

South Pacific Offshore Wind Project

Preliminary Desktop Marine Environmental Assessment

Customer
Project
Deliverable
Version

South Pacific OWP Project Pty Ltd
A11966
003
05
8 June 2023

Document Control

Document Identification

Title	South Pacific Offshore Wind Project
Project No	A11966
Deliverable No	003
Version No	05
Version Date	8 June 2023
Customer	South Pacific OWP Project Pty Ltd
Classification	BMT (OFFICIAL)
Author	Sophie Barrett, Dr Darren Richardson
Reviewed By	Lisa McKinnon
Project Manager	Lisa McKinnon

Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
00	28 July 2022	South Pacific OWP Project	Draft Report – Word only
01	01 August 2022	South Pacific OWP Project	Updated Draft Report
02	10 November 2022	South Pacific OWP Project	Updated Report
03	13 January 2023	South Pacific OWP Project	Updated Report
04	30 May 2023	South Pacific OWP Project	Final Report
05	08 June 2023	South Pacific OWP Project	Updated Final Report

This report is prepared by BMT Commercial Australia Pty Ltd (“BMT”) for the use by BMT’s client (the “Client”). No third party may rely on the contents of this report. To the extent lawfully permitted by law all liability whatsoever of any third party for any loss or damage howsoever arising from reliance on the contents of this report is excluded. Where this report has been prepared on the basis of the information supplied by the Client or its employees, consultants, agents and/or advisers to BMT Commercial Australia Pty Ltd (“BMT”) for that purpose and BMT has not sought to verify the completeness or accuracy of such information. Accordingly, BMT does not accept any liability for any loss, damage, claim or other demand howsoever arising in contract, tort or otherwise, whether directly or indirectly for the completeness or accuracy of such information nor any liability in connection with the implementation of any advice or proposals contained in this report insofar as they are based upon, or are derived from such information. BMT does not give any warranty or guarantee in respect of this report in so far as any advice or proposals contains, or is derived from, or otherwise relies upon, such information nor does it accept any liability whatsoever for the implementation of any advice recommendations or proposals which are not carried out under its control or in a manner which is consistent with its advice.

Contents

1 Introduction	8
1.1 Background	8
1.2 Study Objectives	8
1.3 Terminology.....	8
2 Relevant Legislation and Planning Advice	11
2.1 Commonwealth	11
2.2 State	13
3 Project Description	15
4 Methodology	16
5 Description of the Existing Environment	18
5.1 General Description of the Marine Environment.....	18
5.2 Oceanography	22
5.3 Bathymetry and Surface Sediment.....	22
5.4 Protected Areas.....	26
5.5 Benthic Environment and Habitats	32
5.6 Other Existing Human Uses	36
5.7 Matters of National Environmental Significance	41
5.8 State Matters	74
5.9 Other Matters	79
5.10 Summary of Baseline Issues	84
6 Potential Impacts	86
6.1 Geotechnical and Geophysical Surveys	86
6.2 Entanglement – Construction/ Operation.....	86
6.3 Sensitive Habitat Loss – Construction/ Operation	87
6.4 Turbidity – Construction/ Decommissioning/ Operation.....	87
6.5 Disturbance of Acidic or Contaminated Soils – Construction.....	87
6.6 Vessel Strike – Construction/ Operation/ Decommissioning.....	87
6.7 Marine Pests – Construction/ Operation.....	88
6.8 Spills – Construction. Operation/ Decommissioning.....	88
6.9 Noise/ Vibration Generated by Turbine – Operation.....	88
6.10 Electromagnetic Fields – Operation	88
6.11 Hydrodynamic Impacts – Operation	89
6.12 Bird Strike and Avoidance of Rotors – Operation	89
6.13 Light Pollution.....	90
6.14 Artificial Reef Creation and Fishing Exclusion – Operation	90

6.15 Cultural and Social Access – Construction/ Operation 91

6.16 Marine Cultural Heritage – Construction/ Operation 91

6.17 Navigational Hazards – Construction/ Operation 91

7 Preliminary Risk Assessment 92

7.1 Matter of National Environmental Significance 92

8 Next Steps 100

9 References 101

Tables

Table 5.1 Jervis Marine Park (Commonwealth) Key Features (Director of National Parks 2013) 26

Table 5.2 Listed Threatened (Marine) Species for South Pacific Offshore Wind Project Study Area 47

Table 5.3 Listed migratory species (not listed as threatened under EPBC Act) 75

Table 7.1 Critically Endangered and Endangered Species: Potential Significance of Impact 93

Figures

Figure 1.1 Site Overview 10

Figure 5.1 Key Ecological Features of the Temperate East Marine Region (DSEWPC 2012) 19

Figure 5.2 Marine Bioregions within the Study Area (IMCRA 2011) 21

Figure 5.3 Australian Currents (Australia State of Environment 2016) 22

Figure 5.4 Navigational Chart of Study Area (GPS Nautical Charts 2023) 24

Figure 5.5 Substrate Composition in offshore Study Area (DCCEEW 2017) 25

Figure 5.6 Protected Areas within and around the Study Area 30

Figure 5.7 Jervis Bay Commonwealth Marine Park Zones (Commonwealth of Australia 2018) 31

Figure 5.8 Seabed Landforms and KEFs within and around the Study Area (Linkwater and Morris 2022; NCVA 2022) 34

Figure 5.9 Benthic Habitats within and around the Study Area (SEED 2002) 35

Figure 5.10 Defence Training Areas in the East Marine Region (Australian Hydrographic Office 2020) 37

Figure 5.11 Unexploded Ordnance (UXO) Sites (ADF 2023) within and adjacent to the Study Area 38

Figure 5.12 Oil and Gas Leases, Shipwrecks and Key Fish Habitat Areas within and adjacent to the Study Area 40

Figure 5.13 Maritime Boundaries within and adjacent to the Study Area 43

Figure 5.14 Biologically Important Areas for Marine Megafauna within and adjacent to the Study Area 45

Figure 5.15 Seabirds Records and BIAs within and adjacent to the Study Area 56

Figure 5.16 Shorebird and Parrot Records within and adjacent to the Study Area 57

Figure 5.17 Known Distribution of the Orange-Bellied Parrot (Australian Government 2016) 59

Figure 5.18 Distribution of the Swift Parrot in Southeast Australia (Commonwealth of Australia 2019) 60

Figure 5.19 Marine Turtle Sightings within and adjacent to the Study Area 62

Figure 5.20 Sites at Shellharbour where grey nurse sharks have been reported (Reproduced from Otway et al. 2003) 64

Figure 5.21 Grey nurse shark critical habitat and aggregation sites in NSW (Source: NSW Department of Primary Industries 2014)	65
Figure 5.22 Coastal aggregation areas and geographic range of southern right whale (<i>Balaena australis</i>) (SPRAT 2022).....	68
Figure 5.23 Whale Sightings within and adjacent to the Study Area	70
Figure 5.24 Distribution of the Humpback Whale in Australia (SPRAT 2022)	73
Figure 5.25 Fishing effort (fisher days) by fishing zone for the NSW/ACT resident population aged five years and older who fished recreationally in NSW or the ACT during 2013/14 (Source: West et al. 2015)	79
Figure 5.26 Sampling Sites Monitored by Wollongong City Council under Beachwatch Programs (NSW DPIE 2021).....	81
Figure 5.27 Vessel Tracking Data for 2022 (Marine Traffic 2022).....	83

Abbreviations and Acronyms

ADF	Australian Defence Force
AMSA	<i>Australian Maritime Safety Authority Act 1990</i>
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BIA	Biologically Important Area
CLM Act	<i>Crown Land Management Act 2016</i>
CSIRO	Commonwealth Scientific Research and Industrial Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEWHA	Department of Environment, Water, Heritage and Arts (now DCCEEW)
DIWA	Directory of Important Wetlands
DoEE	Department of the Environment and Energy (now DCCEEW)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (now DCCEEW)
EEZ	Exclusive Economic Zone
EPA Act	<i>Environmental Planning and Assessment Act 1979</i>
FM Act	<i>Fisheries Management Act 1994</i>
HAT	Highest Astronomical Tide
IBAs	Important Bird Areas
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IUCN	International Union for Conservation of Nature
KEF	Key Ecological Feature
KFH	Key Fish Habitat
KTPs	Key Threatening Processes
LAT	Lowest Astronomical Tide
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NAGD	National Assessment Guidelines for Dredging (2009)
NCVA	National Conservation Values Atlas
NPW Act	<i>National Parks and Wildlife Act 1974</i>
NSW DPI	New South Wales Department of Primary Industries
NSW DPIPWE	New South Wales Department of Planning, Industry and the Environment
OEI Act	<i>Offshore Electricity Infrastructure Act 2021</i>
OIR	Offshore Infrastructure Regulator

BMT (OFFICIAL)

PMST	Protected Matters Search Tool
Sea Dumping Act	<i>Environment Protection (Sea Dumping) Act 1981</i>
SEED	Sharing and Enabling Environmental Data portal
SPOWP	South Pacific Offshore Wind Project
SPRAT	Species Profile and Threats Database
SSD	State Significant Development
SSI	State Significant Infrastructure
TEC	Threatened Ecological Community
TSB	Territorial Sea Baseline
UXO	Unexploded Ordnance

1 Introduction

1.1 Background

The South Pacific OWP Pty Ltd (the Proponent) is planning to develop the South Pacific Wind Project (SPOWP, 'the Project'). The Project is located off the coast of the Illawarra region of New South Wales (NSW) (refer to Figure 1.1).

This document is a preliminary scoping study of the marine environmental attributes and values. In first instance, it will be used to support a referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In due course, it may be used to inform applications under the *Environmental Planning and Assessment Act 1979* (EPA Act) and other NSW State legislation.

1.2 Study Objectives

The objectives of this scoping study are to:

- develop a first-pass assessment of marine environmental, social or economic values and associated constraints for the Study Area
- undertake a first-pass assessment of potential impacts to the marine environment as a result of planning, construction, operation and decommissioning of the Project at a Commonwealth and State level
- inform decision-making about the level of assessment required once the Project receives approval to proceed to the next phase

1.3 Terminology

The following terms are used frequently in this report:

- The term *marine environment* is defined as all marine and coastal waters up to the Highest Astronomical Tide (HAT) boundary. This is distinct from 'Commonwealth marine environment' which is the area between 3 and 200 nautical miles from the coast.
- Within this report, the conservation status of a species is defined in accordance with the provisions of relevant state legislation and its regulations and amendments such as *Biodiversity Conservation Act 2016*, and the EPBC Act (refer to Section 2 for further information). Threatened is a common use term to collectively describe endangered and vulnerable species.
- The *Project Area* is defined as the direct footprint of wind turbines, substations and subsea cabling routes up to the shoreline. Figure 1.1 shows the entire Project Area (including onshore connections) and the offshore *Study Area* which is defined below.

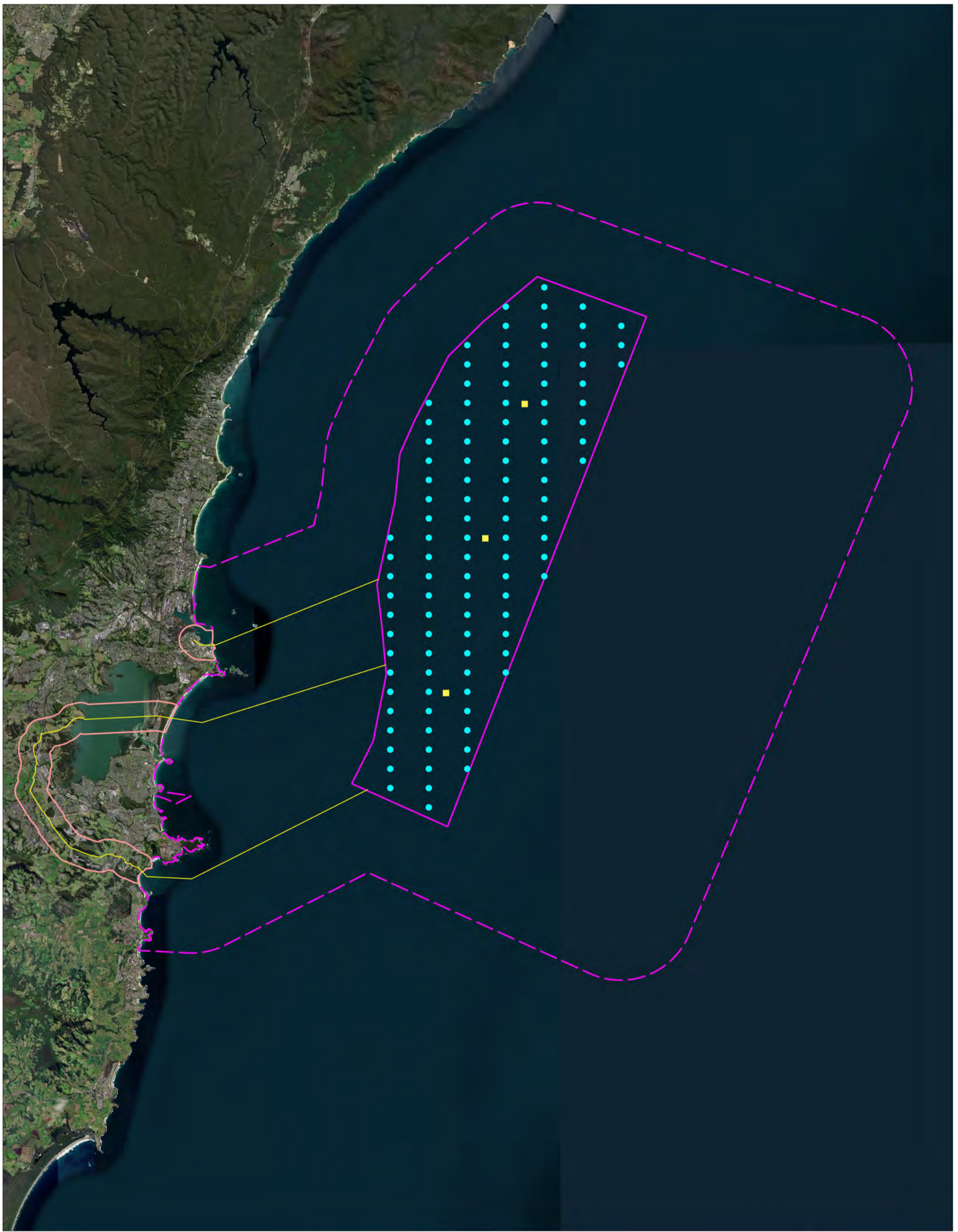
As shown in Figure 1.1, the Study Area extends beyond the Project Area. The purpose of the Study Area is to provide additional context to the existing site conditions and for identification of potential impacts. It provides flexibility in siting and design as a response to the outcomes of Phase 1 and subsequent assessments.

The Study Area includes:

- An approximate 5 km buffer around the Project components (offshore wind turbines and substations) and subsea export cable routes up to the shoreline.
- A 1 km buffer around the onshore overhead (or underground where needed) transmission line and the onshore substation (referred to as the transmission line corridor) except where alternatives are considered.
- An additional 10 km buffer to the east of the Project components (wind turbines and offshore substations)

The following definitions apply within the Study Area:

- *Offshore* refers to all areas from the low water line along the coast out to sea. For the purpose of the Project, the Study Area and Project Area lie in Commonwealth and State Waters (see definitions below).
- *Onshore* refers to all land-based areas above the low water line.
- *State Waters* refers to area from the low water line along the coast up to 3 nautical miles seaward.
- *Territorial Waters* and *Contiguous Zone* (Commonwealth) refers to land from the State Water boundary up to 12 and 24 nautical miles respectively, from the low water line along to the coast.
- *Exclusive Economic Zone* extends from the Territorial Waters and Contiguous Zone up to 200 nautical miles from the low water line along to the coast.



LEGEND

- Project Area
- Marine Study Area
- Terrestrial Study Area
- Transmission Route
- Wind Turbine Layout
- Offshore Substations

Title:
Project Location

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Figure:
1-1

Rev:
C



2 Relevant Legislation and Planning Advice

As discussed in Section 1, this report provides the preliminary marine environmental assessment for the SPOWP to support referrals under the EPBC Act.

Other relevant legislation specific to the marine environment that will need to be considered as the Project (and environmental assessment) progresses are summarised below.

As the Project is largely within Commonwealth waters, this review focuses on Commonwealth legislation, however there are a range of state legislative requirements and policies that also need to be considered for works in State waters.

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the primary piece of legislation for management and assessment of environmental protection in commonwealth waters. It provides for the protection of a range of matters of national environmental significance (MNES) which include commonwealth waters, threatened and migratory species (for further information on MNES, refer to Section 5.7).

The Act also sets out requirements for activities in the Australian Whale Sanctuary, which protects all cetaceans (whales, dolphins) in Australian waters comprising of the Commonwealth marine area beyond coastal waters as well as the Exclusive Economic Zone (EEZ). Requirements will include ensuring vessels do not cause interference to whales, having monitors in place during construction etc. Any field work associated with whale monitoring may also require a separate approval under the EPBC Act.

2.1.2 Offshore Electricity Infrastructure Act 2021

The *Offshore Electricity Infrastructure Act 2021* (OEI Act) and associated regulations stipulate the framework to enable construction, operation and decommissioning of offshore electricity infrastructure projects. The framework applies to offshore locations from 3 nautical miles off the coast to the boundary of the EEZ, with coastal waters up to 3 nautical miles remaining the responsibility of the relevant State government.

A Feasibility Licence will be required for the Project in order for the SPOWP to conduct certain site feasibility studies. The Proponent will also be required to submit management plan(s) to the Offshore Infrastructure Regulator (OIR) for assessment.

Under the OEI Act, the OIR is responsible for assessing licence applications based on technical, financial and overall suitability of a project. The OIR advises the Commonwealth Minister for Energy, who undertakes all licensing decisions.

2.1.3 Australian Maritime Safety Authority Act 1990

The *Australian Maritime Safety Authority Act 1990* (AMSA) sets out the processes and procedures for responding to marine pollution events, particularly oil spills. The Proponent will be required to work under this Act to put procedures in place to both minimise and respond to potential spill events during construction and operational phases.

2.1.4 Biosecurity Act 2015

The *Biosecurity Act 2015* manages the introduction of exotic pests and diseases in Australia. Of most relevance is requirements around vessels that enter Australian waters and requirements for ballast exchange offshore and pest inspections. This Act will guide requirements for any incoming vessels (or other goods and services) required for construction or operational purposes.

2.1.5 Environment Protection (Sea Dumping) Act 1981

The *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act) regulates the loading and dumping of waste at sea within Australian Waters. The National Assessment Guidelines for Dredging (NAGD) (2009) set out the assessment framework for dredging activities which informs the suitability of dredge material for offshore placement. Under the Sea Dumping Act, an approval is required for the placement of material within Commonwealth Waters. Commonly, the NAGD are also used to determine the suitability of material for placement in state waters.

If there is a need to undertake dredging either for cabling installation or drilling works, then an assessment against the guidelines will be necessary; this involves consideration of the following:

- Opportunities to beneficially reuse or recycle dredge material (this includes land reclamation, beach nourishment, offshore berms, and capping material, agriculture and product uses (aquaculture, construction material, liners) and environmental enhancement (restoration and establishment of wetlands, upland habitats, nesting islands and fisheries).
- If hazardous, can the material be treated to destroy, reduce or remove the hazardous constituents.
- What the comparative risks are to the environment and human health of alternatives.
- What the costs and benefits are of proposed alternatives.

2.1.6 Fisheries Administration Act 1991

The *Fisheries Administration Act 1991* is largely responsible for the management of Australian fisheries in Commonwealth waters. Of particular relevance to this Project is the allocation of fishing rights and plans of management. Section 5.8.2 provides further information about Commonwealth Fisheries.

2.1.7 Protection of the Sea (Prevention of Pollution from Ships) Act 1938

The *Protection of the Sea (Prevention of Pollution from Ships) Act 1938* largely deals with the management of marine pollution associated with air emissions, water quality and noxious substances such as sewage discharged from ships. Vessels used for construction and operations of the facility will be required to adhere to the requirements of this Act.

2.1.8 Underwater Cultural Heritage Act 2018

The *Underwater Cultural Heritage Act 2018* (UCH Act) protects shipwrecks, sunken aircraft and their associated artefacts, that occurred 75 or more years ago, regardless of whether their location is known. A permit may be required to enter and utilise the area within a shipwreck protection zone. The Project must adhere to the following additional requirements:

- Do not disturb or damage underwater heritage and its surrounding environment or remove artefacts, during the course of any visits.
- Observe the requirements of protected zones.
- Provide authorities with a notification of any new underwater heritage discovery within 21 days.
- Report any suspicious or illegal activity that you observe happening around underwater heritage sites.

2.2 State

There is currently no clear approval pathway available for offshore wind developments in NSW or transmission lines constructed by private parties. The NSW government has also not publicly released any framework outlining the planning regime for construction of future offshore wind project.

Considering these limitations, a possible approvals pathway and planning framework has been developed considering the following relevant State legislation.

2.2.1 Environmental Planning and Assessment Act 1979

The EPA Act is the primary land use legislative document in NSW. The EPA Act governs matters such as planning administration, planning instruments, development assessments, building certification, infrastructure finance, appeals and enforcement.

The approval pathway through the NSW Planning system has not yet been confirmed, however the Project may require further development as either a State Significant Development (SSD) or State Significant Infrastructure (SSI). The Minister for Planning is the approval authority for SSI and SSD applications.

Aboriginal cultural heritage approvals are also addressed under the EP&A Act.

2.2.2 Biodiversity Conservation Act 2016

The purpose of the *Biodiversity Conservation Act 2016* is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable developed. The Act establishes a framework for assessing and offsetting biodiversity impacts from proposed development. Native animals and plants as well as threatened species populations and ecological communities in NSW are protected under this Act.

A license or approval under the Act may be required to approach or interfere with marine fauna the activities are considered likely to cause harm or damage to threatened species, populations or ecological communities, or to their habitats e.g. marine mammals through vessel strike.

2.2.3 Crown Land Management Act 2016

A *Crown Land Management Act 2016* (CLM Act) oversees the governance of 35,000 Crown reserves across NSW. A lease or license under the CLM may be required for the construction and operation of facilities for the harnessing of energy and conversion into electricity energy on Crown land.

In this instance, the Project largely occurs within a Commonwealth marine area being the Territorial Sea and EEZ, any infrastructure in State waters would be subject to this Act.

2.2.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* oversees the management of fisheries resources. The Act lists and manages threatened and protected marine species and ecological communities, facilitates management of aquatic reserves and aquatic resources and key threatening processes (KTPs). The Act also guides the planning approvals/permits/ licenses process for recreational and commercial fishing activities within the state.

Under the Act, a permit is required for the following activities:

- Activities involving dredging and reclamation work
- Activities temporarily or permanently obstructing fish passage

- Using explosives and other dangerous substances
- Harming marine vegetation.

The project infrastructure (i.e. turbines and cabling) is not within a state marine park or aquatic reserve however, there is a small aquatic reserve within the southwest section of the broader offshore Study Area. Developments in or adjacent to aquatic reserves are managed according to the *Marine Estate Management Act 2014* (see Section 2.2.5 below). A permit would be required for the disturbance and/or removal of any marine plants such as mangroves, saltmarsh or seagrass.

2.2.5 Marine Estate Management Act 2014

The *Marine Estate Management Act 2014* establishes the framework for strategic and integrated management of the whole marine estate – marine waters, coasts and estuaries. Specifically, the Act facilitates the management and protection of marine parks including the planning approvals process. The Act also operates in alignment with other state legislation including the *Fisheries Management Act 1994*.

The Marine Estate Management Regulation 2017 supports the Act and outlines the procedures and criteria to be used in assessing applications for activities regulated within marine parks and aquatic reserves. Procedures for permit administration and offence for breaching permit conditions are also indicated within the regulation.

The Bushrangers Bay Aquatic Reserve is within the broader offshore Study Area approximately 1.6 km north of the southernmost cable route option. Therefore, a permit and application against assessment criteria set out in the Marine Estate Management Regulation 2017 may be required for preliminary offshore field surveys, and for cable laying during the construction phase to the extent the latter may cause an impact into the reserve.

2.2.6 Heritage Act 1997

The purpose of the *Heritage Act 1997* is to conserve important NSW heritage items. A permit or approval may be required under the *Heritage Act 1997* to interfere with any historic shipwrecks or other underwater heritage.

NSW government agencies work collaboratively with the Australian Government to monitor, manage, protect and conserve underwater cultural heritage. Permits to enter shipwreck protected zones are granted under the *Underwater Cultural Heritage Act 2018* however, are issued by NSW government on behalf of the Commonwealth.

2.2.7 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) was legislated to conserve the natural and cultural heritage of NSW.

Approvals under the NPW Act related to Aboriginal cultural heritage may be required (only if the Project is not considered SSI or SSD and therefore the Aboriginal cultural heritage approvals are not assessed under the EPA Act).

2.2.8 Coastal Management Act 2016

The purpose of the *Coastal Management Act 2016* is to manage the use and development of the coastal environment in an ecologically sustainable way. Any marine-based or coastal structures will require approval under the Act. The *State Environmental Planning Policy (Coastal Management) 2018* also sets out the framework for land use planning in a coastal zone in alignment with the Act.

3 Project Description

The Project is located approximately 10 – 30 km off the Illawarra coast, between Shellharbour and Clifton.

The Project includes 107 floating¹ wind turbine generators (WTG), three offshore substations and associated infrastructure with a capacity to generate up to 1.575 gigawatts (GW) of electricity. The WTGs will have a capacity between 15 megawatts (MW) and 20 MW, hub heights between 165 m and 190 m and rotor diameters of 250 m to 275 m.

Figure 1.1 shows the Project Area, which contains the offshore and onshore components of the Project, including the transmission line route options, associated with its construction, operation and decommissioning.

For transmission line route, three options are being considered:

- Option 1 - travels southwest from the offshore Project Area crossing the coastal barrier at the northern end of North Beach, then continues a short distance around the southern side of Port Kembla to connect to a substation within the Port.
- Option 2 - travels southwest from the offshore Project Area reaching land at Windang Beach. From here, the transmission line travels across Lake Illawarra in a westerly direction towards Tallawarra Point. The transmission line would then travel along portions of the existing Tallawarra Power Station transmission line easement towards the Princes Highway until it reaches the Dapto 330 kV switchyard.
- Option 3 - travels southwest from the offshore Project Area and reaches land at Minnamurra Beach. The route passes through Kilalea Regional Park and the suburb of Dunmore, continues west avoiding the Albion Park and Bombo Quarries and deviates northwest, traveling through the suburb of Croom and via the Princes Highway easement until it reaches the Dapto 330 kV switchyard.

The offshore wind farm component of the Project is located within Australia's EEZ. The Project Area (consisting of the wind turbines and associated infrastructure) covers an area of approximately 359 km² but a broader Study Area of approximately 856 km² is being investigated. The grid connection point is the existing Dapto 330kV switchyard, located within the Wollongong Local Government Area (LGA).

¹ A floating turbine is mounted on a floating structure which is tethered to the seabed via mooring lines.

4 Methodology

Publicly available information relating to the marine environmental features and values for the Study Area (refer to Section 5) was collated and reviewed, specifically:

- MNES, as defined under the EPBC Act
- Threatened and other conservation-dependent species (e.g. protected etc.) listed under the *Biodiversity Conservation Act 2016* and the *Fisheries Management Act 1994 BC Act* and *FM Act*.

Primary data sources were as follows:

- EPBC Protected Matters Search (PMST), undertaken for the Study Area including the Project Area and additional buffers.
- Species sightings records and/or benthic habitat mapping:
 - NSW BioNet Atlas
 - Sharing and Enabling Environmental Data portal (SEED) in NSW.
- National Conservation Values Atlas (NCVA) for mapping of protected areas, Biologically Important Areas (BIAs), Critical Habitats and Key Ecological Features (KEFs).
- Marine Park, Ramsar Wetland and National Park listing criteria and/or Management Plans, which include descriptions of the values of these areas.
- Species Profile and Threats Database (SPRAT) for mapping of the distribution and occurrence of species and/or their habitats, together with life-history information.
- Australian Wetlands Database for information on Wetlands of International Significance (Ramsar sites) and Directory of Important Wetlands in Australia (DIWA) sites.
- Species Recovery Plans for various threatened species prepared under the EPBC Act.
- Previous marine environmental studies within or in proximity to the Study Area.

An assessment was made of the likelihood of occurrence of listed species in the Study Area². Where known, important life-history functions supported by the Study Area (i.e., breeding, foraging, nesting etc.) and other notable values supported were described based on mapping of Biologically Important Areas (BIAs) for regionally significant marine species³ (<https://www.environment.gov.au/marine/marine-species/bias>) and Important Bird Areas⁴ (IBAs).

² (i) known to occur = good quality, contemporary records, (ii) habitat/species likely to occur = as defined in SPRAT; (iii) possible occurrence = habitat/species 'may occur', as defined in SPRAT; (iv) unlikely to occur within the Study Area because there are insufficient records or habitat does not exist

³ BIAs are defined as areas where aggregations of individuals of a species are known to display biologically important behaviour such as breeding, foraging, resting or migration. BIA's are designed to assist decision-making under the EPBC Act. They are identified using expert scientific knowledge about species distribution, abundance and behaviour in a region.

⁴ IBA's are defined as places of international significance for birds, and are determined by an internationally agreed set of criteria by BirdLife International.

BMT (OFFICIAL)

An assessment has been carried out at this early stage to understand whether an impact had the potential to be significant, in accordance with the criteria within the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*. This will be further evaluated following comprehensive field investigations and studies as the Project progresses.

5 Description of the Existing Environment

5.1 General Description of the Marine Environment

The *Temperate East Marine Region Bioregional Plan* (Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) 2012) describes the bio-physical environment of the marine region and its conservation values, including key ecological features, protected places and species and species groups protected by the EPBC Act.

Figure 5.1 indicates the listed Key Ecological Features (KEFs) of the marine environment. KEFs are defined as elements of the commonwealth marine environment in the marine region that, based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity (DCCEEW 2022).

