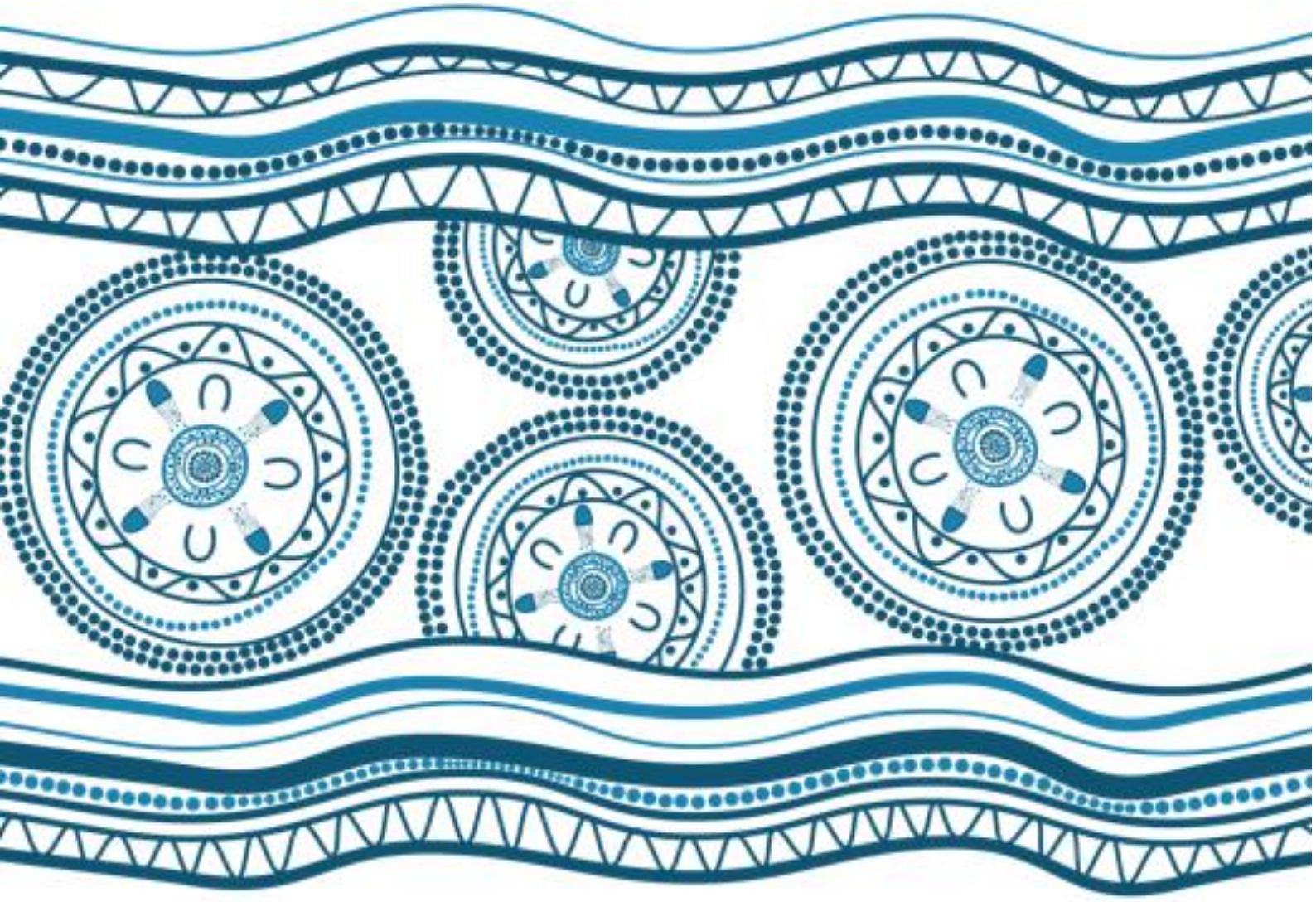
Appendix H

Marine Biodiversity Assessment Report



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Transport for NSW

Kamay Ferry Wharves Project

Marine Biodiversity Assessment Report

KFW01-ARUP-BPW-EN-RPT-000049

Final | 11 June 2021

Job number 273023

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Executive summary

Transport for New South Wales (TfNSW) is seeking approval to reinstate the ferry wharves at La Perouse and Kurnell in Botany Bay (the project) under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as State Significant Infrastructure. The project would allow for an alternative connection between La Perouse and Kurnell rather than by road. The primary purpose of this infrastructure would be to operate a public ferry to service visitors to the area and by the local community for cultural and recreational purposes.

The proposed ferry would utilise the original Kamay Ferry location at Kurnell as the wharf location and connect to La Perouse at the southern end of Frenchmans Bay. Botany Bay has been heavily modified over the years through various large scale developments in relation to the Sydney Airport, Port Botany (reclamation and dredging), the Caltex Jetty (structure and dredging), and through urbanisation of the wider Botany Bay catchment.

With the current pressures through urbanisation and shipping traffic, the natural environment and biodiversity in Botany Bay is subject to some level of continual disturbance. However, in more recent years controls have been in place to improve water quality and effort have been deployed to monitor and re-establish marine habitats though artificial reef structures and seagrass rehabilitation trials.

The marine habitats at La Perouse consists of subtidal reefs dominated by rocky reef crevasses along the shoreline. In the tidal zone there are open seagrass meadows dominated by *Halophila sp*. and an isolated patch of *Posidonia australis*. The marine environment of La Perouse is likely habitat for Black Rockcod (*Epinephelus daemelii*), a listed vulnerable species under the *Fisheries Management Act 1991* (FM Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There is also possible habitat for White's Seahorse (*Hippocampus whitei*) in the *Posidonia australis* seagrass meadows.

At Kurnell the marine habitats are dominated by low sloping seabed of intertidal /subtidal sandstone reef dominated by *Sargassum spp.* In tidal and sub-tidal zones there is a large seagrass meadow of *Posidonia australis,* and an interconnected mosaic of *Posidonia australis, Zostera sp. and Haolphila sp.* There is also subtidal reef habitat in association with Watt's Reef and Inscription Point (outside the construction area). There is likely Black Rockcod habitat near the areas of subtidal reefs located outside the constriction boundary, as well as White's Seahorse habitat in the dense seagrass meadows.

Although the wharf structures are small in comparison to the surrounding developments, the locality of the jetties will result in a direct impact to seagrass habitats of approximately 21,270m^2 through construction and operation of the project, taking into account direct impacts and indirect impacts associate with shading and scour from ferry wash. These impacts include approximately 682m^2 of *Posidonia australis* seagrass meadow which corresponds to the same area of impact associated with White's Seahorse.

Additional impact such as construction noise in relation to piling will have broad impacts across the bay on behavioural responses to marine mammals. The noise

and vibration produced from the piling will have impacts on listed and threatened species under the EPBC Act and *Biodiversity Conservation Act 2016* (BC Act)/FM Act. These animals will likely experience temporary impacts to foraging behaviour, respite during migration and possible breeding. Operational impacts are considered low due to the current levels of disturbance within the bay region.

The project is anticipated to have a significant impact on the following EPBC Act listed species:

- *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion threatened ecological community
- Black Rockcod
- White's Seahorse.

Other impacts that may occur during operation over time is increased usage of the ferry access and recreational vessels that will likely influence the cover of seagrass within the ferry swept path.

It is anticipated that many of the impacts described can be reduced and mitigated for through proactive management measures underpinned by well-planned adaptive management plans and the implementation of the marine Biodiversity Offset Strategy.

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1 Introduction

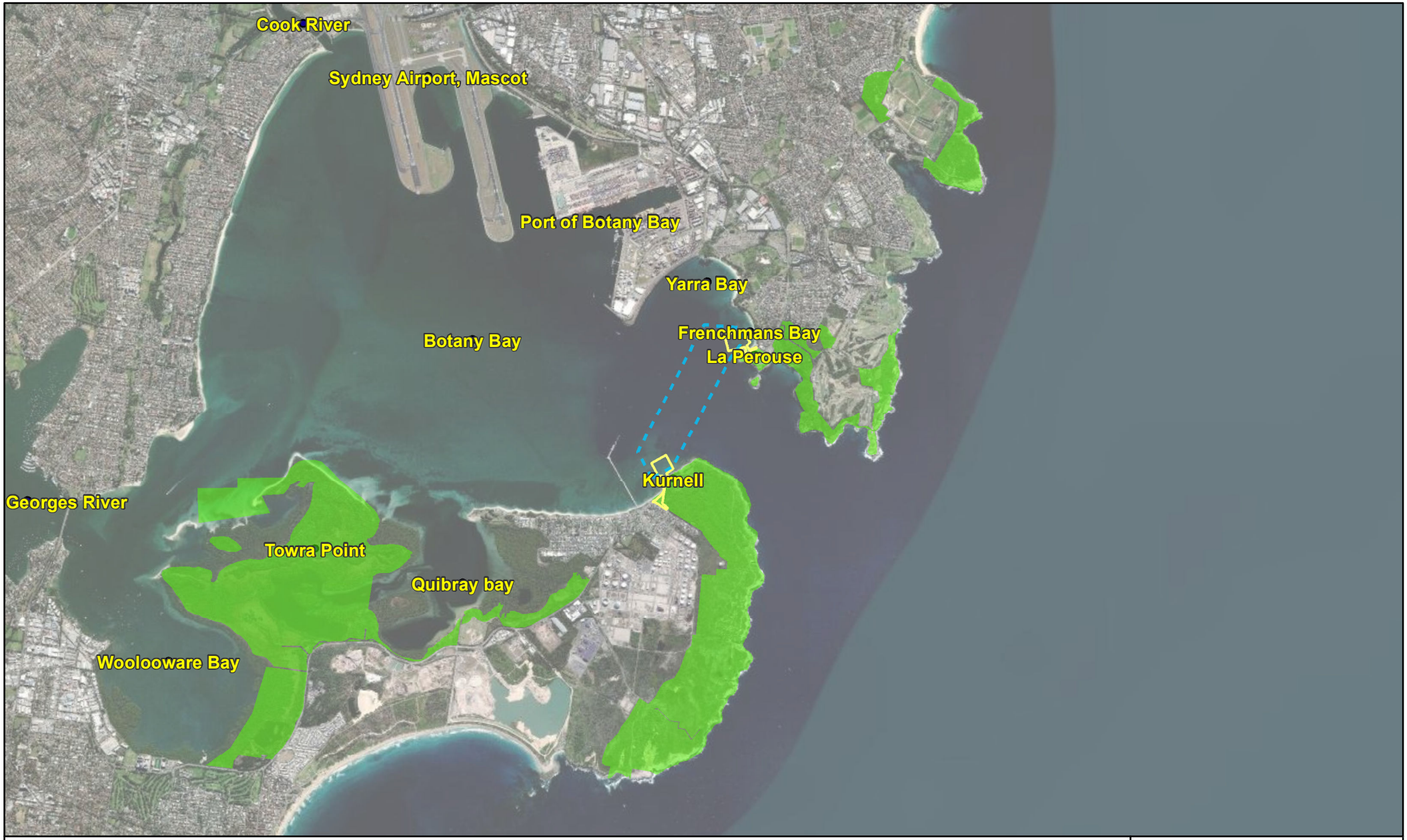
1.1 Project description

Transport for New South Wales (TfNSW) is seeking approval to reinstate the ferry wharves at La Perouse and Kurnell in Botany Bay (the project) under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as State Significant Infrastructure. The project would allow for an alternative connection between La Perouse and Kurnell rather than by road. The primary purpose of this infrastructure would be to operate a public ferry to service visitors to the area and by the local community for cultural and recreational purposes. It would also provide supplementary temporary mooring for tourism-related commercial vessels and recreational boating.

- The project provides opportunities for significant cultural and economic benefits to the local Aboriginal community by providing improved access to culturally significant sites. It is also expected to deliver benefits and opportunities to wider communities on either side of Botany Bay such as investment opportunities in a ferry service and other new visitor/tourist experiences. The project area is located at the inlet to Botany Bay, between the two landside points at Kurnell to the south and La Perouse to the north (Figure 1). Key features of the project include:
- Two new wharves, one at La Perouse and one at Kurnell that would include:
    - Berth for ferries (to accommodate vessels up to 40m long)
    - Berth for recreational and commercial vessels (to accommodate vessels up to 20m long)
    - Sheltered waiting areas and associated furniture
    - Additional space within waiting areas to accommodate other users such as fishing and those using recreational vessels
    - Signage and lighting.
- Landside paving, access ramps, seating and landscaping at the entrance to the wharves
- Reconfiguration of existing car parking areas at La Perouse to increase the number of spaces (including provision of accessible parking and kiss-and-ride bays)
- Reconfiguration of footpaths around the new car parking areas at La Perouse
- Provision for bike racks at La Perouse
- Installation of utilities to service the wharves.

The total construction period is anticipated to take up to 13 months, starting in early 2022. The construction of the two wharves will occur at the same time with landside and waterside works occurring simultaneously. A concept design has been developed for the project, which forms the basis of this assessment. This

Marine Biodiversity Assessment supports the Environmental Impact Statement (EIS) prepared for the project.



Legend

- Ferry Swept Path Envelope
- Development site
- National Park Lands

Figure Title

Project Overview

Figure No 1

Metres

0 475 950 1425 1900

Construction of the project will be carried out in stages as detailed in Table 1. These works will be carried out wholly within the development footprint as shown in Figure 2 and Figure 3.

Table 1. Construction staging and associated activities

Stage	Activities
Stage 1: Early works and site establishment	• Security and fencing • Setting up site offices and access • Demolishing of the existing Kurnell viewing platform • Establish temporary causeway at Kurnell, and construction platform at La Perouse
Stage 2: Main construction	• Piling • Wharf construction • Car parking reconfiguration at La Perouse • Installation of wharf furniture • Earthworks and installation of utilities • Landscaping
Stage 3: Site demobilisation	• Removal of temporary work areas

1.2 Purpose

This report has been prepared to support the EIS for the project and to address the environmental assessment requirements of the Secretary of the Department of Planning, Industry and Environment ('the Secretary's environmental assessment requirements' - SEARs). This report has been completed by Arup to assess the potential impacts of the project on receiving marine habitats and biota.

Legend

- Ferry Swept Path Envelope
- Concept design wharf location
- Development footprint Terrestrial - permanent and temporary
- Development footprint - permanent
- Development footoprint - temporary
- Development site

Figure Title

Development footprint La Perouse

Figure No **2**

Metres

0 30 60 90 120

Legend

- Development site
- Ferry Swept Path Envelope
- Concept design wharf location
- Development footprint - permanent
- Development footprint - temporary

Figure Title

Development Footprint at Kurnell

Figure No **3**

Metres

0 40 80 120 160

1.3 Relevant SEARs

Table 2 identifies the SEARs which are relevant to this marine technical assessment.

Table 2. SEARs for marine biodiversity

SEARs relevant to this technical report	Where addressed in this technical report
4. Biodiversity The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity. Offsets and/or supplementary measures are assured which are equivalent to any residual impacts of project construction and operation.	
1. Biodiversity impacts in accordance with s7.9 of the *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Assessment Method (BAM), and be documented in a Biodiversity Development Assessment Report (BDAR).	See EIS Appendix I, Biodiversity Development Assessment Report (BDAR)
2. The BDAR must include information in the form detailed in s6.12 of the BC Act, cl6.8 of the Biodiversity Conservation Regulation 2017 and the BAM.	See BDAR
3. The BDAR must be submitted with all digital spatial data associated with the survey and assessment as per Appendix 11 of the BAM.	See BDAR
4. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the BC Act.	See BDAR
5. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM.	See BDAR
6. The BDAR must include details of the measures proposed to address offset obligations.	See BDAR
7. The BDAR must include an assessment of biodiversity values not covered by the BAM. This includes: (a) a threatened aquatic species assessment (Part 7A *Fisheries Management Act 1994*) to address whether there are likely to be any significant impact on listed threatened species, populations or ecological communities under the *Fisheries Management Act 1994* (FM Act); and	Section 4 Section 5
(b) impacts to marine mammals and wandering sea birds. The assessment must be undertaken in accordance with the "marine biodiversity assessment", described in section 4.5.3 of the Kamay Ferry Wharves State Significant Infrastructure Scoping Report (Transport for NSW, May 2020). The Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (Commonwealth Department of the Environment and Energy, EPBC Act Policy Statement 3.21) may be used as a guide in this assessment. The assessment must include, but not limited to potential injury, entrapment and damage to habitat.	Section 4 Section 5

SEARs relevant to this technical report	Where addressed in this technical report
8. Water-based construction and vessel operation impacts on aquatic biodiversity, including: (a) disturbance to *Posidonia australis* populations and other seabed grasses (including from dredging, and propeller wash, anchoring, turbidity and sedimentation from vessel operations);	Section 5
(b) the nature and impact of underwater noise generating activities; and	Section 5
(c) proposed specific sound exposure and peak impulsive and continuous noise criteria for identified noise sensitive fauna.	Section 5
9. Identify whether the project, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the BC Act, FM Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).	Section 5
5. Noise and Vibration Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity. Increases in noise emissions and vibration affecting nearby properties and other sensitive receivers during operation of the project are effectively managed to protect the amenity and well-being of the community.	
1. Land, water and under-water-based construction noise and vibration impacts of the project in accordance with relevant NSW noise and vibration guidelines. The assessment must include noise impacts of construction related traffic.	Section 5
8. Social and Economic The project minimises adverse social impacts and capitalises on opportunities potentially available to affected communities. The project minimises impacts to property and business and achieves appropriate integration with adjoining land uses, including maintenance of appropriate access to properties and community facilities, and minimisation of displacement of existing land use activities, dwellings and infrastructure.	
3. The potential disruption and restrictions arising from the construction and operation of the proposal on the recreational uses in Frenchmans Bay and Kurnell, including swimming, snorkelling, sailing and beach users.	Section 5
5. Potential impacts to properties, businesses, recreational users and land and water users (for example, recreational fishers, commercial fishers and aquaculture activities), including property acquisitions/adjustments, access, amenity and relevant statutory rights.	Section 5
Agency comments	
DPI Fisheries	
DPI Fisheries requests that the SEAR's for SSI-10049 also consider: • The extent and impact on seagrass beds, in particular *Posidonia australis* populations, from all stages of the proposed development from construction to operation and ongoing maintenance including but not limited to direct propeller and propeller dredging impacts, anchoring impacts by recreational	Section 5

SEARs relevant to this technical report	Where addressed in this technical report
boaters using the wharves, turbidity and sedimentation from boat operations.	
• Potential for introduction of aquatic weeds (including *Caulerpa taxifolia*);	Section 5
• Wharf construction impacts on the habitats used by Black Rockcod (*Epinephelus daemelii*) or protected *Syngnathids (seahorses and pipefish).*	Section 5
• Mitigation from any impacts and potential habitat enhancements from the construction and operation of the sites.	Section 6
Design & infrastructure considerations: • The provision of 24hr fishing access and adequate lighting and other facilities along the wharf. • Appropriate car parking facilities for all users. • Designated fishing areas to reduce fisher, commuter and ferry worker interaction. • Increase habitat and fishing amenity via installing artificial reef balls or modules that does not impede ferry operation. • Provision of appropriate fishing amenities (litter receptacles, rod holders, underwater lights, seating and gear storage, appropriate responsible fishing signage). • Increased mooring opportunities for boaters, including fishing charter operators picking up and dropping off clients, that do not impact on the adjacent seagrass beds.	The wharves are designed to be multi-user wharves, including for fishing purposes. Provision of appropriate fishing amenities would be considered during detailed design. Opportunities for the provision of artificial habitat will be detailed in the Marine Biodiversity Offset Strategy.
Habitat & fishing enhancement opportunities associated with the wharf project: • Installation of suitable artificial reefs within casting distance of the proposed fishing platforms to enhance local habitat and fishing opportunities. • Additional artificial reefs deployed within the Botany Bay Recreational Fishing Haven to maximise fishing opportunities and habitat generally. • Potential restocking of key species (kingfish, bream, dusky flathead, mulloway).	Opportunities for the provision of artificial habitat will be detailed in the Marine Biodiversity Offset Strategy.
Randwick City Council	
The impact of any dredging, channelling and scouring of the seabed in Frenchmans Bay to accommodate the wharf structure and associated ferry lanes on the geomorphology of the Bay and potential dispersal of dormant contaminants on the seabed.	Section 5
Assess and identify any loss of seagrass and other marine life in Frenchmans Bay and Yarra Bay from a dredging to accommodate the proposed La Perouse Wharf and ferry lanes.	Section 5
There are 17 protected species in Botany Bay, including the weedy seadragon and Sydney's pygmy pipehorse which may be affected by the proposal, so impacts should be assessed in the EIS	Section 4 Section 5
Sutherland Shire Council	
The head of the wharf is listed as a locally significant heritage item, however any remnants (if any) of the wharf extending out into the water (i.e.: pylons etc.) have not been documented or	Section 4

SEARs relevant to this technical report	Where addressed in this technical report
identified. The aquatic ecological survey or heritage survey should also determine whether any pylons and other remnants of the original wharf exist and if yes, then take steps to protect them for future generations. Also if there are remnant pylons then they are likely to have been inhabited by local marine life and should be conserved.	

