x	x		x		x			x	
Chenopodiaceae	*Salsola*	*australis*		x	x																				x
Chenopodiaceae	*Tecticornia*	*auriculata*		x	x				x						x		x								
Chenopodiaceae	*Tecticornia*	*halocnemoides*		x	x				x	x			x		x		x		x		x	x	x		
Chenopodiaceae	*Tecticornia*	*indica* subsp. *bidens*		x	x			x	x				x		x	x	x		x		x	x	x		
Convolvulaceae	*Operculina*	*aequisepala*		x																					
Cyperaceae	*Bulbostylis*	*barbata*			x																				
Euphorbiaceae	*Adriana*	*tomentosa*		x	x																				x
Euphorbiaceae	*Euphorbia*	*myrtoides*		x	x																				x
Euphorbiaceae	*Euphorbia*	*tannensis*		x	x																				x
Fabaceae	*Acacia*	*bivenosa*		x	x	x	x					x		x		x									
Fabaceae	*Acacia*	*coriacea* subsp. *coriacea*		x	x		x					x		x						x					x
Fabaceae	*Acacia*	*gregorii*		x	x	x	x									x									
Fabaceae	*Acacia*	*sclerosperma* subsp. *sclerosperma*		x																					
Fabaceae	*Acacia*	*synchronicia*		x	x			x								x									
Fabaceae	*Acacia*	*trachycarpa*		x																					
Fabaceae	*Crotalaria*	*cunninghamii*		x																					

Family	Genus	Species	Status	DMMA	Pipeline	Q1	Q2	Q3	T1	R1	R2	R3	R4	R5	R6	T2	T3	R7	R8	R9	R10	R11	R12	R13	R14
Fabaceae	*Indigofera*	*linifolia*		x								x		x											
Fabaceae	*Indigofera*	*monophylla*		x	x	x	x	x				x		x		x		x		x				x	
Fabaceae	*Rhynchosia*	*minima*		x	x			x						x		x									
Fabaceae	*Senna*	*artemisioides* subsp. *oligophylla*		x																					
Fabaceae	*Senna*	*glutinosa* subsp. *pruinosa*		x		x																			
Frankeniaceae	*Frankenia*	*ambita*		x	x		x	x	x			x		x	x	x	x						x	x	
Goodeniaceae	*Goodenia*	*forrestii*		x																					
Goodeniaceae	*Goodenia*	*microptera*		x		x																			
Goodeniaceae	*Scaevola*	*acacioides*		x	x	x	x	x						x		x				x					
Goodeniaceae	*Scaevola*	*sericophylla*		x	x	x	x									x		x		x				x	
Lauraceae	*Cassytha*	sp. (insufficient material)		x	x	x	x							x		x		x		x					
Malvaceae	*Abutilon*	*lepidum*		x																					
Malvaceae	*Corchorus*	*sidoides* subsp. *vermicularis*		x	x		x													x					
Malvaceae	*Gossypium*	*australe*		x																					
Malvaceae	*Lawrencia*	*viridigrisea*		x	x			x	x						x	x	x					x			
Myrtaceae	*Eucalyptus*	*victrix*		x																					
Plantaginaceae	*Stemodia*	sp. Onslow (A.A. Mitchell 76/148)		x	x			x								x									
Plumbaginaceae	*Muellerolimon*	*salicorniaceum*		x	x				x				x		x		x					x	x		
Poaceae	*Cenchrus*	*ciliaris*	*	x	x	x	x	x								x		x		x	x			x	x
Poaceae	*Chloris*	*pectinata*		x																					
Poaceae	*Eragrostis*	*falcata*		x	x				x				x		x		x		x		x		x		
Poaceae	*Panicum*	*decompositum*		x	x		x									x									
Poaceae	*Sorghum*	*plumosum*		x	x			x								x									x
Poaceae	*Sporobolus*	*mitchellii*		x	x			x					x		x	x	x		x		x		x		
Poaceae	*Triodia*	*epactia*		x	x	x	x	x				x		x		x		x		x				x	x
Poaceae	*Triodia*	*schinzii*		x																					
Proteaceae	*Hakea*	*lorea*		x	x																				x
Scrophulariaceae	*Myoporum*	*montanum*		x	x																				x
Solanaceae	*Solanum*	*lasiophyllum*		x	x	x	x									x									
Stackhousiaceae	*Stackhousia*	*clementii*	P3		x																				
Tamaricaceae	*Tamarix*	*aphylla*	*DP, WoNS	x																					
Zygophyllaceae	*Zygophyllum*	*aurantiacum*		x		x																			

Where: * = weed/introduced, P3 = Priority 3, DP = Declared Pest, WoNS = Weed of National Significance

Appendix C

Threatened and Priority Reporting Form

TPRF – *Stackhousia clementii*

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

Please complete as much of the form as possible.
For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at http://www.dpaw.wa.gov.au/

TAXON: Stackhousia clementii **TPFL Pop. No:** n/a
OBSERVATION DATE: 20/10/2017 **CONSERVATION STATUS:** P3 New population ☒
OBSERVER/S: Joshua Foster **PHONE:** 0428 524 605
ROLE: Ecologist **ORGANISATION:** Earth Stewardship

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Onslow, Shire of Ashburton, Western Australia
1.0 km south of Beadon Creek Road intersection on Onslow Road and then 275 m east of Onslow Road.
Plants located on beach between tidal mudflats and flat coastal plain.