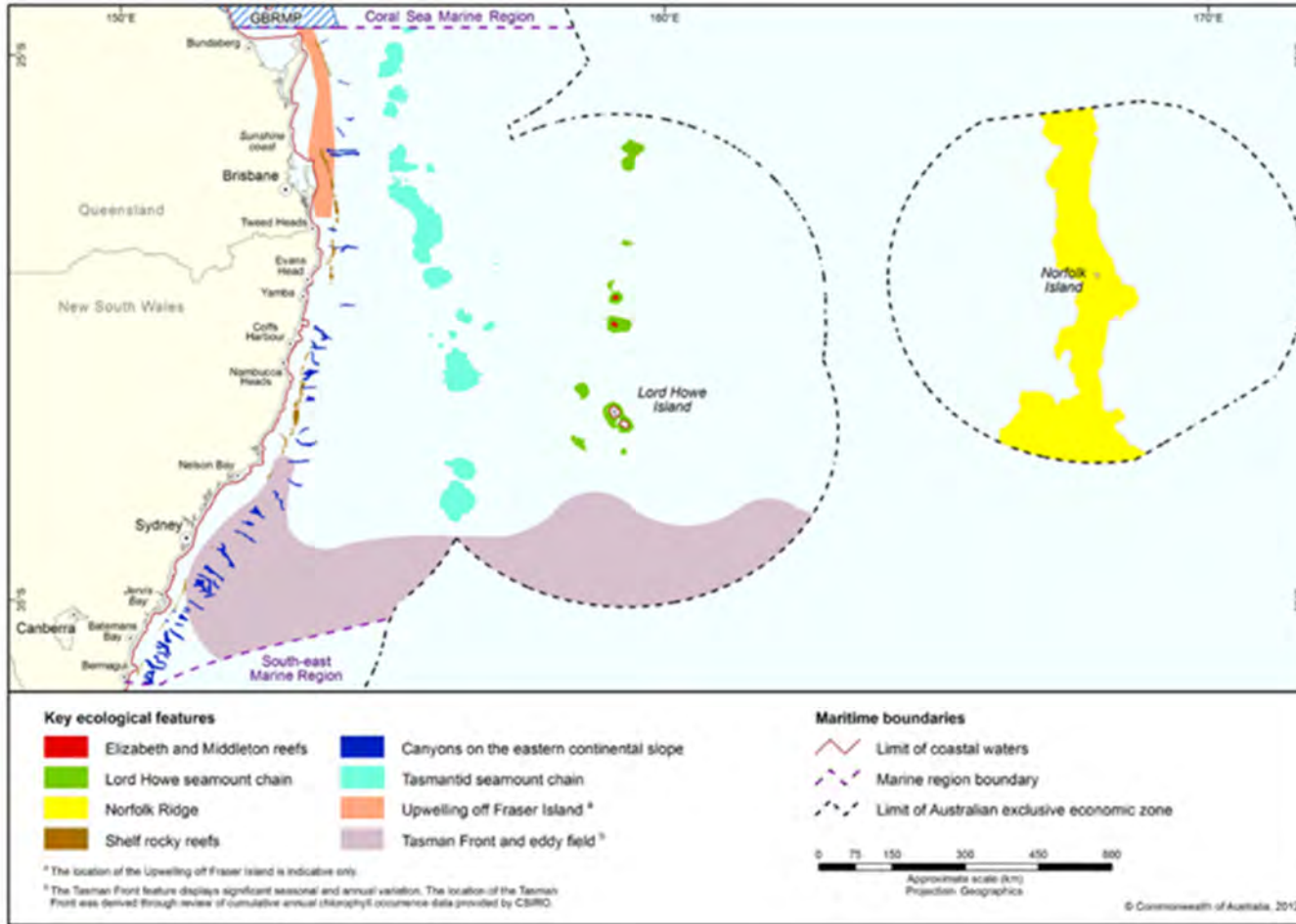


Figure 5.1 Key Ecological Features of the Temperate East Marine Region (DSEWPC 2012)

BMT (OFFICIAL)

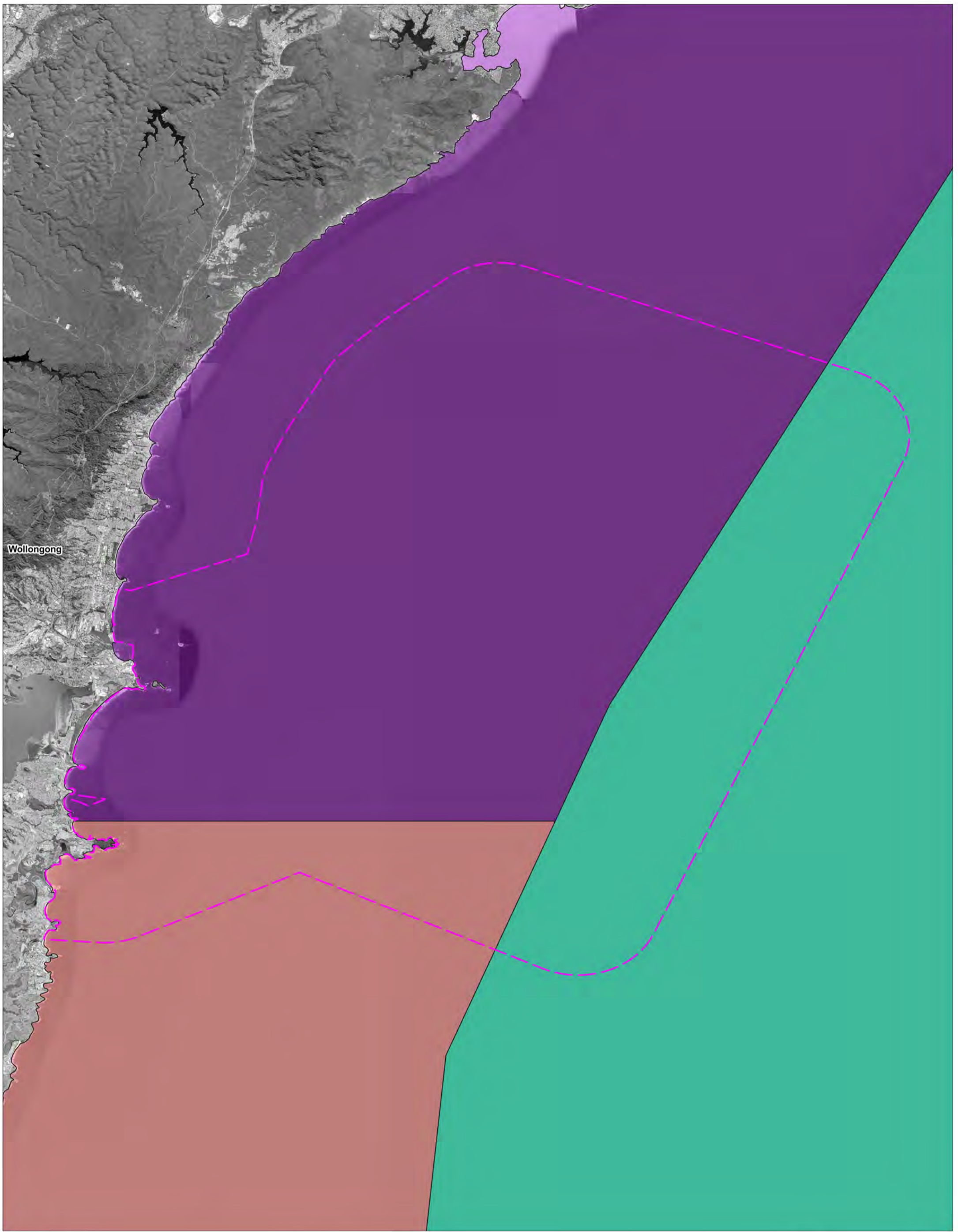
The *Temperate East Marine Region* is characterised by a narrow continental shelf, with great variation in sea-floor features (including seamount chains and canyons), dynamic oceanography, and a unique mix of tropical and cold water reef systems. Due to the latitudinal range of the region, biodiversity includes both tropical and temperate species in which temperate species are dominant in the southern parts of the region and tropical species are progressively more common towards the north of the region (DSEWPC 2012).

There are approximately 83 species protected under the EPBC Act that are known to use the region, as described below:

- Ten (10) bony fishes;
- Six (6) sharks – including the threatened white shark (*Carcharodon carcharias*);
- 24 marine reptiles – including four (4) species of marine turtles that utilise the area for foraging purposes;
- 34 seabirds – including threatened and/ or migratory marine species such as petrels and albatross; and
- Nine (9) cetaceans including blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*) and southern right whale (*Eubalaena australis*) species.

The Temperate Eastern Marine Region covers all or part of 10 provincial level bioregions identified in the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) system. The system classifies Australia's entire marine environment into broadly similar ecological regions. There are three marine bioregions that occur in the Study Area which share similar major ecosystem processes (refer to Figure 5.2):

- **Central Eastern Shelf Province** – The Study Area is predominately within this bioregion which extends over the continental shelf from Nambucca Heads to Shellharbour. The province is categorised by frequent upwellings crossing the continental shelf and river sediments which influence biological productivity. Rocky caves and sand filled gutters within the region provide habitat for populations of the grey nurse shark (*Carcharias taurus*).
- **Southeast Shelf Transition** – This province runs parallel to the coastline from Shellharbour to Bermagui. It is the most southerly shelf provincial bioregion in the East Marine Region with depths of up to 240 m. This province is important for shipping, defence, sea dumping, commercial fisheries operations, tourism and recreational fishing. The Southeast Shelf Transition Province shares a number of species with neighbouring provinces (see detail on Central Eastern Province below).
- **Central Eastern Province** – This region is located offshore between North Stradbroke Island and Ulladulla. Approximately 630 demersal fish species inhabit this provincial bioregion, including 56 endemic species. Plankton blooms created by upwellings associated with ocean gyres attract populations of yellowfin tuna (*Thunnus albacares*), whales and albatross species (Commonwealth of Australia 2008). This province is important for shipping, defence, sea dumping and commercial fisheries operation.



LEGEND

- Marine Study Area
- Central Eastern Province
- Central Eastern Shelf Province
- Southeast Shelf Transition

Title:

Marine Bioregions

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Figure:

5-2

Rev:

A



5.2 Oceanography

The Central Eastern Province is situated in warm temperate waters. Physical processes and ecosystems of the marine region are influenced by the southerly movement of the East Australian Current (EAC) (Figure 5.3). Circular currents separate from the main body of the EAC as it flows south along the continental shelf, forming upwellings and downwelling which influence biological productivity. The Tasman Front, the path of the EAC between Australia and New Zealand, separates the cooler waters of the Tasman Sea and the warmer, more saline waters of the Coral Sea (Commonwealth of Australia 2008). The Southeast Shelf Transition has a transitional water mass indicating warm temperate to cold temperate waters. Similarly to other shelf provincial bioregions in the East Marine Region, the Southeast Shelf Transition is also driven by the movement of the EAC. There is a predictable eddy field in this area associated with mixing cold and warm temperature water masses.

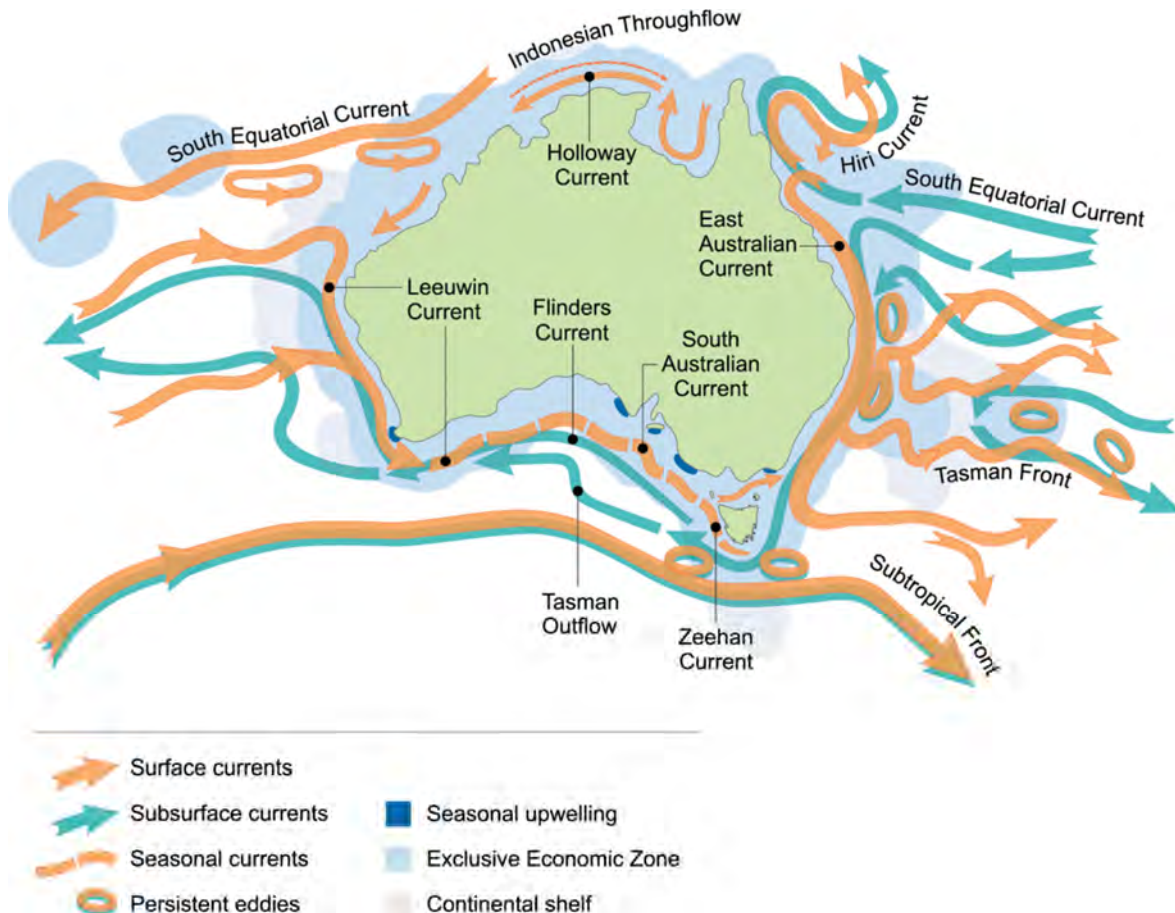


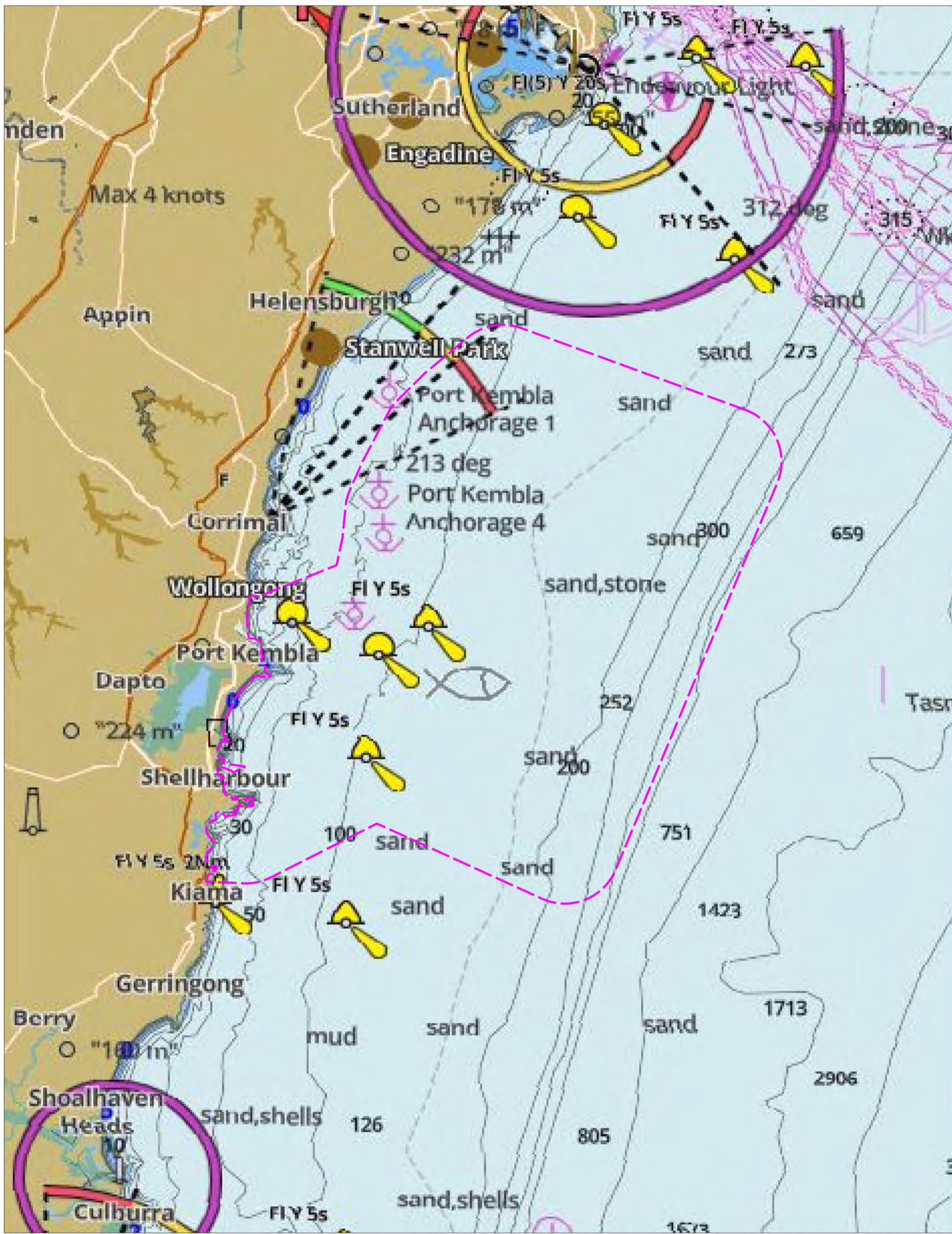
Figure 5.3 Australian Currents (Australia State of Environment 2016)

5.3 Bathymetry and Surface Sediment

The navigational chart in Figure 5.4 shows the depth contours around the Study Area which range between 20 – 300 m and that the substrate encountered is predominately sand with smaller areas comprised of mud, rock, stone and shells. Vessel navigational pathways are shown in pink.

The sediment texture of the Central Eastern Shelf Province is dominated by sand with localised deposits of gravel in the north of the provincial bioregion. Sand is the dominant sediment type associated with the geomorphic features found in this provincial bioregion including shelf, slope and shallow water terraces. Similarly, seabed sediments in the Southeast Shelf Transition are dominated by sand, with mud and gravel fragments forming less than 20% of sediments. Higher mud contents are located offshore of Wollongong moving towards the deeper waters in the Central Eastern Province. The gravel content of sediments in this provincial bioregion is generally less than 5%. The carbonate content of seabed sediments is also high (above 60%) and increases towards the outer continental shelf.

More detailed mapping of the offshore Study Area indicates the nearshore environment and substrate in the vicinity of the transmission cable route is comprised of sand, silt and gravel with less than 50% mud and calcareous gravel, sand and silt (refer to Figure 5.5). Sediment in the offshore sections of the Study Area (turbines locations) have a higher mud content, which increases with distance offshore. Further field investigations are required to map the substrate type.

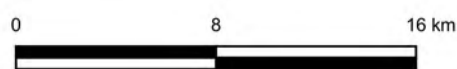


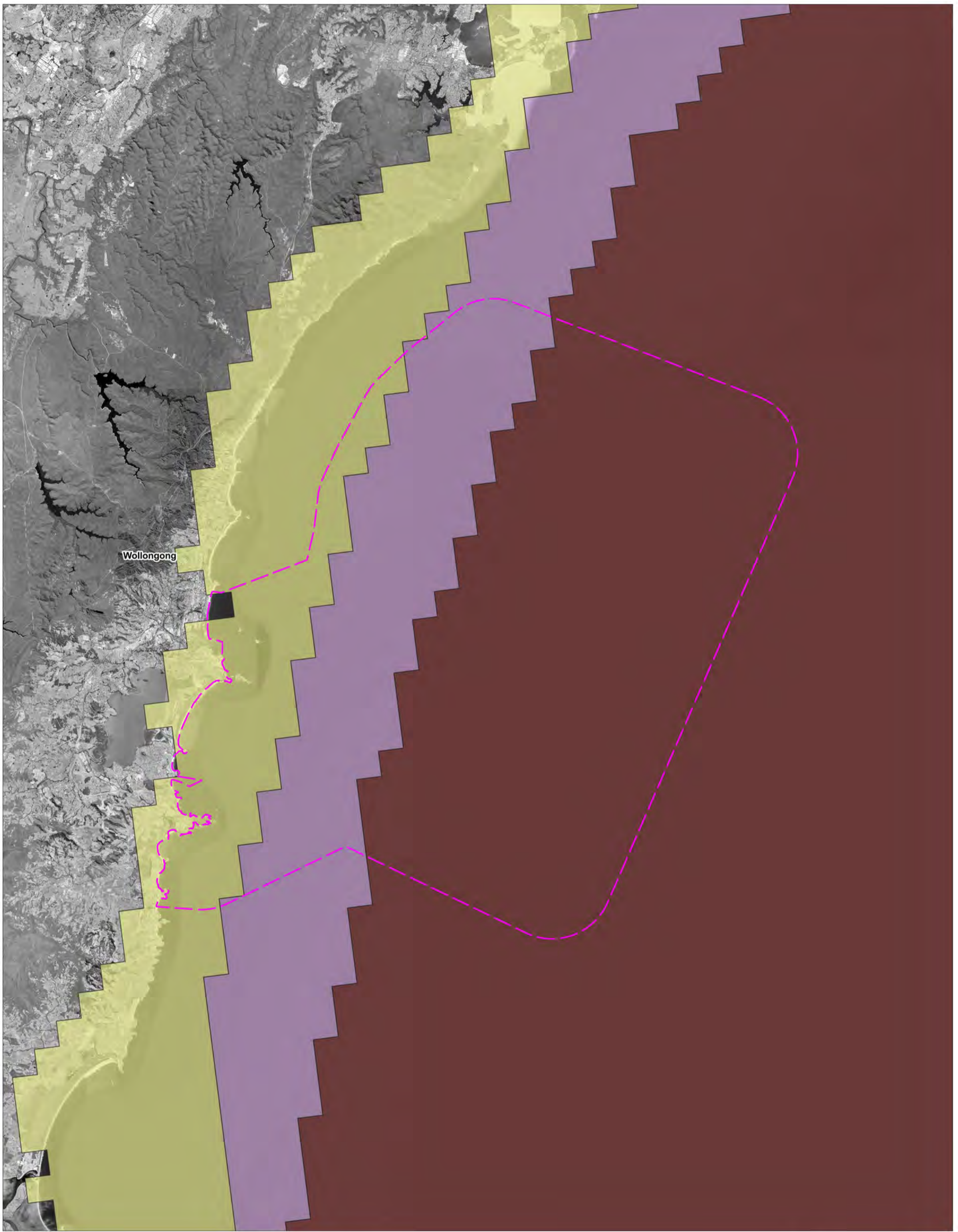
LEGEND
 Marine Study Area

Title:
Project Location

Figure:
5-4 Rev:
B

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.





LEGEND

- Marine Study Area
- Calcareous gravel, sand and silt
- Mud and sand
- Sand, silt and gravel with less than 50% mud

Title:

**Substrates
New South Wales**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

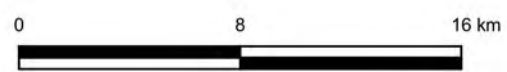


Figure:

5-5

Rev:

C



5.4 Protected Areas

5.4.1 Marine Parks

Commonwealth

The Commonwealth Jervis Marine Park is situated approximately 35 km from the Study Area and nearby the State Jervis Bay Marine Park. It is located approximately 20 km offshore in Commonwealth waters within the Temperate East Network. Jervis Marine Park is one of eight Commonwealth marine reserves within the Temperate East Commonwealth Marine Reserves Network (Director of National Parks 2013). The marine park has two zones – Habitat Protection Zone and Special Purpose (Trawl) Zone (Figure 5.7).

Under the Temperate East Marine Parks Network Management Plan 2018 Zoning and Rules (Australian Marine Parks 2018), the Special Purpose (Trawl) Zone may be used for the following purposes:

- general use and access,
- recreational fishing,
- commercial shipping and
- national security and emergency response.

Activities such as commercial fishing, tourism, structures and works, and research and monitoring will require a license to occur within the marine park area. The Habitat Protection Zones follows the same rules for activities however, mining within the region is prohibited.

Jervis Marine Park is located within a BIA for humpback whales and a range of shark and seabird species (see Section 5.7.3). The Marine Park supports two unique KEF (Table 5.1) that are described in Section 5.5.2. Additional field surveys will need to be undertaken to determine habitat types and marine ecological values.

Table 5.1 Jervis Marine Park (Commonwealth) Key Features (Director of National Parks 2013)

Attribute	Description
Date of effect	17-Nov-12
Reserve boundaries	As described in the Environment Protection and Biodiversity Conservation (Commonwealth Marine Reserves) Proclamation 2012 (Federal Register of Legislative Instruments No. F2012L02188)
International Union for Conservation of Nature (IUCN) category assigned to the reserve	IUCN Red List Category VI
Marine park zones	Multiple Use Zone (IUCN VI) (1 965 km ²) Special Purpose Zone (IUCN VI) (508 km ²)
Depth of reserve below seabed	1,000 m

Attribute	Description
Total Area	2,473 km ²
Major conservation values	<ul style="list-style-type: none"> • Canyons represented in this reserve incise the mid-slope at depths of 1500 -3500 m and extend to a depth of 5000 m • Seafloor features represented in the reserve include abyssal-plain/deep ocean floor, canyons, shelf, and slop • Biologically important areas for the protected humpback whale and migratory seabirds including the white-faced storm-petrel • Examples of the ecosystems of the Central Eastern Province, the Southeast Shelf Transition and the Batemans Shelf meso-scale bioregion • Includes two key ecological features: <ul style="list-style-type: none"> - one of three shelf-incising canyons of the eastern continental slope occurring in the Region (unique sea-floor feature with ecological properties of regional significance) - shelf rocky reefs (unique sea-floor feature with ecological properties of regional significance)
Location	The Marine Park is located approximately 20 km offshore extending into deep water off the continental shelf down to the abyssal plain (deep ocean floor), adjacent to Jervis Bay and Booderee National Park.
General Description	<ul style="list-style-type: none"> • The Marine Park has depth ranges from approximately 120 m to abyssal depths of 5000 m. • A key ecological feature in the Marine Park is one of three shelf-incising canyons occurring in the Region. Canyons provide habitat that supports a diverse range of benthic, demersal and pelagic species. • Shelf rocky reefs are another key ecological feature within the area. Shelf rocky reefs support a diverse range of complex benthic habitats that, in turn provide food and shelter a diverse array of fish and invertebrate assemblages and support diverse benthic communities. • The diverse environment of the Marine Park is important for a number of migratory seabirds that forage and breed in the area as well as for humpback whales, which follow seasonal migration pathways through these waters. • Dense sponge gardens, algae-dominated reefs and fish communities including jackass morwong, butterfly perch and the orange-spotted catshark are prevalent within the region.

State

Jervis Bay Marine Park

Jervis Bay Marine Park is a state marine park that extends from Kinghorn Point south to Sussex Inlet, incorporating most of Jervis Bay and adjacent coastal waters located approximately 35 km from the Study Area (Figure 5.6).

The marine park is comprised of four different marine park use zones:

- Sanctuary Zones (20%)
- Habitat Protection Zones (72%)

- General Use Zones (8%)
- Special Purpose Zones for Huskisson Wharf and HMAS Creswell Special Purpose Zones catering for existing infrastructure.

Booderee National Park is also located at Jervis Bay and includes 8.75 km² of Jervis Bay. Together, the marine park and tidal portions of Booderee National Park cover approximately 215km², and support a mosaic of coastal, embayment and estuarine habitats of high biodiversity value.

A small section of the Jervis Bay Marine Park is controlled by the Commonwealth as a marine extension of the Booderee National Park which includes a small Special Purpose Zone around the western side of Bowen Island. Although recreational fishing is permissible, spearfishing and collection of intertidal invertebrates is prohibited within these Commonwealth waters.

The marine park supports a diverse range of species including fish, sharks, rays, marine mammals, birds, crustaceans and marine plants. The Jervis Bay region, including the marine park, is home to a resident pod of approximately 60 Indo-pacific bottlenose dolphins (*Tursiops aduncus*), supports two Australian (*Arctocephalus pusillus*) and New Zealand (*Arctocephalus forsteri*) fur seal haul-out sites, and is utilised by several whale species. The marine park's sandy beaches, coastal rocky shores and estuaries are key nesting, feeding and roosting sites for waders, shorebirds and seabirds. Jervis Bay Marine Park provides habitat for commercially important species such as tuna, mackerel, and sharks. The hooded plover also inhabits pockets of Bhowerre Beach (Barrett and Lynch 2008).

Ecosystem monitoring of the rocky subtidal reefs within the Jervis Bay Marine Park was undertaken between 1996 and 2007 to determine the effectiveness of marine protected areas in Australian temperate waters (Barrett and Lynch 2008). Fish, macroalgae and benthic invertebrate communities were assessed. In summary:

- Temperate species numerically dominated fish assemblages, however subtropical species were also present, especially during summer.
- Red morwong *Cheilodactylus fuscus* and rock cale (*Crinodus lophodont*) numerically dominated fish assemblages throughout the region, while the abundance of schooling species such as snapper *Acanthopagrus australis* and yellowfin bream *Pagrus auratus* varied greatly among sampling sites.
- Benthic macroinvertebrate epifauna was numerically dominated by the long-spined urchin *Centrostephanus rodgersii* turbo snails (*Turbo torquatus*), red-throated ascidians *Herdmania grandis* and gastropods *Astraea tentoriformis* and *Astraliium squamiferum*, though abundance had declined over time.
- Commercially and recreationally important abalone and rock lobster species were uncommon.
- Grey nurse sharks were also present within the Jervis Bay Marine Park (State) area.

The marine park is managed under the Jervis Bay Marine Park Operational Plan (Marine Parks Authority 2003), which sets out management strategies to address the following:

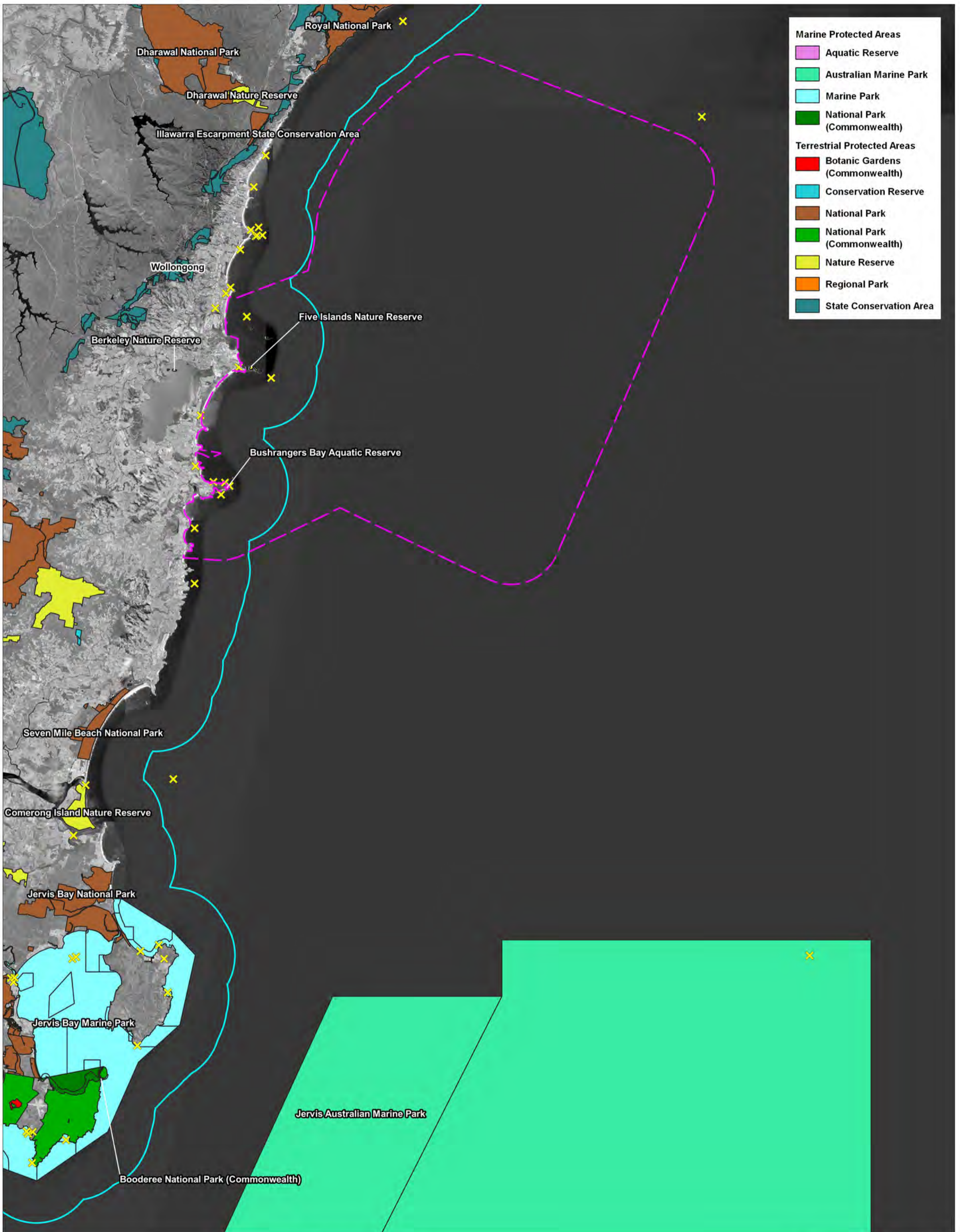
- Conservation of marine biodiversity;
- Maintenance of ecological processes;
- Providing opportunities for ecologically sustainable use; and
- Supporting public appreciation, enjoyment and understanding of the marine park.