2 Legislation

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth EPBC Act applies to those actions which are likely to have a significant impact on matters of national environmental significance (MNES). An EPBC Act referral is triggered by undertaking an action that will have or is likely to have a significant impact on MNES or other protected matters. The project was referred to the Commonwealth Department of Agriculture, Water and Environment (DAWE) on 10 December 2020 and was determined to be a controlled action, as it would likely result in a significant impact on:

- Posidonia australis Seagrass Meadows of the Manning-Hawkesbury Ecoregion TEC
- Black Rockcod (*Epinephelus damemelii*) – vulnerable
- Cauliflower Soft Coral (*Dendronepthya australis*) – endangered (added while under assessment)
- White's Seahorse (*Hippocampus whitei*) – endangered (added while under assessment).

It has been subsequently assessed that this project is unlikely to impact upon Cauliflower Soft Coral as there were no sightings of the species during any of the surveys completed.

An assessment of proposal impacts to MNES associated with the marine environment is presented in Section 5 of this document. The assessment was carried out in accordance with the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Commonwealth of Australia 2013).

2.2 New South Wales

2.2.1 *Environmental Planning and Assessment Act 1979*

All projects assessed as state significant infrastructure under Part 5, Division 5.2 of the EP&A Act require an EIS to address the SEARs. According to the SEARs, the EIS must assess marine mammals and MNES in addition to the assessment of biodiversity impacts in accordance with the Biodiversity Assessment Method (BAM), which covers terrestrial biodiversity matters. This MBAR has been prepared to address the SEARs requirements to assess impacts to marine biodiversity as a result of the project.

2.2.2 *Biodiversity Conservation Act 2016*

The BC Act and Biodiversity Conservation Regulation 2017 (BC Regulation) were introduced in 2017 to replace the *Threatened Species Conservation Act 1995* and those parts of the *National Parks and Wildlife Act 1974* that provide authorisation to undertaken activities that would otherwise be an offence. The BC Act provides a framework for the assessment of biodiversity and the implementation of the Biodiversity Offset Scheme (BOS) in NSW. The NSW BAM supports the implementation of the BOS and establishes a consistent approach to assessing biodiversity values on lands within NSW. A Biodiversity Development Assessment Report (BDAR) has been developed separately to address the specifics of terrestrial impacts.

2.2.3 *Coastal Management Act 2016*

The *Coastal Management Act 2016* (CM Act) replaces the previous *Coastal Protection and Management Act 1979.* The new CM Act forms part of the new State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP).

The CM Act establishes a strategic framework and objectives for managing coastal issues in NSW. The CM Act promotes strategic and integrated management, use and development of the coast for the social, cultural and economic wellbeing of the people of NSW.

The CM Act also supports the aims of the *Marine Estate Management Act 2014*, as the coastal zone forms part of the marine estate.

The CM Act defines the coastal zone, comprising of four coastal management areas: coastal wetlands and littoral rainforests area, coastal vulnerability area, costal environment area and coastal use area. The CM Act establishes management objectives specific to each of these management areas, reflecting their different values to the coastal communities.

2.2.4 *Fisheries Management Act 1994*

The FM Act is the primary Act governing the management of fish and their habitat in NSW. The FM Act aims ‘to conserve, develop and share the fisheries resources of the State for the benefit of present and future generations.’

In NSW, populations of *Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie have been listed as endangered populations under the Threatened Species Schedules of the NSW FM Act. *Posidonia australis* is also listed as a Type 1 Key Fish Habitat under the FM Act.

The FM Act also protects a number of fish species including Syngnathiformes that include seahorses, seadragons, pipefish, pipehorses, ghostpipefish and seamoths. These species are listed as “protected”. In addition to a number of other species listed as threatened in NSW and reviewed in Section 4.

2.2.5 State Environmental Planning Policy (Coastal Management) 2018

The *State Environmental Planning Policy (Coastal Management) 2018* (CM SEPP) identifies and maps the coastal zone according to definitions in the CM Act. The CM SEPP streamlines coastal development assessment requirements and identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the CM Act.

The Coastal Management SEPP integrates and improves current coastal-related SEPPs and ensure that future coastal development is appropriate and sensitive to our coastal environment, and that public access to beaches and foreshore areas are maintained. The Coastal Management SEPP is the single land use planning policy for coastal development, bringing together and modernising provisions from SEPP 14 – Coastal Wetlands, SEPP 26 – Littoral Rainforest and SEPP 71 – Coastal Protection.

2.3 NSW Biodiversity Offsets Policy for Major Projects for Aquatic Biodiversity

The policy (DPI, 2014) requires that proponents should, as a first priority, aim to avoid impacts to Key Fish Habitat such as marine vegetation, blockages to fish passage, and impacts from various coastal developments as the first applied principle. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. Any remaining impacts should then be offset with compensatory works, where possible. NSW Department of Primary Industries (DPI) assesses activity and development proposals in relation to general policies and with consideration for the 'sensitivity' of the affected fish habitat.

The SEARs for the project specifically identified the following as a key issue and desired performance outcome:

> *"2(d) demonstrate how potential impacts have been avoided (through design, or construction or operation methodologies)"*

The project has been designed to avoid and minimise potential impacts on marine ecology, as much as practical given the overriding design requirement for the ferry terminals to be located in the marine environment. The existing project footprint has been reduced as far as practicable to avoid areas of marine vegetation and habitat. Where applicable standard mitigations are applied throughout the project to minimise potential impact to the region's marine biodiversity. Residual impacts on marine ecology as a result of the project are predicted (Section 5) and measures are recommended to mitigate these impacts to achieve a 'no net loss' of marine habitats in particular key fish habitat.

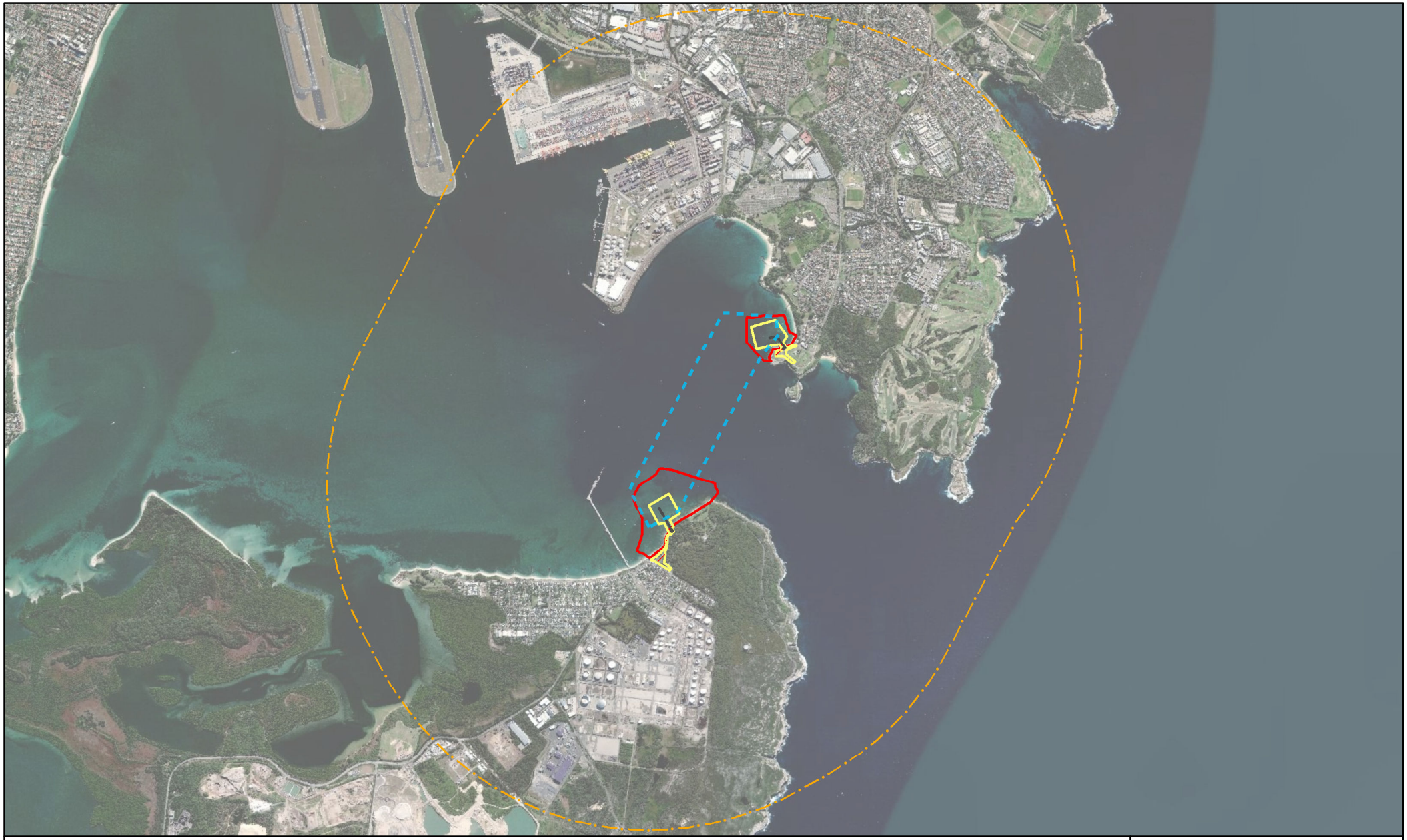
3 Methodology

3.1 Study area

The study area was defined at two scales for the initial desktop study to inform the baseline environmental values of the project site. The EPBC Act Protected Matters Search Tool (PMST) and the NSW Bionet databases were reviewed for a 10km buffer around the project site to identify potential species and communities that were likely or known to occur. This was then refined to a 3km buffer to identify species and ecological communities that are considered known or likely to occur within the project area.

The marine study area for more detailed field investigations consisted of the area immediately adjacent to the construction boundary for the project and extended further afield to better gauge habitats near to the site (Figure 4).

Within the Botany Bay waters the main shipping channel intersects with the proposed swept ferry path and significantly deepens beyond the construction boundaries of the site. The initial risks of the project determined this main channel would unlikely be impacted beyond interactions with marine fauna given the depth range and current use of the channel. As such the main site locations assessed as part of fieldwork are generally restricted to near and around La Perouse Frenchmans Bay towards Yarra Bay and Kurnell towards the Caltex jetty to Sutherland Point.



Legend

- Ferry Swept Path Envelope
- Concept design wharf location
- Development footprint - temporary
- Marine Study Area
- Desktop Study 3km
- Development site

Figure Title

Study Area

Figure No **4**

Metres

0 340 680 1020 1360

3.2 Desktop assessment

A desktop assessment was undertaken to identify and understand the risks and site constraints including key fish habitats, critical habitats, surrounding sensitive receptors and listed threatened communities and other protected areas under the FM Act and EPBC Act. Information reviewed as part of the desktop assessment included mapped based platforms such as:

- NSW SEED mapping
- NSW Bionet Atlas search
- Atlas of Living Australia
- Conservation Values Atlas mapping.

Once initial searches were completed likelihood assessment was undertaken to determine the probability of the species, community and or sensitive receivers being present within an or adjacent to the project boundary. This also informed the requirements for the initial surveys.

Additional desktop assessment was undertaken following the initial round of surveys to further refine likely impact and risk associated by the proposed works.

The following policies, guidelines and plans were considered when assessing the marine biodiversity impacts:

- Biodiversity Assessment, Environmental Impact Assessment Practice Note EIA-N06 (Roads and Maritime, 2015)
- Ecologically Sustainable Development, Environmental Impact Assessment Practice Note EIA-N02 (Roads and Maritime, 2010)
- Policy and Guidelines for Fish Habitat Conservation and Management – Update 2013 (DPI, 2013)
- Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (Department of Environment, Water, Heritage and the Arts, 2013)
- Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries, 2003)
- NSW Sustainable Design Guidelines Version 3.0 (TfNSW, 2013)
- Coastal Management SEPP (2018)
- Aquatic Ecology in Environmental Impact Assessment – EIA Guideline (Marcus Lincoln Smith, 2003)
- EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species
- Survey Guidelines for Australia's Threatened Fish (Commonwealth of Australia, 2011)

- Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013)
- Underwater Piling Noise Guidelines (South Australia, 2010)
- Great Barrier Reef Underwater Noise Guidelines (GBRMPA, 2017) and other noise-related guidelines for Marine Mammals, Fish, Turtle, Sharks and squid to determine sensitivities and areas of impact.
- Biologically Important Areas (National Conservation Values Atlas, Department of Agriculture, Water and the Environment, 2020)
- The Convention on Wetlands of International Importance
- Threatened Species information, survey and assessment guidelines, including but not exclusively to:
  - Approved Conservation Advice (including listing advice) for *Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion ecological community (Department of the Environment and Energy, 2018)
  - Black Rockcod (*Epinephelus daemelii*) recovery plan (DPI, 2012)
  - White's Seahorse (*Hippocampus whitei*): Fisheries Scientific committee determination FM Act (Fisheries Scientific Committee, 2019)
- Threatened Species Assessment Guidelines (DPI, 2008)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC, 2004)
- Recovery Plan for Marine Turtles in Australia (DOEE 2017)
- Guidelines for Developments Adjoining Land and Water Managed by the Department of Environment, Climate Change and Water (DECCW, 2010)
- Policy and Guidelines for Aquatic Habitat Management and Fish Conservation (DPI, 1999).

3.2.1 Other project technical studies

A number of additional studies were undertaken to support the project EIS. These studies and the outcomes were considered and applied in this assessment. These include:

- Coastal modelling report
- Biodiversity Development Assessment Report (BDAR)
- Underwater Noise Assessment
- Surface Water Assessment Report
- Preliminary Site Investigation for La Perouse
- Preliminary Site Investigation for Kurnell
- Detailed Site Investigation.

- Kamay Ferry Wharves Constructability memo.

3.2.2 Personnel

The Marine Biodiversity Assessment was prepared by the following:

- Andrea McPherson (BSc, Grad Cert Res Meth, MSc) Technical Lead, Aquatic Ecologist

Field Studies were undertaken by Niche Environment and Heritage:

- Matthew Russell (BSc) Aquatic Ecologist
- Dr David Cummings (BSc, PhD) Aquatic Ecologist (H20 Consulting Group).

3.3 Field investigations

A number of field investigation were conducted to determine the extent and condition of habitat within and around the project area.

The available marine habitat mapping of the region was limited and did not fully cover the project area. It was known that the region contained *Posidonia australis*, *Zostera spp.* and *Halophila spp.* seagrass communities, in addition to intertidal and subtidal reef habitats. The known extent and condition of these habitats outside of the large *Posidonia australis* meadow was out of date.

A preliminary habitat investigation was conducted to map the habitats present and provide information on site constraint around the construction boundaries of La Perouse and Kurnell then to inform more targeted surveys (Table 3). The surveys completed aimed at capturing seasonal variation, likely presence of listed threatened and protected species and confirm presence of TEC communities.

Table 3. Survey and field investigations summary.

Survey	Dates	Description
Preliminary habitat assessments and mapping	• Benthic infauna sampling: 6-7 April 2020 • Seagrass survey 1: 6-7 April 2020	• Confirmation of habitat presence and extent • Determine the current extent and type of seagrass beds in the project areas • General description of intertidal habitats
Seagrass Surveys	• Seagrass survey 2: 4-7 August and 17 September 2020 • Seagrass survey 3: 3-4, 9-10 December 2020	• Qualitative and quantitative assessments for seagrass density and, community composition and cover

Survey	Dates	Description
Subtidal Reef Surveys	• Survey 1: 6-7 April 2020 • Survey 2: 31 August- 2 September 2020	• Mapping of kelp beds • Quantitative assessments for habitat and macroalgae community
Targeted threatened fauna surveys	• 3-4 September 2020	• Diver searches and habitat based assessments availability for Black Rockcod

3.4 Survey methodology

To support the EIS and assess the existing baseline condition and inform potential impact a number of surveys were completed to determine the project area constraints and confirm known or likely presence of significant marine biodiversity features.

3.4.1 Preliminary habitat assessment

Mapping and characterisation of sub-tidal habitat

Data was collected in-situ using GPS (accuracy +/- 3m) based handheld devices with GIS based data collection software (Arc Collector) using a combination of observations with a bathyscope and a towed camera system that provided live video feed to the surface. The camera system was towed along transects that traversed Kurnell and La Perouse. Benthic habitat was assigned to categories of soft sediment, seagrass, macroalgae, soft coral or rock/reef.

For seagrass habitat, seagrasses were assigned a species label using the dominant seagrass species, with other species noted when they occurred in mixed beds. In addition to seagrass species, a seagrass density category (low, medium or high) was assigned. Data collected in the field was digitised onto aerial imagery and interpreted in ArcGIS (geographical mapping software) with aid of the most recent available aerial imagery to determine seagrass boundaries.

Description of foreshore habitat

The intertidal zone was assessed during at low tide to provide safe access to the lower intertidal areas. Typical habitat was recorded and common species identified.

Sediment and benthic infauna sampling

Sediment was sampled using a Ponar grab deployed from a small vessel. Five benthic infauna and one PSD samples were taken at each proposed wharf location for laboratory analysis.

A two litre sample of homogenised sediment was retained and sieved through a one-millimetre gauge sieve in situ to sample benthic infauna. The remaining material was carefully washed into a labelled container and preserved in 100% ethanol. Once preserved, samples were shipped with chain of custody forms to a

specialised laboratory for identification and quantification of fauna present by a specialist infauna taxonomist. Sediment for PSD analysis was also collected from an homogenised sample. The samples were bagged, labelled, and shipped to a National Association of Testing Authorities (NATA) accredited laboratory with chain of custody forms.

Opportunistic fauna observations

Opportunistic description of the fish or other marine fauna assemblages observed at the time of survey were also recorded.

3.4.2 Seagrass surveys

Three seagrass surveys were completed to assess extent, cover and condition of the seagrass communities and surrounding habitats within and adjacent to the construction boundary of the project area (refer to Figure 5 and Figure 6 for survey site locations).

- Survey 1: Autumn survey (early May 2020) established extent and community composition of the wider project areas (completed during Preliminary Habitat Assessment)
- Survey 2: Late winter survey (September 2020) further refine extents and community composition, included quantitative surveys to better inform community composition, percentage cover and condition.
- Survey 3: Summer survey (December 2020) further assessment for seasonal changes of distribution, density and species composition.

Seagrass mapping was undertaken using the methodology described above. Additional and more detailed mapping of small patches of *Posidonia australis* beds was undertaken within 10m of the proposed footprint of the Kurnell Wharf. Mapping was undertaken during periods of clear water to identify bottom structures, which were further investigated using a combination of drop-camera and in-water inspection. Additional patches of seagrass were recorded using ArcCollector with GPS accuracy. Seagrass mapping was updated in ArcMap to reflect these changes. Some additional opportunistic observations on seagrass temporal changes since previous mapping and evidence of storm damage were also noted during these works.

Quantitative surveys were undertaken at eight sites with a radius of 15m and representative of seagrass habitat within and adjacent to the project area. Surveys were undertaken using a drop-camera deployed from a small vessel. The drop camera allowed for collection of high definition photo quadrats ($0.25m^2$). The collection of photo quadrats was stratified to seagrass to provide a conservative estimate of density, as they were mapped to be very patchy throughout the project and adjacent areas. Photo quadrats were analysed using Coral Point Count with Excel Extensions (CPCe) software to determine percent cover of each seagrass species.

3.4.3 Subtidal reef surveys

Two surveys were completed to determine the extent of the subtidal rocky reef, describe the associated macroalgae assemblage and identify potential habitat for threatened species within the construction boundary of the project area (refer to Figure 5 and Figure 6 for survey site locations).

- Survey 1: Autumn survey (early May 2020) established extent and community composition of the wider project areas (completed during Preliminary Habitat Assessment).
- Survey 2: Late winter survey (September 2020) further refine extents and community composition, complete more quantitative surveys to better inform community composition, percentage cover and condition.

Benthic habitat mapping was undertaken in conjunction with the seagrass mapping using the methodology described above.

Rocky reef community composition was quantitatively surveyed at nine sites representative of habitat within and adjacent to the project area. Survey transects 30m in length were randomly positioned approximately following the rocky reef substrate and depth contours for two depths (shallow: 1- 3m and deep:4-6m). Depending on suitability and amount of rocky reef habitat, between two and four transects were surveyed for each depth zone. Surveys data was collected by experienced ADAS Scientific divers.

Divers recorded in situ Kelp (*Ecklonia radiata*) frond numbers and Long-spined Sea Urchins (*Centrostephanus rodgersii*) within 1m of the survey tape. These two species were chosen as a habitat quality indicator for Kelp dominated macroalgae stands in the area. These Kelp dominated assemblages also provide important habitat for protected Sygnathids species such as the Weedy Seadragon (*Phyllopteryx taeniolatus*).

High resolution photo quadrats ($0.25m^2$) of the reef community were recorded using a custom designed diver operated frame every 1m along the transect. Photoquadrats were collected on the rocky reef surface or at the top of the canopy where canopy forming macroalgae occurred. Following collection of the photo quadrats any photos that did not include any rock, rubble or reef community habitat or were of poor quality were disregarded. Up to 25 of the remaining photo quadrats were analysed using CPCe to describe the macroalgae community and other sessile biota components of the reef community.