Reserve No:

DISTRICT: Pilbara **LGA:** Shire of Asburton Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☒ DegMinSec ☐ UTMs ☐
Lat / Northing: 21.654105
Long / Easting: 115.121764
Zone: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: Map used:
Boundary polygon captured: ☐ Map scale:

LAND TENURE:
Nature reserve ☐ Timber reserve ☐ Private property ☒ Rail reserve ☐ Shire road reserve ☐
National park ☐ State forest ☐ Pastoral lease ☐ MRWA road reserve ☐ Other Crown reserve ☐
Conservation park ☐ Water reserve ☐ UCL ☐ SLK/Pole _____ to _____ Specify other: Shire managed lands

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☒ Area observed (m²): 5
EFFORT: Time spent surveying (minutes): 0.2 hours No. of minutes spent / 100 m²: _____
POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒
Count method: (Refer to field manual for list) _____
WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive	15			
Dead				

Area of pop (m²): 5
Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☒
Immature fruit ☐ Fruit ☒ Dehisced fruit ☐ Percentage in flower: 50%

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐
COMMENT:

THREATS - type, agent and supporting information: E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. **Rate current and potential threat impact:** N=Nil, L=Low, M=Medium, H=High, E=Extreme **Estimate time to potential impact:** S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
• Off Road Vehicular Activities	H	H	S
• Storm Surge (Cyclonic activities)	M	M	M
• Pipeline Installation for Onslow Marine Support Base Dredge Activities	L	L	M

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Accepted in Database** ☐

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest ☐	Granite ☐	(on soil surface; e.g. gravel, quartz fields)	Sand ☒	Red ☐	Well drained ☒
Hill ☐	Dolerite ☐		Sandy loam ☐	Brown ☐	Seasonally inundated ☒
Ridge ☐	Laterite ☐	0-10% ☒	Loam ☐	Yellow ☐	Permanently inundated ☐
Outcrop ☐	Ironstone ☐	10-30% ☐	Clay loam ☐	White ☐	Tidal ☒
Slope ☒	Limestone ☐	30-50% ☐	Light clay ☐	Grey ☐	
Flat ☐	Quartz ☐	50-100% ☐	Peat ☐	Black ☐	
Open depression ☐					
Drainage line ☐	Specify other:		Specify other:	Specify other:	Specify other:
Closed depression ☐	nil			pale orange	beach edge of tidal mudflat
Wetland ☐					

Specific Landform Element: (Refer to field manual for additional values)

Lower Slope, Gentle … Beach

CONDITION OF SOIL:

Dry ☒ Moist ☒ Waterlogged ☐ Inundated ☐ Cracked ☐ Saline ☒ Other:

VEGETATION CLASSIFICATION:* E.g. **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) **3**. Isolated clumps of sedges (Mesomelaena tetragona)	1. Tecticornia indica subsp. bidens, T. auriculata, halocnemoides low open samphire shrubland over Sprorobolus mitchellii, Eragrostis falcata sparse hummock grassland
	2. on saline sandy beach.
	3.
	4.
ASSOCIATED SPECIES: Other (non-dominant) spp	Neobassia astrocarpa, Muellerolimon salicorniaceum, Atriplex semilunaris
	*Cenchrus ciliaris and Triodia epactia on upper slope of beach where intersects coastal plain

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good ☐ Good ☐ Degraded ☒ Completely degraded ☐

COMMENT: Impact from off road vehicles

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☒

FENCING: Not required ☒ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☒ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Site likely to be flagged and fenced as part of management works for the proposed pipeline installation.

Large numbers of this taxon have been recorded on nearby Pilbara Islands (Astron, 2015) and at other locations in its extremely widespread range (e.g. 180 plants per 100 m2 near Wiluna - GHD, 2014: Goldfields Hwy Portlink Project) and as such, its current conservation status may be reviewed.

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Accepted in Database** ☐

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

DRF PERMIT/ LICENCE No:

Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: SL012114 WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: No specimen

ATTACHED: Map ☒ Mudmap ☐ Photo ☒ GIS data ☒ Field notes ☐ Other:

COPY SENT TO: Regional Office ☐ District Office ☒ Other:

Submitter of record: Joshua Foster - Earth Stewardship **Role:** owner/manager / ecologist

Signature: JFOSTER **Date submitted:** 26/10/2017

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Accepted in Database** ☐