Bushrangers Bay Aquatic Reserve

The southwest of the Study Area intercepts Bushrangers Bay Aquatic Reserve (Figure 5.6) and is situated approximately 1.6 km from the southernmost cable route option. This reserve is a small rocky embayment located towards the eastern end of Bass Point, 4 km south of Shellharbour. The reserve is approximately 4 hectares and declared for its representation of rock platforms, crevices and rock pools that support a diverse array of marine life including common temperate and seasonal subtropical and tropical fish species.

Seagrass beds provide habitat and foraging areas for a variety of fish including maori wrasse (*Ophthalmolepis lineolatus*), senator wrasse (*Pictilabrus laticlavius*), red morwong (*Cheilodactylus fuscus*), striped trumpeter (*Latris lineata*), blue groper (*Achoerodus viridis*), horseshoe and pygmy leatherjackets (*Meuschenia hippocrepsis* and *Brachaluteres jacksonianus*) and herring cale (*Odax cyanomelas*) (NSW DPI 2014).

Fishing, spearfishing and collection of marine fauna or plants is prohibited within the reserve however recreational activities such as diving are permissible.



LEGEND

Marine Study Area 

Shipwrecks 

Coastal Waters Limit 


Title:

Protected Areas

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

Figure: **5-6**

Rev: **C**

 **BMT**
www.bmt.org

150°45'E

151°E

151°15'E

151°30'E

151°45'E

35°S

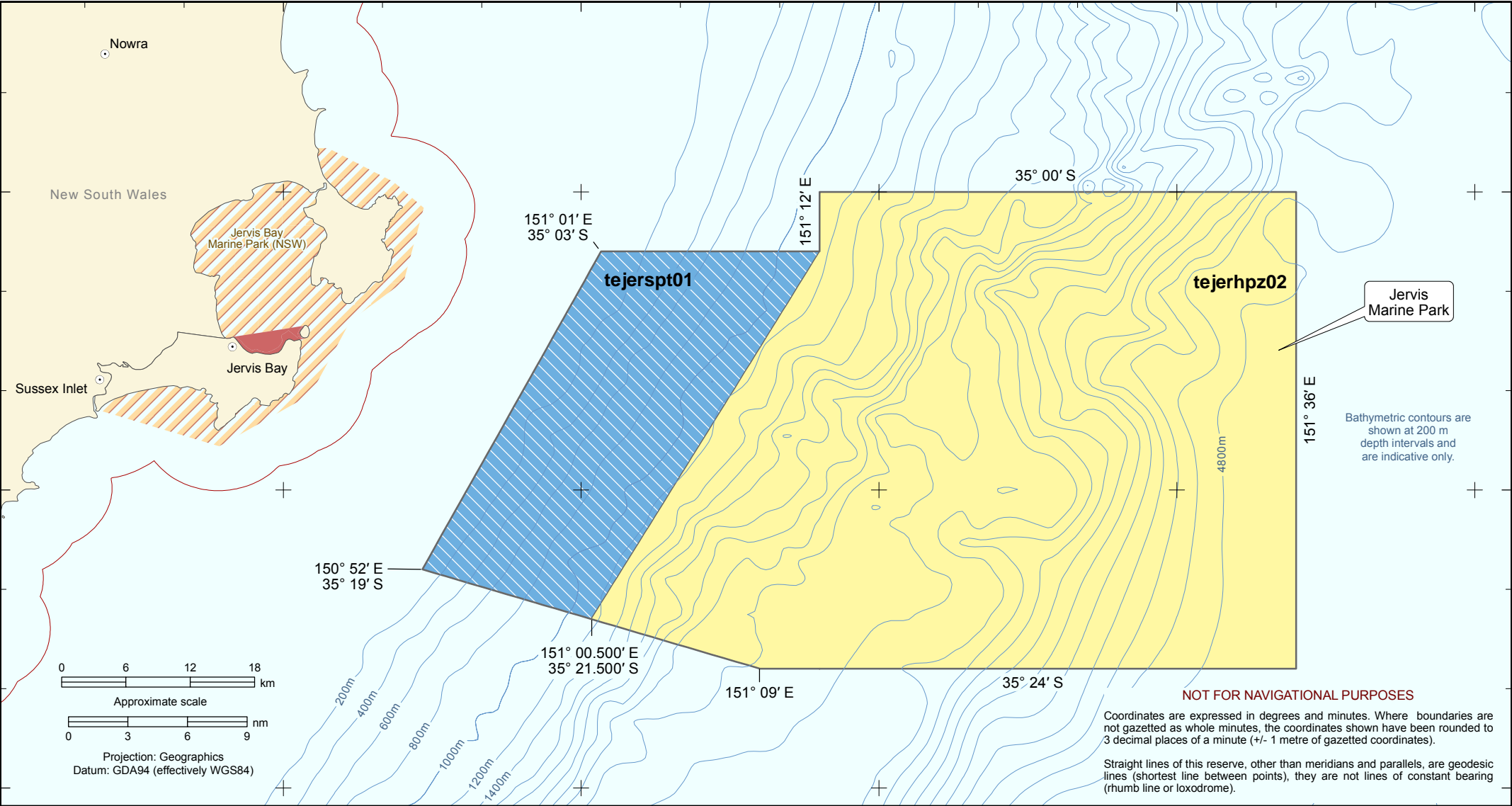
35°S

35°15'S

35°15'S

35°30'S

35°30'S



Bathymetric contours are shown at 200 m depth intervals and are indicative only.

NOT FOR NAVIGATIONAL PURPOSES

Coordinates are expressed in degrees and minutes. Where boundaries are not gazetted as whole minutes, the coordinates shown have been rounded to 3 decimal places of a minute (+/- 1 metre of gazetted coordinates).

Straight lines of this reserve, other than meridians and parallels, are geodesic lines (shortest line between points), they are not lines of constant bearing (rhumb line or loxodrome).

Jervis Marine Park Temperate East Network Management Plan 2018

- Zoning**
- Habitat Protection Zone (IUCN IV)
 - Special Purpose Zone (Trawl) (IUCN VI)

- Marine protected areas**
- Marine component of Booderee National Park (Cwlth)
 - State marine park (NSW)

- Maritime boundaries**
- Limit of coastal waters

Spatial data sources:
 DoEE (2016): Collaborative Australian Protected Areas Database (CAPAD)
 DoEE (2018): Australia's Network of Marine Parks
 Geoscience Australia (2005): Australian Bathymetry and Topography
 Geoscience Australia (2006): GEODATA TOPO 250K
 Geoscience Australia (2014): Australian Maritime Boundaries (AMB) v3.0

Produced by the Environmental Resources Information Network (ERIN),
 Australian Government Department of the Environment and Energy.

5.4.2 Other Protected Areas

In 2018, a new marine park proposal for the Hawkesbury Shelf bioregion was put forward to help conserve marine biodiversity in alignment with the Marine Estate Management Strategy (2018-2028). The proposal incorporated management changes at 25 sites in estuaries, coastline and marine waters from Newcastle to Wollongong. The Five Islands marine site and Wollongong offshore artificial reef are two proposed marine protected areas identified within the Study Area.

Following the Marine Estate Management Strategy, the Wollongong offshore artificial reef was deployed in September 2019 off the coast near Port Kembla. The reef is approximately 22 hectares and intended to provide the basis of a special purpose zone enabling recreational activities such as boating, line fishing and spearfishing permitted under general NSW fishing rules and regulations. The reef consists of steel pinnacle reef towers with a vertical profile of up to 12 metres and is expected to promote aggregation of several important recreational fishing species including yellowtail kingfish, snapper, silver trevally, mulloway, yellowtail scad and blue mackerel (DPI 2019).

The Five Islands marine site is another protected area proposed under the Marine Estate Management Strategy. Though this proposal has not progressed, documentation identifies key marine values within the region (Marine Estate Management Authority 2018). Five Islands is a group of offshore islands and subtidal reefs located east of Port Kembla and within the Study Area. It encompasses the foreshore and marine waters of the Five Islands Nature Reserve. The Five Islands support a range of values, most notably habitat and breeding sites for the sooty oystercatcher (*Haematopus fuliginosus*), wedge-tailed shearwater (*Puffinus pacificus*), short-tailed shearwater (*Puffinus tenuirostris*), and white-bellied sea-eagle (*Haliaeetus leucogaster*). The islands are also important haul out and feeding areas for the Australian fur seal (*Arctocephalus pusillus*). A colony of little penguins (*Eudyptula minor*) is also known to congregate around the Five Islands region. (Marine Estate Management Authority 2018). The waters surrounding the islands are used for recreational activities including kayaking, scuba diving and recreational fishing and spearfishing.

5.4.3 Ramsar Wetlands

There are no Ramsar wetlands within or adjacent to the Study Area.

5.5 Benthic Environment and Habitats

Linkwater and Morris (2022) used multibeam sonar data to map seabed landforms in nearshore sections of the Study Area (refer to Figure 5.8). The mapping covers parts of state coastal waters in the Wollongong-Shellharbour region, and part of the Commonwealth Marine Area. The coastal zone between Coalcliff and Lake Illawarra contains broad areas of rugose low profile reef intersected by sinuous and straight channel features. Large sandy plains are also present. East of Wollongong, the coastal zone is comprised of a mosaic of sand plains and rocky reefs. Coarse sands are the dominant soft sediment class and cover approximately 25% of the total survey area (Linkwater et al. 2019). The depth of sands in this area is undefined.

There is comparatively limited information on substrate types in the deeper sections of the Study Area. NCVA (2022) maps 'shelf rocky reefs' approximately 28 km off the coast, which are located within the Study Area (see discussion regarding KEF in Section 5.5.2).

The spatial boundary of this reef type was derived from a combination of low and high resolution (20 m) bathymetry and backscatter by Kloser and Keith (2010), and is considered qualitative. These deepwater reefs are morphologically complex (NCVA 2022), which may differ from the low profile nearshore reefs mapped by Linkwater and Morris (2022).

Substrate types in most of the deeper sections of the Study Area are undefined. Further surveys are required to assess cross-shelf patterns in reef and soft sediment habitats and communities within and adjacent to the Study Area.

5.5.1 Epibenthic Communities

There is limited information on the epibenthic communities of the Study Area. Habitat surveying obtained from the SEED Database (2002) presents benthic communities within the marine environment that extend a short distance from the shoreline. Subtidal sand comprises a large proportion of mapping, with smaller extents of reef and shoal and rocky intertidal habitats present within the remaining Study Area (refer to Figure 5.9).

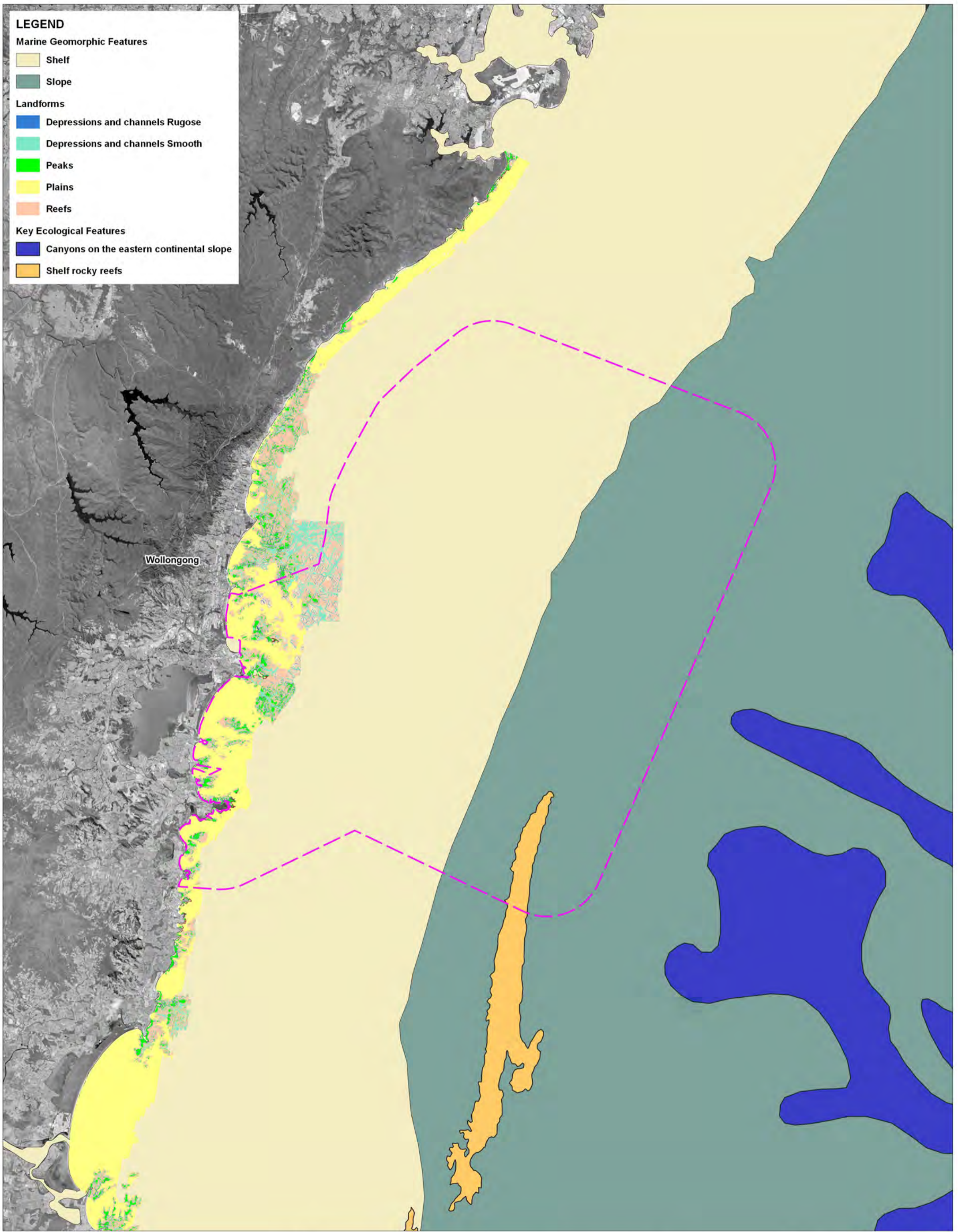
Elsewhere in the bioregion, there is a general cross-shelf pattern in reef communities consisting of: (i) algae-dominated substrates in shallow well-lit waters, and (ii) sessile invertebrates, especially filter-feeders, in mesophotic⁵ waters >30m (Underwood et al. 1991; James et al. 2017; SPRAT 2022). Upwelling events driven by the EAC, together with riverine inputs, provide nutrient rich waters for filter feeders communities.

James et al. (2017) found that mesophotic reefs (30 - 90 m) were numerically dominated by mixed sessile invertebrate assemblages comprised of sponges, cnidarians (gorgonians, octocorals), ascidians and bryozoans. Communities in the warm temperate areas (Batemans Bay, Sydney, Port Stephens), as occurs in the Study Area, were structurally more similar to each other than sub-tropical and cool temperate sites. Unlike sub-tropical and cold temperate sites, warm temperate reefs were characterised by greater abundance of stalked solitary ascidians (sea squirts) and the fenestrate (many opening) bryozoans (moss animals). James et al. (2017) did not detect consistent depth-related changes in communities, possibly due to high variability at fine spatial scales. By contrast, Roberts and Davis (1996) found that sponge species richness and density generally increased with depth at sites off Sydney.

The attached invertebrate communities provide complex micro-habitats for other invertebrates and fish. There is limited information on longitudinal (cross-shelf) patterns in shellfish and demersal fish communities in the Study Area. Distinct cross-shelf patterns in benthic invertebrate and demersal fish communities have been documented in the east Australian sub-tropics (Malcolm et al. 2010) and southern NSW (Williams and Box 2001). It is expected that cross-shelf gradients in reef and soft sediment demersal fish communities would also occur in the Study Area.

Mesotrophic reef (and possibly soft sediment) communities are potentially vulnerable to disturbance. This is especially the case for fragile, long-lived species that are likely to occur in deepwater environments (SPRAT 2022). Any range-restricted/endemic species will also be highly vulnerable to disturbance.

⁵ mesophotic zone – the zone between the well lit shallow waters and deep, low light waters



LEGEND

Marine Study Area

Title:

Landforms, Marine Geomorphic Features and KEFs

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

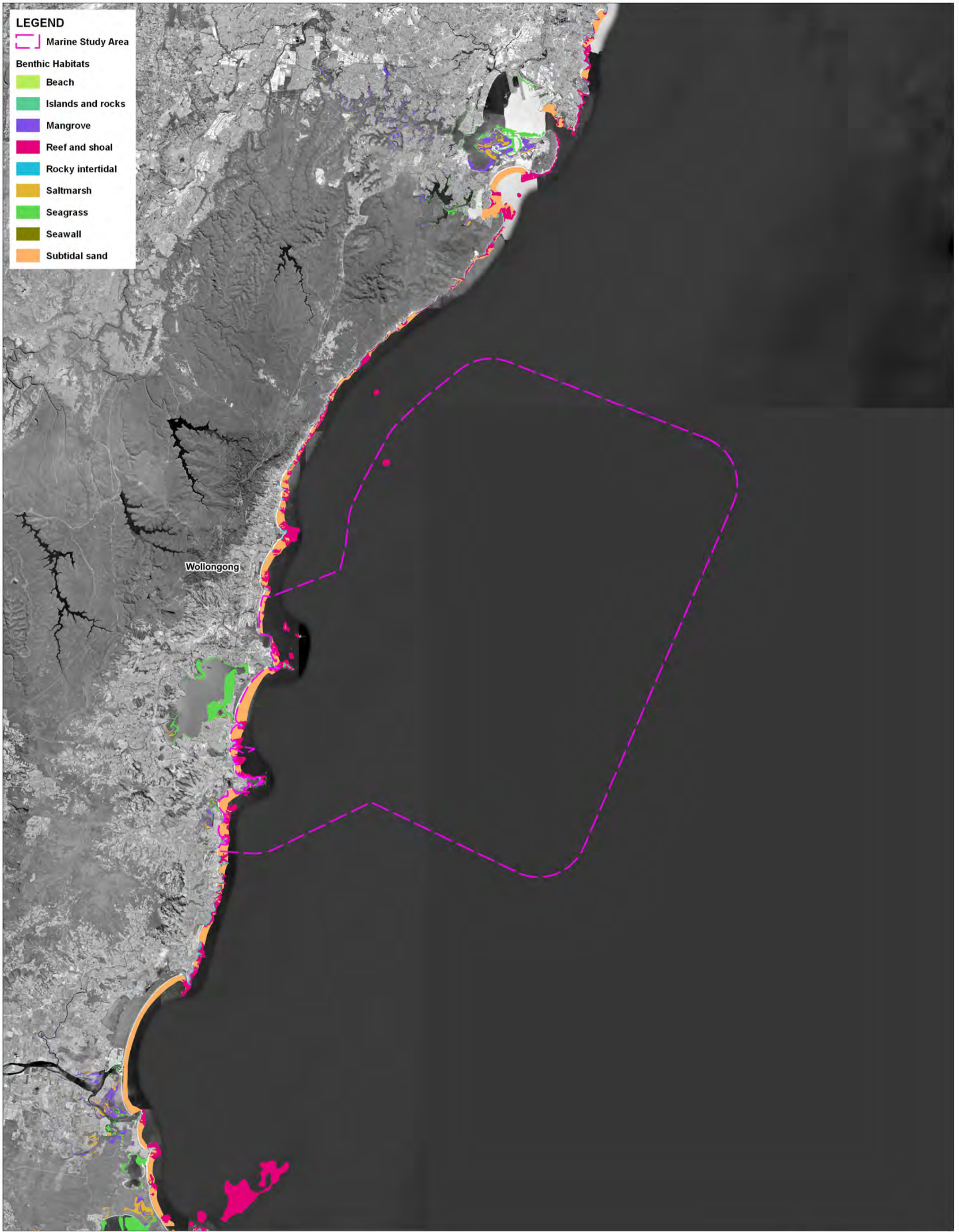


Figure:

5-8

Rev:

B



- LEGEND**
- Marine Study Area
 - Benthic Habitats**
 - Beach
 - Islands and rocks
 - Mangrove
 - Reef and shoal
 - Rocky intertidal
 - Saltmarsh
 - Seagrass
 - Seawall
 - Subtidal sand

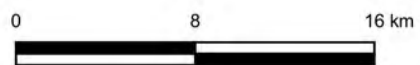
Wollongong

Title:
Benthic Habitats

Figure:
5-9

Rev:
B

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



5.5.2 Key Ecological Features

NCVA (2022) maps one KEF of Australia's marine environment in the Study Area and surrounds (refer to Figure 5.8): *shelf rocky reefs*. While not a MNES in its own right, they form important components of the Commonwealth Marine Area. The Director of National Parks (2013) describes shelf rocky reefs as "...unique sea-floor features with ecological properties of regional significance". These reefs can support epibenthic communities dominated by attached invertebrates, including dense aggregations of large sponges and mixed assemblages of bryozoans and soft corals. These epibenthic communities create complex habitat for other invertebrates and fish species, as previously described (SPRAT 2022).

NCVA (2022) maps another Key Ecological Feature adjacent to but outside the Study Area (approximately 5 km away): *canyons on the eastern continental slope*. This KEF is comprised of shelf-incising canyons that occur on the eastern continental slope. These canyons provide hard substrates that support diverse and abundant benthic communities dominated by filter-feeding species (especially sponges, crinoids etc.). Due to their limited connectivity, these canyons are thought to support local endemic species, and are therefore potential centres of biological diversity (SPRAT 2022). Nutrients and sediments that are funnelled into canyons also promote biological productivity (SPRAT 2022). The Director of National Parks (2013) therefore describes these as "...unique sea-floor features with ecological properties of regional significance".

5.6 Other Existing Human Uses

5.6.1 Defence

The Australian Defence Force (ADF) conducts a range of training, research activities, and preparatory operations in the East Marine Region in support of ships and aircraft stationed at bases in various locations along the east coast of Australia. The region along the Wollongong coast is utilised as a military and firing practice and exercise area for intercept training (refer to Figure 5.10). Major exercises are conducted infrequently within the East Marine Region.

The Department of Defence provides spatial maps that depict the potential for unexploded ordnance (UXO) to be present at a particular location (refer to Figure 5.11). The following UXO sites are mapped within the offshore Study Area:

Sea Dumping of Depth Charges

- DEP016 Potential Depth Charge UXO – North East of Bulli and DEP005 Potential Depth Charge UXO – Tom Thumb Island. These sites are declared areas where depth charges and/ or failed to function during World War 2 (WW2).

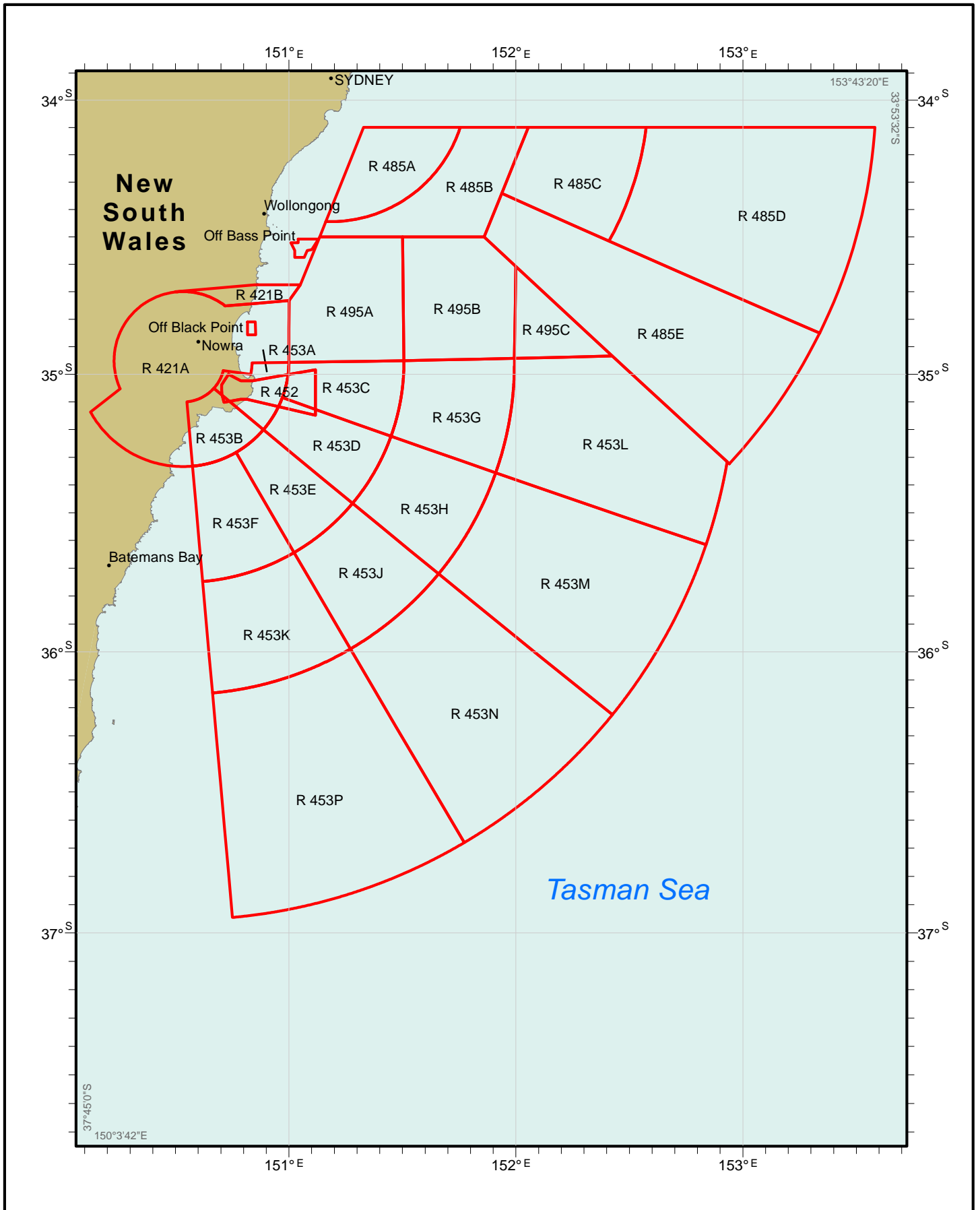
Other

- 209 Belambi Point - this site was a Royal Australian Air Force Air to Air Range during WW2
- 55 Bass Point – this site may have been used as Royal Australian Navy bombing and rocket range during WW2


Other Sea Dumping Sites

- SDG010, SDG011 and SDG016 Sea Dumping – Sydney Area – these sites were areas used for the dumping of ordnance at sea including projectiles.

There are no areas mapped as 'slight potential' or 'substantial potential' within the Study Area.

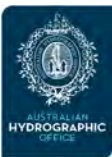


N

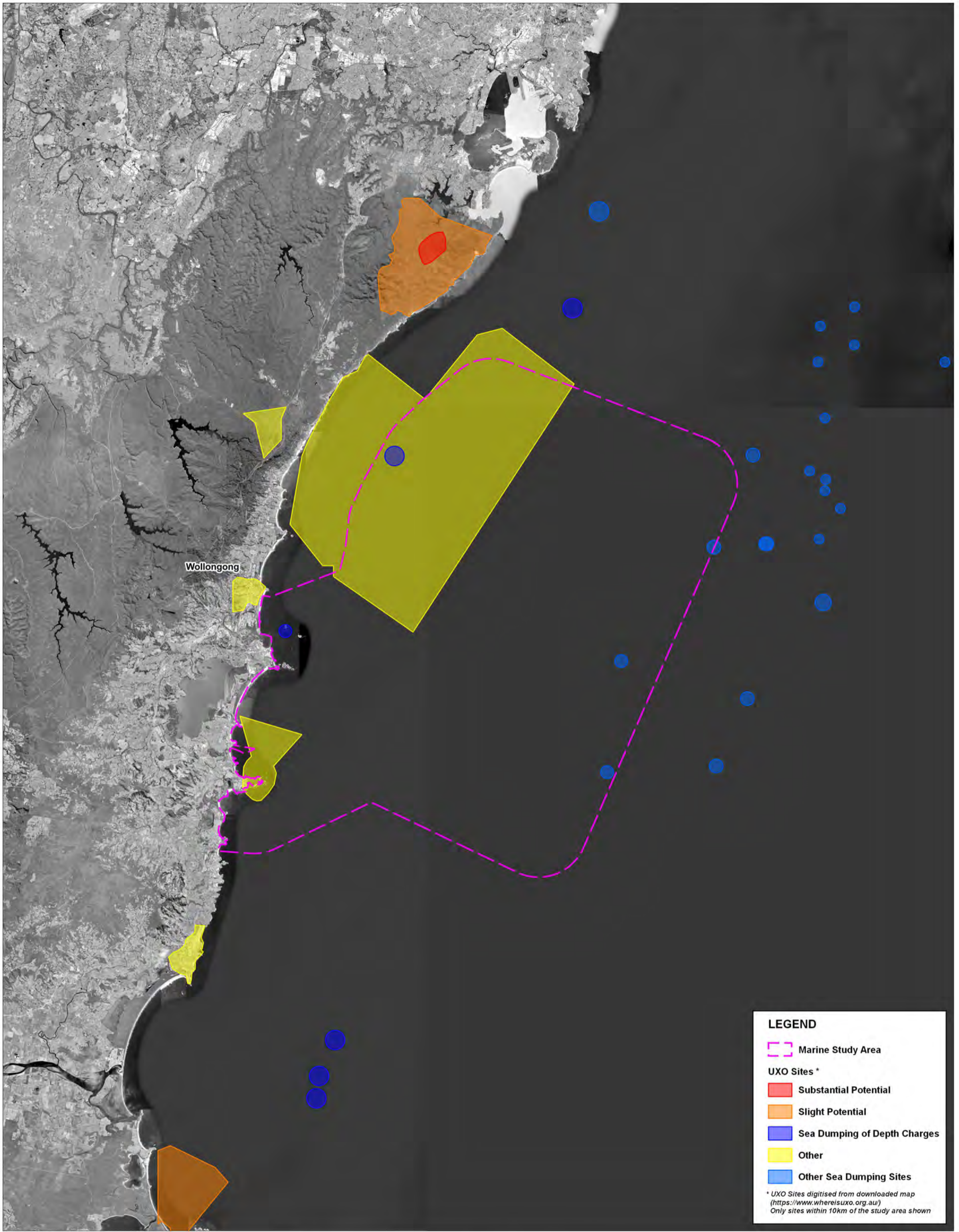


NOT FOR NAVIGATION
Horizontal datum: WGS 1984
Projection: Mercator







MILITARY FIRING AND PRACTICE AREAS
Tasman Sea
Jervis Bay
Nov2020 - Jun2021



<http://hydro.gov.au>
Australian Hydrographic Office
© Commonwealth of Australia 2020



LEGEND

-  Marine Study Area
- UXO Sites ***
-  Substantial Potential
-  Slight Potential
-  Sea Dumping of Depth Charges
-  Other
-  Other Sea Dumping Sites

* UXO Sites digitised from downloaded map (<https://www.wherisuxo.org.au/>)
Only sites within 10km of the study area shown

Title:
Unexploded Ordnance (UXO) Sites

Figure:
5-11

Rev:
C

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

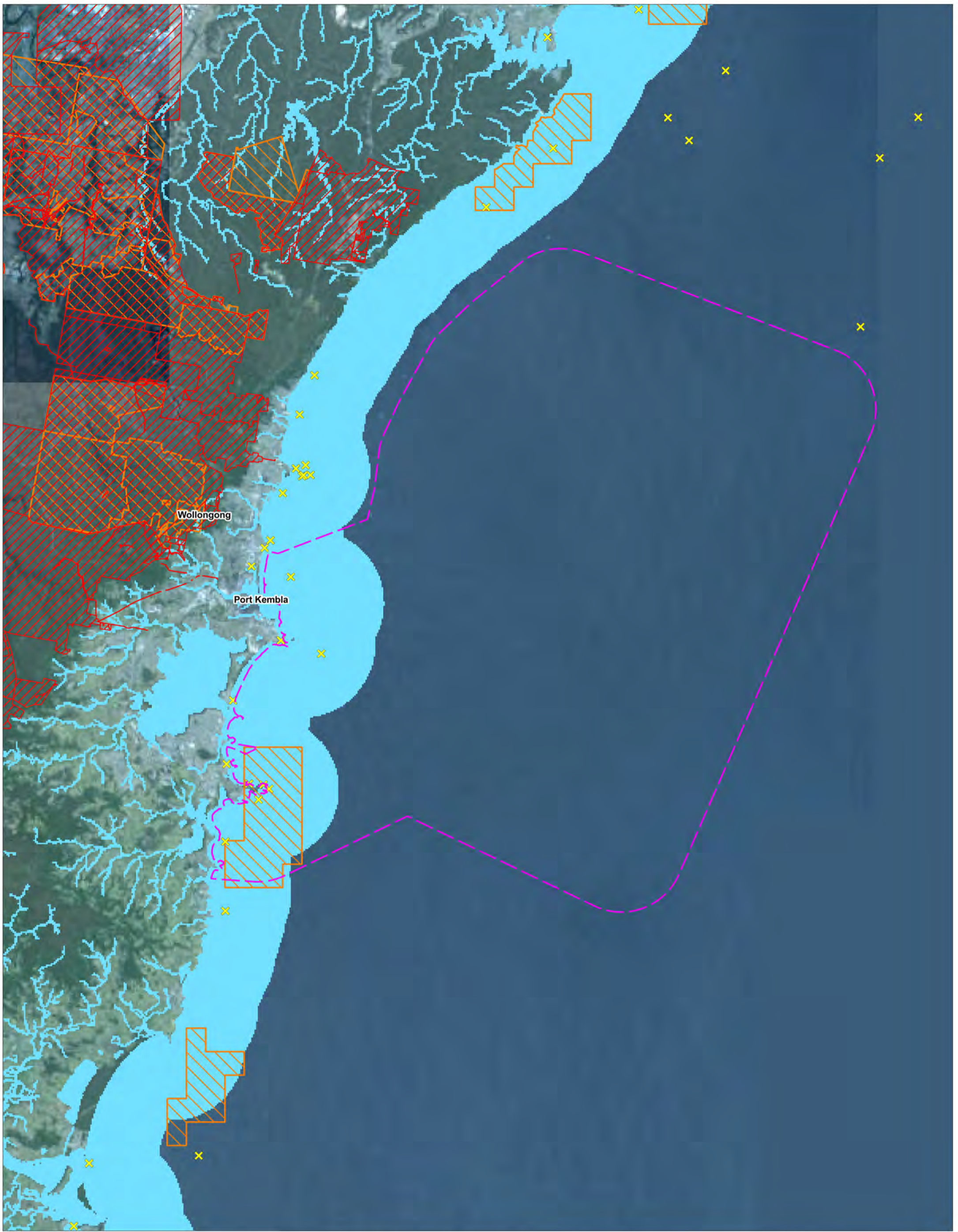


5.6.2 Oil and Gas Leases

There is one exploration title in place within the Study Area (Site B): EL3217 mining exploration title sought by Metromix Pty Limited and first granted on 15 November 1988 (refer to Figure 5.12).