3.4.4 Threatened Species Searches

Searches for Black Rockcod off rocky reef habitat was undertaken by experienced ADAS Scientific Divers. Searches targeted areas of high reef complexity and steep drop-offs. Searches include visual inspection of caves, gutters, deep cracks and around drop-offs by divers. Targeted search effort included approximately 30mins search time at each reef community site (total search effort = 4.5hrs) for threatened fish species (Black Rockcod and White's Seahorse), as well as an additional two x 90-minute (approximate) dives with two divers (total search effort = 6 hrs). The additional dives targeted areas with potential Black Rockcod

habitat not visited as part of the reef community surveys. Areas with high habitat attributes (gutters, deep cracks, caves, overhangs, drop-offs) for adult Black Rockcod were recorded and mapped in ArcGIS.

These additional dives also provided opportunity for opportunistic observation and documenting of other species and deeper communities such as some sponge and soft coral gardens adjacent to the project study area.

Ferry Swept Path Envelope
Concept design wharf location
Development site

Botany Bay Estuarine Macrophytes (DPI, 2005)

Macrophyte OEH TEN Botany Bay Estuarine Veg E4133V1 1998

Halophila

CATEGORY

Kelp
Mixed Halophila

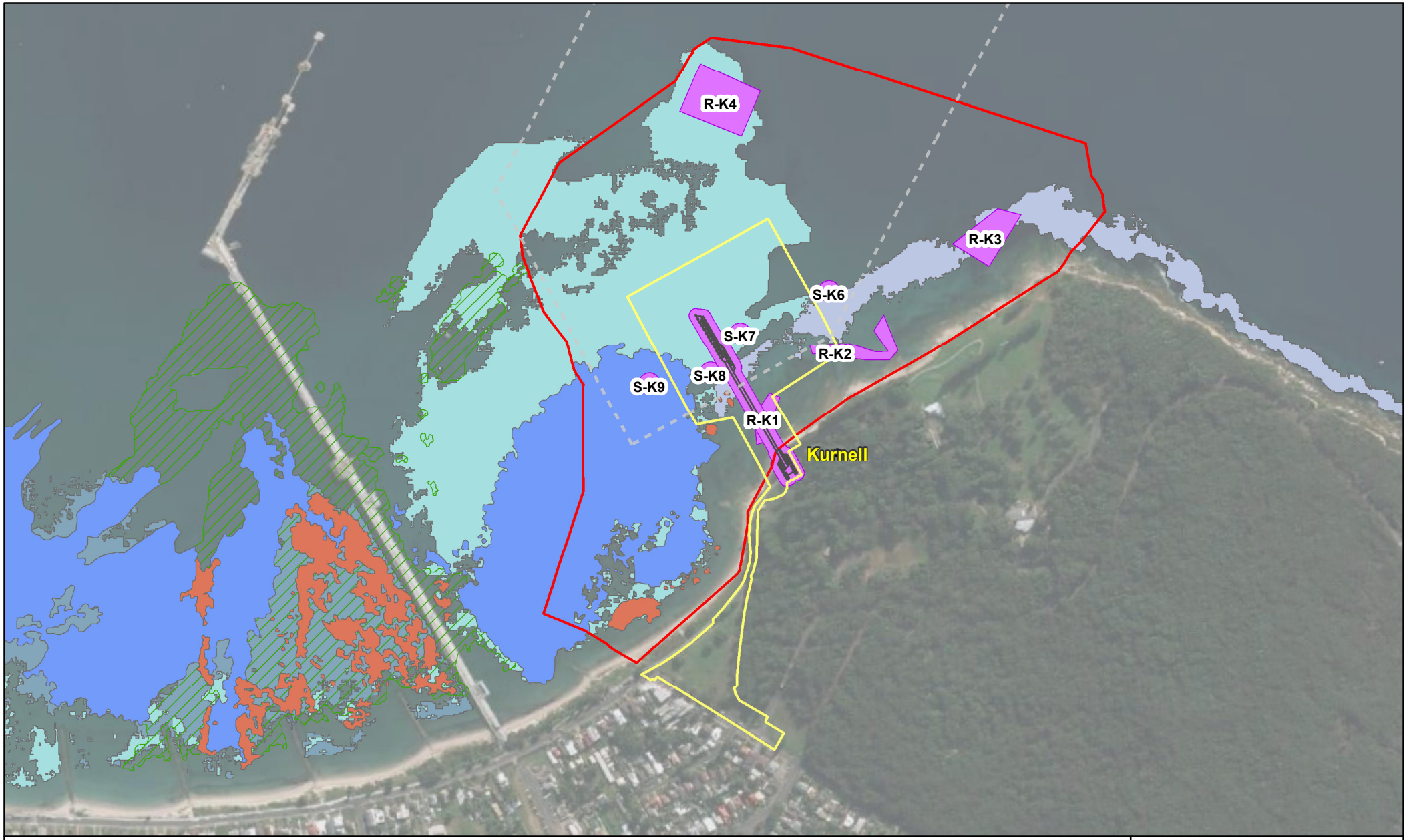
Figure Title

Marine Survey Study Areas and sites at La Perouse

Figure No **5**

Metres

0 40 80 120 160



Legend

- Development site
- Ferry Swept Path Envelope
- Concept design wharf location

Botany Bay Estuarine Macrophytes (DPI, 2005)

Macrophyte

- Halophila
- Posidonia
- Posidonia/Halophila

OEH TEN Botany Bay Estuarine Veg E4133V1 1998 CATEGORY

- Kelp
- Mixed Halophila
- Mixed Posidonia

Figure Title

Survey study areas, sites and previously mapped habitat, Kurnell

Figure No **6**

Metres

0 50 100 150 200

3.5 Limitations

A number of the listed species that may be impacted by the proposed works are very cryptic, meaning even with targeted surveys the species may not be observed. With limitations in timing the survey effort focussed on assessing if the habitat was suitable for the species in question. Efforts were employed to maximise potential sightings while undertaking the habitat assessments.

Impacts associated with the construction methods and operation of the project have been assessed on a worst-case scenario and are based on concept designs, with detailed design to continue beyond the EIS approval. Mitigation measures will continue to be considered in designs to further mitigate impacts that have yet to be resolved. All impact areas have been calculated based on the most recent survey in December 2020.

A Marine Biodiversity Offset Strategy is being researched and drafted to better inform the controls of impact and mitigations. Finalisation and implementation of this MBOS will be a condition of approval for the project.

3.6 Assessment of potential impacts and development of mitigation

Once the existing environment was established, potential impacts were identified and reviewed to provide context to the risk assessment. An impact risk assessment was undertaken to determine the extent and overall impact to marine biodiversity. Values, hazards and risks levels are identified to further understand the likely impact to each environmental value relevant to marine biodiversity that has the potential to be impacted by the project.

Impacts were assessed through:

- Areas of direct and indirect impact, utilising GPS ground truthed data and GIS (ArcMap) to determine extents, areas and buffers where applicable.
- Shading impacts were determined through calculating the estimated shade angles (by a basic altitude angle calculation), to determine the extent at which an area will be likely affected by prolonged shading.
- Review of risk of interaction.

Mitigation measures were developed to provide control measures to further reduce the risks of impacts across the construction and operational phases of the project.

4 Existing environment

The project is in Botany Bay at either side of the ocean entrance to the Bay. Botany Bay is located about 14 km south of the Sydney central business district (CBD).

The La Perouse headland is located next to a residential area and the commercial area of Port Botany. The La Perouse headland includes a museum and access to La Perouse park and beaches.

The Kurnell Peninsula is located south of the ocean entrance within Kamay Botany Bay National Park. To the west of the Peninsula is the suburb of Kurnell; a residential area and industrial area. Cronulla is located about 8 km south and the Royal National Park about 18 km south.

Botany Bay connects to directly to the Tasman Sea part of the Pacific Ocean. The bay itself is about 5 km in diameter (Encyclopædia Britannica, inc., 2017). Botany Bay has a catchment of approximately 55km^2 and is relatively shallow, with most of the Bay being less than five metres deep, except for the navigation channel which runs between Port Botany, the Caltex Kurnell Terminal and the harbour entrance. Botany Bay is fed by Georges River from the west and Cooks River from the north, and tidal flow. The nearshore environment at La Perouse and Kurnell are tidally affected.

The bay has been significantly modified over the years with the inclusion and operation of Port Botany, Sydney (Kingsford) Airport, the Caltex Wharf and historical uses that have seen the bay dredged, coastlines modified and as such significant changing in habitats.

Given the usage of the Botany Bay the environment is heavily modified in sections and continuously disturbed through the operations of the port through vessel traffic and airplane activity. Given the level of human activity there are however a number of protected areas within the bay.

In the middle and south western end of the bay is the Towra Point Nature Reserve, which is a Ramsar wetland of international significance. This wetland is located about 2km west of the Project Site. There are also State protected aquatic reserves like Cape Banks Aquatic Reserve, located about 1.4km to the east of the Project Site near the entrance of the bay.

The Kurnell side of the Project Site is immediately adjacent to the Kamay Botany Bay National Park. Although the marine waters are not considered part of the national park.

4.1 Prevailing conditions and coastal processes

The existing nearshore wave climate in Botany Bay is largely influenced by both swell and sea waves. Swell waves are defined as offshore waves that are generated by storms or large pressure events outside Botany Bay. Sea waves are defined as waves generated by the local wind climate within Botany Bay.

The La Perouse project site receives unidirectional swell that are typically 0.4m in height, where on the Kurnell side the wave come from the north-north west and are typically 0.3m in height in normal conditions.

Due to the size of the bay, water levels and movement are impacted by a range of processes including tides, wind, freshwater flow and storm water flow. With astronomical tidal[1] movements ranging from -0.64 (MLWS) and 0.69 (MHWS).

Currents are driven by a range of factors including freshwater inflow, tidal movements, winds, coastal waves and nearshore process. The Coastal Modelling Report by Cardno (Appendix T of the EIS) notes that localised current movements are affected by the high frequency of shipping movements in Botany.

Dominant wind direction varies throughout the year. Winds coming from the south and east are more common during summer, while winds coming from the west prevail during winter. Autumn and Spring are transition periods where no wind direction is dominant. Calm conditions occur around five per cent of the time.

The average (median) wind speed in Botany Bay is around 5m/s (or ~10 knots), while a 9m/s wind speed is exceeded around 10 per cent of the time and 14m/s is exceeded around 1 per cent of the time.

4.1.1 Sediment transport

The conditions in Frenchmans Bay at the La Perouse site are stable and as such are unlikely to be adversely impacted by storm erosion. However, at Kurnell there is historical evidence of shoreline receding between 2009-2016 with only slight changes of up to 5 m in some areas. Shoreline protection works were undertaken in the forms of geotextile sand containers located north east of the existing viewing platform.

4.1.2 Bathymetry and geological formations

Botany Bay has undergone significant modification through land changes to the coastline in large areas of reclamation and significant dredging campaigns for cargo ship access and port berthing. The majority of the Bay's coastline is modified as the regional population encroaches on the coastal areas, with the exception of Towra Point, 2km west of Kurnell. Within the shallow waters of the bay, rock groynes are common along areas of beach.

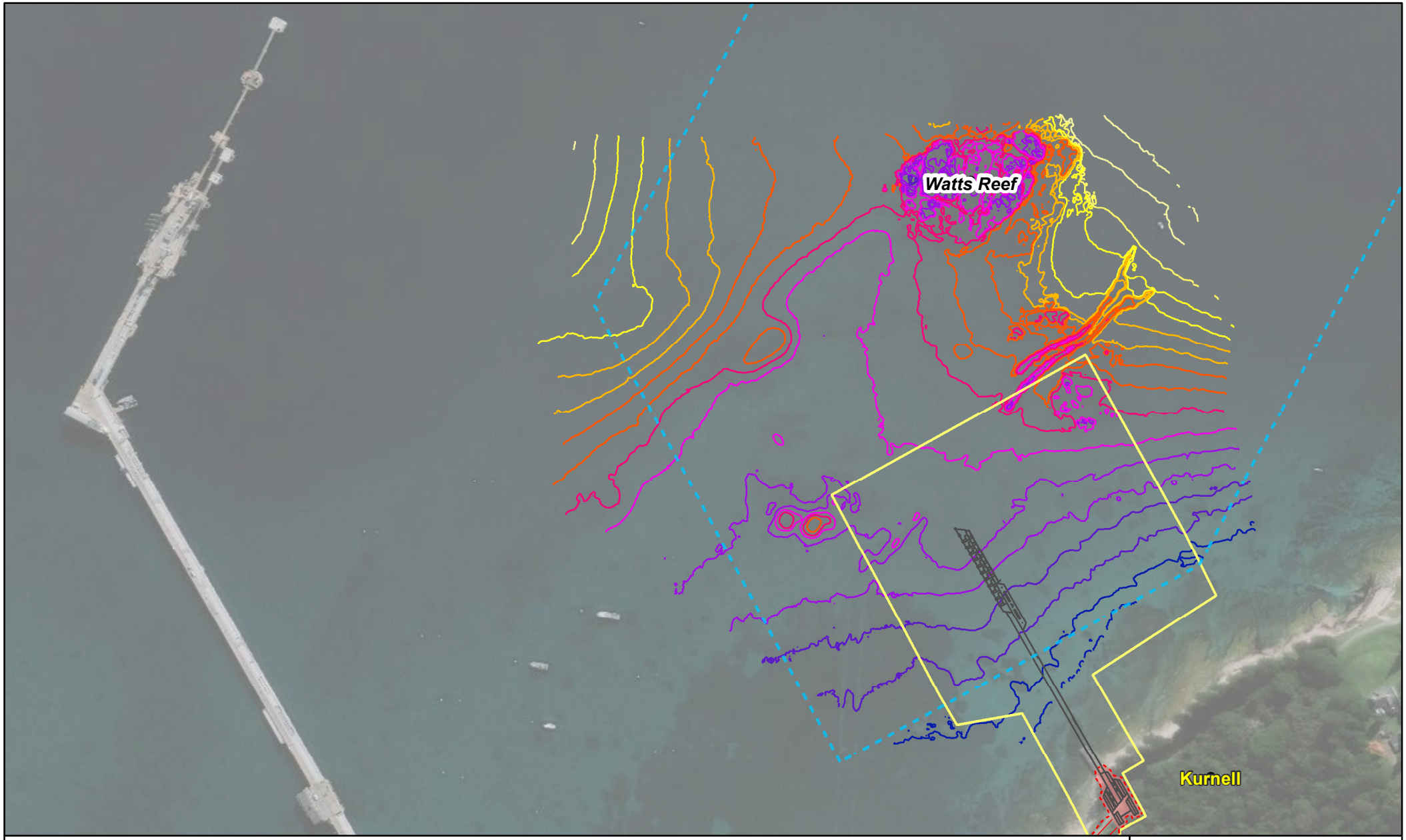
The majority of the bay is shallow (<5m depth) with artificially deepened sections of upwards of 18m in depth. Near the project area water depth ranges from land through shallow areas of <4m. At both sites depth quickly drops off into the navigation channel.

[1] Astronomical tide as per the Australian Height Datum (mAHD), MLWS is mean low Water Springs and MHSW is the Mean High Water Springs

Towards the headland of the bay sand exposed beaches become less common and large outcrops of sandstone bed rock form rocky reef habitat that drops very quickly to deep depths of the channel and the mouth of the bay.

Near the Kurnell site there are rocky reefs along the intertidal and immediate subtidal range. These reefs (associated with Watt's Reef) extend 4-5m up from the sea floor to 1-2m below the water's surface, opening into shallow sand flat and about 240m north from the end of the proposed jetty (Figure 7).

On the La Perouse side the rocky reef habitat hugs the headland and then meets sandy sediment of Frenchmans Bay which gradually increases in depth.



Legend

- Development footprint Terrestrial - permanent and temporary
- Development footprint - permanent
- Development footprint - temporary
- Development site
- Ferry Swept Path Envelope
- Concept design wharf location

Kurnell Bathymetry Contours

-9.0 - -8.5 -8.4 - -8.0 -7.9- -7.0 -6.9- -6.0 -5.9 - -5.0 -4.9 - -4.5 -4.49 - -4.0 -3.9 - -3.0 -2.9 - -2.0 -1.9 - -1.0

Figure Title

Watts Reef about 200m north of the end of the proposed jetty at Kurnell

Figure No 7

Metres

0 25 50 75 100

4.2 Water quality

Water quality in Botany Bay is influenced by runoff from Cooks River, Georges River, Woronora River and direct flow from other smaller tributaries that are within the Botany Bay catchment. Botany Bay catchment covers an area of approximately 1,165km^2, of which 40% is used for residential, industrial and commercial purposes.

The Cooks River and Georges River catchment areas are degraded, with 71% of the stream reaches in the Cooks Catchment and 7% of Georges River catchment stream reaches with no vegetation cover (SMCMA, 2011). The Woronora River is in much better condition with a higher percentage of stream reaches with intact vegetation. Areas throughout the Georges River and Woronora River with intact vegetation are mostly within reserves.

Historically, Botany Bay had been slowly developing prior to the 1900s. Early in the 1900s many factories were built in the Cooks River and Botany Bay areas. Water quality significantly declined in the following years. The bay was chosen as the Sydney airport location at Mascot in 1921 and has since undergone significant commercial residential development adding further pressure to the water quality of the bay (SMCMA, 2011).

With the current and historic pressures and usage of Botany Bay there is a legacy of pollution and the beaches around the bay are regularly tested for pollutant sand contaminants during the summer recreational period. The NSW Department of Planning, Industry and Environment (DPIE) undertakes water quality monitoring at beaches across Sydney, including 15 sites in Botany Bay and lower Georges River. Water quality sampling occurs weekly between October and April, and monthly between May and September. In 2018-2019, 80% of Botany Bay and lower Georges River swimming sites were graded ‘Good’ in terms of water quality (DPIE, 2019). This was unchanged from 2017-2018.

An EIS prepared in 2013 for the nearby Kurnell Port and Berthing Facility Upgrade (URS, 2013) assessed concentrations levels of tributyltin (TBT) in Botany Bay. TBT is a chemical substance found in paint of vessels or ship hulls used as an antifouling agent. TBT was found to be toxic to marine ecology and humans which resulted in a ban after 2003. In 2004, the Natural Heritage Trust conducted TBT measurements west of Kurnell Wharf and confirmed that concentrations of TBT were found to be below measurable levels.

Suspended sediment concentrations in Botany Bay vary due to fluvial and oceanic conditions. During calm conditions, sediment concentrations were recorded at an average of 5 mg/L, however, after heavy rainfall, concentrations can significantly increase to 25 mg/L across the bay (URS, 2013).

4.3 Botany Bay's major developments

4.3.1 Port Botany

Botany Bay has been an active and major hub for transport, shipping and development has been an active port for many decades. In the 1950s the port went under a significant development to increase capacity and adapted to accepting modern shipping containers. In 1979 the port further expanded, constructing the first container terminal, which involved major dredging and reclamation works. The port re-opened in 1982. In 2013 the third container terminal commenced operations. All expansions included significant dredging and bed modifications.

4.3.2 Mascot Airport

Sydney Airport's first commercial flight was on 19 November 1919. This airport location has evolved over generations with the changes in fight, development of the Royal Australian Air force, and the first Australian built Aeroplanes and eventually evolving into an Airport between 1924-1938.

During World War II, the Airport expanded to support further training and utilisation of aeroplanes. The airport also became an international Airport, undergoing significant modifications to the waters that enter the bay and a realignment of the river around Mascot Airport.

From 1963 to 1972, Sydney Airport extended the runway to meet the requirements of evolving aircraft (jet engine planes). This upgrade required the construction of a peninsula into Botany Bay.

With growing aviation demand to and from Sydney, a third runway was completed by 1994. Like the previous redevelopments, construction was entirely on reclaimed land from Botany Bay. These large reclamations were achieved through extensive sand dredging within the bay.

4.3.3 Caltex Wharf

There has been a wharf at the site of the current Caltex Wharf since the 1940s. The utilisation of the wharf evolved with the development of the refinery in Kurnell. Dredging completed specifically for the wharf commenced in 2013 removing approximately 143,000m^3 of sediment from around the end of the wharf to receive larger vessels with the redevelopment of the refinery.

Botany Bay has undergone significant change in its coastline, coastal processes and is continually under pressure for the ongoing facilities and surrounding catchment pressure.

4.3.4 Botany Bay today

As the bay is a major hub of activity, it is currently under constant levels of pressure from commercial vessel traffic, noise associated from these vessels and air traffic, in addition to recreation usage in the region.

Figure 8 shows the path of proposed ferry movements during operation. Botany Bay is currently a major port and berthing location for large container and cargo ships, as well as active recreational users of the bay. Large vessels move in and out of the bay daily, resulting in high traffic volumes moving through the entrance of the bay towards the port to the west. Despite this, ferry operations may pose some increased risk to migratory/ nomadic marine fauna including whales, turtles and shark through boat strike and interference with species behaviour as the proposed route is aligned perpendicular to the port-related traffic.

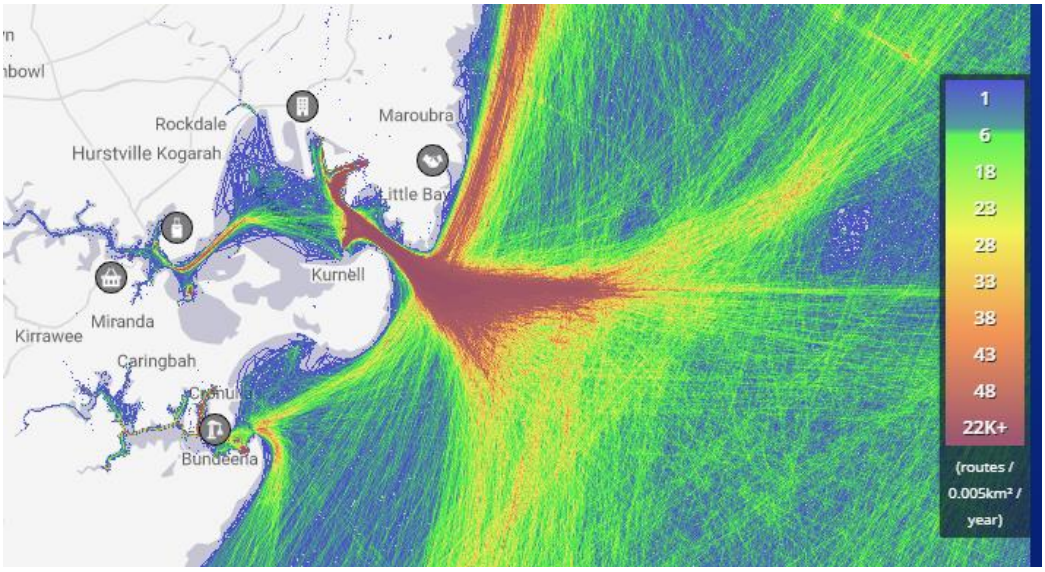


Figure 8. Marine traffic density map from 2017(source MarineTraffic.com)

4.4 Habitats

The varied sediment structures and depth profiles allow for a number of highly productive and biodiverse habitats to flourish within close proximity to one another. Habitats present in the project area include:

- Seagrass meadows
- Subtidal reefs (rock and rubble)
- Subtidal soft sediments
- Rocky intertidal shorelines and
- Sandy beaches.

These habitats have been subject to modification and human pressure as discussed in the previous section. The habitats have undergone additional pressure through recreational fishing, recreational diving and boating.

This section provides a summary of the findings of the Preliminary Habitat Assessment surveys and the more detailed habitat assessments conducted in September / October 2020 by Niche (detailed summary memos are provided in Appendix A).

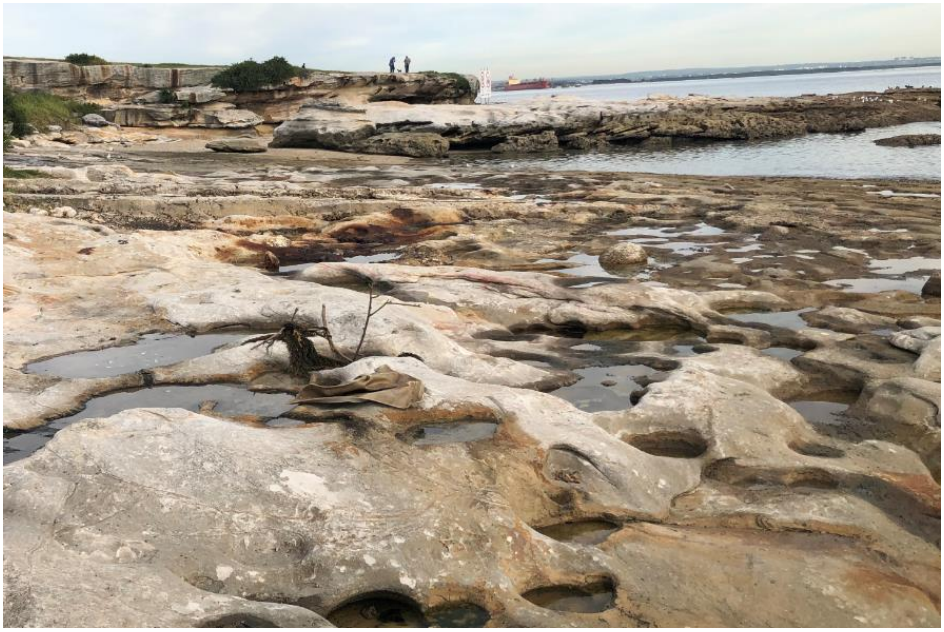
Generally, La Perouse and Kurnell appear to have similar habitats, however it has been established that the Kurnell site is much more complex in the surrounding habitats and coastal variation.

4.4.1 La Perouse

Intertidal zone

The intertidal zone in the Study Area at La Perouse consists of a rocky shoreline on the western side of La Perouse headland, and a sandy beach along the shore of Frenchmans Bay. There were areas of clean marine sands along the beaches.

The rocky shoreline is a typical weathered sandstone rock-shelf shoreline of the Hawkesbury-Shelf bioregion (Photograph 1). It ranges in width between 10 and 40m and becomes steeper with higher relief and more complexity (e.g. crevices, gutters and cracks and ledges) in more exposed areas towards the south-west. The intertidal zones are described in Table 4. A pair of Sooty Oystercatchers (*Haematopus fuliginosus*) were observed foraging on the rock platform at low tide.



Photograph 1. Weathered sandstone rock shelf.

Table 4. Intertidal areas and description of La Perouse.

Zone	Fauna and Flora community
High intertidal	Common and abundant species in the high intertidal zone include the Little Blue Periwinkle (*Nodilittorina unifasciata*), the Pyramid Periwinkle (*N. pyramidalis*) and the Six-Plated Barnacle (*Chthamalus antennatus*).
Mid-intertidal	Common and abundant species in the mid-intertidal zone include the Rose Barnacle (*Tesseropora rosea*) and Honeycomb Barnacle (*Chamaesipho tasmanica*). The Variegated Limpet (*Cellana tramoserica*), sea snail Black Nerites (*Nerita atramentosa*), Zebra Snail (*Austrocochlea porcata*) and Stripe-Mouth Conniwink (*Bembicium nanum*). Some Waratah Anemones (*Actinia tenebrosa*) were also noted in the rock pools in the mid intertidal zone.
Low intertidal zone	Sydney rock oyster (*Saccostrea glomerata*) was the most abundant sessile fauna species. Other common sessile fauna species included B. *nanum, A. porcata, C. tramoserica* and the mulberry whelk (*Morula marginalba*). Near the low water mark cunjevoi (*Pyura stolonifera*) and coralline algae (*Amphiroa sp.*) also formed dense mats in areas.

Subtidal Rocky Reef

A fringing rocky reef occurred around the foreshore of the La Perouse headland. This rocky reef typically extended 50m seaward to soft sandy sediments, where in many places steep drop-offs occurred. The rocky reef was observed to have areas of high relief and substantial complexity from the presence of gutters, crevices, large boulders and drop-offs.

The rocky reef at La Perouse is most extensive outside of Frenchmans Bay and towards Bare Island. Inside Frenchmans Bay and along the northerly face of the rock platform where the wharf is proposed, subtidal rocky reef is minimal. The majority of subtidal reef in this area is confined to a rocky ledge 1-2m in height that drops on to sand habitat, and occasional rocky outcrops and areas of rubble accumulations.

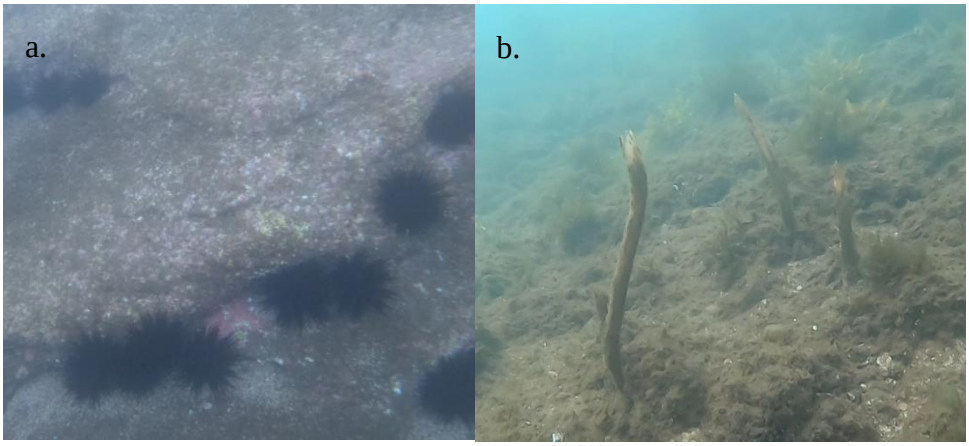
Rocky reef surveys in this region were limited to shallow transects along the bottom of the rocky drop-off, where patches of sand and silt were common and rocky reef substrate was dominated by turfing algae and macroalgae. In this area (Site RLP1, Figure 5), the brown macroalgae *Sargassum sp*. accounted for the majority (18%) of macroalgae cover, while geniculate coralline algae (*Amphiroa anceps* and *Corallina officinalis*) and kelp (*Ecklonia radiata*) were the lesser contributors with less than 5% cover. This corresponded with findings of the kelp frond counts of two plants per metre squared.

The closest area of expansive subtidal rocky reef community to the proposed wharf at La Perouse is approximately 50m to the south-west (Site R-LP2, Figure 5). This rocky reef area consists of gradually sloping and shallow sandstone rock formations and boulders that extend up to 100m from the shore, where it meets the sand in relatively shallow water (approximately 4m depth). In this area, macroalgae accounted for 59% to 77% of cover, with kelp accounting for 40% and *Sargassum sp.* 19% of cover. This also corresponded with the increased density of kelp, which was measured at seven fronds per metre squared. At the other sites around La Perouse (Sites R-LP3 and R-LP4, Figure 5), macroalgae

represented up to 87% cover in these rocky reef areas, of which kelp was the major contributor. Other macroalgae species that were common within subtidal areas of the La Perouse rocky reef community included geniculate coralline algae, the red *Plocamium sp*., the brown *Colpomenia sp*. and encrusting algae including encrusting coralline algae.

The fifth La Perouse site (R-LP5, Figure 5) was located on the north western side of Frenchmans Bay, adjacent to Yarra Point. The subtidal reef here was refined to shallow ledges and rubble accumulations that typically did not extend more then 5m seaward of the rock platform. At this site the rocky reef habitat consisted of 24 % to 54% macroalgae cover, with *Sargassum spp*. the highest contributor, followed by geniculate coralline algae, while kelp contributed less than 5% cover in this area and occurred at densities of less than one plant metre squared. The barren forming urchin *Centrostephanus rodgersii*, which is known to graze and reduce Kelp cover quickly on temperate coastal reefs was only found, and in very low numbers at Site R-LP3, in this area.

Some barrens were also observed likely as a result of the Longspined Sea Urchin (*Centrostephanus rodgersii*). In some areas patches of kelp appeared to be defoliated, with fronds being removed and leaving only the holdfast and stipes, likely as a result of disturbance from storms and large swells (Photograph 2).



Photograph 2. Urchin barren (a) and broken kelp fronds(b).

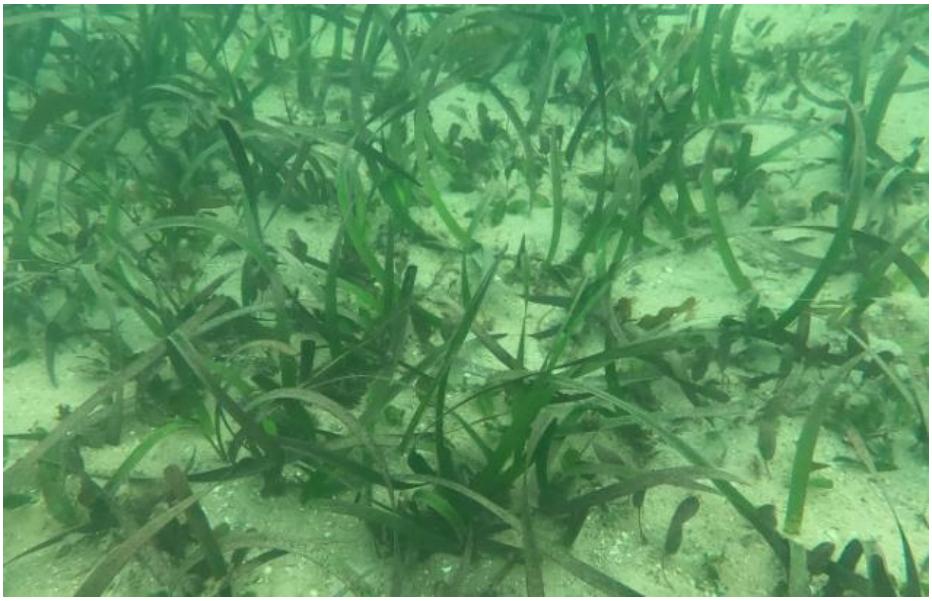
Seagrasses

Seagrasses were widespread from the edge of the rocky reef to approximately the 6m contour. These seagrasses were growing with a patchy distribution in low (<15%) to medium (15-50%) cover. *Halophila spp.* (likely mostly consisting of *H. ovalis*) was the dominant species throughout much of soft sediment habitat (Photograph 3), especially in the deeper areas. *Zostera capricorni* was typically confined to the southern corner along Frenchmans Bay Beach and was growing with *Halophila spp*. Some small isolated patches of *Posidonia australis* were also found growing amongst other seagrasses in this area.

Photograph 3. Typical coverage of Halophila sp. with some red algae interspersed amongst the seagrass.

The total density of seagrass at La Perouse (inside Frenchmans Bay) ranged between 27% and 48%. The seagrass community inside Frenchmans Bay was dominated by *Halophila sp*. This species was found to be growing in higher densities on the northern side of Frenchmans Bay, where at Site 1 it neared 50% cover. Site 4, adjacent to the proposed wharf finger, *Halophila sp*. was by far the dominant species with 27% cover in comparison to less than 1% cover of the sparse and very patchy *Zostera capricorni*. Very low densities of sparse and patchy *Z. capricorni* were also detected at Sites S-LP1 and S-LP3 (Figure 5). Some small patches of low density *Posidonia australis* (Photograph 4) growing amongst other species of seagrass were found to occur in shallow water in the south-eastern corner of Frenchmans Bay, where at Site S-LP3, *Posidonia australis* had a cover of 10%.

Surveys indicate that the distribution and dentistry of *Halophila sp*. varied temporally between seasons. In addition, epiphytic macroalgae, attached to the seagrass was also notable more abundant in summer months.



Photograph 4. Example of *Posidonia australis* and *Halophila sp*. mixed.

Development site
Concept design wharf location
Ferry Swept Path Envelope

Mapped Marine Habitats December 2020
Halophila

Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila

Mapped Marine Habitats October and May 2020
Halophila

Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila

Figure Title
Mapped Marine Habitats at La Perouse

Figure No **9**

Metres
0 40 80 120 160

4.4.2 Kurnell

Intertidal area

The intertidal area at Kurnell consisted of a rocky shoreline along the majority of the study area and extended around Inscription Point to the east and a sandy beach which forms the eastern end of Silver Beach to the west. There were areas of clean marine sands along the beaches.

The rocky shoreline consists of a partially protected rock-shelf comprised typically of a gradually sloping and eroded sandstone rock. It ranges in width between 10 and 30m and includes sandy gutters and rubble accumulations, especially in areas to the west with less influence from swells wrapping around Inscription Point (Table 5).

Table 5. Intertidal Zones of Kurnell.

Zone	Fauna and Flora community
High intertidal	This Zone consisted typically sands and a modified shoreline where shore stabilization works have occurred. As a result, natural rocky formations in the high intertidal zone were minimal. Common and abundant species in the high intertidal zone were the Little Blue Periwinkle (*Nodilittorina unifasciata*) and the Stripe-Mouth Conniwink (*Bembicium nanum*).
Mid-intertidal	Common and abundant species in the mid-intertidal zone included the Sydney Rock Oyster (*Saccostrea glomerata*), B. nanum, Variegated Limpet (*Cellana tramoserica*), Zebra Snail (*Austrocochlea porcata*), Black Nerites (*Nerita atramentosa*), Purple Four Plated Barnacle (*Tetraclitella purpurascens*) and the Honeycomb Barnacle (*Chamaesipho tasmanica*). Given the more gradual sloping rock shelf, pooling of water at the back of the rock shelf and the modified higher shoreline the mid intertidal zone was not as defined at this site in comparison with the La Perouse site. As a result, there is substantial overlap of these species with the other intertidal zones (Photograph 5).
Low intertidal zone	Cover dominated by Sydney Rock Oyster (*Saccostrea glomerata*) was the most abundant sessile fauna species. Other common sessile fauna species included the Owl Limpet (*Patella peronii*), Rose Barnacle (*Tesseropora rosea*), *B. nanum, A. porcata, C. tramoserica* and the Mulberry Whelk (*Morula marginalba*). Near the low water mark cunjevoi (*Pyura stolonifera*), brown macroalgae *Hormosira banksii* and coralline algae (*Amphiroa sp.*) also formed dense mats in areas.

Photograph 5. Example of Mid-intertidal fauna and flora communities.

Subtidal area

Along the shoreline at Kurnell, near Captain Cooks Landing, the subtidal rocky reef is typically very patchy, confined to shallow areas less than 2m in depth, and does not extend more than 50m beyond the MLWM. At the sites in this area (Sites R-K1 and R-K2, Figure 6), the rocky reef habitat beyond the -1m contour was typically broken areas of reef consisting of sand scoured sandstone rock shelf and areas of rubble. In this area accumulations of sand silt still accounted for a large proportion of benthic habitat, with macroalgae typically limited to less than 50% cover. The brown macroalga *Sargassum spp*. was the dominant macroalgae, with other brown macroalgae of *Colpomenia sp*. and *Dictyota dichotoma* notable contributors (Table 5). The occurrence at the time of survey of kelp and urchins were rare, with none recorded during counts in this area.

During the surveys in August and September there was anecdotal evidence that areas of kelp had reduced in shallow areas around Captain Cooks Landing and towards Sutherland Point. This appears to be indicative of storm damage during three low-pressure systems forming on the Sydney Coast during late June and July.

Subtidal reef

The remaining reef habitat survey sites at Kurnell were located of Sutherland Point along the shoreline east of the project area (Site R-K3, Figure 6), and on Watts Reef, approximately 500m offshore (Site R-K4, Figure 6). The subtidal rocky reef of the Kurnell side included three district areas, listed below and detailed in Table 6:

- Broken reef and rock amongst sandy sediments
- Fringing subtidal reef along the shoreline, and
- Offshore rocky reef rises.

The reef of Sutherland Point (about 350m from the proposed jetty location) is much more extensive, extending over 100m from the shore. The reef includes a series of sandstone rock shelves with numerous drop-offs and overhangs. In places vertical drop-offs of 4 to 5m occur into deeper water and boulder field habitat that extends to the north and out into the main channel of Botany Bay. In this area macroalgae accounted for up to 65% cover, while corals and sessile invertebrates such as sponges and ascidians (near where transects approached the sponge gardens, described below) were typically more common than other sites sampled in Botany Bay. The most common species in the macroalgae stand at this site was found to be kelp, irrespective of depth zone. This corresponded with survey findings of three plants per metre squared, while urchin density was very low. The brown macroalgae *Sargassum spp., Colpomenia sp.,* the red macroalga *Plocamium sp*. and encrusting algae were almost found to be notable contributors to this assemblage.

Between Sutherland Point and Inscription Point between the 6 and 12m depth contours diverse sponge gardens were found. The community consisted of a mixture of sponges (encrusting, tubular, arborescent and papillate growth forms), stalked ascidians, and branching soft corals (*Capnella gaboensis*).

The final Kurnell site was confined to the deeper survey zone on the outer section of Watts Reef (Site R-K4, Figure 6). This reef consisted of steep rises on its north and easterly sides, where habitat complexity, of gutters, overhangs, drop-offs, caves, and steep rises was the greatest, with deep gutters continuing across the crest of the reef. At this site macroalgae represented up to 87% of benthic cover, with kelp representing up to 52% of cover. This corresponded with kelp count finding of close to 4 plants per metre squared, while urchin density was typically less than 1 per metre squared. The brown macroalgae *D. dichotoma* and *Sargassum spp*., and red macroalga *Plocamium sp*. were also notable contributors to the macroalgae community.

Photograph 6. Kelp (*Ecklonia radiata)* dominant community on rocky reef.

Table 6. Subtidal Rocky Reef areas at Kurnell.