Two other marine exploration mining titles sought by Metromix Pty Limited are situated adjacent to the Study Area (EL3218 and EL3219).

There are no known active wells or other pipelines within the Study Area.



LEGEND

Marine Study Area	Key Fish Habitat Areas
Australian National Shipwrecks	Exploration and Mining Titles
	Exploring
	Mining

Title: **Shipwrecks, Mining and Fisheries**

Figure: **5-12** Rev: **C**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



5.6.3 Underwater Cultural Heritage Sites

As shown in Figure 5.12, although the Study Area is not within the vicinity of any shipwreck protection zones, several underwater cultural heritage sites have been identified within and adjacent to the Study Area.

The following shipwrecks are protected on a Commonwealth level under the UCH Act:

- Alexander Berry (Shipwreck ID 81)
- Hawkesbury Packet (ID 818)
- Our Own (ID 1391)
- Kiltobanks (ID 1018)
- Charlotte (ID 352)
- Bombo (ID 239).

Shipwrecks that are deemed historic shipwrecks in Australian waters are the responsibility of Commonwealth Government under the UCH Act; none of these wrecks have a broader protection zone declared around them.

Wollongong is considered a key recreational destination for shipwreck diving and the Study Area is frequently used by commercial fishers and recreational anglers (refer to Section 5.8.2 for further information).

Seabed surveys in the next phase of works will identify if any materials remain in situ. These surveys would be undertaken by sub-bottom profilers or magnetometer surveys which would not disturb shipwrecks. Should any remaining items be located through these surveys, a more detailed investigation by a marine archaeologist would be conducted, which may include diving and camera footage being collected.

It is likely that any sub-sea cables would need to be realigned to avoid any protected items that are located.

5.7 Matters of National Environmental Significance

Under the EPBC Act, an action will require approval if the action has, will have, or is likely to have, a significant impact on a MNES:

- World Heritage Properties
- National Heritage Places
- Wetlands of international importance (Ramsar wetlands)
- Nationally threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions
- A water resource, in relation to coal seam gas development and large coal mining development.

The Protected Matters Search Tool (PMST) of the marine environment has identified (accessed in May 2023) the following MNES as potentially occurring within or immediately adjacent to the Project Area:

- One (1) Commonwealth Marine Area
- Seven (7) Listed Threatened Ecological Communities (TECs)
- 104 Listed Threatened Species including 45 birds, 7 fish, 4 frogs, 14 mammals, 21 plants, 6 reptiles, and 7 sharks
- 81 Listed Migratory Species

In addition to MNES, the PMST also provides additional information on ecological values such as Listed Marine Species (108), Whales and Other Cetaceans (31), Nationally Important Wetlands (5), Key Ecological Features (2) and Biologically Important Areas (BIAs) (20). Note the PMST is based on predictive modelling of species distributions and does not provide certainty that a MNES is present.

Terrestrial matters are discussed the report prepared by Umwelt (2023) report.

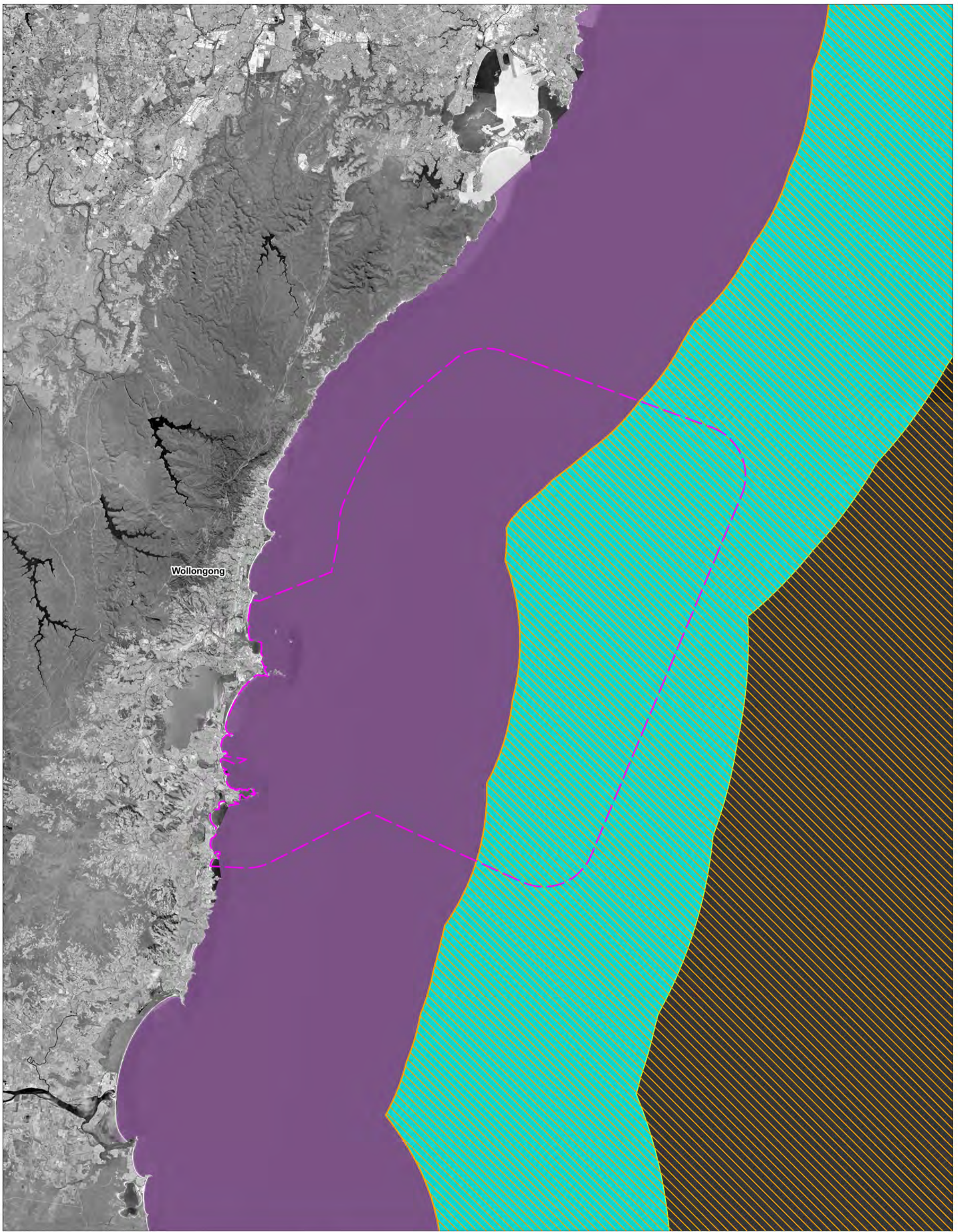
5.7.1 Commonwealth Marine Areas

The Commonwealth Marine Area commences three nautical miles (defines as three nautical miles from Lowest Astronomical Tide (LAT) under the *Seas and Submerged Lands Act 1973*) from the coastline, also known as the Territorial Sea Baseline (TSB).




The Commonwealth Marine Area is any part of the sea, including the waters, seabed and airspace within Australia's EEZ and/ or over the continental shelf of Australia that is not state or Northern Territory Waters. The Territorial Sea is a belt of water not exceeding 12 nautical miles in width measured from the TSB and the EEZ is an area beyond and adjacent to the territorial sea. The offshore components of the Project Area are predominately located within the EEZ (refer to Figure 5.13).

The Study Area is located within the Commonwealth Marine Area situated within the temperate east marine region. This region is an area of high biological productivity, controlled by upwellings created by the southern flowing EAC and inputs of riverine sediments (DEWHA 2009). The province contains a mix of warm and cool temperate species. Refer to Section 5.5.2 for a description of KEF in the Commonwealth Marine Area.

The Project is likely to involve direct physical disturbance to the Commonwealth Marine Area. Additional surveying of the marine environment will be required to determine the presence of major conservation values.



LEGEND
Marine Study Area

-  Exclusive Economic Zone AMB2020 Areas
-  Contiguous Zone AMB2020 Areas
-  Territorial Sea AMB2020 Areas

Title:
Maritime Boundaries

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

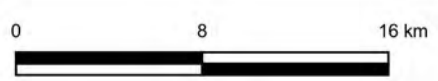


Figure:
5-13

Rev:
C



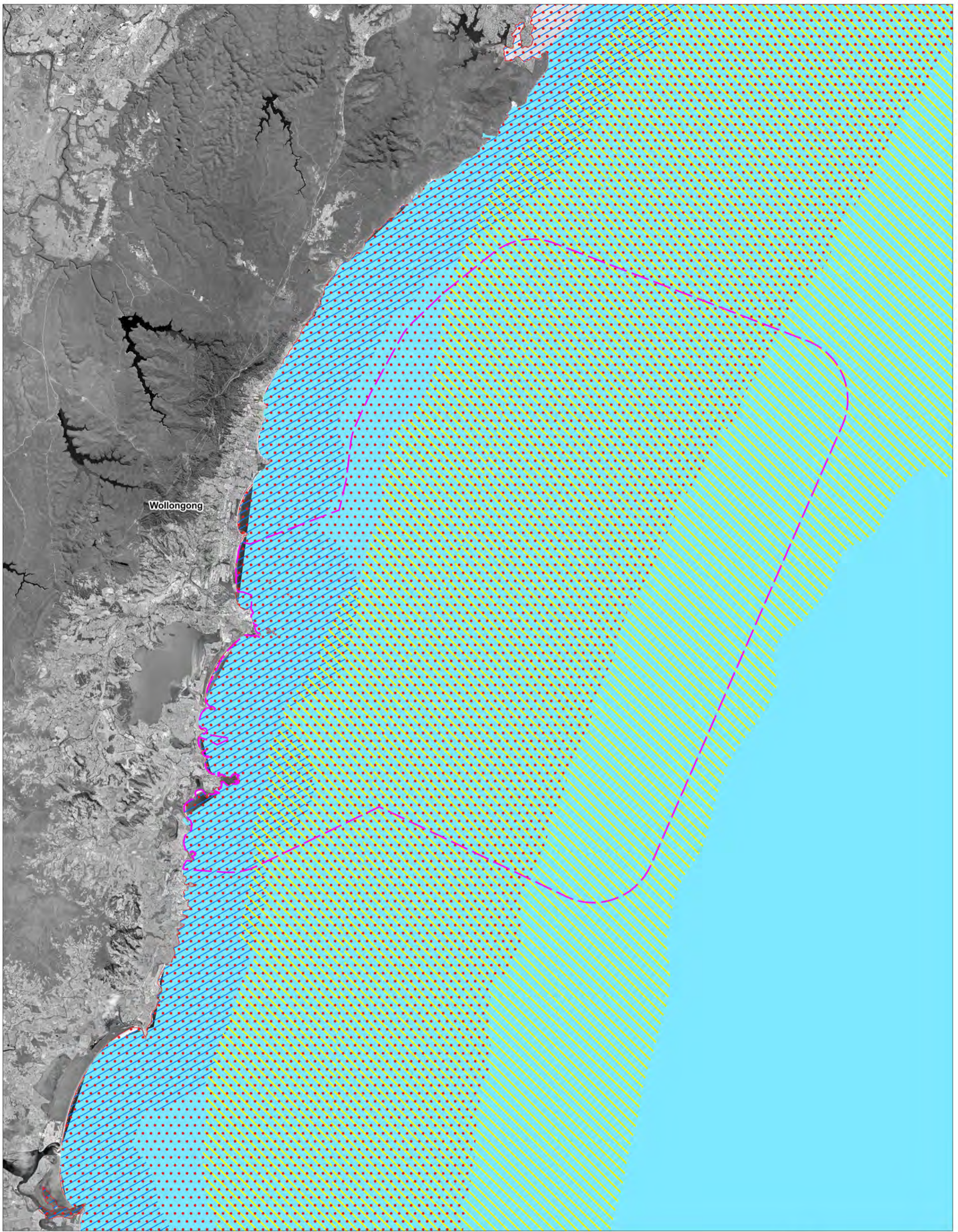
5.7.2 Biologically Important Areas

Though technically not a MNES, a BIA is an indication that an area has a high level of importance for a species, typically threatened or migratory under the EPBC Act. BIAs are spatially defined areas where aggregations of individuals of a species are known to display biologically important behaviour such as breeding, foraging, resting or migration.

The Study Area is nominated as a BIA for the following species:

- Sharks: grey nurse shark (*Carcharias taurus*) – foraging and migration area, white shark (*Carcharodon carcharias*) - distribution
- Whales: humpback whale (*Megaptera novaeangliae*) – foraging area
- Seabirds: flesh-footed shearwater (*Ardenna carneipes*), wandering albatross (*Diomedea exulans* (sensu lato)), antipodean albatross (*Diomedea exulans antipodensis*), southern giant petrel (*Macronectes giganteus*), northern giant petrel (*Macronectes halli*), Wilsons storm petrel (*Oceanites oceanites*), black petrel (*Procellaria parkinsoni*), great-winged petrel (*Pterodroma macroptera*), white-capped albatross (*Thalassarche cauta steadi*), Indian yellow-nosed albatross (*Thalassarche chlororhynchos bassi*), black-browed albatross (*Thalassarche melanophris*), Campbell albatross (*Thalassarche melanophris impavida*) – all nominated as foraging areas, except for Wilsons storm petrel which is mapped for migration purposes.
- Penguins: little penguin (*Eudyptula minor*) – breeding area
- Dolphins: Indo-Pacific/ spotted bottlenose dolphin (*Tursiops aduncus*) (note not threatened or listed as migratory) – breeding area

BIAs for marine megafauna are mapped in Figure 5.14.



- LEGEND**
- Marine Study Area
 - Grey Nurse Shark
 - Humpback Whale
 - Indo-Pacific/Spotted Bottlenose Dolphin
 - White Shark

Title:
**Biologically Important Areas
 New South Wales**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

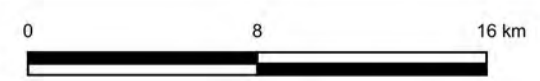


Figure: **5-14** Rev: **C**



5.7.3 Listed Threatened Species

The PMST for the Study Area identified 104 Listed Threatened Species as potentially occurring within the Study Area. Table 5.2 lists the threatened species (Critically Endangered, Endangered, Vulnerable or Conservation Dependent) under either the EPBC Act or *Biodiversity Conservation Act 2016* that have been recorded as occurring, or potentially occurring, within or adjacent to the Study Area.

Species records have been drawn from available databases including the NSW BioNet Atlas. Note Table 5.2 only considers marine-based species and incorporates species that may traverse/ migrate through the marine environment (migratory birds travelling to feeding areas).

The PMST report indicates that seven (7) EPBC-listed Critically Endangered marine species occur or may occur within the Study Area:

- Orange-bellied parrot (*Neophema chrysogaster*)
- Herald petrel (*Pterodroma heraldica*)
- Swift parrot (*Lathamus discolor*)
- Grey nurse shark (*Carcharias taurus*)
- Curlew sandpiper (*Calidris ferruginea*)
- Eastern curlew, far eastern curlew (*Numenius madagascariensis*)
- Great knot (*Calidris tenuirostris*)

Further commentary on how these species may utilise the marine environment is provided in the following sections.

Table 5.2 Listed Threatened (Marine) Species for South Pacific Offshore Wind Project Study Area

Scientific Name	Common Name	EPBC Status	NSW Biodiversity Conservation Act Status	NSW Fisheries Management Act Status	Type of Presence (EPBC PMST) ⁶
Parrots					
<i>Neophema chrysogaster</i>	Orange-bellied parrot	Critically Endangered	Critically Endangered	-	Species or species habitat may occur within Study Area
<i>Lathamus discolor</i>	Swift parrot	Critically Endangered	Endangered	-	Species or species habitat known to occur within Study Area
Listed Migratory Shorebirds					
<i>Calidris ferruginea</i>	Curlew sandpiper	Critically Endangered, Migratory	Endangered	-	Species or species habitat known to occur within Study Area
<i>Numenius madagascariensis</i>	Eastern curlew, far eastern curlew	Critically Endangered, Migratory	-	-	Species or species habitat known to occur within Study Area
<i>Haematopus fuliginosus</i>	Sooty oystercatcher	-	Vulnerable	-	-
<i>Haematopus longirostris</i>	Pied oystercatcher	-	Endangered	-	-
<i>Xenus cinereus</i>	Terek sandpiper	Migratory	Vulnerable	-	-
<i>Calidris canutus</i>	Red knot, knot	Endangered, Migratory	-	-	Species or species habitat known to occur within Study Area
<i>Charadrius leschenaultii</i>	Greater sand plover, large sand plover	Vulnerable, Migratory	Vulnerable	-	Species or species habitat known to occur within Study Area
<i>Calidris tenuirostris</i>	Great knot	Critically Endangered, Migratory	Vulnerable	-	Roosting known to occur within Study Area
<i>Charadrius mongolus</i>	Lesser sand plover, Mongolian plover	Endangered, Migratory	Vulnerable	-	Roosting known to occur within Study Area
Seabirds					

⁶ PMST Threatened Species Simple Presence: May = Species or species habitat may occur within area or Foraging, feeding or related behaviour may occur within area, Likely = Species or species habitat likely to occur within the area or Foraging, feeding or related behaviour likely to occur within area, Known = Species or species habitat known to occur within area or Foraging, feeding or related behaviour known to occur within area.

Scientific Name	Common Name	EPBC Status	NSW Biodiversity Conservation Act Status	NSW Fisheries Management Act Status	Type of Presence (EPBC PMST) ⁶
<i>Pterodroma heraldica</i>	Herald petrel	Critically Endangered	-	-	Species or species habitat likely to occur within Study Area
<i>Thalassarche eremita</i>	Chatham albatross	Endangered, Migratory	-	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Macronectes giganteus</i>	Southern giant-petrel, southern giant petrel	Endangered, Migratory	Endangered	-	Species or species habitat may occur within Study Area
<i>Diomedea sanfordi</i>	Northern royal albatross	Endangered, Migratory	-	-	Species or species habitat may occur within Study Area
<i>Pterodroma leucoptera leucoptera</i>	Gould's petrel, Australian Gould's petrel	Endangered	Vulnerable	-	Species or species habitat may occur within Study Area
<i>Thalassarche cauta</i>	Shy albatross	Endangered, Migratory	Vulnerable	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Macronectes halli</i>	Northern giant petrel	Vulnerable, Migratory	Vulnerable	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Thalassarche melanophris</i>	Black-browed albatross	Vulnerable, Migratory	Vulnerable	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Phoebastria fusca</i>	Sooty albatross	Vulnerable, Migratory	Vulnerable	-	Species or species habitat may occur within Study Area
<i>Thalassarche bulleri platei</i>	Northern Buller's albatross, Pacific albatross	Vulnerable	-	-	Species or species habitat may occur within Study Area
<i>Diomedea antipodensis gibsoni</i>	Gibson's albatross	Vulnerable	Vulnerable	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Thalassarche bulleri</i>	Buller's albatross, Pacific albatross	Vulnerable, Migratory	-	-	Species or species habitat may occur within Study Area
<i>Thalassarche salvini</i>	Salvin's albatross	Vulnerable, Migratory	-	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Thalassarche steadi</i>	White-capped albatross	Vulnerable, Migratory	-	-	Foraging, feeding or related behaviour known to occur within Study Area
<i>Thalassarche carteri</i>	Indian yellow-nosed albatross	Vulnerable, Migratory	-	-	Species or species habitat likely to occur within Study Area

Scientific Name	Common Name	EPBC Status	NSW Biodiversity Conservation Act Status	NSW Fisheries Management Act Status	Type of Presence (EPBC PMST) ⁶
<i>Diomedea antipodensis</i>	Antipodean albatross	Vulnerable, Migratory	Vulnerable	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Pterodroma neglecta neglecta</i>	Kermadec petrel (western)	Vulnerable	Vulnerable	-	Foraging, feeding or related behaviour may occur within Study Area
<i>Diomedea epomophora</i>	Southern royal albatross	Vulnerable, Migratory	-	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Diomedea exulans</i>	Wandering albatross	Vulnerable, Migratory	Endangered	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Fregatta grallaria grallaria</i>	White-bellied storm-petrel (Tasman Sea), white-bellied storm-petrel (Australasian)	Vulnerable	Vulnerable	-	Species or species habitat likely to occur within Study Area
<i>Ardenna carneipes</i>	Flesh-footed shearwater	Migratory	Vulnerable	-	-
<i>Pterodroma nigripennis</i>	Black-winged petrel	-	Vulnerable	-	-
<i>Pterodroma solandri</i>	Providence petrel	-	Vulnerable	-	-
<i>Puffinus assimilis</i>	Little shearwater	-	Vulnerable	-	-
<i>Thalassarche impavida</i>	Campbell albatross, Campbell black-browed albatross	Vulnerable, Migratory	-	-	Species or species habitat may occur within Study Area
Other Birds					
<i>Rostratula australis</i>	Australian painted snipe	Endangered	Endangered	-	Species or species habitat known to occur within Study Area
<i>Botaurus poiciloptilus</i>	Australasian bittern	Endangered	Endangered	-	Species or species habitat known to occur within Study Area
<i>Pachyptila turtur subantarctica</i>	Fairy prion (southern)	Vulnerable	-	-	Species or species habitat known to occur within Study Area
<i>Sternula nereis nereis</i>	Australian fairy tern	Vulnerable	-	-	Species or species habitat known to occur within Study Area
<i>Oxyura australis</i>	Blue-billed duck	-	Vulnerable	-	-
<i>Stictonetta naevosa</i>	Freckled duck	-	Vulnerable	-	-
<i>Phaethon rubricauda</i>	Red-tailed tropicbird	Migratory	Vulnerable	-	-
<i>Ephippiorhynchus asiaticus</i>	Black-necked stork	-	Endangered	-	-

Scientific Name	Common Name	EPBC Status	NSW Biodiversity Conservation Act Status	NSW Fisheries Management Act Status	Type of Presence (EPBC PMST) ⁶
<i>Ixobrychus flavicollis</i>	Black bittern	-	Vulnerable	-	-
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	-	Vulnerable	-	-
<i>Hieraaetus morphnoides</i>	Little eagle	-	Vulnerable	-	-
<i>Pandion cristatus</i>	Eastern osprey	-	Vulnerable	-	-
Fish Species					
<i>Thunnus maccoyii</i>	Southern bluefin tuna	Conservation Dependent	-	Endangered	Species or species habitat likely to occur within Study Area
<i>Rexea solandri</i> (eastern Australian population)	Eastern gemfish	Conservation Dependent	-	-	Species or species habitat likely to occur within Study Area
<i>Seriola lalandi</i>	Blue warehou	Conservation Dependent	-	-	Species or species habitat known to occur within Study Area
<i>Hoplostethus atlanticus</i>	Orange roughy, deep-sea perch, red roughy	Conservation Dependent	-	-	Species or species habitat likely to occur within Study Area
<i>Hippocampus whitei</i>	White's seahorse, crowned seahorse, Sydney seahorse	Endangered	-	Endangered	Species or species habitat known to occur within Study Area
<i>Prototroctes maraena</i>	Australian grayling	Vulnerable	-	Endangered	Species or species habitat likely to occur within Study Area
<i>Epinephelus daemeli</i>	Black rockcod, black cod, saddled rockcod	Vulnerable	-	Vulnerable	Species or species habitat likely to occur within Study Area
Mammalian Species					
<i>Eubalaena australis</i>	Southern right whale	Endangered, Migratory	Endangered	-	Species or species habitat known to occur within Study Area
<i>Balaenoptera musculus</i>	Blue whale	Endangered, Migratory	-	-	Species or species habitat may occur within Study Area
<i>Balaenoptera physalus</i>	Fin whale	Vulnerable, Migratory	-	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Balaenoptera borealis</i>	Sei whale	Vulnerable, Migratory	-	-	Foraging, feeding or related behaviour likely to occur within Study Area
<i>Physeter macrocephalus</i>	Sperm whale	-	Vulnerable	-	-

Scientific Name	Common Name	EPBC Status	NSW Biodiversity Conservation Act Status	NSW Fisheries Management Act Status	Type of Presence (EPBC PMST) ⁶
<i>Megaptera novaeangliae</i>	Humpback whale	Migratory	Vulnerable		-
<i>Dugong dugon</i>	Dugong	Migratory	Endangered		-
<i>Arctocephalus forsteri</i>	New Zealand fur-seal	-	Vulnerable		-
<i>Arctocephalus pusillus doriferus</i>	Australian fur-seal	-	Vulnerable		-
Reptilian Species					
<i>Caretta caretta</i>	Loggerhead turtle	Endangered, Migratory	Endangered		Breeding likely to occur within Study Area
<i>Dermochelys coriacea</i>	Leatherback turtle, leathery turtle, Luth	Endangered, Migratory	Endangered		Species or species habitat known to occur within Study Area
<i>Natator depressus</i>	Flatback turtle	Vulnerable, Migratory	-		Foraging, feeding or related behaviour known to occur within Study Area
<i>Chelonia mydas</i>	Green turtle	Vulnerable, Migratory	Vulnerable		Foraging, feeding or related behaviour known to occur within Study Area
<i>Eretmochelys imbricata</i>	Hawksbill turtle	Vulnerable, Migratory	-		Foraging, feeding or related behaviour known to occur within Study Area
Shark Species					
<i>Sphyrna lewini</i>	Scalloped hammerhead	Conservation Dependent	-		Species or species habitat likely to occur within Study Area
<i>Centrophorus uyato</i>	Little gulper shark	Conservation Dependent	-		Species or species habitat likely to occur within Study Area
<i>Centrophorus harrissoni</i>	Harrisson's dogfish, Endeavour dogfish, dumb gulper shark, Harrison's deepsea dogfish	Conservation Dependent	-		Species or species habitat likely to occur within Study Area
<i>Galeorhinus galeus</i>	School shark, eastern school shark, snapper shark, Tope, soupfin shark	Conservation Dependent	-		Species or species habitat may occur within Study Area
<i>Carcharias taurus (east coast population)</i>	Grey nurse shark (east coast population)	Critically Endangered	-		Species or species habitat known to occur within Study Area
<i>Carcharodon carcharias</i>	White shark, great white shark	Vulnerable, Migratory	-		Species or species habitat known to occur within Study Area



BMT (OFFICIAL)

Scientific Name	Common Name	EPBC Status	NSW Biodiversity Conservation Act Status	NSW Fisheries Management Act Status	Type of Presence (EPBC PMST) ⁶
<i>Rhincodon typus</i>	Whale shark	Vulnerable, Migratory	-		Species or species habitat may occur within Study Area

Seabirds

The PMST indicates that 20 EPBC listed threatened seabird species have a known or possible occurrence in the Study Area (Table 5.2). The Study Area is mapped as a BIA under the EPBC Act for the following seabird species which utilise the area for foraging and breeding purposes (Figure 5.15):

- Flesh-footed shearwater
- Wandering albatross
- Antipodean albatross
- Southern giant petrel
- Northern giant petrel
- Wilsons storm petrel
- Black petrel, great-winged petrel
- White-capped albatross
- Indian yellow-nosed albatross
- Black-browed albatross
- Campbell albatross
- Little penguin.

Figure 5.15 shows the NSW BioNet records of seabird species within the Study Area including several petrel, shearwater and tern species. It is expected that many other seabird species would also occur.

Albatross and petrel species largely breed in Antarctica and islands south of Australia (Australian Government 2021). Albatross and petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast distances over oceans, all waters within the Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat are waters southwards of the parallel of 25 degrees, where most species spend most of their foraging time (Australian Government 2021). Albatross and petrel species predominately breed on remote, offshore islands in the higher latitudes.

Shearwater species may also breed along the eastern Hunter coastline, often travelling from places such as Antarctica, Siberia, Japan, South America and New Zealand. Shearwaters also utilise coastal waters for foraging activities with small fish, squid, crustaceans, molluscs and planktonic crustaceans (such as krill) forming the main parts of their diet. Specifically, the Five Islands which are located within the Study Area (see Section 5.4.2), are recognised habitat and breeding sites for the wedge-tailed shearwater and short-tailed shearwater (Marine Estate Management Authority 2018).