Zone	Fauna and Flora community
Broken reef and rock amongst sandy sediments	Broken reef and rock amongst sandy sediments This area was confined to areas at the end of Silver Beach and adjacent to the shore in the Study Area. These areas typically occurred above the 2m depth contour and consisted of isolated rocks and rock shelf creating kelp dominated patches of reef (*Ecklonia radiata*) near the shore. It also included some relief sections of sand scoured rock shelf and sections dominated by turfing brown algae.
Fringing subtidal reef along the shoreline	The fringing subtidal reefs were confined to areas to the east of the Study Area near Sutherland Point and where steep benthic gradients occurred. This area was typically a more complex and higher relief rocky reef with ledges, gutters, caves and potential overhangs, which typically terminated with steep drop-offs on to another ledge and eventually the deeper soft sediments towards the main tidal channel. This area was dominated by kelp, with storm damage (frond removal leaving stipes and stalks) evident in patches. Other common macroalgae included the brown seaweeds *Padina sp*. and *Sargassum sp*. and red seaweeds *Amphiroa sp.* and *Plocamium sp*. These deeper areas also include some sponge gardens that consisted of encrusting, massive, tubular and arborescent sponges.
Low intertidal zone (Watts Reef)	An offshore area that rises up with a high relief rocky reef occurs in the north-eastern section of the Study Area. On its eastern side this reef rises rapidly from 6 to 8m depths to 2-3m depth on its top, providing a complex and high relief area of reef with boulders, gutters, and ledges. In this area and on the top of the reef, kelp was the most abundant species, with red macroalgae (*Plocamium sp.* and *Laurencia sp.*) notable in the understory. The complexity and steepness in gradient was typically less on the western side of the reef and areas to the south, where the benthic habitat is more typical of a mixed rocky reef and sand habitat. In these areas the brown macroalgae *Padina sp.* and *Sargassum sp.* were the most common species.

Seagrasses

Seagrasses on the Kurnell side were widespread throughout the Study Area and included *Posidonia australis*, *Zostera capricorni* and *Halophila spp* (likely mostly consisting of *H. ovalis*). Generally extending from 1m of depth to around the 5m contour. This seagrass community at Kurnell is much more variable in species composition and density, although total cover within the study area was typically less at 13 to 40%, but variable in its distribution.

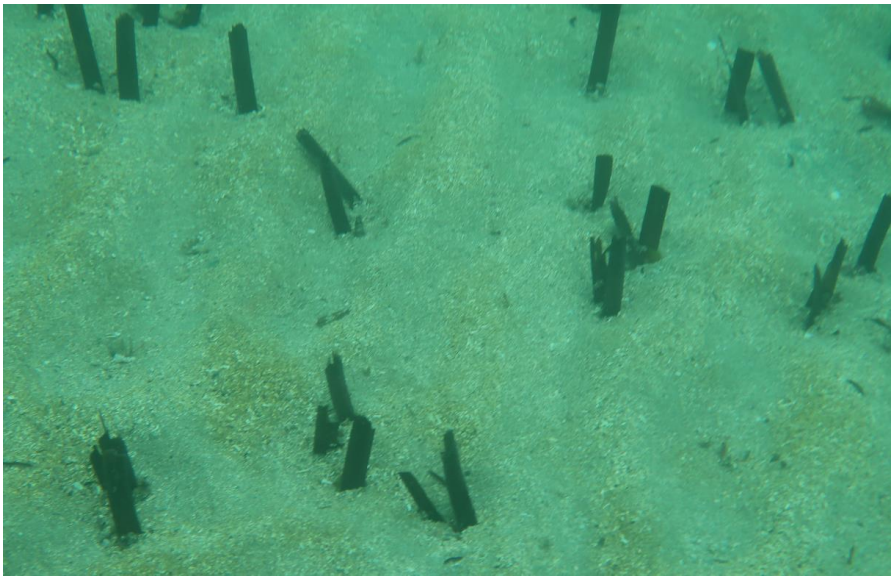
All three species were recorded at all sites, with *Posidonia australis* contributing the highest densities of seagrass at Sites S-K6 and S-K9 (Figure 6), *Halophila sp.* contributing the most at Sites S-K7 and S-K8 (Figure 6), which were also located adjacent (on opposing sided) to the proposed wharf, and *Z. capricorni* has the lesser cover at all sites. At Sites S-K6 and S-K7 (Figure 6), and near to the proposed wharf, seagrass cover was found to be 15% in total, with Halophila at 7% to 10% cover being the most common.

Posidonia australis was typically confined to a large medium (15-50% cover) to high (>50% cover) density bed on the western side of the study area. Smaller and what appeared to be typically isolated patches of low (<15% cover) to medium density *Posidonia australis* continued amongst other seagrasses along the shoreline to the east. In general, *Posidonia australis* was typically confined to depths of less than 3m on the Kurnell side.

Photograph 7. *Posidonia australis* dominant meadow with epiphytic growth such as red algae.

Mixed patchy seagrass beds of low to medium density *Z. capricorni* and *Halophila spp*. extended into deeper areas, beyond the large *Posidonia australis* bed and towards the east. In shallower areas closer to shore, *Z. capricorni* was typically the more abundant species with higher densities, while in deeper areas (especially beyond the 5m depth contour) *Halophila spp*. was typically the more abundant with higher density.

During the surveys in August and September there was anecdotal evidence (based on visual observations) that *Halophila* seagrasses at Kurnell were reduced in distribution in deeper areas, approximately 300m from shore, where it had been mapped previously during May. In shallower areas closer to shore, some large sand patches were noted where seagrass was previously mapped, while some areas of *Posidonia australis* appeared to reduce, and in some cases disappear, or only plants that have been defoliated (e.g. fronds broken away above stalk) remained (Photograph 8). This appears to be indicative of storm damage during three low-pressure systems forming on the Sydney Coast during late June and July. During mapping works, review of aerial imagery from various dates over recent years indicates that areas near the shore at Kurnell are very dynamic and seagrass distribution may be constantly changing as a result of storm events.



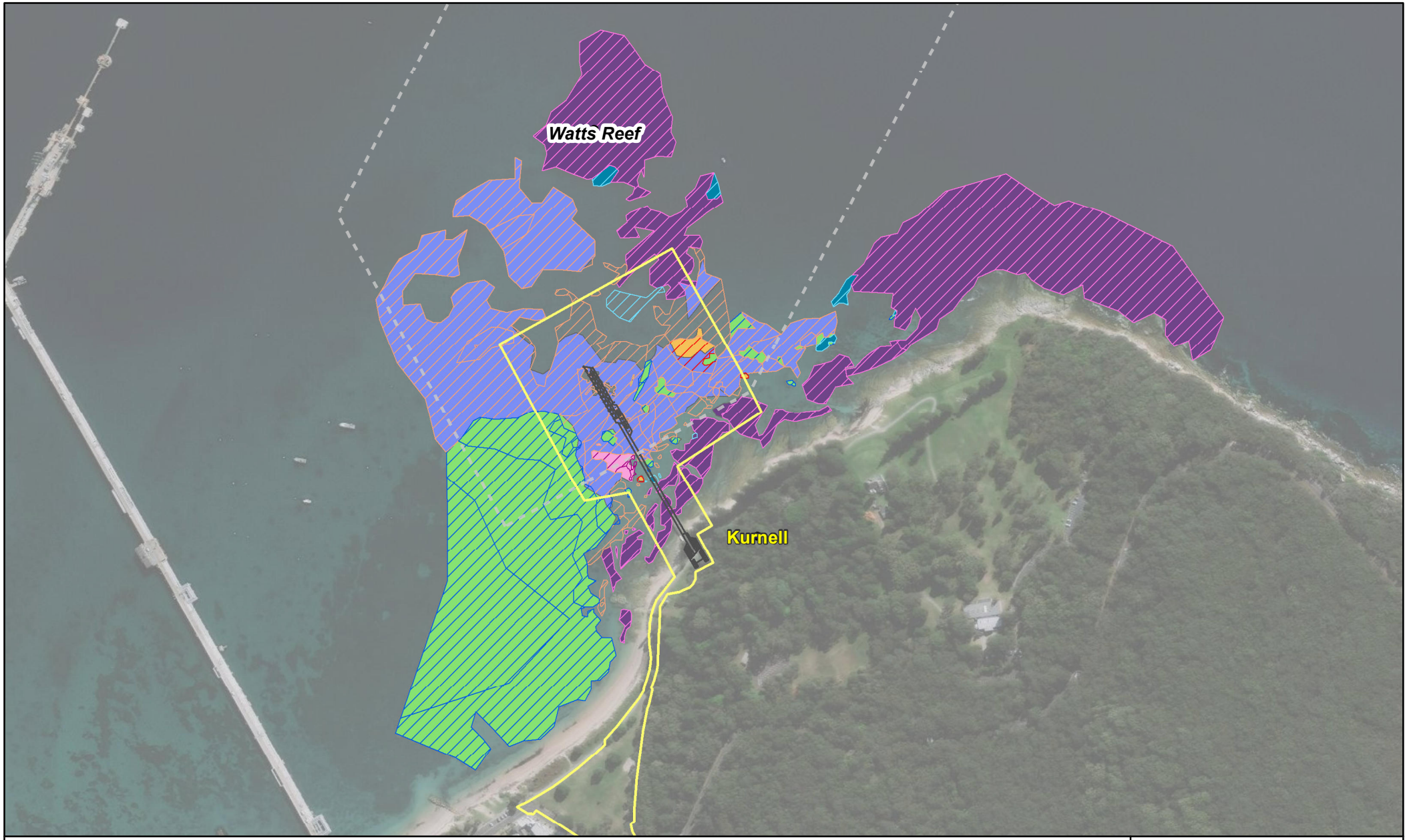
Photograph 8. Broken *Posidonia australis* fronds.

All communities experienced some change in the percentage cover and distribution given the seasonal changes and storm events. Generally speaking, seagrass was the subtidal community at Kurnell and La Perouse (Table 7). At Kurnell the proposed jetty construction boundary extends in to the area that is considered a TEC as per the Conservation Advice for *Posidonia australis* (see Section 4.4.5).

Table 7. Marine habitat and community composition within marine survey area.

Marine habitat	Description La Perouse	Extent within the study area (ha)	Description Kurnell	Extent within the study area (ha)
Rock/ Rubble/ Reef communities				
Broken reef and rock amongst sandy sediments	-	-	These areas typically occurred above the 2m depth contour and consisted of isolated rocks and rock shelf creating macroalgae dominated patches of reef near the shore and areas of turfing brown algae.	5.91
Subtidal reef along the shoreline	This rocky reef typically extended 50m seaward to soft sandy sediments, where in many places steep drop-offs occurred. The rocky reef was observed to have areas of high relief and substantial complexity from the presence of gutters, crevices, large boulders and drop-offs. The rocky reef was dominated by kelp (*Ecklonia radiata*) in shallower areas and turfing brown algae, in deeper areas. Other abundant macroalgal species included *Dictyota dichotoma*, *Amphiroa* sp. and *Saragssum* sp.	1.90	In areas of short and steep benthic gradients where typically a more complex and higher relief rocky reef with some ledges, gutters, caves and potential overhangs. This area was dominated by kelp, with storm damage (frond removal leaving stipes and stalks) evident in patches. Other common macroalgae included the brown seaweeds Padina sp. and Sargassum sp. and red seaweeds *Amphiroa* sp. and *Plocamium* sp.	
Offshore rocky reef rises (Watts Reef)	-	-	This reef rises rapidly from 6 – 8 m depths to 2 – 3 m depth on its top, providing a complex and high relief area of reef with boulders, gutters, and ledges. In this area and on the top of the reef, kelp was the most abundant species, with red macroalgae (*Plocamium* sp. and *Laurencia* sp.) notable in the understory.	

Marine habitat	Description La Perouse	Extent within the study area (ha)	Description Kurnell	Extent within the study area (ha)
Seagrass communities				
Halophila	Seagrasses were widespread from the edge of the rocky reef to approximately the 6m contour. These seagrasses were growing with a patchy distribution in low (<15%) to medium (15-50%) cover. *Halophila* spp. (likely mostly consisting of *H. ovalis*) was the dominant species throughout much of soft sediment habitat, especially in the deeper areas. *Zostera capricorni* was typically confined to the southern corner along Frenchmans Bay Beach and was growing with *Halophila spp.*	5.31	Mixed patchy seagrass beds of low to medium density *Z. capricorni* and *Halophila spp.* extended into deeper areas, beyond the large *Posidonia australis* bed and towards the east. In shallower areas closer to shore, *Z. capricorni* was typically the more abundant species with higher densities, while in deeper areas (especially beyond the 5m depth contour) *Halophila spp.* was typically the more abundant with higher density.	0.14
Zostera / *Halophila*		0.39		6.45
Posidonia / Halophila	Some small isolated patches of *Posidonia australis* were also found growing amongst other seagrasses in this area. (just outside the proposal boundary).	0.03	*Posidonia australis* was typically confined to a large medium (15-50% cover) to high (>50% cover) density bed on the western side of the study area. Smaller and what appeared to be typically isolated patches of low (<15% cover) to medium density *Posidonia australis* continued amongst other seagrasses along the shoreline to the east. In general, *Posidonia australis* was typically confined to depths of less than 3m on the Kurnell side.	0.10
Posidonia / Zostera		0.02		0.09
Posidonia	-	-		7.00
Open water (unmapped area within marine study area)	Open sand generally lacking in vegetation or structure	~7.20	Open sand generally lacking in vegetation or structure	~39.20



Development site
Concept design wharf location
Ferry Swept Path Envelope

Mapped Marine Habitats December 2020
Halophila

Posidonia
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila

Mapped Marine Habitats October and May 2020
Halophila

Posidonia
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila

Figure Title
Mapped Marine habitats at Kurnell

Figure No **10**

Metres
0 40 80 120 160

4.4.3 Benthic infauna

Benthic infauna data is provided in Appendix A. Overall Kurnell samples were more diverse (36 species) compared to La Perouse (20 species). La Perouse had higher total abundance (278 individuals) compared to Kurnell (115 individuals). Kurnell was dominated by polychaetes, crustaceans, and molluscs while La Perouse characterised by predominately crustaceans and polychaetes (Table 8).

The benthic infauna suggests good foraging habitats for a range of fish species, especially on the Kurnell side with a higher abundance and diversity than La Perouse. This may also represent the availability of sandy substrate near the end of the proposed jetty locations.

Table 8. Summary of benthic infauna diversity of species within each Taxa.

Taxa	La Perouse	Kurnell
Annelida / Polychaeta	9	5
Crustacea	12	9
Echinodermata	2	1
Mollusca	12	3
Nemertea	1	0

4.4.4 Key Fish Habitat

The habitats found within in the study area can be classified according to the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013a), and the ‘sensitivity classification scheme’ which requires consideration of the waterway ‘sensitivity’ or Type, which ranks the “importance of the habitat to the survival of fish and its robustness (ability to withstand disturbance)”. This ranking is used within the policy and guidelines to differentiate between permissible and prohibited activities or developments and for determining value in the event offsetting is required. Classification of types are linked to marine vegetation cover (Table 9).

The waterway Class is also considered which is based on the functionality of the water as fish habitat and can be used to assess the impacts of certain activities on fish habitats in conjunction with the habitat sensitivity. The waterway Class can also be used to make management recommendations to minimise impacts on different fish habitats. The study area only includes ‘CLASS 1- Major Key Fish Habitat’, which includes “Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or ‘critical habitat’.”

Table 9. Type classification for each marine habitat.

Marine habitat	Description of key fish habitat sensitivity Types Type 1 – high sensitivity Type 2 – moderate sensitivity Type 3 - minimal sensitivity	Within study area	
		La Perouse Type	Kurnell Type
Rock/ Rubble/ Reef			
Broken reef and rock amongst sandy sediments	Type 2 Marine macroalgae such as *Ecklonia* and Sargassum species Estuarine and marine rocky reefs	-	Type 2
Fringing subtidal reef along the shoreline	Type 2 Marine macroalgae such as *Ecklonia* and Sargassum species Estuarine and marine rocky reefs	Type 2	Type 2
Offshore rocky reef rises.	Type 2 Marine macroalgae such as *Ecklonia* and Sargassum species Estuarine and marine rocky reefs Type 1 Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act	Type 2 with sections of Type 1	Type 2 with sections of Type 1
Seagrass			
Halophila	Type 1 *Zostera*, *Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds >5m^2 in area	Type 1	Type 1
Zostera	Type 1 *Zostera*, *Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds >5m^2 in area	Type 1	Type 1
Posidonia / Halophila	Type 1 *Zostera*, *Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds >5m^2 in area *Posidonia australis* (strapweed)	Type 1	Type 1
Posidonia / Zostera	Type 1 *Zostera*, *Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds >5m^2 in area *Posidonia australis* (strapweed)	Type 1	Type 1
Posidonia	Type 1 *Posidonia australis* (strapweed)	-	Type 1
Open water (unmapped area within marine study area)	Type 3 Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches with minimal or no in-fauna	Type 3	Type 3

4.4.5 Threatened Ecological Communities

The desktop and marine habitat assessment confirmed the presence of a threatened ecological community (TEC) within the marine study area: *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion (Table 10). *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion has seen a continued decline in distribution over the last decade within its limited geographic range and is listed as endangered under the EPBC Act.

Table 10. TECs within the marine study area

TEC	EPBC Act status	FM Act status	Likelihood	Habitat description
Posidonia australis Seagrass Meadows of the Manning-Hawkesbury Ecoregion	Endangered Community	Endangered population	Known	This seagrass community occurs mostly within the sheltered environments of permanently open estuaries, from Wallis Lake to Port Hacking. Mostly in shallow sub-tidal coastal waters <10 m) in locations with protection from high wave energy, typically, permanently open estuaries. *Posidonia australis* is widespread throughout sections of Botany Bay and is common along Kurnell towards Towra Point Nature Reserve.

The seagrass species *Posidonia australis* plays a significant role in the integrity of the TEC and population, by contributing to ecological and biogeochemical process (DoE, 2015). This species is long lived, with persistent rhizomes and is meadow forming. *Posidonia australis* fronds can grow to over 80cm long and as much as 90% of the mass of the plant may be in the roots and rhizomes. In accordance with Key Diagnostic Criteria for the TEC, as defined in the EPBC Act Conservation Advice (DoE, 2015), the TEC can occur in a naturally patchy distribution. Mosaic patches can be ‘discrete’, areas can ‘bare’ and or ‘intermixed with other species of seagrass’ between the patches of *Posidonia australis* are *Halophila* and *Zostera* which are part of the overall community structure. Cover of *Halophila* and *Zostera* can fluctuate much more seasonally whereas *Posidonia australis* have more permanent beds, is slow growing and is less likely to fluctuate between seasons (bar storm and or anthropogenic impacts) compared to other species.

In NSW, *Posidonia australis* is also protected as a species and is listed as endangered population under the threatened species schedules of the FM Act. *Posidonia australis* is an endangered population within Botany Bay as this population is under threat due to historical and current intensity of urbanisation and associated disturbance.

On the La Perouse side there are scattered patches of *Posidonia australis* (Table 11) and on the Kurnell side there is much more extensive coverage of *Posidonia australis.*

Table 11. *Posidonia* cover within the study area

Community	La Perouse	Kurnell
Posidonia australis	-	7.00
Posidonia australis, and *Zorostera Capricornia*	0.02	0.09
Posidonia australis and *Halophilia spp*	0.03	0.10

Threats to the TEC include:

- Coastal development (direct and indirect disturbance)
- Dredging
- Boat mooring and other boating related activities
- Catchment disturbance
- Climate change
- Changes in water quality.

Posidonia australis is particularly susceptible to damage as it is one of the slower growing species of seagrass, and therefore can be slow to recover following disturbance.

4.5 Marine Flora

On 12 December 2020, *Eunephthya thyrsoidea* (Cauliflower Soft Coral) was added as an endangered species under the EPBC Act and the FM Act.

There have been sightings of this coral near Bare Island and Kurnell (DAWE, 2020), although it was not observed during the survey effort and may be confined to areas outside the study area. Based on surveys conducted of soft sediment area, it is considered unlikely the coral would be located within the project area at either Kurnell or La Perouse. There is more suitable habitat in the high current and exposed locations further around to Bare Island at La Perouse and further northeast towards Inscription and Sutherland points on Kurnell, both of these regions are outside of the project area.

4.6 Marine Fauna

Botany Bay has a range of habitats that support high biodiversity even with the historic and highly modified coast of the bay. Marine and terrestrial species were divided up based on lifestyle and habit. Some migratory species (particularly birds) are discussed in the BDAR as they relate directly to the requirements of the BAM.

Searches of the EPBC Act, FM Act and the BC Act were completed to assess the species likely within the region.

The Protected Matter Search Resulted in 75 Listed threatened Species and 80 Listed Migratory Species, of these species there are a range of Marine species including:

- 16 Whales and Cetaceans, of those 5 are listed threatened
- 22 Migratory Marine birds
- 1 marine fish species
- 3 sharks, rays
- 5 marine turtles.

Species identified in desktop searches listed under the BC Act included 61 Listed Threatened Species and of those species, 28 are identified as Marine.

A likelihood assessment was completed to determine if listed threated species are likely to occur in the region and study area. The likelihood criteria is described in Table 12. The potential species list is extensive and is available in Appendix B. The species listed here are only those identified as possible and likely to occur.

Table 12. Likelihood Criteria

Classification	Records	Habitat	Regionally suitable
Unlikely	No records	No to little habitat present	Outside normal range
Possible	Previously records in the general region more than 20 years old	Some habitat present	Close to or within normal range
Likely	Records with in 3km of the site	Preferred habitat present	In known range
Transient	Recorded within region	Little to no habitat available on site	On route to habitat

4.6.1 Marine mammals

The majority of the species present are highly transient and freely move in and out of the bay. Although some species are commonly sighted there is not a set population with the bay as they will often move to forage and breed elsewhere. Many species are seasonally driven through strong migration drivers.

Humpback Whale

Humpback Whales have a migratory range that includes the coast of NSW. There are records and sightings of the whales entering Botany Bay during their annual migration. The entrance of the bay is mapped as a Biologically Important Areas for Humpback Whales as part of their migratory route. It is likely the whales may enter the bay to rest on their migration journey.

No direct habitat is located within the proposal boundary, but the whales will move through the ferry swept path and could be impacted by construction noise.

Southern Right Whale

Southern Right Whales have been recorded within Botany Bay (officially and anecdotally) with the most recent sighting in 2016. Despite this, there are still limited sightings of the species as Botany Bay is located at the northern extent of its migratory route.

The channel at the bay entrance has been dredged to allow for large cargo ships to access the port limits providing deep water access for the species to access the bay. Shallow calm waters within the bay may allow the species to rest during migration, typically occurring in May and November within NSW. Foraging will likely occur outside the bay in open waters.

There is no direct habitat within the proposal boundary, but the whales will move through the ferry swept path and could be impacted by construction noise.

Australian Fur-seals

A number of protected species such as dolphins and seals will access and utilise the bay area periodically. During the survey event a number of seals (species not identified but likely Australian fur-seals) were spotted resting on the seawall at Molineaux Point (Photograph 9).

Photograph 9. Seal basking on seawall near port.

Table 13. Listed threatened and migratory marine mammals

Scientific name	Common name	EPBC Status	NSW Status	Likelihood of occurrence
Arctocephalus pusillus doriferus	Australian Fur-seal	Mar	V, P	Likely - transient
Balaenoptera musculus	Blue Whale	E, M		Possible – transient offshore
Dugong dugon	Dugong	V, M		Possible - transient
Lagenorhynchus obscurus	Dusky Dolphin	M		Possible- transient
Megaptera novaeangliae	Humpback Whale	V, M	V, P	Likely - transient
Arctocephalus forsteri	New Zealand Fur-seal	Mar	V, P	Possible - transient
Eubalaena australis	Southern Right Whale	E, M		Likely - transient

M- migratory, E- Endangered, V- vulnerable, Mar- Marine listed, P- protected (not threatened)

4.6.2 Marine reptiles

Although Botany Bay has suitable foraging habitat for a number of marine turtles, there is no breeding habitat in the region. Most species if present are highly transitory and are often moving between areas of foraging and breeding habitat. Hawksbill Turtles are also considered unlikely to occur within the project area include as they have significant migratory ranges (Table 14).

Loggerhead Turtle

Loggerhead Turtle occurs in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia (DAWE, 2020). The species is known to occur within Botany Bay where extensive seagrass beds and reef habitats situated towards the bay entrance provide foraging habitats. Nesting areas are located further north outside of Botany Bay in coastal areas of Northern NSW and Queensland. Within the marine study area, habitat for Loggerhead Turtle is limited. However adjacent to the proposed wharves there are some areas of suitable foraging habitat.

The species' diet varies with their location although they are known to typically eat gastropod molluscs, sea urchins, crabs and fish (DOE, 2020). The species is at risk of consuming marine debris (plastic bottles and bags) and being bycatch from scavenging from bait off drumlines as part of the shark control programs.

This species is also vulnerable to vessel strike and ingestion of marine debris. In Queensland between 2000- 2011 vessel strike accounted for the highest number of mortalities in marine turtles (DoEE, 2017). Ferries proposed to run across the bay between La Perouse and Kurnell would pass in close proximity to areas likely support foraging for marine turtles including Loggerhead Turtle.

Green Turtle

Green Turtles are migratory and generally would migrate to warmer waters, north towards breeding grounds generally along the northern coast of Australia. There is

some evidence that they may 'stray' into temperate areas such as those in Botany Bay. Green Turtles have been recorded with in the bay and waters within and adjacent to the marine study area are likely to support sporadic species movement.

Although the species may be less common within the bay, there is suitable foraging habitat available, including seagrass and macro algae in and around the proposal boundary, though foraging habitat within the proposal boundary is limited and is not likely to be important for the species.

Table 14. Marine reptiles likely to be within the project area

Scientific name	Common name	EPBC Status	NSW Status	Likelihood of occurrence
Chelonia mydas	Green Turtle	V,M	V	Likely - recorded
Caretta caretta	Loggerhead Turtle	E, M	E	Likely - transient

M- migratory, E- Endangered, V- vulnerable, Mar- Marine listed, P- protected

4.6.3 Sharks, fish and rays

There are only a few listed threatened species of sharks and fish in the region (see Table 15.

Grey Nurse sharks

Grey Nurse Sharks are not commonly sighted. However, the species has been recorded at popular recreational dive locations near Bare Island and Kurnell (Altas of Living Australia record in 2019 and anecdotal records through recreational diving websites and personal blogs). It would be unlikely for the species to move into the very shallow habitats within proximity to the wharves, as they prefer deeper water (>50m). However the species is transitory and as such there is opportunity for the species to move into shallower reaches of the rocky reef habitat that exists along the more exposed La Perouse coast and the seaward coast of Kurnell. Botany Bay has also been identified as breeding habitat for the species as per the National Conservation Values Atlas (DAWE, accessed 5 May 2020).

Habitat is likely on the edges of the proposal boundary, where reef features descend to the deeper channel of the mouth of the bay.

Black Rockcod

Black Rockcod are known to utilise habitat associated with rocky shorelines around the entrances to estuaries in the Sydney region, including Botany Bay. The Hawkesbury Shelf within the Coastal Depth Zone of 0 – 20m in intertidal rocky shores is considered Significant Habitat for the species (Aquaculture, Conservation and Marine Parks Unit, 2011). These fish generally inhabit near-shore rocky and offshore coral reefs at depths down to 50m. In coastal waters adult Black Rockcod are found in rock caves, rock gutters and on rock reefs. These habitats are likely present around La Perouse and the eastern edge of Kurnell towards Inscription Point. The Black Rockcod have a limited home range and do not travel far from their nominated areas. Black Rockcod are an

aggressive, territorial species and individuals may occupy one particular cave for most of their adult life (Aquaculture, Conservation and Marine Parks Unit, 2011).

Diver surveys indicated that potential habitat for Black Rockcod within the proposal boundary was very minimal and marginal. The diver surveys of the adjacent reefs did however identify suitable habitat adjacent to the proposal boundary of both Kurnell and La Perouse for Black Rockcod, although no Black Rockcod were observed during the survey effort.

There was minimal potential habitat for adult for Black Rockcod in the immediate vicinity of the proposed wharf at La Perouse as subtidal reef in this area was minimal and typically confined to one shallow ledge. Potential habitat for adult Black Rockcod was found in areas on the western and south-western side of the La Perouse (Figure 11).

This subtidal reef habitat with suitable, gutters, ledges, caves etc that could be used by adult Black Rockcod commences approximately 150m to the south-west of the proposed La Perouse wharf footprint. In general, the Black Rockcod habitat was confined to areas between the 5m depth contour and sand line at 8-12m depth. The habitats in the study area are most likely to be used by much cryptic juveniles, which may also utilise smaller cracks and crevices.

The reef at Yarra Point had a minimal potential habitat for Black Rockcod as it typically lacked enough complexity, however, some deep caves were noted in shallow water (approximate 2m depth) near its most south-westerly extent that provided a small amount of potential habitat for Black Rockcod (Figure 11).

There was minimal potential habitat for adult for Black Rockcod in the immediate vicinity of the proposed wharf at Kurnell as subtidal reef was confined to shallow and typical low relief and/or sand scoured areas of broken reef. Potential habitat for adult Black Rockcod was found in areas adjacent to Sutherland Point and extending east and on the outer areas of Watts Reef.

White's Seahorse

White's Seahorse was added to the NSW Threatened Species listing under the FM Act in 2019 and was officially added to the EPBC Act as endangered in December 2020. Botany Bay is a confirmed location for the species. They are known to inhabit areas of seagrass, often in association with *Posidonia australis* and soft corals. They prefer areas with more complex structure and are generally restricted to depths of 1-15m (FSC, 2019). No White's Seahorses were observed during the targeted surveys.

White's Seahorse is known to occur at depths to 12m and is found utilising a wide range of habitat types including seagrasses, macroalgae, corals, sponges, and anthropogenic structures (Harasti & Pollom, 2017). White's Seahorse can vary in preference of type of habitat for juveniles and adults, for example in Port Stephens the adults are more commonly associated with soft coral *Dendronephthya australi* and sponges (Harasti, 2016). No public studies have been completed to date that review Botany Bay, habitat preference and or distribution of White's Seahorse.

The species is known inhabit structures, seagrass, canopy forming macroalgae (e.g. kelp) and soft coral habitats. Artificial structures in the proximity to the proposal are confined to vessel moorings, which provide moderate to low habitat.

At La Perouse, seagrasses provide minimal habitat as they are predominately the smaller *Halophila spp*., while the longer and more habitat forming species of *Zostera* and *Posidonia australis* are typically of low density and of very patchy occurrence. Isolated denser stands of *Zostera* and *Posidonia australis*, canopy forming kelp and macroalgae, as well as soft corals in deeper water likely offer the most suitable habitat for White's Seahorse around La Perouse (Figure 11).

At Kurnell, seagrasses, especially stands of medium to high density *Posidonia australis* are likely to provide good quality habitat for White's Seahorse. Areas with canopy forming kelp and soft corals in deeper areas to the east of the project area and on Watt's Reef are also likely to provide good quality habitat for White's Seahorse, although storm effects may impact establishment of this species in shallow areas around Kurnell (Figure 12).

Table 15. Listed sharks, fish and rays

Scientific name	Common name	EPBC Status	NSW Status	Likelihood of occurrence
Sharks				
Carcharias taurus	Grey Nurse Shark	CE	CE	Possible
Fish				
Epinephelus daemelii	Black Rockcod	V	V	Likely
Hippocampus whitei	White's Seahorse	E	E	Likely
	Family Sygnathids		P	Likely

M- migratory, E- Endangered, V- vulnerable, Mar- Marine listed, P- protected

Legend

- Ferry Swept Path Envelope
- Concept design wharf location
- Development site

White's Seahorse habitat

- Posidonia / Halophila
- Posidonia / Zostera

- Black Rockcod Habitat

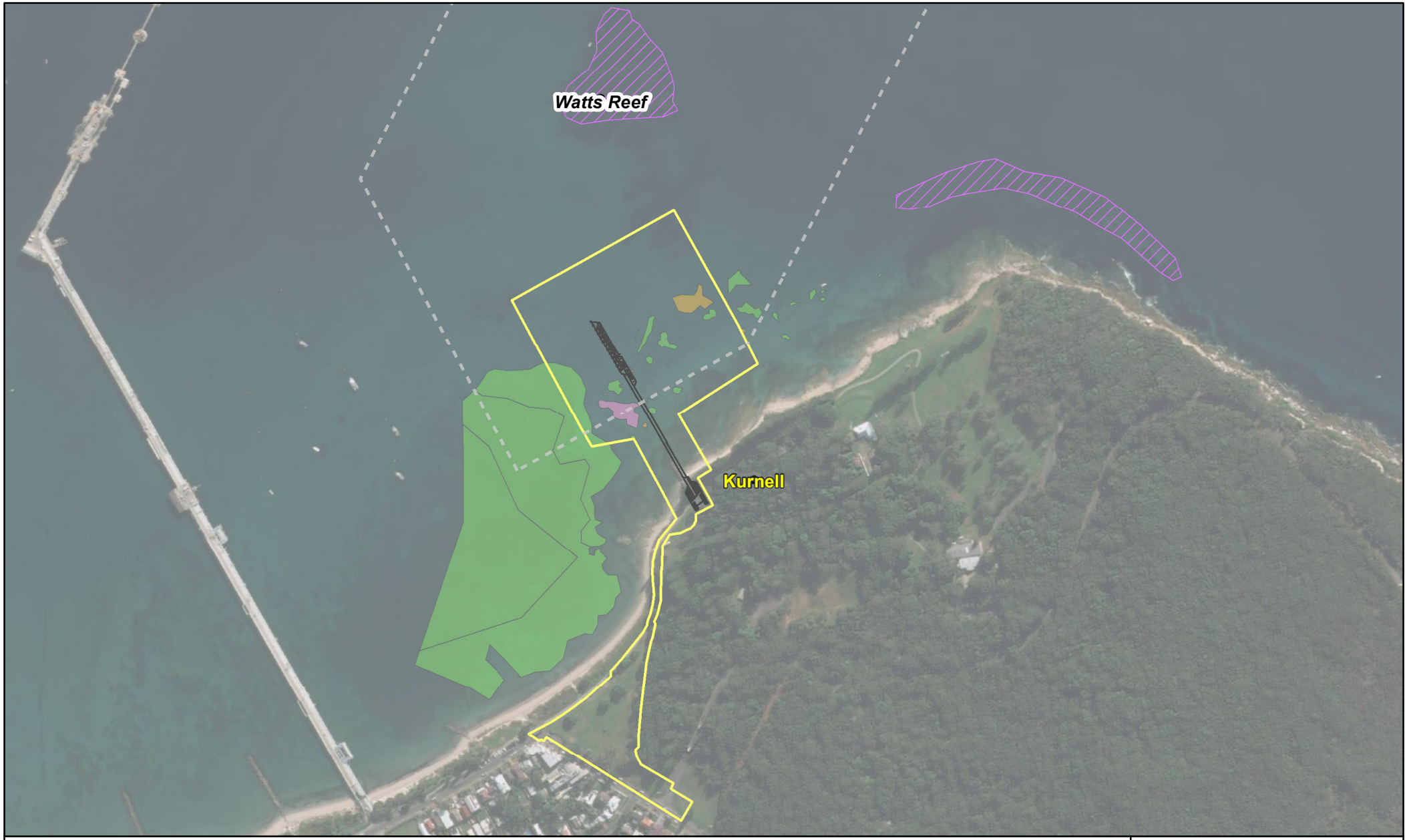
Figure Title

Black Rockcod and White's Seahorse habitat at La Perouse

Figure No **11**

Metres

0 25 50 75 100



Legend

- Ferry Swept Path Envelope
- Concept design wharf location
- Development site

White's Seahorse habitat

- Posidonia
- Posidonia / Halophila
- Posidonia / Zostera
- Black Rockcod Habitat

Figure Title

Black Rockcod and White's Seahorse habitat at Kurnell

Figure No **12**

Metres

0 40 80 120 160

4.6.4 Critical habitat

Critical habitat is listed under the FM Act and the EPBC Act. Critical habitat declared under Division 3 of the FM Act refers to the whole, or part of, the habitat of an endangered population or threatened species or ecological community that is critical to the survival of the population, species or ecological community.

A review of the NSW DPI and the Australian Government's Register of Critical Habitat revealed no declared critical habitat to occur within the study locality.

4.6.5 Wandering sea birds

Several species of Albatross listed as migratory and/or threatened under the EPBC Act and NSW listed species have the potential to occur within the proposal boundary. Albatross and other wandering seabirds are generally restricted to open water environments and specific breeding locations but have been known to occasionally be observed along the seaward coast of Botany Bay. The species listed have been recorded within a 5 – 10km search range of the proposal boundary, however nearly all records were recorded on the open oceanic coast. There are no biologically important areas located within the bay area (National Conservation Values Atlas, DEWA, accessed 05 May 2020) and birds are unlikely to use the proposal boundary for any important life cycle stages or foraging activities. It is possible the birds may follow schools of fish into the bay, but the majority of the foraging habitat is offshore. As such, the species are considered likely to have only a transient presence within the proposal boundary.

There is a possibility that some migratory species may have a transient presence within the study area due to the availability of suitable foraging habitats, open marine waters and proximity to the entrance of Botany Bay. There are a number of species listed as migratory and migratory marine that may use the Towra Point Nature Reserve. Many of the identified migratory marine species are open water oceanic species. There have generally been records of these species along the oceanic/ exposed coast, but few within the bay. The majority of these species would be vagrants into the proposal boundary and would be passing through the region.

Similarly, the beach area and rocky shores offer marginal habitat for some migratory wetland species and migratory marine birds. However, no EPBC Act listed migratory species were identified during terrestrial field surveys and available habitats within the study area are not considered significant for migratory species given the extent of more suitable sites within the surrounding bay and coastline.

Pied Oystercatchers (*Haematopus longirostris*) were observed at La Perouse during the April survey, at low tide on the sandstone rock shelf. They are more often found in area of mudflats, exposed sandy sub straights (DECC, 2008) and were likely in transit to areas of preferred habitat further within Botany Bay, such as Towra Point which is a known habitat.

Table 16. Listed marine bird species.

Scientific name	Common name	EPBC Status	FM Act and BC Status	Likelihood of occurrence
Diomedea antipodensis	Antipodean Albatross	V,M	V	Possible - transient
Pelecanus conspicillatus	Australian Pelican	-	P	Likely
Sula leucogaster	Brown Booby	C,J,K	P	Possible
Daption capense	Cape Petrel		P	Possible – transient offshore
Hydroprogne caspia	Caspian Tern	J	P	Possible - transient
Thalassarche eremita	Chatham Albatross	E, M		Possible - transient
Pelecanoides urinatrix	Common Diving-Petrel		P	Likely
Sterna hirundo	Common Tern	C,J,K	P	Possible - transient
Pachyptila turtur	Fairy Prion		P	Likely – transient
Sternula nereis	Fairy Tern		P	Possible - transient
Puffinus gavia	Fluttering Shearwater		P	Possible - transient
Diomedea gibsoni	Gibson's Albatross	V	V	Possible - transient-vagrant
Pterodroma leucoptera leucoptera	Gould's Petrel	E	V	Possible - transient-vagrant
Phalacrocorax carbo	Great Cormorant		P	Likely
Gelochelidon nilotica	Gull-billed Tern	C	P	Possible - transient
Puffinus huttoni	Hutton's Shearwater		P	Possible - transient
Larus dominicanus	Kelp Gull		P	Likely
Eudyptula minor	Little Penguin		P	Likely
Sternula albifrons	Little Tern	C,J,K	E,P	Possible-transient

Scientific name	Common name	EPBC Status	FM Act and BC Status	Likelihood of occurrence
Diomedea sanfordi	Northern Royal Albatross	E, M, mar		Possible - transient
Larus pacificus	Pacific Gull		P	Likely
Haematopus longirostris	Pied Oystercatcher	-	E,P	Likely
Thalassarche salvini	Salvin's Albatross	V, M		Possible - transient

C,J,K – protected under international agreement, M- migratory, E- Endangered, V- vulnerable, Mar- Marine listed, P- protected

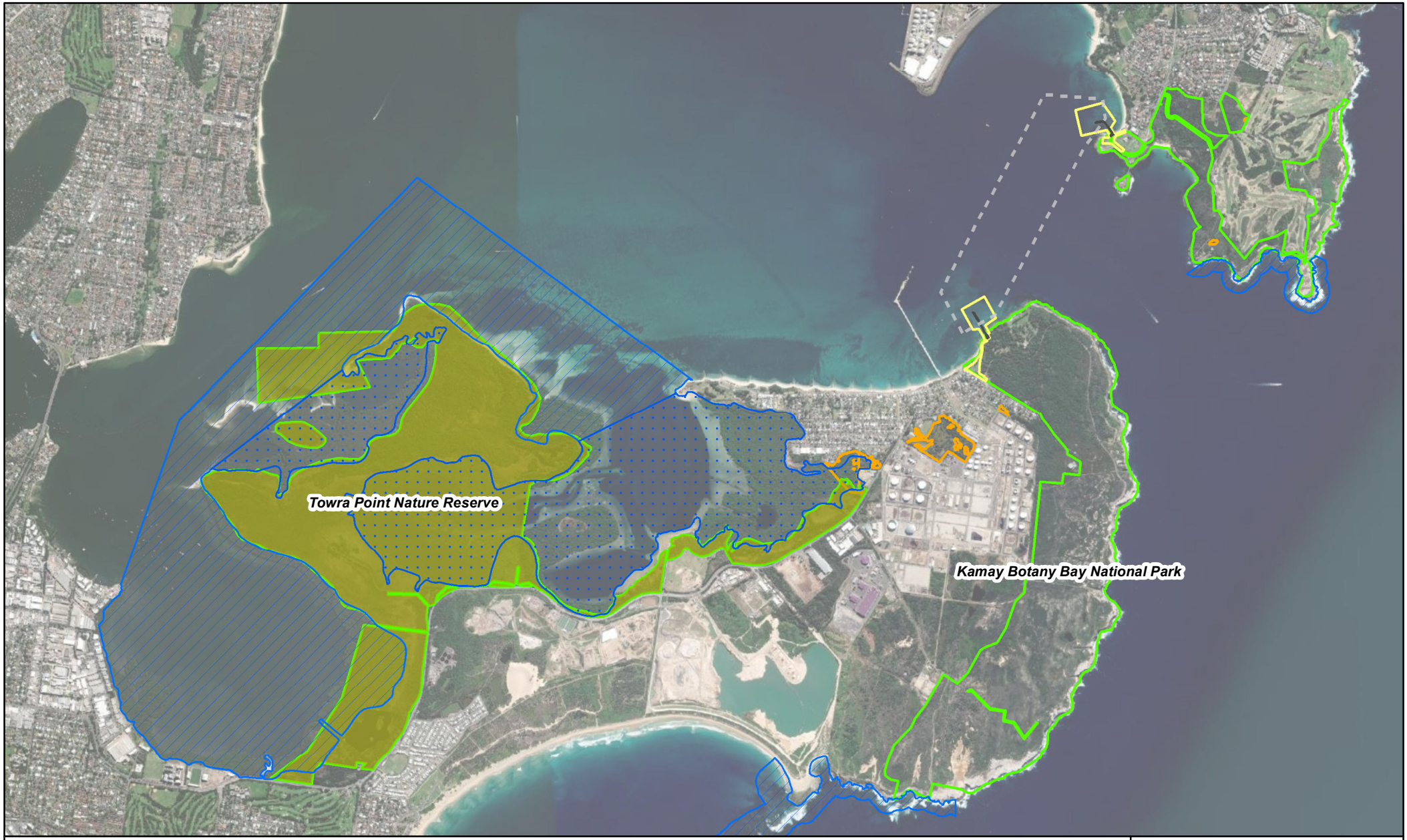
4.7 Wetlands and conservation areas

There are no marine parks within and or immediately adjacent to the project boundaries at La Perouse and or Kurnell.