The little penguin is distributed along the southern coasts of Australia with colonies as far north as Coffs Harbour in NSW. Currently, the only known mainland breeding colony in NSW is a secluded cove in the Manly area of Sydney Harbour approximately 38 km north of the Study Area (NSW DPE 2019). They usually nest in borrows and establish colonies in sand-dune vegetation. Five Islands Nature Reserve within the Study Area provides suitable habitat for this species and a colony of little penguins is known to congregate around this region.

The herald petrel listed as Critically Endangered under the EPBC Act is a marine, pelagic species of tropical and subtropical waters that breeds and nests on tropical and subtropical islands, atolls, cays and rocky islets. There are no known breeding or nesting sites for this species within the Study Area. The main breeding area for this species occurs on Raine Island, off the east coast of far north Queensland, though their migratory pathway extends as far as the central NSW coastal borders. The species has relatively few threats and receives a high level of protection from government agencies and occasional sightings have been recorded in NSW.

The Study Area is therefore considered to support suitable breeding and foraging habitat for seabird species, particularly the Five Islands region. Note the Study Area supports suitable foraging habitat that is broadly representative of the marine and coastal habitats that occur in the bioregion and offshore of the wider NSW coastline.

Further assessment of the habitat values of the Study Area to seabirds and the risks posed by turbine strike is required.

International Migratory Shorebirds

The PMST indicates that 9 EPBC listed threatened migratory shorebird species have a known or possible occurrence in the Study Area (Table 5.2). The PMST reports three EPBC listed Critically Endangered migratory shorebirds as occurring or potentially occurring in the Study Area:

- Curlew sandpiper
- Eastern curlew
- Great knot.

NSW BioNet sightings of migratory shorebirds are provided in Figure 5.16.

International migratory shorebirds refer to shorebirds and wader birds that typically migrate on an annual basis and breed in wetland environments in the northern hemisphere during the northern summer, before migrating south to Australia and other locations over winter (Australian summer) As part of the annual migration, shorebirds tend to aggregate at major coastal wetland and intertidal sites across Australia, with smaller aggregations occurring in inland habitats.

Lake Illawarra, which is located directly adjacent to the Study Area, is known to host over 55 species of waterbird including key migratory shorebird species such as the little tern, eastern curlew and bar-tailed godwit. These species are visitors to the lake during the summer.

The double-banded plover (*Charadrius bicinctus*) is known to use the entrance shoals of the lake for feeding and roosting while other piscivorous species (birds which feed on fish) utilise the area for roosting. However, migratory shorebird populations (including curlew sandpiper, pacific golden plover (*Pluvialis fulva*), sharp-tailed sandpiper (*Calidris acuminata*) and great knot within the Lake Illawarra region have greatly reduced over time due to habitat loss (Chafer and Brandis 2006).

The Study Area and surrounds provide suitable roosting and foraging habitat for shorebirds, including intertidal mud flats, shoals, reef and beach habitats. Piscivores likely utilise the marine environment for foraging purposes (Chafer and Brandis 2006). Hunter Estuary far north of the Study Area is considered important habitat for the curlew sandpiper and great knot (NSW Government 2022a). These wetlands are used as a staging post for migratory wader birds during the summer. Further information on the Critically Endangered listed migratory bird species is provided below.

BMT (OFFICIAL)

The curlew sandpiper breeds in Siberia and migrates to Australia for the non-breeding period, arriving in Australia between August and November. This species forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed. Preferred roosting areas include on shell or sand beaches or occasionally salt marsh.

In NSW, the eastern curlew (listed as Critically Endangered under the EPBC Act) frequents intertidal mudflats and sometimes saltmarsh of sheltered coasts. Roosting areas include sandy spits and islets particularly dry beach near the high water and among coastal vegetation. The Hunter Estuary is a Ramsar wetland situated approximately 160 km of the Study Area and supports at least 1% of the population of waterbird species including the eastern curlew.

The great knot is another critically endangered migratory species that typically prefers sheltered coastal habitats, with large intertidal mudflats or sandflats including inlets, bays, harbours, estuaries and lagoons including the Hunter River Estuary. The great knot roosts in open areas, often at the waters edge or in shallow water close to feeding grounds. Migration patterns of the great knot indicate large numbers arrive in in Australia during late August/ early September throughout the non-breeding period.

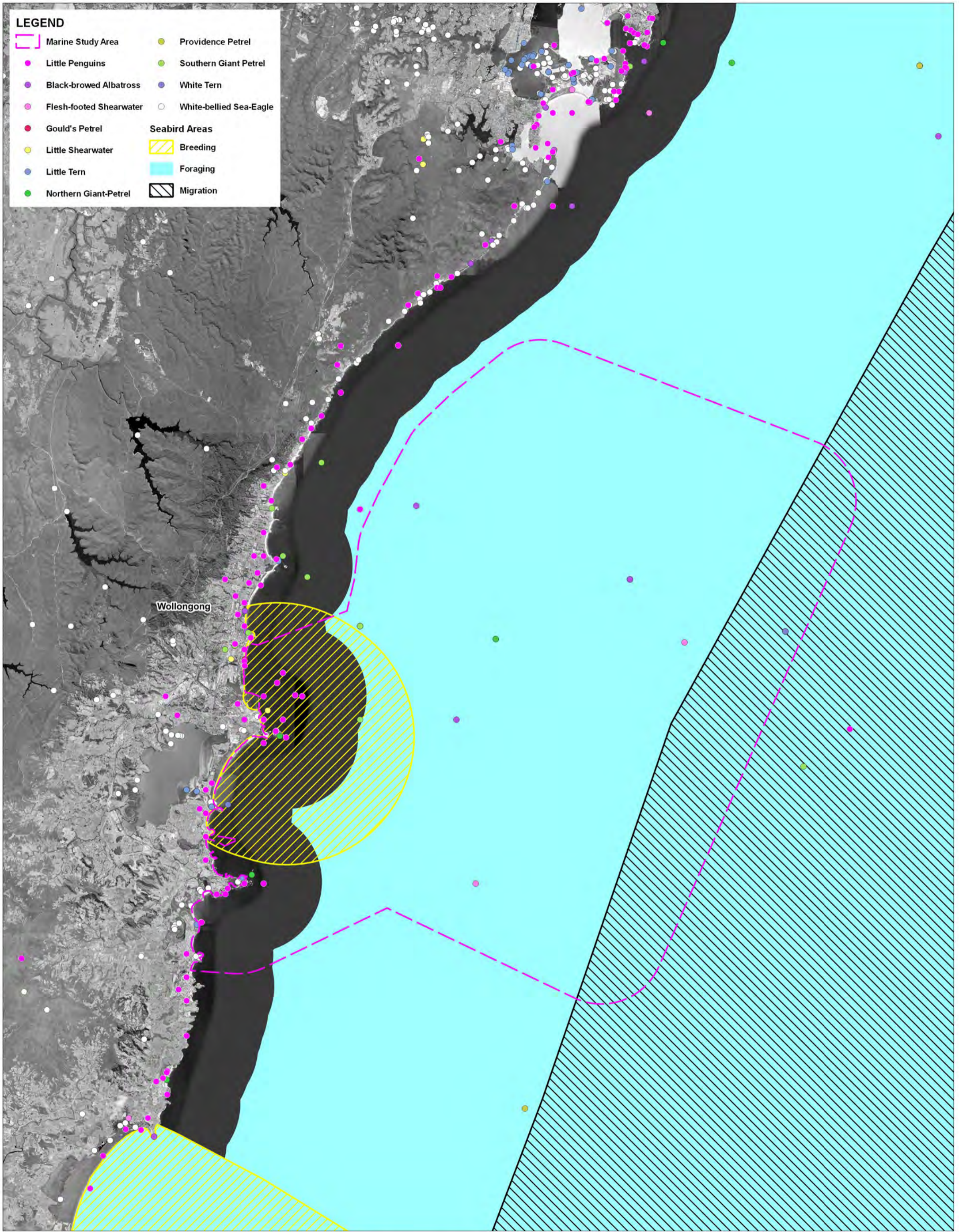
In summary, migratory shorebird species congregate around nearshore habitats and piscivores may regularly utilise the Study Area for foraging purposes. With regard to providing habitat critical to the survival of threatened species:

- The Study Area is not known to support important breeding habitat for listed threatened species.
- The Study Area supports suitable foraging habitat that is broadly representative of the marine and coastal habitats that occur in the bioregion and offshore of the wider NSW coastline.

Further studies will be required to determine the flight paths and behaviours of migratory shorebirds and evaluate their use of the Study Area and risks posed by turbine strike.

LEGEND

- Marine Study Area
 - Little Penguins
 - Black-browed Albatross
 - Flesh-footed Shearwater
 - Gould's Petrel
 - Little Shearwater
 - Little Tern
 - Northern Giant-Petrel
 - Providence Petrel
 - Southern Giant Petrel
 - White Tern
 - White-bellied Sea-Eagle
- Seabird Areas**
- Breeding
 - Foraging
 - Migration

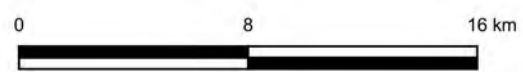


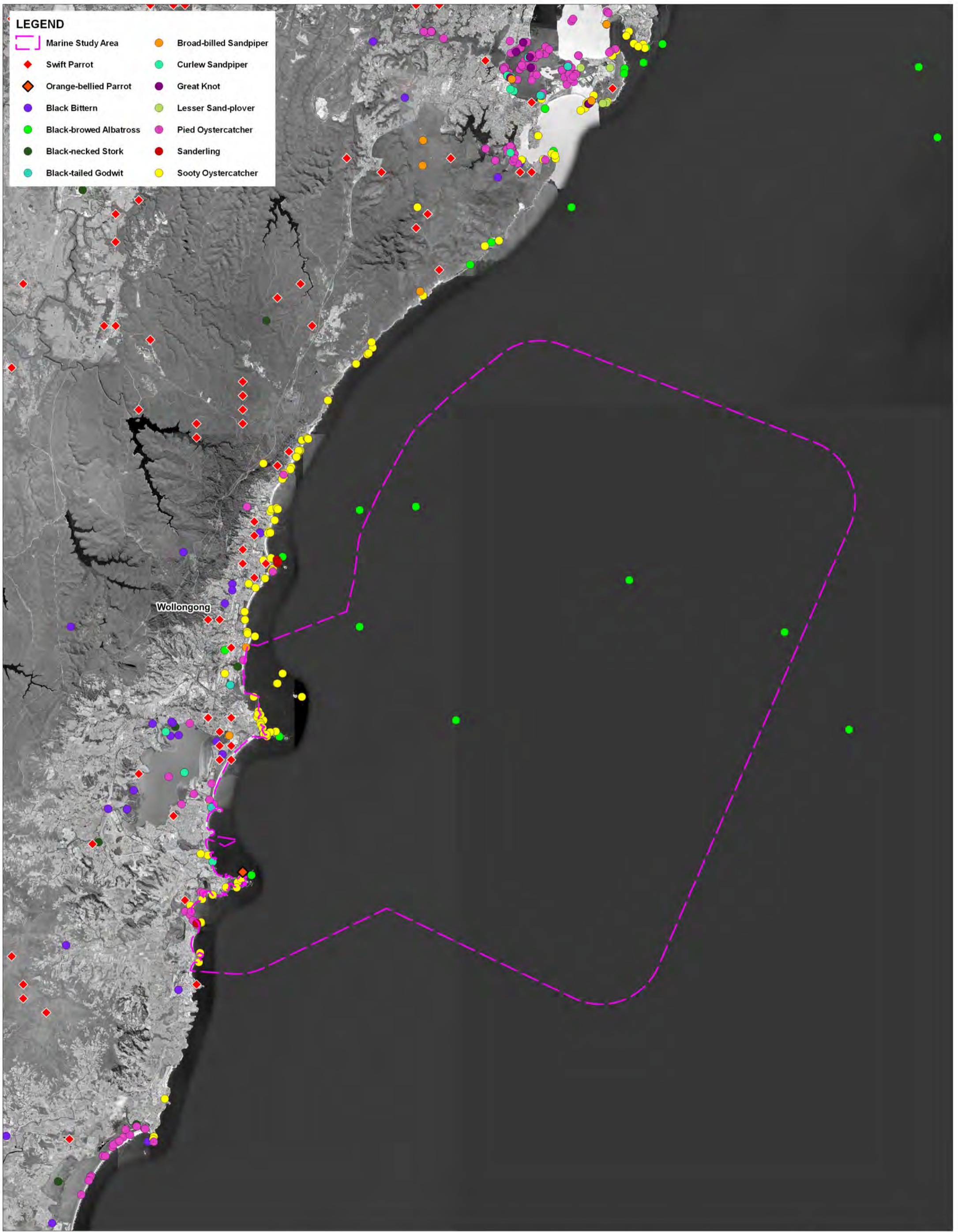
Title:
Seabird Sightings (NSW BioNet) New South Wales

Figure:
5-15

Rev:
C

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



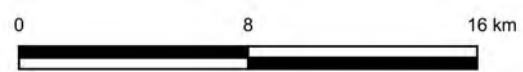


Title:
Shorebird Sightings (NSW BioNet) New South Wales

Figure:
5-16

Rev:
C

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Parrots

Orange Bellied Parrot

The orange-bellied parrot (*Neophema chrysogaster*) inhabits coastal and surrounding areas including saltmarshes, littoral heathlands and scrublands. The orange-bellied parrot breeds in Tasmania and then migrates to southern mainland Australia for winter; it is considered Critically Endangered, with around 140 birds leaving the nesting site in Tasmania (known as Melaleuca) after the 2020/21 breeding season (Orange-bellied Parrot Recovery Program, 2022).

The orange-bellied parrot (Critically Endangered under the EPBC Act) is typically distributed on the mainland coast of south-eastern south Australia and southern Victoria, though their non-breeding range extends to NSW (Figure 5.17). There have been occasional reports from NSW, with the most recent records off Shellharbour and Maroubra Beach in May 2003 (refer to Figure 5.16) (NSW Government 2019). Birds were seen foraging on weed species several hundred metres from the coastline. Historical records indicate the orange-bellied parrot was formerly more abundant and widespread on NSW coastlines, but numbers have reduced possibly due to depletion of available winter feeding habitat.

It would appear that habitat for the species exists within and adjacent to the Study Area such as saltmarshes, and it is possible NSW habitats may be more frequently utilised than observations suggest.

Swift Parrot

Swift parrots (Critically Endangered under the EPBC Act) breed in Tasmania and migrate to mainland Australia in autumn. During winter, the parrots disperse across a broad landscape, foraging on nectar in eucalypt woodlands mainly in inland Victoria and New South Wales. The migratory pathways of the species is not well understood, however their distribution in NSW mostly occurs on the coastline and south west slopes throughout the autumn and winter months.

Figure 5.16 presents swift parrot sightings within and adjacent to the Study Area based on contemporary species records provided by BioNet Atlas. Figure 5.18 shows the indicative distribution of the swift parrot on the east coast of Australia. Whilst the Study Area does not contain habitat for the species i.e. Eucalypt woodland, it is possible individuals may pass through the Study Area whilst migrating to their preferred habitat.

The National Recovery Plan for the Swift Parrot (Commonwealth of Australia 2019) lists the construction of wind turbines in South-eastern Australia as a potential threat to survival of the species, if they are poorly sited.

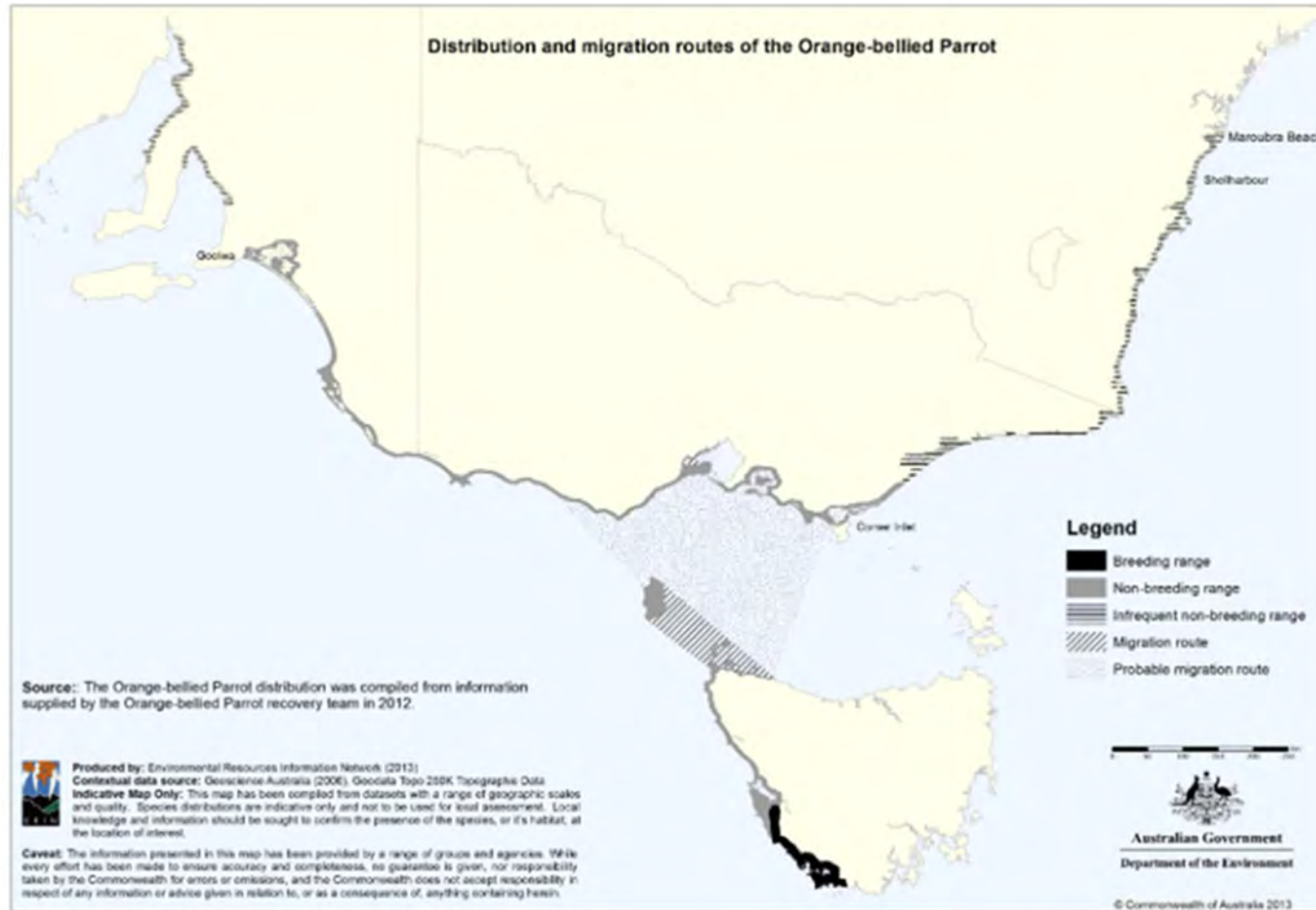


Figure 5.17 Known Distribution of the Orange-Bellied Parrot (Australian Government 2016)

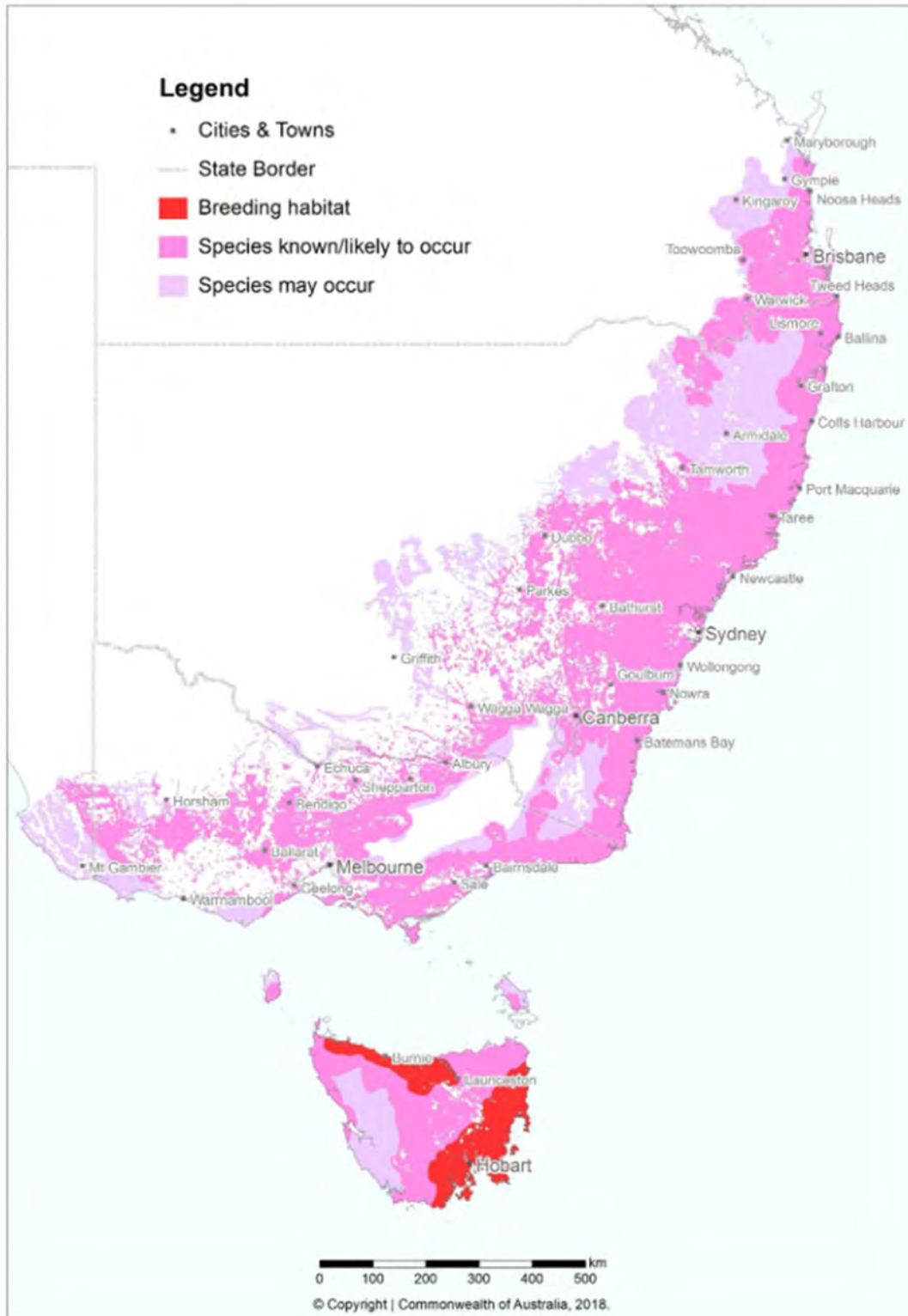


Figure 5.18 Distribution of the Swift Parrot in Southeast Australia (Commonwealth of Australia 2019)

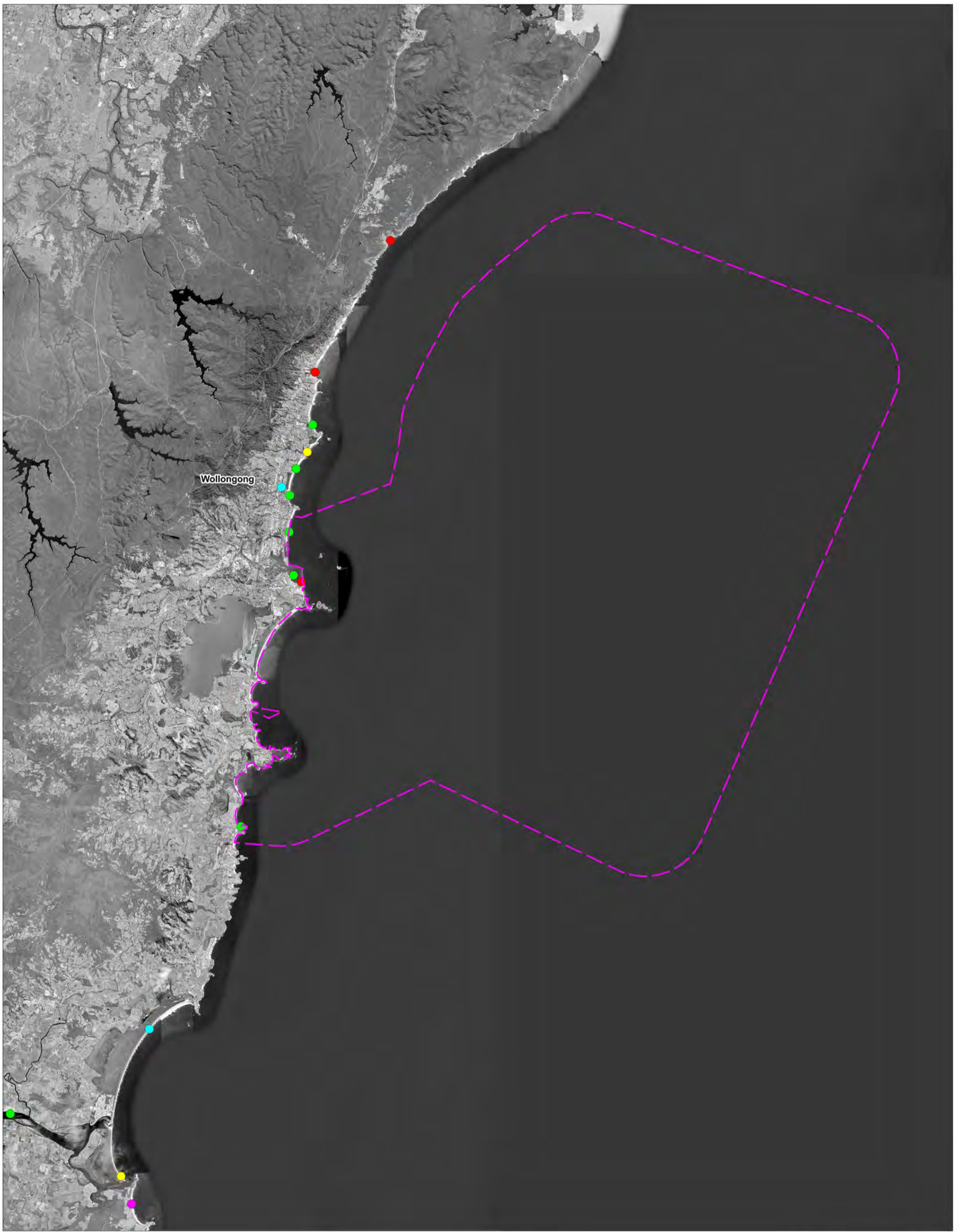
Marine Turtles







The PMST identifies five marine turtles as known or likely to occur in the search area. Four species were identified as occurring or species habitat known to occur within the Study Area (flatback turtle (*Natator depressus*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and leatherback turtle (*Caretta caretta*)) while for one species (loggerhead turtle (*Caretta caretta*)) breeding is likely to occur in the area. Marine turtles nest on sandy beaches in subtropical and tropical environments, however successful turtle nesting has been recorded as far south as Port Macquarie (NSW Government 2022c), >400 km north of the Study Area.

The Recovery Plan for Marine Turtles in Australia (Australian Government Department of the Environment and Energy 2017) identifies the geographic distribution of nesting sites for marine turtle species including the five species that have been identified within the Study Area. Mapping indicates that all species are known/ likely to occur within the boundaries of the Commonwealth marine area. The Study Area does contain beaches that provide suitable nesting habitat for these species.

A BioNet search identified multiple records for green turtle and hawksbill turtle as well as two records of loggerhead turtle and one of the leatherback turtle within and adjacent to the Study Area (Figure 5.19). Green turtles feed predominantly on seagrass and other marine plants, which do not occur in the Study Area. It is likely that any use of the Study Area by green turtles will be for migration purposes. Leatherback turtle occurs in inshore and offshore tropical and temperate waters, and is a pelagic feeder (mostly jellyfish). It is likely that the Study Area, like other parts of the east Australia coast and marine environment, provides feeding habitat and migratory areas for this species. Loggerhead turtles are an offshore marine species that forage in deep benthic and pelagic environments for benthic fauna, fish and jellyfish. Like leatherback turtle, it is likely that the Study Area, like other parts of the east Australia coast and marine environment, provide suitable feeding habitat and migratory areas for this Loggerhead turtle. Flatback turtle and hawksbill turtle are predominantly tropical/subtropical species (Cogger 2001) but are possible vagrants in the region.

There are no BIAs or critical habitats for marine turtles in the Study Area.



LEGEND	
	Marine Study Area
	Hawksbill Turtle
	Leatherback Turtle
	Flatback Turtle
	Loggerhead Turtle
	Green Turtle
	Unidentified Sea Turtle

Title:
Sea Turtle Sightings (NSW BioNet)

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.


 0 8 16 km

Figure:
5-19

Rev:
C



www.bmt.org

Sharks

White Shark

The white shark *Carcharodon carcharias* is widely but patchily distributed in Australian waters (Australian Government 2014). It is most common in nearshore habitats, but also occurs on the continental shelf and slope to water depths >1200 m. Habitat usage appears to vary with age. Surf zones represent white shark nursery, with important areas in the Hunter/Forster coast (Bruce and Bradford 2008) located >100 km north of the Study Area, and areas in Victoria and south Western Australia. Adults can occur in large numbers around seal colonies in Victoria, South Australia and Western Australia, but are common around other rocky environments and embayments. There are no BioNet records in the Study Area, however it is expected that this species forages and migrates through the Study Area. The Study Area occurs in the mapped distribution of the white shark, which constitutes a BIA for the species (Figure 5.14). The Study Area is not however, a BIA for this species for aggregation, breeding or foraging.

Grey Nurse Shark

Grey nurse shark *Carcharias taurus* is a wide-ranging species found in tropical and warm temperate waters. It occurs in continental shelf waters, with habitats including sandy nearshore environments and reef environments down to >150 m depth. It typically swims near the sea floor, and is most commonly observed in sand gutters, and around reefs and caves (Last and Stevens 1994).

The entire NSW nearshore zone including the Study Area is a BIA for this species (refer to Figure 5.14). The Study Area adjoins several sites known to support grey nurse shark at Bass Point, Shellharbour (Otway *et al.* 2003, Figure 5.20). Otway *et al.* 2003 reports that grey nurse sharks occur at Bass Point from December to June. The Bass Point area is located in nearshore environments outside the Project Area. The nearest defined critical habitat to the Study Area for this species is Magic Point (Sydney) and Tollgate Islands (Batesman Bay) (refer to Figure 5.21).

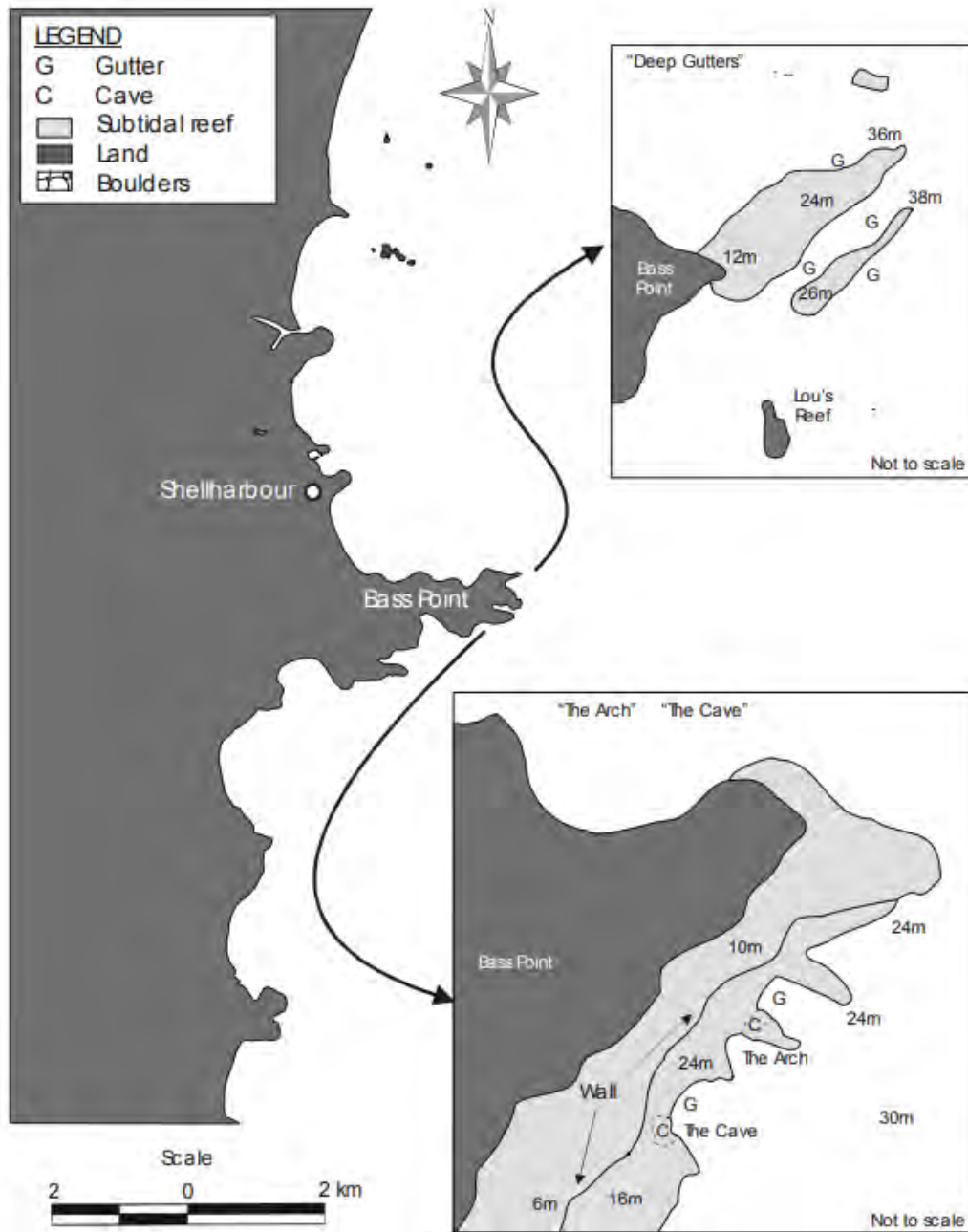


Figure 5.20 Sites at Shellharbour where grey nurse sharks have been reported (Reproduced from Otway et al. 2003)

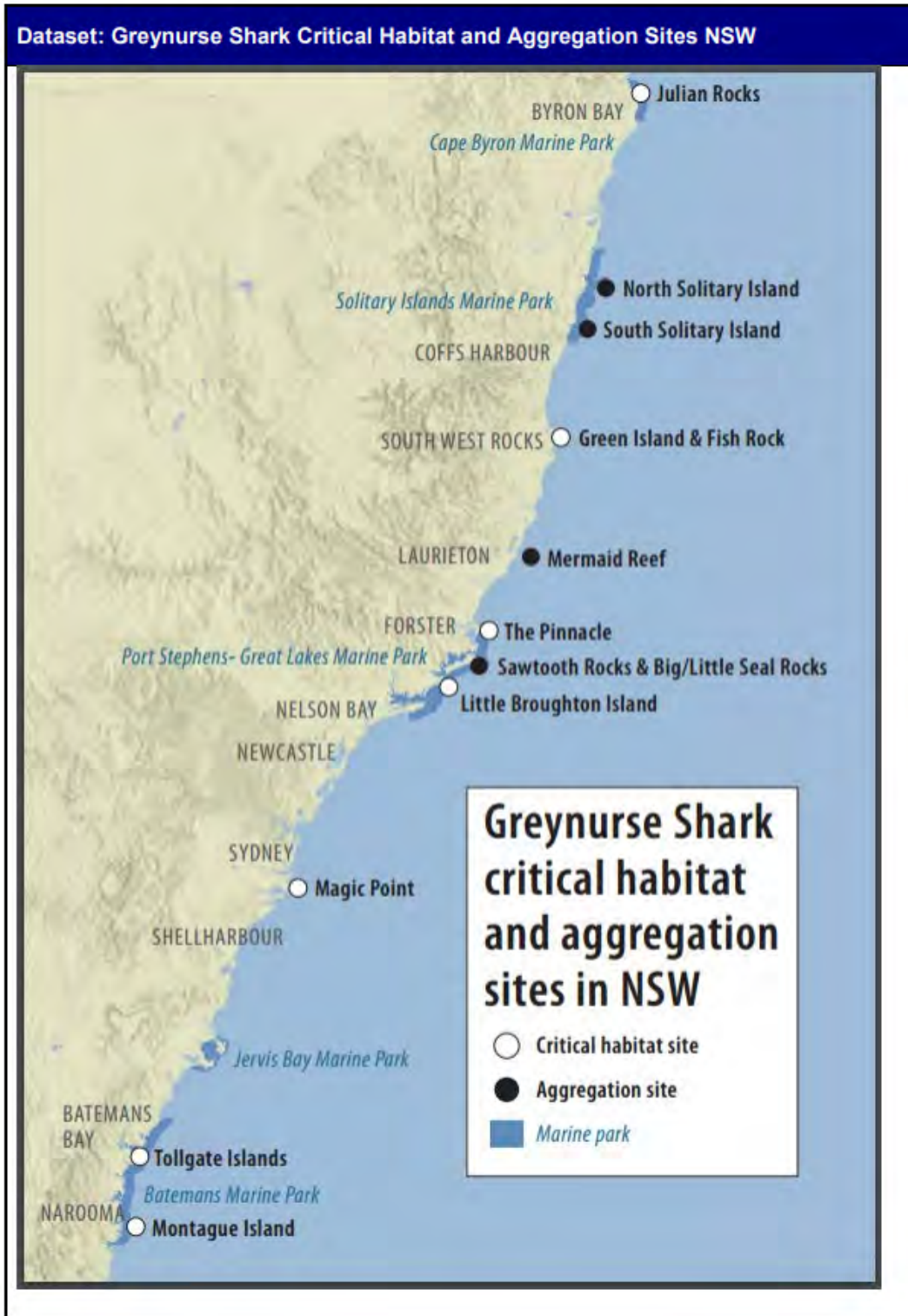


Figure 5.21 Grey nurse shark critical habitat and aggregation sites in NSW (Source: NSW Department of Primary Industries 2014)

Whale shark *Rhincodon typus* potentially occurs in the Study Area. It is a pelagic planktivore that occurs in continental shelf and offshore waters, typical in tropical and sub-tropical environments (Last and Stevens 1994). The NSW coast (including the Study Area) is not a BIA for this species. There are few records of this species in NSW (BioNet 2022) but it may occasionally pass through the Study Area.

Four EPBC listed 'conservation dependent' shark species potentially occur in the Study Area:

- scalloped hammerhead *Sphyrna lewini* (NSW: Endangered) is tropical/sub-tropical coastal pelagic species. It has been recorded as far south as Sydney (DPI 2012) and may be a vagrant in the Study Area.
- little gulper shark *Centrophorus uyato* (NSW not listed) is a deepwater dogfish species typically distributed around the southern Australian coastline in depths up to 1,400 m and is unlikely to occur in the Study Area.
- Harrison's dogfish *Centrophorus harrisoni*. This is a deepwater (350-800 m) continental slope species and is unlikely to occur in the Study Area (Bray 2021).
- school shark *Galeorhinus galeus* is a temperate water coastal pelagic species which occurs in estuaries as juveniles, and shelf and slope waters as adults. It is primarily a deepwater species (Bray 2022) but may occur in occur in the Study Area.

Bony Fish

Three threatened bony fish species or their habitat may occur in the Study Area:

- White's seahorse *Hippocampus whitei* is a coastal and estuarine species found at water depths of 1-18 m. It is often found in seagrass beds, sponge gardens and around soft corals (DAWE 2022). The proposed Project is >18 m depth and therefore do not support the preferred habitat of this species. Nearshore reef environments of the Study Area may provide suitable habitat for this species. There are no records in BioNet (2022) for this species in the Study Area.
- Australian Grayling *Prototroctes maraena* is an amphidromus species that spends most of its life cycle in rivers. It spawns in rivers and its eggs are transported to estuaries and the sea, and juveniles then migrate upstream to their primary freshwater habitat. There are no BioNet records of this species in the Study Area and the site does not support important habitat for this species.
- Black Rockcod *Epinephelus daemeli* is a warm temperate and subtropical reef species. Adults are often found in caves and gutters, at depths to 50 m. Juveniles are more common in inshore environments including coastal rockpools and estuaries (Bray 2020). Reef habitats in the Study Area are therefore potential habitats for this species. There are no BioNet records for this species in the Study Area.

Four conservation dependent species potentially occur in the Study Area. All four species are commercially important: southern bluefin tuna (a pelagic species), eastern gemfish (deepwater demersal species: 100 - 750 m), blue warehou (deepwater benthic-pelagic species: 50 - 300 m) and orange roughy (deepwater benthic species: 700 - 1400m). Of these, southern bluefin tuna is the most likely to occur in the Study Area.

Pinnipeds

New Zealand Fur-seal *Arctocephalus forsteri* has a distribution that extends throughout NSW, but is more common in the southern part of the state. While it is most common around rocky islands, it may also occasionally occur in mainland rocky shores. There are records of this species within and adjacent to the Study Area. There is no critical habitat for this species in NSW waters.

Australian fur-seal *Arctocephalus pusillus doriferu* has similar habitat requirements as *A. forsteri*. There are multiple records of this species at and adjacent to the Study Area. There is no critical habitat or breeding habitat for this species in NSW waters.

Cetaceans

The southern right whale (*Eubalaena australis*) is listed as Endangered under the EPBC Act. This species migrates between summer feeding areas in the Southern Ocean to inshore coastal waters off Australia. The eastern coast of NSW is within its current core coastal range however, NSW does not contain any present-day coastal aggregation areas (Figure 5.22). Contemporary species records obtained from NSW BioNet indicate a number of sightings for the southern right whale within and adjacent to the Study Area (refer to Figure 5.23).

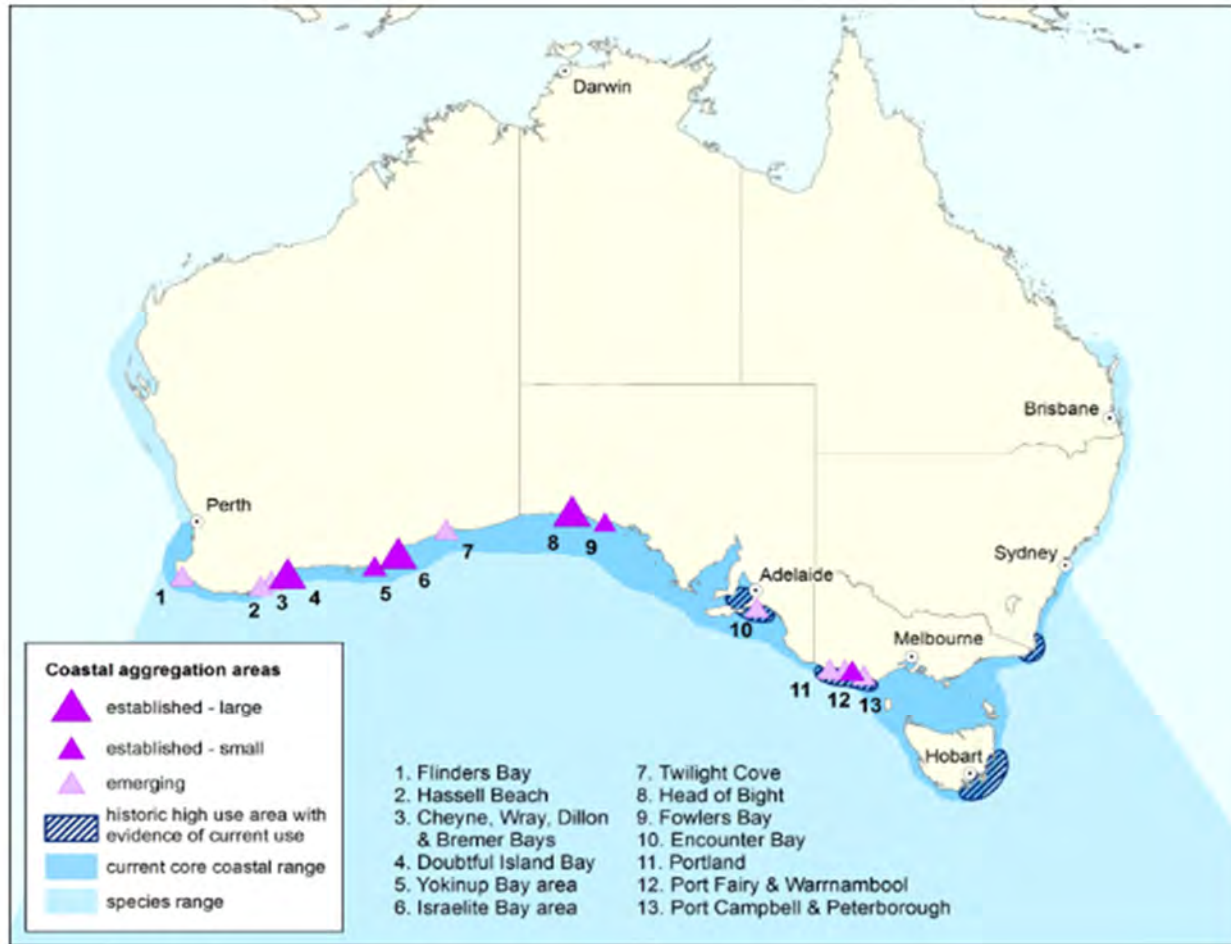
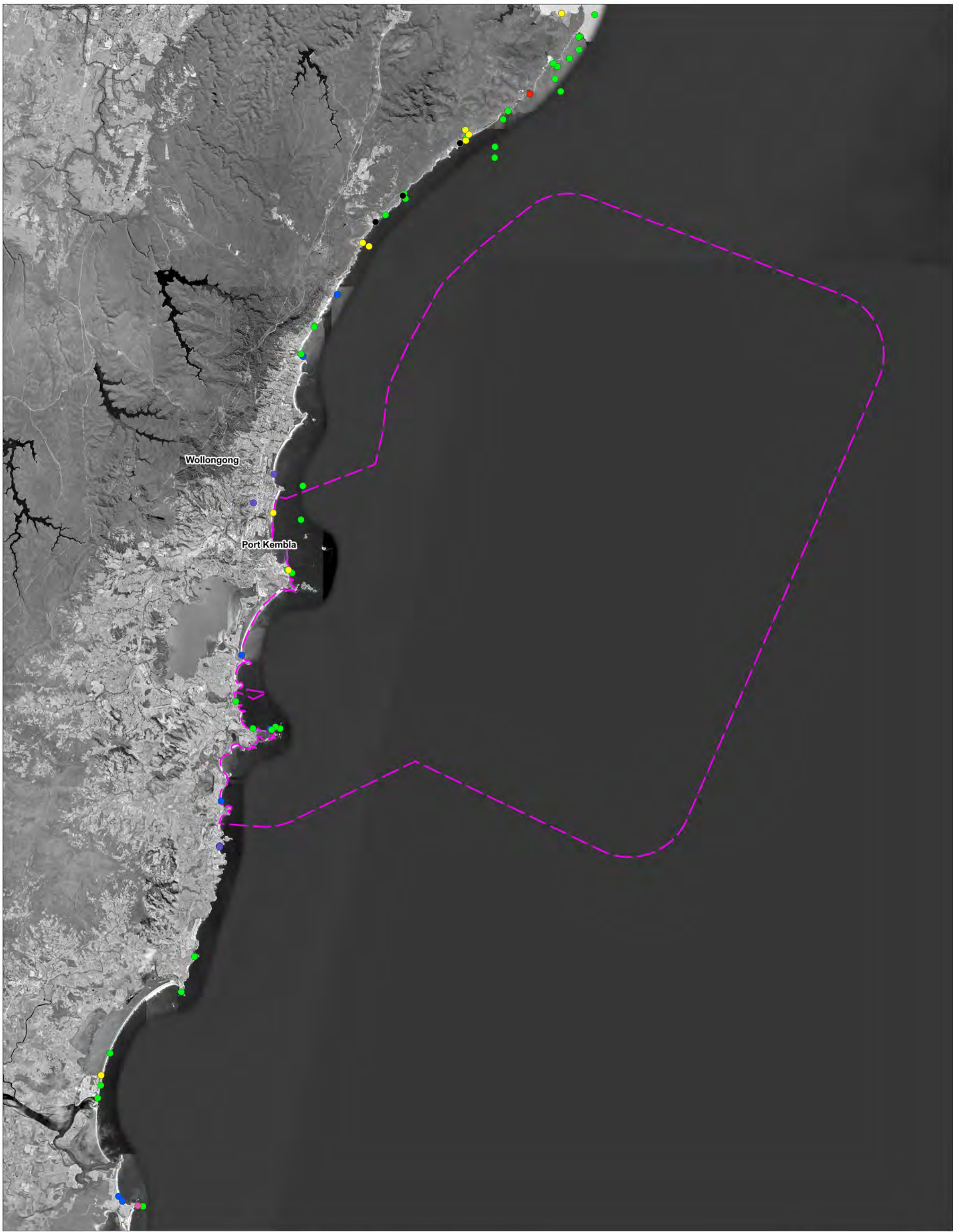


Figure 5.22 Coastal aggregation areas and geographic range of southern right whale (*Balaena australis*) (SPRAT 2022)

Several other threatened whale species occur or could occur in the Study Area:

- sperm whale *Physeter macrocephalus* – this species is typically found in deep offshore waters, especially where there is a rise in the seafloor off the continental shelf. There are several BioNet records of this species at and adjacent to the Study Area, however the preferred deepwater habitat is not present.
- fin whale *Balaenoptera physalus* and sei whale *Balaenoptera borealis* – there are no confirmed sei whale records in NSW waters, and only two unconfirmed records of fin whale in NSW waters (Smith 2001). Both species are therefore considered threatened by the NSW legislation, and both are highly unlikely to occur in the Study Area.



Whale Sightings (NSW BioNet)

- Humpback Whale
- Pygmy Sperm Whale
- Sperm Whale
- Southern Right Whale
- Melon-headed Whale
- Short-finned Pilot Whale
- Strap-toothed Beaked Whale

Title:

**Whale Sightings (NSW BioNet)
New South Wales**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

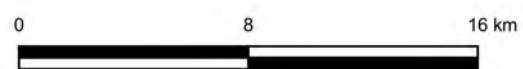


Figure:

5-23

Rev:

C



5.7.4 Migratory Species

Table 5.3 lists species that are considered Migratory under the EPBC Act. There are an additional 31 marine migratory bird species, seven (7) migratory cetacean and four migratory shark species that are not considered threatened. These are described briefly below, based on species information in the SPRAT database (Commonwealth of Australia 2022).

Fork-tailed swift

Fork-tailed swift (*Apus pacificus*) species is recorded in all regions of NSW however, most observations occur east of the great divide. They are an almost exclusively aerial species flying to at least 300 m above ground through predominately dry, open habitats.

Shearwater species

Sooty shearwater (*Ardenna grisea*), streaked shearwater (*Calonectris leucomelas*), flesh-footed shearwater (*Ardenna carneipes*), short-tailed shearwater (*Ardenna tenuirostris*), wedge-tailed shearwater (*Ardenna pacifica*) - these shearwater species are known to breed on islands off the central coast of NSW including Lord Howe Island and Port Stephens north of the Study Area on an annual basis. Shearwaters may utilise the marine environment for foraging purposes.

Seabirds

- Common noddy (*Anous stolidus*) – mainly occur in the ocean off the Queensland coast near islands, rocky islets or cliffs and forage in surrounding waters.
- Little tern (*Sternula albifrons*) and greater crested tern (*Ardenna pacifica*) – tern species are widely distributed in Australia; breeding sites have been observed on the NSW coast. Terns typically inhabit sheltered coastal environment including estuaries and river mouths.
- Osprey (*Pandion haliaetus*) – breeding range of the osprey extends around the northern coast of Australia from Albany in Western Australia to Lake Macquarie in NSW north of the Study Area. Species records decrease towards the southern part of Australia. Ospreys generally occur in coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands.
- Other migratory seabirds (white-tailed tropicbird (*Phaethon lepturus*), lesser frigatebird (*Fregata ariel*), great frigatebird (*Fregata minor*)) – these migratory seabirds are widespread throughout Australian waters however, significant breeding sites are situated towards the northern coastlines. The white-tailed tropicbird in particular is a common visitor to the seas off northern Western Australia.

Shorebirds

- Bar-tailed godwit (*Limosa lapponica*) and black-tailed godwit (*Limosa limosa*) – recorded in coastal areas of all Australian coasts and widespread in NSW including offshore islands. Hunter Estuary north of the Study Area is considered a site of international importance for the bar-tailed godwit population.
- Whimbrel (*Numenius phaeopus*) – regular migrant to Australia with a primarily coastal distribution, more common in the northern jurisdictions.
- Other migratory shorebirds (latham's snipe (*Gallinago hardwickii*), pectoral sandpiper (*Calidris melanotos*), common greenshank (*Tringa nebularia*), common sandpiper (*Actitis hypoleucos*), sharp-tailed sandpiper (*Calidris acuminata*), sanderling (*Calidris alba*), little curlew (*Numenius minutus*) ruddy turnstone (*Arenaria interpres*), double-banded plover (*Charadrius bicinctus*), grey-tailed tattler (*Tringa brevipes*), red-necked stint (*Calidris ruficollis*), Swinhoe's snipe (*Gallinago megala*), pin-tailed snipe (*Gallinago stenura*), marsh sandpiper (*Tringa stagnatilis*), pacific golden plover (*Pluvialis fulva*) – these species are widespread in Australia, around coastal regions in

wetland habitats including the coastlines of NSW. Wetlands surrounding the Study Area are not considered to be core habitat for these species.

Dusky dolphin

Dusky dolphin (*Lagenorhynchus obscurus*) - this species mainly occurs throughout the southern hemisphere in temperate and sub-Antarctic zones. Populations around the NSW coastline are limited.

Shark Species

- Giant manta ray (*Mobula birostris*) – giant manta ray migrates through deeper oceanic environments. Specific migratory pathways on the Australian coastline are not well documented.
- Shortfin mako (*Isurus oxyrinchu*) – the shortfin mako is a prized recreational fish, however migratory patterns along the NSW coastline are limited.
- Porbeagle (*Lamna nasus*) - inhabits oceanic waters around the edge of the continental shelf, moving occasionally into coastal waters, however these movements are temporary.
- Oceanic whitetip shark (*Carcharhinus longimanus*) – widespread pelagic species that favours tropical and subtropical waters. Within Australian waters, this species has been recorded off the NSW coast.

Whale Species

- Bryde's whale (*Balaenoptera brydei*) – Australian species distribution records of this species is limited however they are known to occur in temperate to tropical waters. No specific feeding or breeding grounds have been discovered off Australia.
- Sperm whale (*Physeter macrocephalus*) – this species tends key localities for sperm whales in Australia include areas off southern NSW including Wollongong. However, these species tend to frequent deeper waters that are not present within the Study Area.
- Humpback whales *Megaptera novaeangliae* (listed Cetacean and listed migratory, but no longer threatened under the EPBC Act). This species is commonly observed along the NSW coast including the Study Area. It migrates from cold waters to the tropics for breeding, and then return to cold waters for feeding. The northern migration in NSW occurs in June – July, and the southern migration occurs during October-November. There are no breeding grounds or resting areas in the Study Area or surrounds. The NSW coastal zone, including the Study Area, is a migratory pathway for humpback whale *Megaptera novaeangliae*. Accordingly, the NSW coast is a listed critical habitat for humpback whale (refer to Figure 5.24). Contemporary species records obtained from the BioNet indicate several observations of humpback whales within and adjacent to the Study Area.
- Other whale species (killer whale (*Orcinus orca*), Antarctic minke whale (*Balaenoptera bonaerensis*), pygmy right whale (*Caperea marginata*)- these whale species favour cooler coastal waters where productivity is high and are more common off the coast of Tasmania, South Australia and Victoria. Few records of these species have been identified in the NSW central coast region.

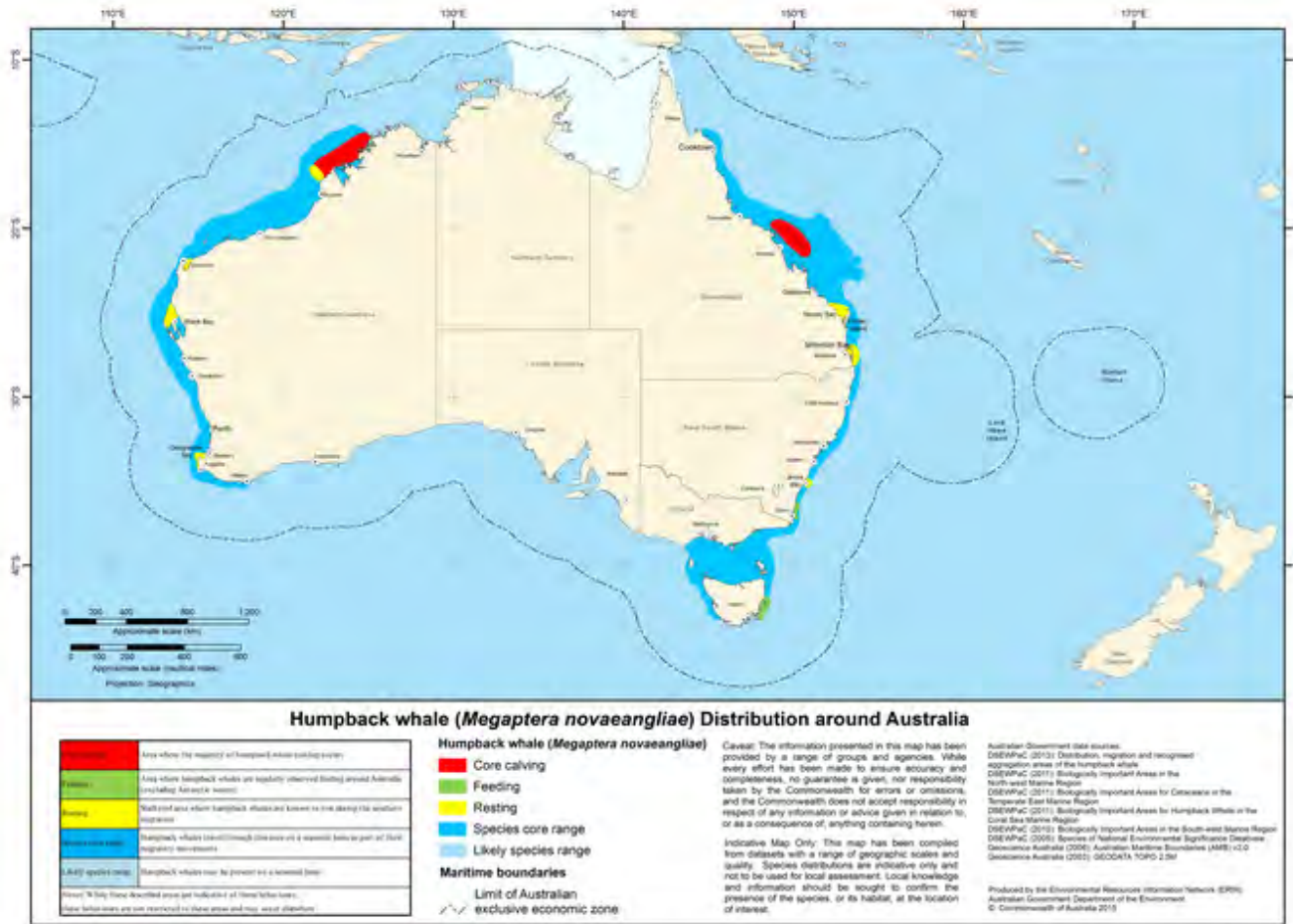


Figure 5.24 Distribution of the Humpback Whale in Australia (SPRAT 2022)

5.8 State Matters

The Study Area is located mostly in Commonwealth waters but includes portions of State waters. Within the marine environment, state matters would relate to laying of the main transmission cable that links the turbines to the grid only. Therefore, the description of state matters is confined to the cabling route and potential matters related to its construction and operation.

5.8.1 State Threatened Species

Most Commonwealth listed threatened species described in Section 5.7.3 are also listed as threatened under NSW legislation. Two other threatened marine and estuarine species protected under *Fisheries Management Act 1994*:

- Marine brown algae *Nereia lophocladia* – which is a subtropical species and is not known or likely to occur in the Study Area.
- *Posidonia australis* – which is a seagrass species that occurs in coastal embayments and estuaries. Six populations have suffered significant declines and are listed as endangered in NSW, the closest being Port Hacking >50 km north of the Study Area. This species is unlikely to occur in nearshore or offshore waters of the Study Area.