Towra Point is a Ramsar wetland (internationally important and MNES) and is located about 4km from the proposal study area. The wetland extends behind Bonna Point along the foreshore Kurnell of Quibray Bay. There are designated coastal wetlands to the west within Quibray Bay. Towra Point Nature Reserve is located approximately 2km northwest of the proposal boundary (Figure 13). The site was listed as a wetland of international significance in 1984.

Other aquatic reserves in the region include Cape Banks Aquatic Reserve, which is located on the northern headland of Botany Bay and extends along the whole foreshore from the bridge at Cape Banks to the Endeavour Lighthouse at Henry Head, and 100m seaward from the mean low water mark (Figure 13). Cape Banks Aquatic Reserve is located about 2km to the east of the project boundary at Kurnell.

There are no Coastal Wetlands (SEPP) located within or immediately adjacent to the project boundaries at La Perouse and or Kurnell. The closest Coastal Wetland (SEPP) is located 660m from Kurnell and about 1.3km southeast of La Perouse.



Legend

- Ferry Swept Path Envelope
- Concept design wharf location
- Development site
- Coastal SEPP 2018 Wetlands
- **NSW Marine Protected Areas**
- Aquatic Reserve (IUCN IV)
- Aquatic Reserve (Sanctuary) (IUCN II)
- General Use Zone (IUCN VI)
- Habitat Protection Zone (IUCN IV)
- Habitat Protection Zone (Restrictions Apply) (IUCN IV)
- Sanctuary Zone (IUCN II)
- Special Purpose Zone (IUCN VI)
- Towra Point Nature Reserve
- National Park Lands

Figure Title

Ramsar and Aquatic Reserve sites around Botany Bay

Figure No **13**

Metres

0 310 620 930 1240

4.8 Marine pests and diseases

There are a number of marine pests and diseases known within and surrounding the greater Botany Bay and Sydney region, including:

- Pacific Oyster (*Crassostrea gigas)*
- European Fan Worm (*Sabella spallanzanii*)
- Pacific Oyster Mortality Syndrome (POMS)
- QX (parasite that effects Sydney Rock oysters)
- *Caulerpa taxifolia*
- Japanese goby (*Tridentiger trigonocephalus*), and
- Yellowfin Goby (*Acanthogbius flavimanus*).

In February 2020, NSW Department of Primary Industries (DPI, 2020) detected two non-native marine seaweed pests in NSW waters; red macroalga *Grateloupia turuturu* and *Pachymeniopsis lanceolate.* Both species can out-compete many native seaweeds within the low intertidal and shallow subtidal zones due to their large size and ability to reproduce quickly (DPI, 2020).

In 2002, a report on *Port Botany Bay Introduced Marine Pest Species Survey (*Pollard and Pethebridge, 2002*)* was released, which confirmed an additional 67 species to the previously recorded pest species. This is directly linked to the historical and current use of Botany Bay. It is understood that the transportation and spread of marine pest is most commonly associated with biofouling and ballast water (NCMC & RS-AMC, 2010).

Other diseases such as POMS and QX can have significant impacts on natural stocks. POMS is a viral disease that can lead to 60-100% mortality in juvenile oysters and is linked to temperature changes (DPI, n.d.4). QX is a parasitic disease that can lead to reduced growth and loss of condition. These diseases can have a major impact on regional populations but can also have significant impacts to aquaculture stocks and production.

Other specie known in the greater region to be a risk include *Caulerpa taxifolia*, which is a fast growing marine algae native to tropical Australia and the South Pacific that has colonised various areas outside its natural range, including several NSW waterways.

Japanese goby (*Tridentiger trigonocephalus)* has not been identified in Botany Bay but is in the wider region, however the Yellowfin Goby (*Acanthogbius flavimanus*) has been identified in the bay area.

4.9 Fisheries

4.9.1 Closures

Within the bay there are a number of fishing closures associated with protected habitat, seasonal constraints and or known diseased fauna. There are currently 13 closures in the wider Botany Bay area within close proximity to the project area (Table 17).

Table 17. Fishing closures immediate to the project boundary.

Area affected	Species of fish that must not be taken Species	Methods of fishing prohibited	Period
Inscription Point – Intertidal Protected Areas	All species of cunjevoi (Pyura spp.) and invertebrates, except abalone, eastern rocklobster (*Jasus verreauxi*) and southern rocklobster (*Jasus edwardsii*).	Any method.	All year
Towra Point to Kurnell – Aquatic Reserve	Any species of fish.	Any method involving digging with a spade or fork	All year
Sydney Airport	Any species of fish.	Any method.	All year

4.9.2 Recreational fishing

Botany Bay is a very popular recreational fishing location. Common methods included line fishing, spear fishing, hand lines, recreational nets and hand collection. Given the high diversity of habitat from transitioning from freshwater, shelters waters, variable depths and benthic structures the bay provides suitable habitat for a range of species popularly targeted.

Culturally valuable species

Aboriginal people have been living in the Sydney Basin and surrounding areas for at least 36,000 years. The Botany Bay area was thought to have been characterised by freshwater valleys and swamplands before the sea reached its current level about 7,000 years ago. Following the inundation of the coastline, Aboriginal people would have primarily eaten sea fish and shellfish. Records from European explorers account that Aboriginal people used bark canoes for line and spear fishing in Botany Bay and collected shellfish on the tidal banks. These accounts of Aboriginal diets are evidenced from the middens within the proposal study area.

Botany Bay still holds important cultural value to the local Aboriginal people and communities. A number of annual celebrations were around the seasonal change in availability of species and important harvest times and events.

In communication with members of the La Perouse Aboriginal Land Council, specifically the Gamay Rangers, a number of species were identified as intrinsically valuable for culture and general sustenance. The community harvests

for Mullet (*Mugilidae*) around March to June and associated with a time of celebration. Other commonly caught species include:

- Flathead (*Platycephalidae spp*)
- Blue Swimmer crabs (*Portunus pelagicus*)
- Rock Lobster (*Palinuridae spp*).
- Yellow fin bream (*Acanthopagrus spp*.)
- Tarwhine (*Rhabdosargus sarba*)
- Whiting (*Sillago ciliata*)
- Kingfish (*Seriola lalandi*)
- Bimba (Cockles)
- Conks
- Black fish (*Girella elevate*)
- Octopus (*Octopodidae spp*)
- Abalone (*Haliotidae*).

Popular recreationally targeted species.

According to the NSW/ACT Recreational Fishing Survey from 2013/2014 (DPI, 2015) an estimated total catch of 14,059,634 organisms occurred in NSW/ACT waters. Catches within the Sydney fishing Zone include:

- Bream (*Acanthopagrus spp*.) (38%)
- Snapper (*Pagrus auratus*) (12%),
- Sand Flathead (*Platycephalus caeruleopunctatus)* (15%)
- Dusky Flathead (*Platycephalus fuscus*) (9%)
- Mulloway (*Argyrosomus hololepidotus*), Tailor (*Pomatomus saltatrix*) and Luderick (*Girella tricuspidata*) (4%).

Stakeholder engagement identified other important species commonly targeted in the bay, including Squid (*Loliginidae*).

A full list of species observed during the surveys is in Appendix B.

4.9.3 Commercial fisheries

Botany Bay was designated as a Recreational Fishing Haven in 2002, with commercial fishing removed, with the exception of abalone gathering and rock lobster trapping. Since that time, and despite the heavy industry surrounding the area, many local anglers believe the fishing and general health and diversity of the system has improved markedly (DPI, n.d.2.).

Prior to 2002, the main Commercial Fishery in Botany Bay was a prawn trawling fishery. A recreational haven was achieved through a voluntary and compulsory buy out process (DPI, n.d1.).

4.9.4 Aquaculture

There are a number of shellfish harvesting and aquaculture lease areas around the Towra Point area including Quibray Bay and near the mouth of the Georges River. The aquaculture production is focused on Sydney Rock Oyster.

4.10 Recreational usage

Botany Bay is a popular recreational area, and both La Perouse and Kurnell are regularly used for a range of water-based recreational activities. There are four beaches within 1km of the project area – Congwong Beach, Frenchmans Beach and Yarra Bay at La Perouse, and Silver Beach at Kurnell. As well as land-based recreation, these are popular locations for swimming, diving, watersports, angling and boating activities. Most notably, Frenchmans Bay and Bare Island at La Perouse, and the Steps at Kurnell are identified as valued locations for snorkelling, diving, research and recreational fishing. The waters off La Perouse are also a well-known for spear fishing.

Scuba diving is a very popular activity around the La Perouse headland and the exposed coastal reaches of Kurnell. Divers are attracted to the natural rock reef features and the opportunities to explore kelp forests and sponge and coral gardens that thrive on the areas of higher currents. Divers seek to catch glimpses of seahorses including the Weedy Sea Dragon (*Phyllopteryx taeniolatus*), which is highly valued for its natural appeal.

There are also numerous recreational boating activities that occur in and around the project area, including rowing, sailing and boat racing activities from sailing and motorboat clubs; recreational fishing; kite surfing (particularly at Kurnell); and swimming races, triathlons and other types of aquatic events (although these predominantly take place on the west side of the bay and clear of the wharves' locations).

5 Impact assessment

The main impacts to marine biodiversity values will occur during construction of the project and will be associated with vessel movements, and piling driving.

Impacts during operation of the ferry terminals includes propeller wash at mooring locations, and shading impacts from the platforms.

The following sections discuss the potential impacts in more detail.

5.1 Construction

Construction impacts will be predominantly temporary in nature. The construction methodology is discussed in detail in Chapter 5, Project description of the EIS.

5.1.1 Loss of habitat

Habitat will be lost through piling, scour from high propeller wash and indirectly by shading from over-water structures. The impact of direct removal of habitat would depend on the sensitivity of the benthic community to change, relative to the surrounding habitat availability and the resilience of the community.

Increased shading from construction equipment is likely to reduce the occurrence and cover of seagrass. Seagrasses requires adequate light conditions for photosynthesis; this is why seagrass is mostly found in shallow clear water. Reduced light availability will reduce growth and development and ultimately result in reduction of cover. As such shading by structures will often result in impacts to seagrass either side of the structure depending on the angle and reduction in direct sun exposure.

Shading impact will be dependent on the species present and the tolerance of reduced light conditions. *Posidonia australis* is susceptible to direct shading effect although changes are slow to occur (Fitzpatrick, J. and Kirkman, H., 1995).

These direct and indirect impacts to benthic communities can also results in displacement of commonly targeted species for recreational fishing. Increased activity from vessels may disturb species who are sensitive to propeller wash, noise and other activities. Fish area also known to habituate to a range of disturbances but the likelihood of this is highly variable dependent on the species present.

Subtidal and seagrass habitat impact

The habitat available at both La Perouse and Kurnell are dominated by seagrass inclusive of *Halophila, Zostera* and *Posidonia* communities, with subtidal reefs located on the edges of the construction boundary. Damage, disturbance and removal of these seagrass communities will occur during construction.

Construction equipment will be located in set areas for extended periods. A supply barge will be moored to a crane barge which will be anchored, and a jack-up barge will be used for piling. To calculate impacts, a buffer of 15m has been used

surrounding the wharves at La Perouse and Kurnell. It has been estimated that the impact within these buffers would result in total loss of habitat, though in reality this is unlikely to be the case.

There are likely to be additional impacts within the construction boundary from vessel movements, as well as sediment disturbance from pile driving during construction, however these cannot be quantified.

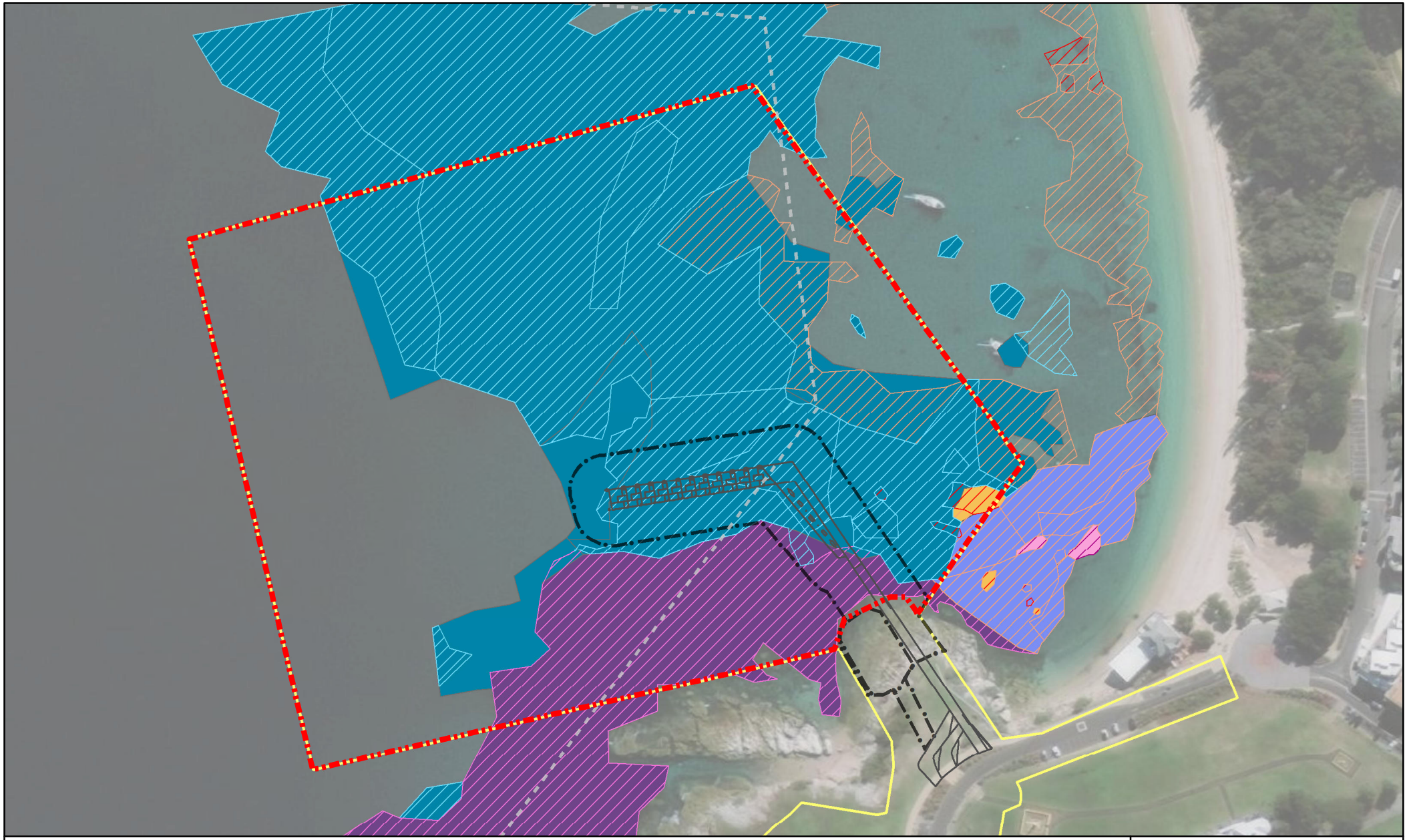
Construction of the project will result in a loss of some intertidal habitat, however this has not been quantified at this stage of the project

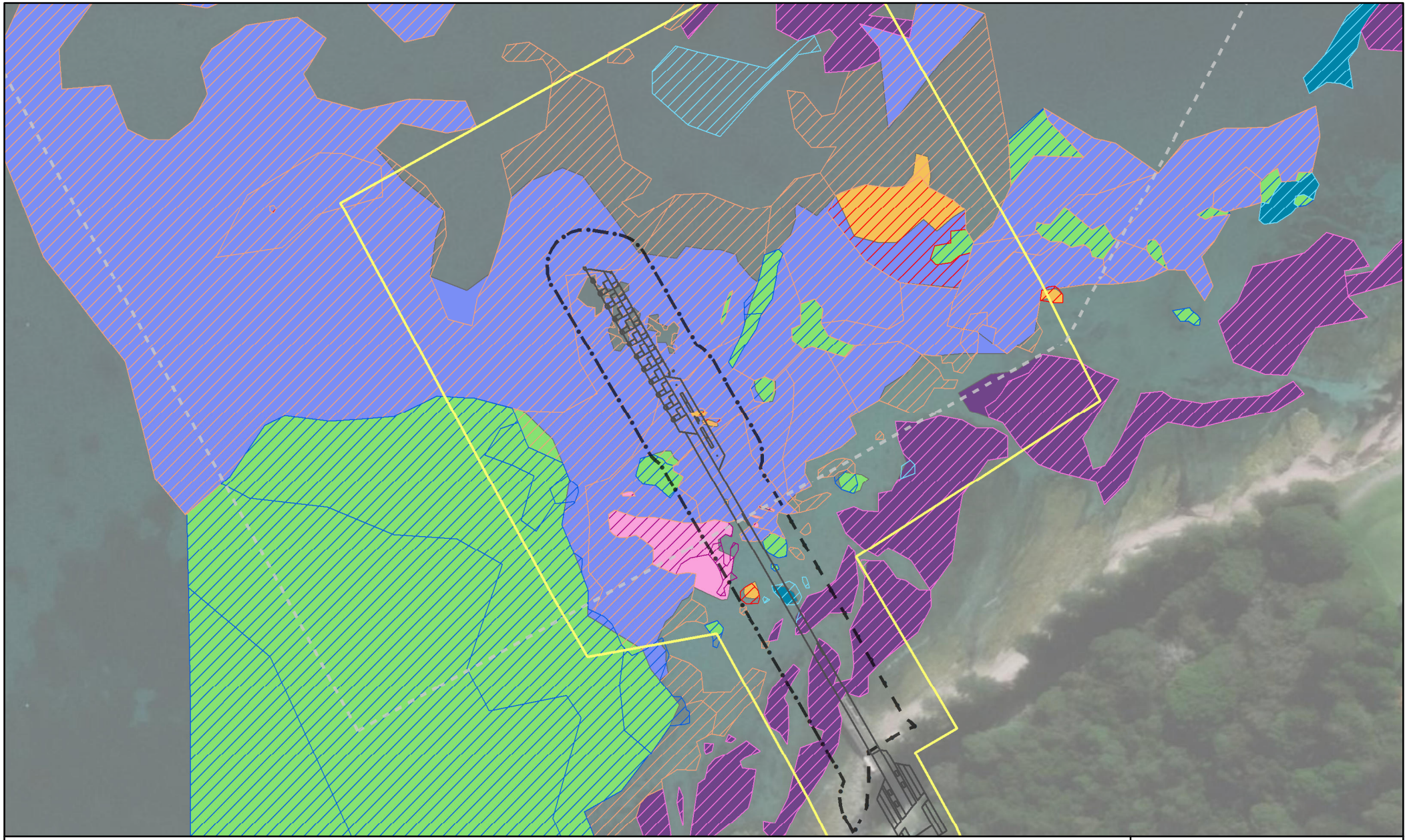
The MBOS will specify requirements for pre-construction surveys which will inform the areas of impact.

Table 18 provides a summary of the loss of seagrass and subtidal habitat from construction of the project, and a summary of the Key Fish Habitat sensitivity types and communities impacted by the project. Type 3 Key Fish Habitat (sand and bare benthic habitat) has not been mapped or quantified at this stage. These areas of construction impacts are shown in Figure 14 and Figure 15.