Table 5.3 Listed migratory species (not listed as threatened under EPBC Act)

Scientific Name	Common Name	Type of Presence	Migratory Category	Marine Status	Cetacean Status
Birds					
<i>Numenius phaeopus</i>	Whimbrel	Roosting known to occur within area	Migratory Wetlands Species	Listed	
<i>Anous stolidus</i>	Common Noddy	Species or species habitat may occur within area	Migratory Marine Birds	Listed	
<i>Apus pacificus</i>	Fork-tailed Swift	Species or species habitat likely to occur within area	Migratory Marine Birds	Listed - overfly marine area	
<i>Ardenna grisea</i>	Sooty Shearwater	Species or species habitat likely to occur within area	Migratory Marine Birds	Listed (as <i>Puffinus griseus</i>)	
<i>Pandion haliaetus</i>	Osprey	Species or species habitat likely to occur within area	Migratory Wetlands Species	Listed	
<i>Calonectris leucomelas</i>	Streaked Shearwater	Species or species habitat known to occur within area	Migratory Marine Birds	Listed	
<i>Sternula albifrons</i>	Little Tern	Breeding known to occur within area	Migratory Marine Birds	Listed (as <i>Sterna albifrons</i>)	
<i>Ardenna carneipes</i>	Flesh-footed Shearwater, Fleshy-footed Shearwater	Foraging, feeding or related behaviour likely to occur within area	Migratory Marine Birds	Listed (as <i>Puffinus carneipes</i>)	
<i>Calidris melanotos</i>	Pectoral Sandpiper	Species or species habitat known to occur within area	Migratory Wetlands Species	Listed - overfly marine area	
<i>Ardenna pacifica</i>	Wedge-tailed Shearwater	Breeding known to occur within area	Migratory Marine Birds	Listed (as <i>Puffinus pacificus</i>)	
<i>Limosa lapponica</i>	Bar-tailed Godwit	Species or species habitat known to occur within area	Migratory Wetlands Species	Listed	
<i>Fregata minor</i>	Great Frigatebird, Greater Frigatebird	Species or species habitat may occur within area	Migratory Marine Birds	Listed	
<i>Fregata ariel</i>	Lesser Frigatebird, Least Frigatebird	Species or species habitat likely to occur within area	Migratory Marine Birds	Listed	
<i>Phaethon lepturus</i>	White-tailed Tropicbird	Species or species habitat known to occur within area	Migratory Marine Birds	Listed	
<i>Tringa nebularia</i>	Common Greenshank, Greenshank	Species or species habitat known to occur within area	Migratory Wetlands Species	Listed - overfly marine area	
<i>Actitis hypoleucos</i>	Common Sandpiper	Species or species habitat known to occur within area	Migratory Wetlands Species	Listed	



Scientific Name	Common Name	Type of Presence	Migratory Category	Marine Status	Cetacean Status
<i>Gallinago hardwickii</i>	Latham's Snipe, Japanese Snipe	Species or species habitat known to occur within area	Migratory Wetlands Species	Listed - overfly marine area	
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Roosting known to occur within area	Migratory Wetlands Species	Listed	
<i>Calidris alba</i>	Sanderling	Roosting known to occur within area	Migratory Wetlands Species	Listed	
<i>Numenius minutus</i>	Little Curlew	Roosting likely to occur within area	Migratory Wetlands Species	Listed – overfly marine area	
<i>Ardenna tenuirostris</i>	Short-tailed Shearwater	Breeding known to occur within area	Migratory Wetlands Species	Listed (as <i>Puffinus tenuirostris</i>)	
<i>Arenaria interpres</i>	Ruddy Turnstone	Roosting known to occur within area	Migratory Wetlands Species	Listed	
<i>Charadrius bicinctus</i>	Double-banded Plover	Roosting known to occur within area	Migratory Wetlands Species	Listed – overfly marine area	
<i>Tringa brevipes</i>	Grey-tailed Tattler	Roosting known to occur within area	Migratory Wetlands Species	Listed (as <i>Heteroscelus brevipes</i>)	
<i>Thalasseus bergii</i>	Greater Crested Tern	Breeding known to occur within area	Migratory Wetlands Species	Listed (as <i>Sterna bergii</i>)	
<i>Limosa limosa</i>	Black-tailed Godwit	Roosting known to occur within area	Migratory Wetlands Species	Listed – overfly marine area	
<i>Calidris ruficollis</i>	Red-necked Stint	Roosting known to occur within area	Migratory Wetlands Species	Listed – overfly marine area	
<i>Gallinago megala</i>	Swinehoe's Snipe	Roosting likely to occur within area	Migratory Wetlands Species	Listed – overfly marine area	
<i>Gallinago stenura</i>	Pin-tailed Snipe	Roosting likely to occur within area	Migratory Wetlands Species	Listed – overfly marine area	
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Roosting known to occur within area	Migratory Wetlands Species	Listed – overfly marine area	
<i>Pluvialis fulva</i>	Pacific Golden Plover	Roosting known to occur within area	Migratory Wetlands Species	Listed	
Mammals					

Scientific Name	Common Name	Type of Presence	Migratory Category	Marine Status	Cetacean Status
<i>Megaptera novaeangliae</i>	Humpback Whale	Species or species habitat likely to occur within area	Migratory Marine Species		Cetacean
<i>Orcinus orca</i>	Killer Whale, Orca	Species or species habitat likely to occur within area	Migratory Marine Species		Cetacean
<i>Lagenorhynchus obscurus</i>	Dusky Dolphin	Species or species habitat likely to occur within area	Migratory Marine Species		Cetacean
<i>Physeter macrocephalus</i>	Sperm Whale	Species or species habitat may occur within area	Migratory Marine Species		Cetacean
<i>Balaenoptera edeni</i>	Bryde's Whale	Species or species habitat likely to occur within area	Migratory Marine Species		Cetacean
<i>Balaenoptera bonaerensis</i>	Antarctic Minke Whale, Dark-shoulder Minke Whale	Species or species habitat likely to occur within area	Migratory Marine Species		Cetacean
<i>Caperea marginata</i>	Pygmy Right Whale	Foraging, feeding or related behaviour may occur within area	Migratory Marine Species		Cetacean
Elasmobranchs					
<i>Mobula birostris</i>	Giant Manta Ray	Species or species habitat likely to occur within area	Migratory Marine Species		
<i>Isurus oxyrinchus</i>	Shortfin Mako, Mako Shark	Species or species habitat likely to occur within area	Migratory Marine Species		
<i>Lamna nasus</i>	Porbeagle, Mackerel Shark	Species or species habitat likely to occur within area	Migratory Marine Species		
<i>Rhincodon typus</i>	Whale Shark	Species or species habitat may occur within area	Migratory Marine Species		
<i>Carcharhinus longimanus</i>	Oceanic Whitetip Shark	Species or species habitat may occur within area	Migratory Marine Species		

5.8.2 Fisheries Values

Commercial Fishing

Commercial fishing in inland, estuarine and NSW coastal waters (inside 3 nautical miles) is managed by the NSW Government in accordance with the *Fisheries Management Act 1994*. Marine and estuarine fishery types supported in the Study Area and surrounds are:

- ocean hauling – located on coastal beaches and primarily targeting pilchards, mullet and Australian salmon
- lobster fishery – located in nearshore and offshore waters to approximately 80 miles from the coast. Lobster species occur in waters up to 200 m depth. Following settlement, they are typically associated with reefs (+/- macroalgae cover), however commercial fishes often set traps in sandy areas near reefs and on low profile to reduce the risk of snagging (NSW DPI 2004).
- ocean trap and line – located in coastal and offshore waters, and primarily targeting snapper yellowtail kingfish, leatherjackets, trevally and bonito.
- ocean trawling – comprised of prawn and finfish trawling using otter trawls.
- estuary general – which includes a wide range of gear and target species (finish, prawns, crabs and other shellfish).

The Study Area is not within the proximity of any aquaculture leasing zones.

Most coastal waters, inshore and inland waters of NSW, including the Study Area, are a component of Key Fish Habitat (KFH) under the *Fisheries Management Act 1994* (refer to Figure 5.12). These areas as aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally, and the survival and recovery of threatened aquatic species.

Recreational Fishing

The Wollongong offshore artificial reef is located within the Study Area. The artificial reef is located approximately 2.4 km offshore from Perkins Beach at a depth of approximately 32 m. The reef structure consists of steel towers with a vertical profile of 12 m, and is expected to attract a wide range of pelagic and reef-associated species of direct fisheries significance (DPI 2022). There are no recreational fishing havens in the Study Area.

The Study Area contains many popular recreational fishing spots, comprised of reefs, wrecks and sandy areas. Popular target species are expected to include snapper, flathead species, leatherjacket species, john dory, kingfish, mulloway, trevally species, Australian salmon and tuna species. Boat-based anglers can launch from numerous boat ramps along the coast. Recreational fishing charters also operate in the Study Area and surrounds.

Recreational fishing survey data indicates that the mid-south coast region (which encompasses the Study Area) has the highest recreational fishing effort in the state (West et al. 2015; refer to Figure 5.4). Within the mid-south coast region, most recreational fishing effort was in the estuaries (62%), followed by inshore coastal waters (32%), with other water types (including offshore waters) representing <4% of effort each. On a state-wide basis, the species with the highest catch in the offshore water type were sand flathead, snapper, yellowtail kingfish, red rock cod, and tuna species.

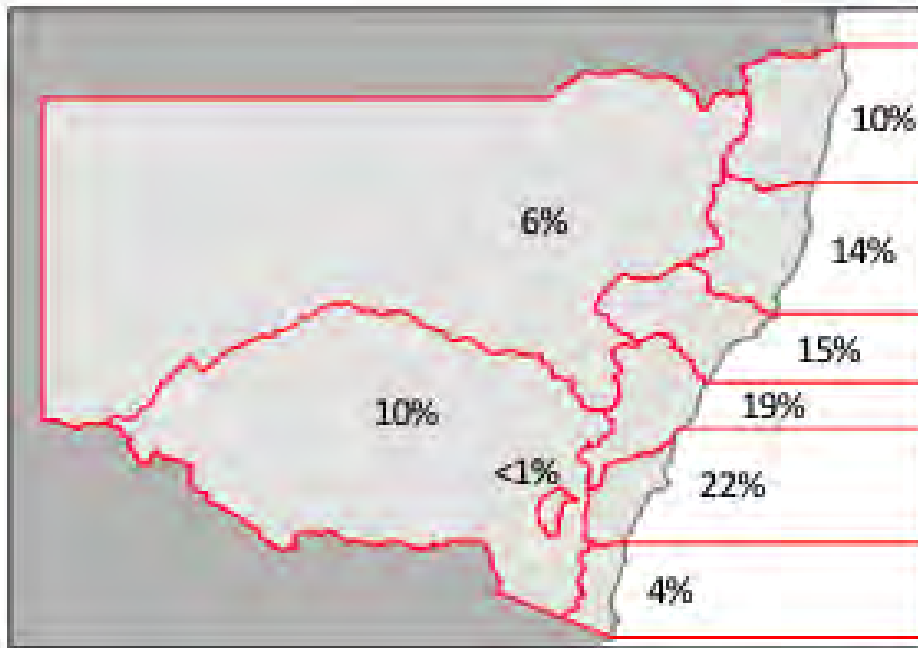


Figure 5.25 Fishing effort (fisher days) by fishing zone for the NSW/ACT resident population aged five years and older who fished recreationally in NSW or the ACT during 2013/14 (Source: West et al. 2015)

5.9 Other Matters

5.9.1 Marine Indigenous Cultural Heritage

The Illawarra coastal region is sea country of the Dharawal people. The sea country of New South Wales has strong significance for Aboriginal people living along the coast. For thousands of years, Aboriginal people have relied on the natural resources provided by the sea. The sea country, including islands, beaches, headlands, rocky shores, the ocean and estuaries, holds spiritual significance, and is central to their cultural practices and activities.

Evidence of Aboriginal use of these coastal and sea environments can be found in many places, and includes large stone fish traps, such as those found in the Solitary Islands and Port Stephens-Great Lakes marine parks, middens adjacent to beaches and estuaries, and tool-making sites on rocky headlands.

Fishing and the cultural values of fishing is extremely important to the Aboriginal people of the south coast of NSW. A staple sea tucker food is the abalone, or muttonfish. Abalone a food source that is highly nutritious and the shell has multiple uses in traditional Aboriginal lifestyle. This includes as fishhooks, bowls for eating from and cooking in, and adornments for ceremony (Department of Primary Industries 2022).

There are no known sites of significance within the Study Area, however further consultation with First Nations people is required to gain a greater understanding of cultural heritage values it may have.

Non-Indigenous Marine Cultural Heritage

The Commonwealth maintains a register of underwater cultural heritage, which includes shipwrecks or other items of maritime historical interest such as WW2 plane wrecks. Refer to Section 5.6.3 for further information.

5.9.2 Water Quality

Recreational water quality has been monitored in the Illawarra region since 1996 by Sydney Water, and by Wollongong City Council and Kiama Municipal Council under the Department of Planning, Industry and Environment's Beachwatch Partnership (NSW DPIE 2021). This partnership forms part of the Beachwatch program which reports annually on recreational water quality across a number of swimming sites within NSW.

A total of 21 swimming sites including ocean beaches in the Illawarra region are monitored on a weekly basis. In 2020–2021, 100% of swimming sites in the Illawarra region were graded as Good or Very Good and suitable for swimming for most or almost all of the time. Similar results have been obtained in previous water quality monitoring campaigns. Swimming sites are ranked in accordance with the Guidelines for Managing Risks in Recreational Waters (National Health and Medical Research Council's 2008).

Marine Water Quality Objectives for NSW rivers and estuaries have been developed for the Illawarra coastal region have been developed as part of the NSW Government's program to set water quality objectives for all major waterways. These objectives are underpinned by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000) and apply to ocean waters that adjoin the NSW coast and extend three nautical miles from the shore.

Coastal upwelling system events occur off the NSW coastline typically from austral spring to autumn. These systems are critical for marine ecosystems as they involve the uplifting of cold and nutrient-rich deeper water towards the sea surface. The NSW coastal upwelling is largely driven by the East Australian Current (see Section 5.2 for further information). Upwelling events may influence water quality variables including temperature, salinity and nutrient profiles.

There are currently no water quality records available for the deeper offshore marine environment. Higher water quality recorded throughout the Illawarra region would indicate that water quality within the marine environment would also be likely of similar quality.



Figure 5.26 Sampling Sites Monitored by Wollongong City Council under Beachwatch Programs (NSW DPIE 2021)

5.9.3 Visual Amenity

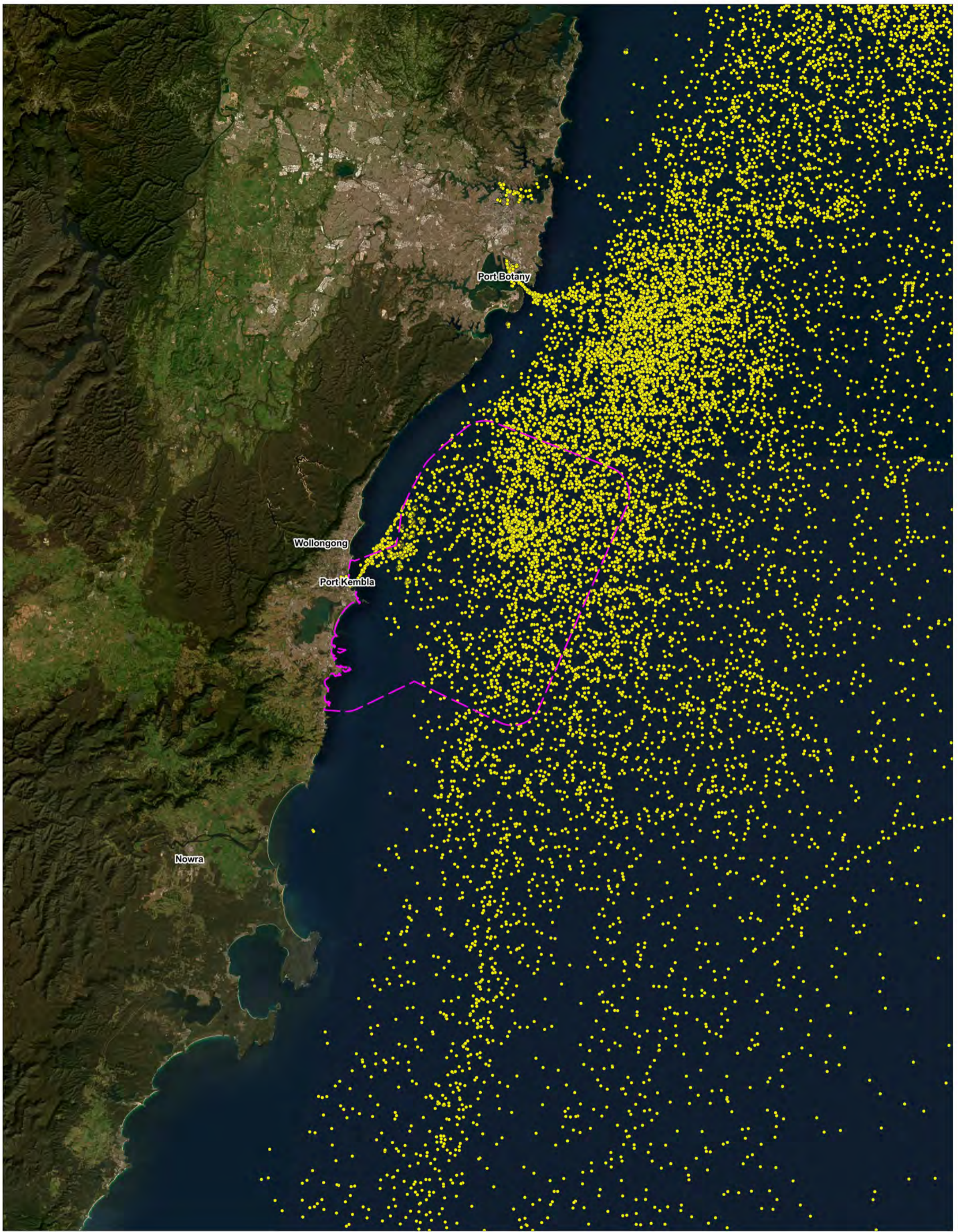
At present, there are no visible structures on the horizon when looking out to sea from the coastline.


Generally, the towers will blend into the distant horizon, however they may be visible at night due to navigational lighting requirements. Night lighting can be disturbing for marine fauna and also migrating birds; this is further discussed in Section 6.13.

5.9.4 Navigational Hazards

The 2022 vessel tracking information for the region (refer to Figure 5.27) shows the main shipping channel from the Port Kembla south of Wollongong is within the Study Area.

Port Kembla is the largest motor vehicle importation terminal in NSW. There are also a number of vessel movements from Port Botany and Sydney Harbour through the Study Area. Port Botany is a primary bulk liquid and gas port and Australia's largest dedicated common-user bulk facility. Sydney Harbour supports movement of recreational, passenger and working vessels including up to 1200 large commercial vessels annually. Jervis Bay, which is approximately 50 km south of the Study Area, is also a popular recreational boating site with high vessel movement.



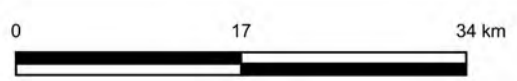
- LEGEND**
-  Project Boundary
 -  Marine Study Area
 -  Reported Vessel Position (Cargo and Tanker)

Title:
Vessel Traffic July 2022

Figure:
5-27

Rev:
C

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



5.10 Summary of Baseline Issues

Table 5.4 Summary of Values for Study Area

Attribute	Relevance	NSW Illawarra Coast
Marine Park	State, Commonwealth	The Study Area intercepts the Bushrangers Bay Aquatic Reserve (State)
Ramsar Wetland	MNES	Nil
Other Protected Areas	State, Commonwealth	The Five Islands Nature Reserve (State) is situated within the offshore Study Area. There are also several additional protected areas in the foreshore environment adjacent to the Study Area including National Parks and State Conservation Areas.
Commonwealth Water	MNES	The wind turbines, cabling and substations are situated within Commonwealth Waters. The Study Area maps the KEFs shelf rocky reefs within the potential disturbance footprint. A second KEF canyons on the eastern continental slope is located just outside the Study Area.
Habitat Types	MNES, State	Whilst there is no detailed mapping of habitat types for the Study Area, previous studies indicate the area is mostly bare sands, with some areas of low profile reefs. A KEF shelf rocky reefs is also mapped within the Study Area.
Threatened Ecological Communities	MNES	Nil
Threatened and Migratory Species	MNES, State	<p>BIA:</p> <ul style="list-style-type: none"> Sharks: grey nurse shark (<i>Carcharias taurus</i>) – foraging and migration, white shark (<i>Carcharodon carcharias</i>) - distribution Whales: humpback whale (<i>Megaptera novaeangliae</i>) – foraging Seabirds: flesh-footed shearwater (<i>Ardenna carneipes</i>), wandering albatross (<i>Diomedea exulans</i> (sensu lato)), antipodean albatross (<i>Diomedea exulans antipodensis</i>), southern giant petrel (<i>Macronectes giganteus</i>), northern giant petrel (<i>Macronectes halli</i>), Wilsons storm petrel (<i>Oceanites oceanites</i>), black petrel (<i>Procellaria parkinsoni</i>), great-winged petrel (<i>Pterodroma macroptera</i>), white-capped albatross (<i>Thalassarche cauta steadi</i>), Indian yellow-nosed albatross (<i>Thalassarche chlororhynchos bassi</i>), black-browed albatross (<i>Thalassarche melanophris</i>), Campbell albatross

BMT (OFFICIAL)

Attribute	Relevance	NSW Illawarra Coast
		<p>(<i>Thalassarche melanophris impavida</i>) – all foraging except for Wilsons storm petrel which is mapped for migration.</p> <ul style="list-style-type: none"> • Penguins: little penguin (<i>Eudyptula minor</i>) – breeding • Dolphins: Indo-Pacific/ spotted bottlenose dolphin (<i>Tursiops aduncus</i>) (note not threatened or listed as migratory) – breeding <p>The Study Area provides suitable habitat for the grey nurse shark and adjoins several sites known to support this species. The Study Area is also regularly used by white sharks (<i>Carcharodon carcharias</i>). The Study Area may be part of a migratory pathway for the Critically Endangered swift parrot (<i>Lathamus discolor</i>) and orange-bellied parrot (<i>Neophema chrysogaster</i>).</p> <p>Study Area supports known and potential habitat for many other threatened and listed migratory species, particularly migratory shorebird species that may utilise the region for foraging or breeding.</p>
Protected Fisheries Species	State	Study Area may provide suitable habitat for listed threatened species under the <i>Fisheries Management Act 1994</i> including the black rockcod (<i>Epinephelus daemeli</i>).
Coastal and Marine Amenity and Recreational Values	State	The Study Area supports a number of coastal values, including biodiversity, coastal processes, public benefits and coastal landscapes. Its 'naturalness' is a value in itself, with limited development along this section of coastline. Shelf rocky reefs may attract recreational fishers or divers.
Important Fisheries Habitat or Function	State	The Illawarra river system in the Study Area is identified as a Key Fish Habitat which supports a variety of finfish, prawns, crayfish and mussels that are important to commercial fisheries.
Indigenous and Non-Indigenous Cultural Heritage	State, Commonwealth	The Study Area has a long history of use by First Nations people, although there are no known sites or artefacts of marine indigenous cultural heritage. There are six Australian National Shipwrecks within the Study Area protected under Commonwealth legislation.

6 Potential Impacts

A general description of potential impacts, risks and mitigation measures is provided below. Section 7 provides a more detailed risk assessment against Commonwealth and State significance criteria.

6.1 Geotechnical and Geophysical Surveys

These surveys need to be conducted to gather high quality data on the sub-surface properties within Project Area. However, there are a variety of impacts associated with conducting these surveys. These can include underwater noise, entanglement, vessel strike, marine pollution and disturbance of the seabed and benthic habitat.

Seismic surveys used to analyse subsurface geological structures utilise techniques that direct acoustic energy into the seabed. The loudest sound sources used in seismic survey operations are produced by air guns or 'pingers' which can generate short, intense pulses of sound repeatedly. This has the potential to cause physical harm or behavioural changes to marine fauna, including whales, dolphins, sharks, crustaceans, cephalopods and fish. Several studies (Kavanagh *et. al* 2019, Weilgart *et al.* 2013, United States National Marine Fisheries Service 2018) report that seismic airgun surveys can be felt over a large area (some kms from activity) and may result in some avoidance behaviour during seismic surveys, particularly those that are high-powered and penetrate to a significant depth. In addition to air guns, vessels also produce noise, however these tend to be low frequency and continuous, and confined to the localised area.

The towed seismic equipment associated with the proposed seismic surveys may pose a risk of entanglement which can result in death or injury of marine mammals and sea turtles (Duncan *et al.* 2017; Moore *et al.* 2009; van Der Hoop *et al.* 2013). Whales and other marine fauna may be at risk from vessels undertaking survey work. There is also potential for small spill, leaks, or onboard waste to enter the marine environment from survey vessels. Additionally, drilling boreholes may also involve the use of drilling fluids that may escape. Boreholes that will need to be made have the potential to disturb the benthic habitat and these should be contained to areas that there is no benthic habitat.

Because floating turbines are proposed, seismic activity will be minimal and relatively shallow compared to most seismic surveys; this should significantly limit the impact of geophysical surveys in comparison to that required for fixed structures which require much deeper foundations.

6.2 Entanglement – Construction/ Operation

Entanglement of species caught in mooring lines and inter-array cables, or the main export cable, has the potential to impact a variety of threatened/ migratory marine fauna and bird species. Depending on the design, there is also the risk of gear such as anchors, fishing nets etc being caught and causing a navigational hazard. This is one of the key potential risk differences between fixed foundation and floating turbines (Maxwell *et. al* 2022). The risk arises from the presence of lines and cables such as mooring lines that attach to anchors and array cables that connect each of the turbines. Primary entanglement potential is greatest for marine mammals particularly large whales that may utilise the Study Area as a migratory pathway and for foraging activities for humpback whale and southern right whale. Marine mammals do have some ability to detect vibrations however, and with appropriately designed cables the risk may potentially be reduced.

There is also a secondary risk of fishing gear or other marine debris being caught on mooring lines or cabling. However, little is known about the likelihood of this occurring and subsequent implications. Species with larger appendages including whale species and turtles are more susceptible to entanglement risk. Entanglement mooring lines or inter-array cables may also pose a risk for diving

seabirds, turtles, elasmobranchs and fishes if underwater debris such as fishing lines, nets or other fishing gear accumulates. The Study Area is known to be migratory pathway and is mapped as BIA for a variety of threatened seabirds including petrel and albatross species.

6.3 Sensitive Habitat Loss – Construction/ Operation

Habitat areas in the construction footprint (anchor points, transmission lines etc.) will be likely permanently removed. The use of floating turbines does significantly reduce seabed disturbance in comparison to fixed foundation turbines. The main disturbance to marine habitat will therefore be related to the export cable and inter-array cabling. The Study Area appears to mostly consist of sandy habitats that are common in the region and does not support highly productive habitats such as kelp beds, seagrass etc. Some areas of low-profile reef or hard substrate may occur such as the KEF shelf rocky reefs.

Positioning of anchoring systems such as dragging anchor or sweeping anchor chain, may lead to damage to benthic habitat. Although the exact disturbance footprint within the Study Area is not yet known, it is likely that any areas of sensitive habitat such as the KEF shelf rocky reefs can be avoided for anchorage point placement.

Though, it is unlikely that habitat loss will physically fragment habitats to the extent that major flow-on impacts to benthic communities and the values they support will occur. It is also unlikely that habitat loss would result in significant displacement of listed threatened/migratory species and high value fisheries species, except at localised scales such as at and directly adjacent to the turbines or cables). Burying the main transmission line will likely assist in habitat recovery. Using low footprint cable configurations for array cabling such as taut/ semi taut moorings will also reduce the risk of habitat disturbance (Maxwell *et al.* 2022).

6.4 Turbidity – Construction/ Decommissioning/ Operation

Modelling will be required to assess turbidity generated by construction and decommissioning activities associated with laying of the export cable or array cabling if not buried. Installation of anchoring points in clean sands is expected to generate a short-term, very low intensity sediment plume. This is unlikely to significantly impact any sensitive habitats.

6.5 Disturbance of Acidic or Contaminated Soils – Construction

Given the sandy nature of the material, it is not expected that any acid sulfate soil material would be disturbed through anchoring installation or cabling activity, except perhaps in the nearshore environment. Provided this material remains below water, it should not impact water quality.

Should piled or dredged material be brought to land, a more detailed investigation of acidity will be required to determine if treatment is necessary. It is possible, but unlikely, given the distance of the site offshore that contaminated material would be disturbed; nor is there a record of any major spills in the area. Soil sampling will be required however to confirm this assumption. If a contaminant does exceed thresholds, it would need to be removed and placed ashore within a contained area/licensed landfill.

6.6 Vessel Strike – Construction/ Operation/ Decommissioning

Vessel movements pose a risk of fauna strike, especially for large, slow-moving fauna near the surface such as whales. Whales are vulnerable due to their slow swimming speed and lack of awareness of the threats posed by vessel (DoEE 2017). Pinnipeds and dolphins are also at risk of collision with high-speed vessels. Further details will be required to determine vessel traffic intensities, but it would likely be higher during the construction and decommissioning stages than operations. Depending on design methodology, floating offshore wind structures may require fewer vessels during the construction phase due to the lack of pile driving activity.

Potential mitigation measures include seasonal windows to avoid peak periods for whales, go slow procedures etc.

6.7 Marine Pests – Construction/ Operation

Construction and maintenance vessels may introduce marine pests to the Study Area. There are two key vectors for introduced marine pests entering a port: biofouling of the vessel hull, or the release of pests into the marine environment via ballast waters (Hewitt and Campbell 2010). The floating platforms also provide a surface for fouling pest species, however not as large a surface as that provided by fixed foundation turbines.

Translocation of exotic marine pests into a new environment is a potentially important issue for the Project. The environmental and economic impacts due to the introduction of exotic marine pests can be significant. Marine pests, once established, can be difficult to eradicate and can have serious and permanent consequences for the marine environment, fisheries productivity and public health.

In addition to standard statutory measures, additional mitigation measures could be adopted such as hull inspections, defouling and local sourcing of vessels.

6.8 Spills – Construction. Operation/ Decommissioning

Vessels, turbines and substation facilities will use and store a variety of fuels, oils, lubricants, bio-fouling paints and other chemicals. These substances can have lethal and sub-lethal effects to organisms (Yuewen and Adzigbli 2018) and can persist in the environment for long periods of time. An uncontrolled release could occur from (for example) vessel collision, equipment failure or leaks.

A marine pollution risk assessment should be undertaken to inform the development of spill management strategies within contingency plan. The Project is unlikely to involve the storage and handling of large quantities of chemicals, nor generate frequent vessel movements.

Standard chemical storage, handling and maintenance procedures will be required.

6.9 Noise/ Vibration Generated by Turbine – Operation

Turbine operation will produce some low frequency noise and vibration, but it is unlikely to cause acute impacts (injury/ mortality) to marine fauna (Madsen *et al.* 2006; Tougaard *et al.* 2020). The noise and vibration generated by turbines is persistent (but dependent on wind speeds) which may result in changes to the behaviour of fauna. This may include for example avoidance or attraction responses, increases in intensity of vocal communication, and masking of noises used by fauna (Vella *et al.* 2001).

The degree of impact is dependent on cumulative noise and vibration levels generated by the wind turbine array varies depending on background noise levels and the sensitivity of fauna (Vella *et al.* 2001; Madsen *et al.* 2006). There is minimal data at present on noise and vibration generated by floating wind turbines due to the technology still evolving.

Background noise sources in the Study Areas include environmental (biological, waves etc.) and vessel traffic (ships, fishing boats etc.). Further work will be required to characterise background, Project generated noise, and potential impacts to fauna.

6.10 Electromagnetic Fields – Operation

Electrical cables between the turbine, transformer and shore-based facilities will produce electromagnetic fields (EMF). Many marine invertebrate and vertebrate fauna species are sensitive to EMF (Francis and Lyon 2014), which summarised as follows:

BMT (OFFICIAL)

- Elasmobranchs (sharks, rays) are sensitive to low frequency electrical fields, which they use for prey detection. Responses to electrical fields can include behavioural changes (attacking on the source of the field), physiological changes, and effects to the ability to orientate.
- Bony fish respond to changes in electrical fields but have less developed detection systems than elasmobranchs.
- Many marine species use magnetic fields for navigation (e.g. seasonal migrations), including many sea turtles, whales, sharks, fishes and crustaceans (Fisher *et al.* 2010; Hutchinson *et al.* 2021). Spurious magnetic fields could theoretically interfere with navigation of these species, depending on magnetic field properties and biological traits that determine sensitivity.

While studies indicate that many marine fauna species can respond to EMF, floating turbines do involve a greater number of unburied cables which could potentially cause increased EMF within the Project Area, increasing the potential interaction with a greater diversity and abundance of marine species (Farr *et al.* 2021). There is however, little field evidence that EMF emissions from undersea cables cause significant impacts to marine fauna such as avoidance of an area. Impacts will largely depend on cable configuration and positioning of anchorage points such as taut/ semi taut moorings and whether laid on the seafloor or buried (and burial depth). Cables will be required to run across the seafloor as well as suspended in the water column, increasing potential impacts compared to pile-driven turbines (Maxwell *et al.* 2022).

Suspended cables are more vulnerable to wear and tear through hydrodynamic stress. Cables suspended in the water column should be monitored for any evidence of wear and tear and maintenance undertaken accordingly. Though further analysis will be required on the impacts of EMF from cables suspended in the water column. This will need to consider exposure and sensitivity of receptors most exposed to EMF (benthic invertebrates such as lobsters and crabs, and demersal (bottom living) fish) and marine fauna living overlying water column such as. most sharks, fish, marine mammals. Burial of cabling where possible may also mitigate this risk.

6.11 Hydrodynamic Impacts – Operation

The marine structures will alter local hydrodynamic processes. This may result in localised changes to sedimentary processes such as scour and sediment deposition. Specifically, scouring from anchoring points and other components of the turbines may be impacted by wave action and currents during the operational period causing changes to sediment dynamics, however the risk is considered lower with floating turbines than fixed foundation turbines.

The downward wind pressure from turbine blades can also potentially impact on the surface mixed layer of the ocean, altering vertical mixing, which can influence primary productivity like. chlorophyll or local wave patterns. This in turn can subtly alter food chain dynamics in close proximity to turbines (Farr *et al.* 2021).

6.12 Bird Strike and Avoidance of Rotors – Operation

The Study Area provides potential feeding areas for seabirds and piscivorous shorebirds. The Study Area is possibly traversed by migratory bird species. There is a risk of birds colliding with rotors, resulting in injury or mortality. Birds may also avoid areas near the rotors, resulting in habitat displacement and altered movement patterns.

- **Migratory species** – The turbines are proposed to be located in offshore waters, avoiding nearshore areas commonly frequented by shorebirds for feeding and roosting. Shorebirds may pass through offshore waters when moving to and from other sites. In the case of migrant species, flights once underway tend to be at high altitude, well above turbine height, to maximise flight and energy efficiency. Birds wait for suitable conditions before embarking on migration, but may be forced to

lower their flight altitude if they encounter bad weather during migration (Newton 2007). Therefore, migrants are at risk of collision with wind turbines mainly during takeoff and descent, when their flight paths take them through the height range of the rotor-sweep zone (Drewitt & Langston 2008).

- **Large pelagic seabirds** – At most risk are large pelagic seabirds, which feed in offshore waters and being slow fliers, may be unable to evade the moving rotors. Note this does not disregard smaller seabirds such as petrel species that forage in the marine environment which may also be at risk of collision with turbine rotors.
- **Migratory parrots** migrate from mainland Australia to Tasmania to breed, potentially intersecting the Study Area. BioNet species records present a number of swift parrot observations and fewer orange bellied parrot records within and adjacent to the Study Area. The flight height while on land is just above vegetation height (Shepherd 1994 in Hokley undated), however their flight height over the ocean is unresolved.

Further assessment will be required, taking into consideration issues raised in *EPBC Act Policy Statement 2.3 Wind Farm Industry* (DEWHA 2009). This will need to consider potential design measures to reduce risk such turbine tower height, bird ‘alarms’, use of different coloured blades, and location relative to any important areas.

Painting blades with different colours makes the turbine more recognisable to birds as a rotating object reducing the risk of bird strike.

Sensory and monitoring devices on turbines such as infrared technology may be utilised to detect bird species and reduce the risk of bird strike through full or partial curtailment. However, this technology is largely still under development. In addition, further bird surveying, temporal flight patterns investigations and possible collision risk modelling should be undertaken to determine species that may be at increased risk.

6.13 Light Pollution

Vision is a critical cue for wildlife, including seabirds, turtles and fish species to orient themselves in terms of finding food, avoiding predation and communicating (Australian Government 2020). Artificial light is known to adversely affect many species in the marine environment and can result in behavioural changes such as avoidance, disorientation or reduced reproductive effort. It can also attract predators or change the availability of habitat or food resources. Artificial light can disorient flying birds during migration, and potentially will cause them to avoid roosting sites in brighter areas. The National Light Pollution Guidelines for Wildlife (Australian Government 2020) suggest that light mitigation may be necessary within 20 km of a BIA for a listed species.

Navigational or hazard lighting on offshore wind turbines may potentially cause impact to marine species, however mitigation measures such as minimising lighting, the use of lights that appear red to the eye and avoiding lighting the water surface can assist in reducing impacts.

6.14 Artificial Reef Creation and Fishing Exclusion – Operation

The floating platforms will provide hard substrate that will be colonised by a diverse range of benthic flora and fauna species. The structures will also act as aggregation devices for fish, however, to a lesser extent than fixed foundation turbines. Floating cabling between towers could potentially create a navigational hazard, which could exclude trawling activity. It is expected that the wind turbines would lead to localised increase in fish biomass in the Study Area. The increase in fish biomass could attract predators to the area (pinnipeds, sharks, dolphins), assuming they acclimatise to the sound emissions from the turbines. This could lead to localised changes to marine communities in the vicinity of the turbines, including beneficial effects to many reef-associated species, but potential adverse effects to

other species due to changes in biological interactions (competition, predation etc.) (Degraer *et al.* 2020).

6.15 Cultural and Social Access – Construction/ Operation

It is likely there will be some level of temporary exclusion within the Study Area during construction. During operations, there is likely to be a small exclusion area around each floating structure. Floating offshore wind projects may present additional challenges to fishers due to the presence of cables throughout the water column which may restrict vessel access (Schupp *et al.* 2021). The risk of secondary entanglement in which fishing lines or other items associated with fishing gear become entangled in the mooring lines or cables within the water column is also present (Maxwell *et al.* 2021).

Further investigation into the potential interference between vessels and mooring lines or cables within the water column will be required.

6.16 Marine Cultural Heritage – Construction/ Operation

The protection of Sea Country will be of importance to indigenous groups; further consultation will be required to understand how the Project will impact on these values and the significance of the Study Area. There are six Nationally Important Shipwreck locations within the Study Area that are protected under Commonwealth legislation. Any shipwrecks or other items of marine cultural heritage significance will be detected during initial benthic habitat and bathymetry mapping using sonar equipment.

6.17 Navigational Hazards – Construction/ Operation

Provided turbines are appropriately marked and lit, they should not create a navigational hazard, particularly since the Study Area is within the footprint of the main navigational channel for container vessels for Port Kembla. Cabling suspended in the water column may create navigational hazard for recreational or fishing vessels. Minimising disturbance through appropriate cabling configuration and positioning of anchorage points may mitigate impacts to navigational pathways.

7 Preliminary Risk Assessment

7.1 Matter of National Environmental Significance

Under the EPBC Act, a significant environmental impact is defined as ‘an impact which is important, notable, or of consequence, having regard to its context or intensity’. Whether or not an action is likely to have a significant impact depends on the sensitivity, value and quality of the environment that is impacted, and upon the intensity, duration, magnitude and geographic extent of the impact.

For an impact to be considered ‘likely’, it is not necessary for the impact to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility.

If there is scientific uncertainty about the impacts of an action, and potential impacts are serious or irreversible, the precautionary principle is applicable. A lack of scientific certainty will not itself justify a decision that an action is not likely to have a significant impact on the environment.

The Commonwealth has provided ‘significant impact criteria’ for each MNES, as described below in the following sections.

7.1.1 Threatened Ecological Community

There are no threatened ecological communities (TECs) within the offshore Study Area, therefore there will be no significant impact.

7.1.2 Critically Endangered or Endangered Species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population;
- reduce the area of occupancy of the species;
- fragment an existing population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of a population;
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species’ habitat;
- introduce disease that may cause the species to decline; and
- interfere with the recovery of the species.

Critically Endangered or Endangered Species that are likely to occur in the Study Area, and the potential impact of the Project on this species is provided in **Table 5.2**. The assessment herein considers potential impacts related to the marine environment only (i.e. terrestrial infrastructure impacts are not considered). Note the assessment is preliminary only and further site-specific studies are required to confirm the use and values of the Study Area by critically endangered or endangered species.

Table 7.1 Critically Endangered and Endangered Species: Potential Significance of Impact

Species	Potential Impacts	Potential Significance of Impact
Albatross and petrel species (herald petrel, Gould's petrel, shy albatross, southern giant petrel, Chatham albatross and northern-royal albatross)	<p>These species are known to forage within the Study Area and adjacent marine environments is mapped as a BIA for the southern giant petrel.</p> <p>These species spend a large proportion of time at sea for foraging. It is conservatively assumed that bird strike by wind turbines has the potential to cause direct bird mortality, which may lead to a long term decrease in size of a population. Further research into the occupancy area of the species, and the risk of bird strike is required.</p>	Potentially Significant
Shorebird species (eastern curlew, curlew sandpiper, Australasian bittern, red knot, great knot, lesser sand plover and Australian painted snipe)	<p>Whilst these species may forage on the foreshore environments, they would only occasionally utilise the marine environment and therefore may be at risk of bird strike. Other potential impacts include disorientation from light pollution.</p>	Potentially Significant
Swift parrot	<p>This species potentially migrates through the Study Area to suitable Eucalypt woodland habitat further northwards. Wind turbines have the potential to modify, destroy, remove or isolate the availability of habitat resulting in bird strike. Numerous sightings of the swift parrot have also been recorded within the Study Area.</p>	Potentially significant
Orange-bellied parrot	<p>Suitable habitats may occur within the region including coastal vegetative communities.</p> <p>There are historical records of this species in the vicinity of the Study Area such as at Shellharbour, but the absence of contemporary records suggest it may not occur here at present.</p> <p>Because of the extremely low numbers of orange-bellied parrots individuals in the wild, any impact to an individual is of a significant impact and the risk of turbine strike could have the potential to modify, destroy, remove, isolate or decrease the availability of habitat.</p>	Potentially Significant
Grey nurse shark	<p>This species has been mapped as BIA within the Study Area for potential foraging, aggregation, or seasonal breeding activities. The Study Area also adjoins several sites known to support the grey nurse shark such as Bass Point and Shellharbour. Therefore, it is highly likely this species frequents the Study Area.</p> <p>Potential impacts to this species may include underwater noise and EMF impacts. Further investigations are required to determine the extent of impacts.</p>	Potentially Significant

Species	Potential Impacts	Potential Significance of Impact
Marine turtles (leatherback turtle, loggerhead turtle)	<p>These species may occasionally forage within the Study Area. Foraging activity could potentially be interrupted by underwater noise and entanglement. Further investigation is required to understand the potential for underwater noise to be generated during construction or operation and the potential for this to impact the use of the area by turtles. The Study Area is not mapped as BIA for turtle species and there are no nesting areas within the region.</p>	Potentially Significant
Whales (southern right whale, blue whale)	<p>The Study Area is not mapped as a BIA for these whale species however, there have been sightings of the southern right whale in the marine environment within and adjacent to the region.</p> <p>Note: Species records within the marine environment are poor, reflective of the relative difficulty of surveying marine species in comparison to terrestrial species.</p> <p>Blue whales may also traverse the marine environment for migratory purposes, although it is unlikely to support an ecologically significant proportion of this species population.</p> <p>Underwater noise (construction and operation) could lead to avoidance behaviour for whale species. This may reduce the area of occupancy available to a population. Further investigation is required to understand the potential for underwater noise to be generated during construction or operation and the potential for this to impact the use of the area by the whale.</p> <p>Risk of entanglement and potential vessel strike is prevalent for marine mammals (including the southern right whale) that may travel through the Study Area.</p>	Potentially significant (southern right whale only)
White's seahorse	<p>This is a coastal and estuarine dependent species typically found in shallow reefs. There are minimal extents of shallow reefs within the Study Area, however the proposed wind turbine footprint is within depths greater than 18 m. There are no BioNet records of this species reported within the Study Area.</p> <p>Potential impacts to this species include injury/ death and loss of habitat.</p>	Not significant

7.1.3 Vulnerable Species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;

- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

An ‘important population’ is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

Vulnerable species that are likely to occur in the Study Area, and the potential impact of the Project on this species is provided in Table 5.2; these consider potential impacts related to the marine environment only (i.e. terrestrial infrastructure impacts are not considered). The assessment is preliminary only and based on desktop information; further site-specific studies are required to confirm the use of the Study Area by critically endangered or endangered species.

Table 7.2 Vulnerable Species: Potential Significance of Impact

Species	Potential Impacts	Potential Significance of Impact
Albatross and petrel species (northern giant petrel, Salvin’s albatross, Buller’s albatross, Gibson’s albatross, Indian yellow-nosed albatross, sooty albatross, white-capped albatross, wandering albatross, northern Buller’s albatross, black-browed albatross, southern royal albatross, white-bellied storm-petrel, Campbell albatross, antipodean albatross, kermadec petrel)	Species records indicate a number of species record within and adjacent to the Study Area which is mapped as BIAs for several of these species including the wandering albatross, antipodean albatross, northern giant petrel, white-capped albatross, Indian yellow-nosed albatross, black-browed albatross and Campbell albatross. The Study Area is not known to support important breeding habitat for Vulnerable species however, it is likely the broader marine environment provides suitable foraging areas. Further studies will be required to understand how seabirds may utilise the Study Area, but potential impacts may include bird strike and artificial light.	Potentially Significant

Species	Potential Impacts	Potential Significance of Impact
<p>Shorebird species (greater sand plover, fairy prion, Australian fairy tern)</p>	<p>Whilst these species may forage on the foreshore, they would only occasionally utilise the marine environment. There are no sightings records available within the Study Area for these species.</p> <p>It is likely the broader marine environment provides suitable foraging habitat for this species and therefore, potential impacts to shorebirds may include bird strike or artificial light. Further assessment of how shorebirds use the Study Area and risk posed by turbine strike will be required.</p>	<p>Potentially Significant</p>
<p>Fish species (Australian grayling, black rockcod)</p>	<p>Australian graylings preferred habitat is within river systems, therefore the offshore Study Area does not support important habitat for this species.</p> <p>Black rockcod may be present within subtropical reefs. Small extents of KEF shelf rocky reefs are present within the south east corner of the Study Area, though it is not likely to lead to a long-term reduction in the size of an important population of this species.</p> <p>There are no species records for either fish species within the Study Area.</p> <p>Potential impacts to fish species include injury/ death and loss of benthic habitat.</p>	<p>Not significant</p>
<p>Whale species (fin whale, sei whale)</p>	<p>Fin whales and sei whales may also occasionally utilise the Study Area for foraging purposes. There are no available sightings records for these species.</p> <p>Underwater noise (construction and operation) could lead to avoidance behaviour for whale species. Moreover, risk of entanglement within cables suspended in the water column is prominent for marine mammals. Further research is required to determine the full impacts of underwater noise and likelihood of entanglement occurring.</p>	<p>Potentially Significant</p>
<p>Marine turtles (flatback turtle, green turtle, hawksbill turtle)</p>	<p>These marine turtles are predominately tropical and subtropical species that nest on sandy beaches. There is limited habitat available within the Study Area to provide nesting area for these species. It is possible these species may migrate through the marine environment or utilise the area for foraging purposes.</p> <p>Foraging activity could potentially be interrupted by underwater noise or entanglement.</p>	<p>Potentially Significant</p>

Species	Potential Impacts	Potential Significance of Impact
Shark species (white shark, whale shark)	<p>The NSW coast has also been identified as a BIA for white sharks which may utilise the area for foraging, aggregation or seasonal breeding. Though there are no known aggregation areas within the Study Area, it is likely this species may utilise the area for foraging.</p> <p>Whale sharks pass through the Study Area, however it is unlikely to have a significant impact on the species population.</p> <p>Potential impacts to these species may include underwater noise, EMF and entanglement impacts. Further investigation into the effects of underwater noise and EMF on marine mammals will be required.</p>	Potentially Significant (white sharks only)

7.1.1 Listed Migratory Species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

An area of ‘important habitat’ for a migratory species is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life-cycle stages; and/or
- habitat utilised by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

Table 5.2 lists migratory species that occur, or are likely to occur in the Study Area. These are mostly critically endangered, endangered or threatened species already considered above including a number of shorebirds and whale species.

Table 7.3 Migratory Species: Potential Significance of Impact

Species	Potential Impacts	Potential Significance of Impact
Shorebird species	<p>These species generally congregate around nearshore habitats but may utilise the adjacent marine environment for foraging activities.</p> <p>Lake Illawarra is directly adjacent to the offshore Study Area hosts over 55 species of waterbird including key migratory shorebird species.</p> <p>Potential impacts to migratory shorebirds include bird strike and disorientation from artificial lighting.</p>	Potentially Significant
Seabird species	<p>Seabird species typically have a large foraging range and it is likely they utilise the Study Area as a migratory pathway. The Study Area is mapped as a BIA for a number of migratory seabird species.</p> <p>Potential impacts to migratory seabirds include bird strike and disorientation from artificial lighting.</p>	Potentially Significant
Whale and dolphin species	<p>Several humpback whale sightings have been recorded within and adjacent to the Study Area, which is also mapped as a BIA for foraging purposes.</p> <p>Other whale species including the sei whale, fin whale and blue whale may also utilise the area as a migratory pathway, although it is unlikely to support an ecologically significant proportion of a population of these species.</p> <p>Potential impacts include underwater noise, EMF and entanglement due to mooring lines or cabling.</p>	Potentially Significant
Turtle species	<p>Three species were identified as having foraging, feeding or related behaviour within the offshore Study Area. It is likely that the Study Area also may act as a migratory area for marine turtles, however there is insufficient beach habitat to indicate the Project activities will impact on important habitat for these species.</p> <p>Foraging activity could potentially be interrupted by underwater noise and entanglement.</p>	Potentially Significant
Shark species	<p>The NSW coast has also been identified as a BIA for white sharks which may utilise the area for foraging, aggregation or seasonal breeding. Though there are no known aggregation areas within the Study Area, the area is likely to be used as a migratory pathway for white sharks.</p>	Potentially Significant

Species	Potential Impacts	Potential Significance of Impact
	<p>Whale sharks may also utilise the study area as a migratory pathway however, it is unlikely to have a significant impact on the species population.</p> <p>Potential impacts to these species may include underwater noise impacts, EMF and entanglement due to mooring lines or cabling.</p>	

7.1.2 Commonwealth Marine Area

An action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will:

- result in a known or potential pest species becoming established in the Commonwealth marine area
- modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results
- have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution
- result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected, or
- have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

The Project is within Commonwealth waters, therefore there will likely be direct impacts to Commonwealth marine areas, as a result of cable laying (or removal), installation of anchorage points and mooring lines, introduction of pest species or changes to hydrodynamics. With appropriate controls in place, these impacts are considered to be a medium risk, which is localised. They are unlikely to have a ‘substantial’ or ‘persistent’ adverse impact on the Commonwealth marine environment. Some impacts such as underwater noise, entanglement or lighting pollution may cause some avoidance behaviour in certain species. Because, at this early stage in the Project, it is possible that turbines may result in an adverse effect on cetaceans and to be conservative, it is possible that impacts to Commonwealth marine areas are significant.

8 Next Steps

Following acceptance of the referral by the Commonwealth and the NSW Government, the Proponent will commence further detailed field investigations and apply for a Feasibility Licence under the OEI Act. A review will be undertaken in accordance with a scoping document or other requirements issued by DPE and DCCEEW.

These marine field studies will likely include the following as a minimum:

- Water quality monitoring – to characterise the existing marine water quality in the Study Area.
- Sediment quality – to characterise contaminant status of bed sediments, and their geotechnical properties that may be disturbed during cable installation.
- Metocean studies – to characterise the wave and current environment in the vicinity of the proposed turbines.
- Marine ecology – to characterise existing marine ecology values, including benthic infauna at the proposed turbines, along with presence and biodiversity of fish, sharks and marine mammals.
- Seabird, migratory parrot and shorebird surveys – the study is a BIA for a number of seabird species and a possible migratory pathway for migrating parrots and shorebirds.
- Benthic habitat assessment – to characterise benthic habitats (e.g. hard substrates/reef areas) in vicinity of the proposed turbine/cables and their habitat value.
- Underwater noise/vibration assessment – to gain a greater understanding of background noise, the noise/vibration likely to be generated by the turbines and the potential disturbance this causes to marine megafauna.
- Community engagement – to gain a better understanding of how residents, visitors, user groups such as commercial fishers and First Nations people use the Study Area.

In addition to field work, other additional studies that will be required as a minimum include:

- Underwater noise modelling to determine the area of impact from turbine operations
- Metocean modelling to inform the design process
- Bird strike modelling to understand flight heights of species and the likelihood of turbine interaction
- Water quality modelling to determine the zones of impact for turbid plumes

9 References

Australian Defence Force (ADF) (2023). UXO Mapping Application. Available online at: <https://www.wherisuxo.org.au/>

Australian Government (2021). *Draft National Recovery Plan for albatrosses and petrels (2021)*. Department of Agriculture, Water and the Environment.

Australian Marine Parks (2018). Temperate East Marine Parks Network Management Plan 2018 Zoning and Rules. Prepared for the Commonwealth of Australia.

Australian Marine Parks (2019). *Hunter Marine Park*. Australian Marine Parks Science Atlas. Available online at: <https://atlas.parksaustralia.gov.au/>.

Barrett, NS., Edgar, GJ., Polacheck, AS., Lynch, T., Clements, F. (2008). Ecosystem monitoring of subtidal reefs in the Jervis Bay Marine Park 1996-2007.

Brand-Gardner SJ, Lanyon JM, & Limpus CJ (1999). Diet selection by immature green turtles, *Chelonia mydas*, in subtropical Moreton Bay, South East Queensland. *Australian Journal of Zoology* 47, 181-191.

Bray, DJ (2019) *Fishes of Australia: Southern Dogfish, Centrophorus zeehaani* White, Ebert & Compagno 2008. <https://fishesofaustralia.net.au/home/species/2610#moreinfo>

Bray, DJ (2021) *Fishes of Australia: Harrison's Dogfish, Centrophorus harrissoni* McCulloch 1915. <https://fishesofaustralia.net.au/home/species/3420#moreinfo>

Bray, DJ (2022) *Fishes of Australia: School Shark, Galeorhinus galeus* (Linnaeus 1758). <https://fishesofaustralia.net.au/home/species/1960#moreinfo>

Bray, DJ (2020) *Fishes of Australia: Epinephelus daemeli*. <https://fishesofaustralia.net.au/home/species/4667>

Bruce B, Bradford R (2008) Spatial dynamics and habitat preferences of juvenile white sharks: identifying critical habitat and options for monitoring recruitment. Final Report to the Department of the Environment, Water, Heritage and the Arts - Marine Species Recovery Program. Hobart: CSIRO. Available from: <http://www.environment.gov.au/coasts/publications/pubs/juvenile-white-sharks.pdf>.

Chafer, CJ, Brandis, CC (2006). Changes in the waterbird community of the Lake Illawarra estuary: 20 years of research. *Wetlands Australia Journal*, 21(2), pp-183. Cogger HG (2001) *The Status of Marine Reptiles in New South Wales*. A report prepared for the New South Wales National Parks and Wildlife Service. Cogger Consulting Services P/L.

Cogger HG (2001) *The Status of Marine Reptiles in New South Wales*. A report prepared for the New South Wales National Parks and Wildlife Service. Cogger Consulting Services P/L.

Commonwealth of Australia (2008). *The East Marine Bioregional Plan Bioregional Profile*. Australian Government, Department of the Environment, Water, Heritage and the Arts.

Commonwealth of Australia (2018). *Jervis Marine Park, Temperate East Network Management Plan 2018*. Produced by the Environment Resources Information Network (ERIN) and Australian Government Department of the Environment and Energy.

Degraer, S., Carey, D. A., Coolen, J. W., Hutchison, Z. L., Kerckhof, F., Rumes, B., & Vanaverbeke, J (2020). Offshore wind farm artificial reefs affect ecosystem structure and functioning. *Oceanography*, 33(4), 48-57.

Department of Agriculture Water and the Environment (2022) Species Profile and Threats Database. Department of Agriculture, Water and the Environment, Canberra.

Department of Climate Change, Energy, the Environment and Water (2017). Marine Benthic Substrate Database - CAMRIS – Marsed. Commonwealth of Australia.

Department of the Environment and Energy (DoEE) (2017). National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna.

Department of the Environment, Heritage, Water and the Arts (DEWHA) (2009) The East Marine Bioregional Plan Bioregional Profile. Department of the Environment, Water, Heritage and the Arts, Canberra.

Department of Primary Industries (DPI) (2012). Primefact: Scalloped Hammerhead Shark *Sphyrna lewini*. https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/635551/Primefact-1218-Scalloped-Hammerhead-Shark-Sphyrna-lewini.pdf

Department of Primary Industries (DPI) (2019). Marine Protected Areas. NSW Government. Available online at: <https://www.dpi.nsw.gov.au/fishing/marine-protected-areas>.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2012). Marine bioregional plan for the Temperate East Marine Region. Commonwealth of Australia.

Farr, H., Ruttenberg, B., Walter, RK., Wang, YH., & White, C. (2021). Potential environmental effects of deepwater floating offshore wind francisenergy facilities. *Ocean & Coastal Management*, 207, 105611.

GPS Nautical Charts (2023). Australia – New South Wales – Wollongong Harbour (Marine Chart: AU_AU5194P1). Available online at https://www.gpsnauticalcharts.com/main/au_au5194p1-new-south-wales-wollongong-harbour-nautical-chart.html.

Hewitt, C., & Campbell, M (2010). The relative contribution of vectors to the introduction and translocation of invasive marine species: keeping marine pests out of Australian waters. Canberra: Commonwealth of Australia, The Department of Agriculture. *Fisheries and Forestry*.

Hutchinson, D. K., Coxall, H. K., Lunt, D. J., Steinhorsdottir, M., De Boer, A. M., Baatsen, M., & Zhang, Z (2021). The Eocene–Oligocene transition: a review of marine and terrestrial proxy data, models and model–data comparisons. *Climate of the Past*, 17(1), 269-315.

Huang, Z., Wang, X. H. (2019). Mapping the spatial and temporal variability of the upwelling systems of the Australian south-eastern coast using 14-year of MODIS data. *Remote sensing of environment*, 227, 90-109.

Interim Marine and Coastal Regionalisation for Australia (IMCRA) (2011). An Ecosystem-Based Classification for Marine and Coastal Environments. Version 3.3.

James LC, Marzloff MP, Barrett N, Friedman A, Johnson CR (2017) Changes in deep reef benthic community composition across a latitudinal and environmental gradient in temperate Eastern Australia. *Marine Ecology Progress Series* 565, 35-52.

Kloser RJ, Keith G (2010). Key ecological features of the East and South-east Marine regions: deep-reefs within 150-700 m depths. Report to the Australian Government Department of Environment, Water, Heritage and the Arts, Canberra.

Last P, Stevens J (1994) 'Sharks and Rays of Australia.' (CSIRO: Collingwood).

Linklater M, Ingleton TC, Kinsela MA, Morris BD, Allen KM, Sutherland MD, Hanslow DJ (2019) Techniques for classifying seabed morphology and composition on a subtropical-temperate continental shelf. 9, 141.

Linklater M, Morris B. (2022), Classification of seabed landforms on continental and island shelves. Manuscript in preparation. (data contained in NSW SEED Database, accessed 6 July 2022).

Malcolm HA, Smith SDA, Jordan A, (2010). Using patterns of reef fish assemblages to refine a habitat classification system for marine parks in NSW, Australia. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 20: 83-92.

Marine Estate Management Authority (2018). Hawkesbury Shelf Marine Bioregion, Part 2 Discussion Paper. Prepared for NSW Government.

Maxwell, SM., Kershaw, F., Locke, CC., Conners, MG., Dawson, C., Aylesworth, S., ... & Johnson, AF. (2022). Potential impacts of floating wind turbine technology for marine species and habitats. *Journal of Environmental Management*, 307, 114577.

Morris, AK (1998). *Directory of Important Wetlands in Australia – Information Sheet*. Department of Agriculture, Water and the Environment, Australian Government.

National Conservation Values Atlas (2022). Australian Government. Department of Climate Change, Energy, the Environment and Water.

NSW Department of Planning, Industry and Environment (DPIE) (2021). State of the beaches 2020-2021, Illawarra region.

NSW Government (2019). *Orange-bellied Parrot – profile*. Office of Environment & Heritage. Available online at: <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10554#:~:text=is%20also%20unique.,Distribution,and%20Maroubra%20in%20May%202003>.

NSW Department of Primary Industries (NSW DPI) (2014). Bushranger's Bay Aquatic Reserve. NSW Government. Available online at: <https://www.dpi.nsw.gov.au/fishing/marine-protected-areas/aquatic-reserves/bushrangers-bay-aquatic-reserve>.

NSW Government (2022a). *Hunter Estuary Wetlands*. Available online at: <https://www.environment.nsw.gov.au/topics/water/wetlands/internationally-significant-wetlands/hunter-estuary-wetlands>.

NSW Government (2022b). River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – profile. Office of Environment & Heritage. Available online at: <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10787>.

NSW Government (2022c). NSW Turtlewatch. Available online at: <https://www.environment.nsw.gov.au/research-and-publications/your-research/citizen-science/get-involved/nsw-turtlewatch>.

NSW Department of Planning and Environment (NSW DPE) (2019). Little Penguin. Available online at: <https://www.environment.nsw.gov.au/topics/animals-and-plants/native-animals/native-animal-facts/little-penguin#:~:text=Little%20penguins%20are%20found%20along,also%20occur%20in%20New%20Zealand.>

NSW Department of Primary Industries (2004) Environmental Impact Statement on the lobster fishery in NSW.

NSW Department of Primary Industries (2014) Protecting the Grey nurse Shark: a guide for recreational fishers and divers First published 2007. Second edition NSW Spatial Dataset Profile September 2016 3 published December 2014. ISBN 978-1-74256-698-6 for the publication 2015. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/635092/GNSProtection-Guide.pdf

NSW Department of Primary Industries (2022) Wollongong offshore artificial reef. <https://www.dpi.nsw.gov.au/fishing/recreational/resources/artificial-reef/wollongong-offshore-artificial-reef>. Accessed 11 July 2022.

Orange-bellied Parrot Recovery Program, 2022. *Orange-bellied Parrot Recovery Program News*, May 2022. Published online at www.birdlife.org.au.

Otway N, Burke L, Morrison N, Parker P (2003) Monitoring and identification of NSW Critical Habitat Sites for conservation of Grey Nurse Sharks. NSW Fisheries, Port Stephens.

Roberts DE, Davis AR, (1996). Patterns in sponge (Porifera) assemblages on temperate coral reefs off Sydney, Australia. *Marine and Freshwater Research*, 47: 897-906.

Schupp, MF., Kafas, A., Buck, BH., Krause, G., Onyango, V., Stelzenmüller, V., ... & Scott, BE. (2021). Fishing within offshore wind farms in the North Sea: Stakeholder perspectives for multi-use from Scotland and Germany. *Journal of Environmental Management*, 279, 111762.

Slater, M., Schultz, A., Jones, R., & Fischer, C (2010). Electromagnetic field study.

Smith P. (2001). Review of the conservation status of marine mammals in New South Wales. Report to the NSW Scientific Committee.

Threatened Species Scientific Committee (2015). *Conservation Advice, Rhincodon typus: whale shark*.

Tougaard, J., Carstensen, J. Teilmann, J., Skov, H., & Rasmussen. P (2009). Pile driving zone of responsiveness extends beyond 20 km for harbor porpoises (*Phocoena phocoena*). *J. Acoust. Soc. Am.* 126, 11-14.

Underwood AJ, Kingsford MJ, Andrew NL (1991) Patterns in shallow subtidal marine assemblages along the coast of New South Wales. *Australian Journal of Ecology* 6, 231-249.

Van Der Hoop, J. M., Moore, M. J., Barco, S. G., Cole, T. V., DAOUST, P. Y., Henry, A. G., ... & Solow, A. R (2013). Assessment of management to mitigate anthropogenic effects on large whales. *Conservation Biology*, 27(1), 121-133.

BMT (OFFICIAL)

West L, Stark K, Murphy J, Lyle J, Ochwada-Doyle F (2015) Survey of Recreational Fishing in New South Wales and the ACT, 2013/14. NSW Department of Primary Industries, Cronulla.

Williams A, Bax NJ (2001). Delineating fish-habitat associations for spatially based management: an example from the south-eastern Australian continental shelf. *Marine and Freshwater Research*, 52: 513-536.

Weilgart, L (2013). A review of the impacts of seismic airgun surveys on marine life. In *CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity*. London, United Kingdom, 1-10.

Yuewen, D & Adzigbli, L (2018). Assessing the impact of oil spills on marine organisms. *J. Oceanogr. Mar. Res*, 6(179), 472-9.



BMT is a leading design, engineering, science and management consultancy with a reputation for engineering excellence. We are driven by a belief that things can always be better, safer, faster and more efficient. BMT is an independent organisation held in trust for its employees.

Level 5
348 Edward Street
Brisbane
QLD 4000
Australia
+61 7 3831 6744

Registered in Australia
Registered no. 010 830 421
Registered office
Level 5, 348 Edward Street,
Brisbane QLD 4000 Australia

For your local BMT office visit www.bmt.org

Contact us

enquiries@bmtglobal.com

www.bmt.org

Follow us

www.bmt.org/linkedin



www.bmt.org/youtube



www.bmt.org/twitter



www.bmt.org/facebook