Table 18. Habitat loss through construction impacts

Location and habitat type	**Area of impact (m^2)**			
	June survey	**October survey**	**December survey**	**Average**
La Perouse				
Seagrass impact (Type 1 Key Fish Habitat) Consisting of *Halophila sp.*	5,025.87	5,004.34	4,377.60	4,802.60
Subtidal impact (Type 2 Key Fish Habitat) Macroalgae	1,421.20	1,421.20	1,297.20	1,379.87
Kurnell				
Seagrass impact (Type 1 Key Fish Habitat) Comprised of:	**7,195.18**	**6,596.20**	**6,857.17**	**6,906.15**
Halophila sp.	-	*44.23*	*95.56*	*69.90*
Posidonia australis	*167.54*	*256.22*	*223.43*	*215.73*
Posidonia sp. / Halophila sp	*31.12*	*55.38*	*71.52*	*52.67*
Posidonia sp. / Zostera sp.	*310.56*	*338.42*	*291.06*	*313.35*
Zostera sp. / Halophila sp.	*6685.96*	*5901.95*	*6175.60*	*6,254.50*
Subtidal impact (Type 2 Key Fish Habitat) (Macroalgae)	1,579.35	1,438.56	1,423.58	1,480.50


Development site
Concept design wharf location
Ferry Swept Path Envelope
Potencial area of impacts from construction vessels
Development footprint - Construction impacts
Mapped Marine Habitats December 2020
Halophila
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila
Mapped Marine Habitats October and May 2020
Halophila
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila
Figure Title
Construction impacts at La Perouse
Figure No 14
Metres
0 10 20 30 40


Development site
Concept design wharf location
Ferry Swept Path Envelope
Development footprint - Construction impacts
Mapped Marine Habitats December 2020
Halophila
Posidonia
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila
Mapped Marine Habitats October and May 2020
Halophila
Posidonia
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila
Figure Title
Construction impacts at Kurnell
Figure No
15
Metres
0 10 20 30 40

Fauna habitat

Habitat for White's Seahorse is associated with *Posidonia australis.* As detailed in Table 18, there would be no loss of habitat for White's Seahorse at La Perouse, and an average of 581.75m^2 lost at Kurnell (considering all seagrass which contains *Posidonia australis*).

This estimate is conservative as seahorses are known to live around structures, and the jetty piles will likely become areas of habitat. The MBOS will include recommendations for the inclusion of artificial structures which could be installed to compensate for loss of habitat.

There is no Black Rockcod habitat within the study area and the project would not result in a loss to any habitat for this species.

5.1.2 Turbidity and sedimentation

Construction of the project may result in an increase of turbidity and sedimentation through the disturbance of bed sediments. This has the potential to impact on adjoining seagrass and benthic communities, both through smothering as well as reducing the absorption of light for photosynthesis.

Fish may also be impacted by an increase in turbidity and sedimentation, with impacts including behavioural changes, where species will avoid area of impact, reduced foraging availability and physiological changes, where more invasive sediment can reduce ability to absorb oxygen, with prolonged exposure leading to reduced growth and development.

5.1.3 Coastal processes

The introduction of fixed, impermeable structures may result in changes to the coastal processes of the area. It is not anticipated that construction of the project would result in significant impacts on coastal processes. Construction of the temporary causeway at Kurnell may result in changes to the local structure of wave propagation which may result in realignments of the shoreline on each side of the temporary causeway. Once this causeway is removed following jetty construction, the shoreline would return to its previous quasi-equilibrium form (Shoreline Impact Assessment within Appendix T of the EIS).

5.1.4 Introduced marine species

Construction may result in the introduction of marine pests, through the increase in levels of disturbance, as well as potentially being introduced through the movement of vessels.

During construction there is an increased risk that some pest species could settle into the region and or on to the new structures (e.g. piles). It is anticipated that this risk can be controlled with appropriate mitigation measures and is considered a lower risk.

5.1.5 Underwater noise

Appendix P, Underwater Noise Assessment of the EIS assesses the predicted underwater noise impacts on marine species. The report predicts the potential for the following impacts in order of severity:

- Temporary behaviour changes, the most common of which is simply avoiding or moving away from an area
- Temporary hearing loss
- Permanent hearing loss
- Injury or death.

Table 19 summarises the criteria from the literature reviewed in Appendix P of the EIS where various impacts are predicted to occur on the species that occur or may potentially occur in Botany Bay.

Table 19. Noise criteria summary (marine animal species)

Impacts	Impulsive (from piling)				Non-impulsive (from vessels)		
	Weighted	Unweighted	Sound pressure (SPL, dB)	Peak pressure (PK, dB)	Weighted	Unweighted	Sound Pressure Level (SPL, dB)
	Sound exposure (SEL 24hr, dB)				Sound exposure (SEL 24hr, dB)		
Behavioural response	-		160-175		-	-	120
Temporary hearing loss	140-189	-	-	196-226	153-200	204	-
Permanent hearing loss	155-204	-	-	202-232	173-220	-	-
Physical injury	-	190-210	-	207-237	-	222	207-237

Modelling predicted that:

- Behaviour changes **would** occur because of the piling works and construction vessel and operational ferry movements. The extent of the behavioural changes would depend on the scale and duration of the construction works, the species, the masking effect of other existing noise sources (as these were not included in the modelling), other behavioural pressures (e.g. presence of food sources, migration routes and how used (habituated) the species would be to noise.
- Temporary hearing loss **would** only occur between 10 metres and 330 metres when piling (depending on the species). The impact may extend beyond this limit when the animal is continuously exposed to piling noise. In this case the modelling predicts that these impacts could occur up to 2.25 km.
- Permanent hearing loss **would** occur within 100 metres when piling. The impact may extend beyond this when the animal is continuously exposed to piling noise.
- Injury or death **would not occur.**

Table 20 below lists the predicted extent of impacts for each group of species. It lists the maximum zones to be adopted when carrying out the piling works if no other mitigation was introduced. The upper zone limits show the default zone used as a worst-case. As noted above in Section 4.3 of Appendix P of the EIS, because the noise modelling includes a range of assumptions, the following zones are likely a precautious upper limit. They should be verified and adjusted onsite before starting the main piling works. They can also be adjusted depending on the species in the area at the time. For instance, the stop work zone could be as little as 10 metres if there are only seals in the area.

Table 20. Recommended observational and exclusion zones summary

Group	Zone 1 Stop work	Zone 2 Restrict work		Zone 3 Observations	
	Both locations	La Perouse	Kurnell	La Perouse	Kurnell
Upper zone limits	330 m	2.25 km	1.75 km	3 km	2 km
Cetaceans (low frequency)	240 m	2.25 km	1.75 km	3 km	2 km
Cetaceans (mid frequency)	10 m	100 m		1 km	
Cetaceans (high frequency)	330 m	1 km		2 km	
Sirenians (dugong)	15 m	500 m	300 m	1.5 km	
Otariids (seals)	10 m	300 m		1.5 km	
Sea turtles	60 m	1 km	750 m	2 km	
Fish and sharks	60 m	-			
Birds	10 m	-			

5.1.6 Lighting

Lighting can impact on breeding, foraging and migration of marine species, including birds. Impacts from light disturbance can lead to a combination of

Seabirds that are active at night are particularly vulnerable as artificial light can disrupt their ability to orient towards the sea. The degree of impact is determined by a combination of physical, biological and environmental factors including the location, visibility, colour and intensity of the light, its proximity to other infrastructure, landscape topography, moon phase, atmospheric and weather conditions and species present (DEE, 2020).

Other species (such as turtles, fish, squid) may be disoriented if they follow natural moon phases and visibility cues in their environment. Light wavelengths, position and levels play a major influence in the likelihood of impact.

While marine turtles can be affected by light pollution, the risk is generally restricted to nesting habitat, of which none is present within or adjacent to the study area.

While there are not currently night works anticipated during construction, the barges, installed structures and other machinery are likely to be lit for safety and security, resulting in areas of light spill. The region is currently impacted by significant light pollution form the surrounding infrastructure of Port Botany, Sydney Airport and the Caltex Jetty.

Lighting impacts during construction impacts are not anticipated to be a significant impact and can be appropriately managed through mitigation measures (see Section 7).

Marine works are anticipated to run for 12 months.

5.2 Operation

It is anticipated that the following impacts would be experienced once the project becomes operational.

5.2.1 Benthic habitat

The extent of shading was calculated using a basic altitude angle calculation. Three points along the wharf were used to determine height from the bed level, with consideration of the deck height of 3.1m AHD. Bathymetry was reviewed to determine general depth at each location to calculate the height of the structure.

As the sun rises, the shadows are long but light levels are low, light levels are highest at midday and then begin to decrease towards the evening. The shadows are longest during the early morning and later afternoon. This is known as the solar azimuth and is shown in Figure 16). The area of shading has been calculated for summer and winter as they have different times of light exposure.

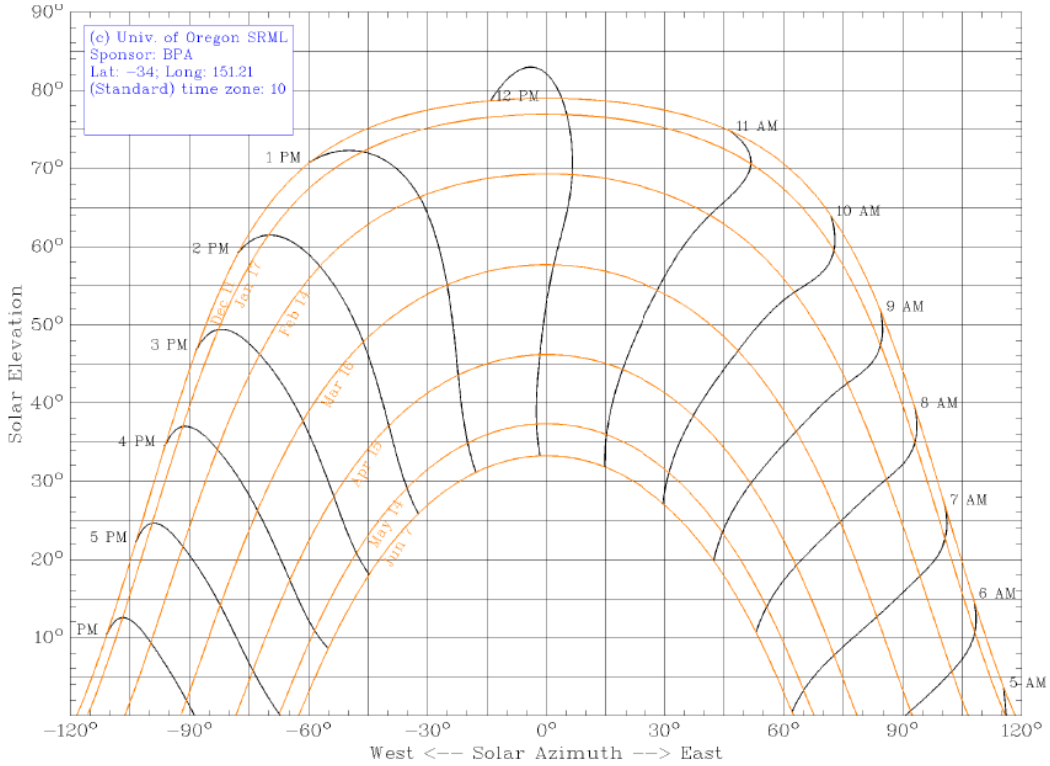


Figure 16. Example of solar azimuth for the project location.

Each species will have a different level of light tolerance where die back and reduction in condition occurs. The height of the structure will impact on the extent of the sun shadow, the closer the structure is to the bed, the shorter the shadow will be.

For comparison, aerial imagery of the Caltex Jetty was reviewed, and the distance at which the seagrass adjacent to the jetty reappears ranged from 6-10 m, increasing with depth. The Caltex Jetty is higher than the proposed wharves, but it provides direct comparison to establish how the seagrass in the area responds to shading.

The project wharves will have slightly different impacts due to the angle of the wharf to the sun movements. Kurnell is positioned so the wharf runs mostly in a north-south alignment, and at La Perouse the jetty has an east-west alignment on the area of seagrass.

Table 21 and Table 22 present the results of the shading distance at La Perouse during summer and winter, indicating that seagrass located within 8.5m of the wharf would reduce in cover. This area of impact is within the 15m buffer which has been used to calculate impacts to seagrass, and there are no additional impacts anticipated as a result of shading at La Perouse.

Table 21. Sun exposure from December during summer at La Perouse

Time	Distance of shading from the La Perouse wharf								
	1m	2m	3m	4m	5m	6m	7m	8m	9-12m
Morning 6:30-12:00 (total time in hours)	5	4	3.5	2.5	2.25	2	1.5	1.25	≤1
Afternoon 12:00-17:15 (total time in hours)	6	5.5	4.5	3	2.5	2	2	1.5	≤1
Worst case dependent on angle to sun	11	9.5	8	5.5	4.75	4	3.5	2.75	≤2

Table 22. Sun exposure from June during winter at La Perouse

Time	Distance of shading from La Perouse Wharf								
	1m	2m	3m	4m	5m	6m	7m	8m	9-12m
Morning 7:00-12:00 (total time in hours)	4	4	4	4	4	4	3.5	3	2.5
Afternoon 12:00-4:30 (total time in hours)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	3.5
Worst case dependent on angle to sun	8.5	8.5	8.5	8.5	8.5	8.5	8	7	5

Table 23 and Table 24 present the results of the shading distance at Kurnell during summer and winter, indicating that seagrass located within 9m of the wharf would reduce in cover. As with La Perouse, this area of impact is within the 15m buffer which has been used to calculate impacts to seagrass, and there are no additional impacts anticipated as a result of shading at Kurnell.

Table 23. Sun exposure from December during summer at Kurnell

Time	Distance of shading from the La Perouse wharf								
	1m	2m	3m	4m	5m	6m	7m	8m	9-12m
Morning 6:30-12:00 (total time in hours)	5	4	4	3.5	2.5	2.25	1.5	1.25	≤1
Afternoon 12:00-17:15 (total time in hours)	6	4	3.5	3	2.25	2	1.5	1.5	≤1
Worst case dependent on angle to sun	11	8	7.5	6.5	4.75	4.25	3	2.75	2

Table 24. Sun exposure from June during winter at Kurnell

Time	Distance of shading from La Perouse Wharf								
	1m	2m	3m	4m	5m	6m	7m	8m	9-12m
Morning 7:00-12:00 (total time in hours)	4	4	4	4	4	4	3.5	3	2.5
Afternoon 12:00-16:30	5	5	5	5	5	5	4.5	4	3.5
Worst case dependent on angle to sun	9	9	9	9	9	9	8	7	6

5.2.2 Turbidity and sedimentation

While vessel movements result in some level of sediment disturbance, this is short-term and localised and the disturbed sediment quickly settles out of suspension. For reference, storm events cause considerably more sediment disturbance in the area (Cardno, 2012).

There is the potential for erosion or sediment build-up at the abutments that would be built to connect the wharves and the land. The scale of the erosion or sediment build-up would be minor and localised given the small scale of the wharves relative to the size of Botany Bay and would not impact on coastal processes.

5.2.3 Coastal processes

The project consists of a deck constructed on piled structures, and it has been determined that there would be no regional effects on coastal processes as a result of operation of the project (Appendix T, Coastal Processes Memorandum of the EIS).

5.2.4 Underwater noise

The predicted noise from the operation of the ferry vessels is above the threshold for behavioural responses (marine mammals at 120 dB SPL) for all source locations, with impacts expected to extend out to approximately +7km offshore. No temporary or permanent injury to marine animals is predicted from ferry operation.

The ferry noise is predicted to be lower than noise from existing shipping traffic and extend over a smaller zone of impact as the ferry has less low-frequency sound despite the broadband source level being similar. This indicates that the operational impacts of the ferry movements associated with the project wharves would not be significant compared to the extensive existing commercial shipping movements to/from Port Botany.

Similarly, noise from additional recreational vessels accessing the area to use the wharves (which would be smaller and, typically quieter than ferries) would not be significant compared to the existing shipping traffic.

5.2.5 Lighting

Lighting for the project will be designed in accordance with AS/NZS 1158 (Lighting for Roads and Public Spaces). Emergency and exit lighting will be required as well as lighting for the waiting area and walkway. Lighting design will aim to minimise light spill where practical.

Designs and management plans should be done in accordance with the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE 2020).

Ferries would only use the wharves for the boarding and alighting of passengers during daytime hours. The overnight layover and refuelling, cleaning and

maintenance of vessels would be undertaken at a secure existing site within Botany Bay.

The use of the wharves for commercial and recreational vessels would not be restricted to daylight hours. The wharves would be lit by low level lighting at night.

It is anticipated that the lighting of the jetties would not dominate the landscape given the nearby Caltex wharf, Port and Airport facilities.

5.2.6 Vessel activity

Strike

Species within close proximity to vessels may experience physical disturbances from the wash, as well as the risk of potential direct strike.

Vessels will be moving perpendicular to the standard flow of vessel traffic and it is possible this would result in an increased risk of strike on marine mammals and turtles. With appropriate mitigation measures, it is considered likely that the risk from vessel strike can be reduced with increased vigilance during migration periods.

Propeller wash and boat wash

Appendix T, Coastal Processes Memorandum of the EIS assesses the potential impacts from propeller wash. Previous studies have determined that the maximum disturbance from ferry wash is at the surface within 10m of the propellers, with the impact decreasing further from the propellers with virtually no impact after 70m. The disturbance at the seabed (4.5m below surface) is about 20 – 40m behind the propellers, creating a scour hole of 1 – 2m. This appears to be a slow process as the propeller wash only occurs in short bursts when a ferry arrives and departs.

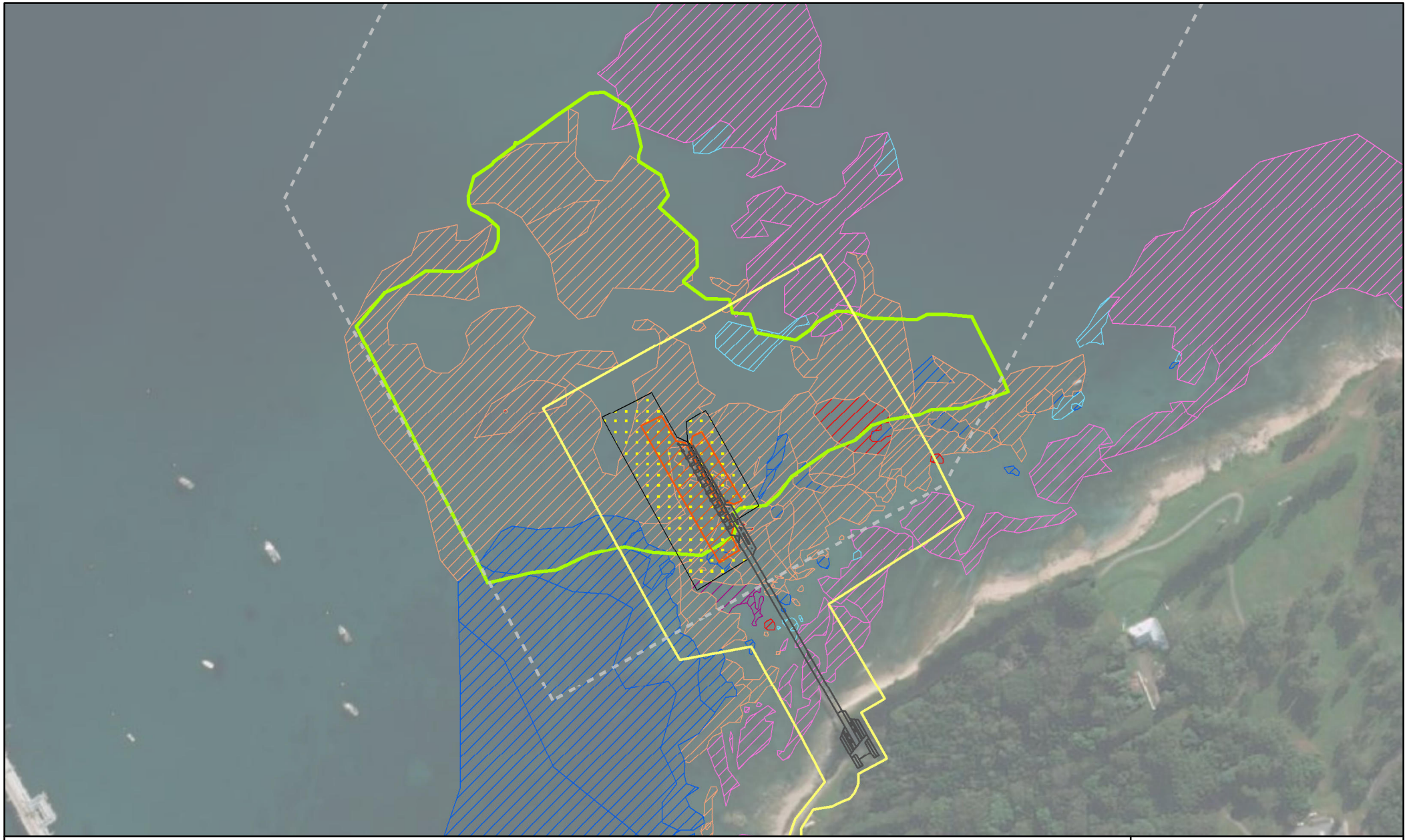
The ferries at La Perouse and Kurnell would berth in water of about 3.5 – 4.5m depth. While a scour hole is likely to occur, the extent of this would depend on final ferry specifications, the frequency of the ferry service and the local conditions. High level predictions of scouring of vessels at full speed indicated the scour hole could be up to 2m deep near the wharves, however this is considered unlikely as the vessels will not be approaching at full speed. At this stage, as the approach speed and angels have not been defined, the size of the scour is uncertain.

Table 25 provides a summary of the areas of habitat impact from ferry wash at both La Perouse and Kurnell, with the area affected by scour shown in Figure 17 and Figure 18. This numbers are in addition to the impacts calculated from the habitat loss through construction impacts (see Table 18).

Table 25. Area of habitat impact from ferry wash

Location and habitat type	**Area of impact (m2)**			
	June survey	October survey	December survey	Average
La Perouse				
Seagrass impact (Type 1 Key Fish Habitat) Consisting of *Halophila sp.*	7,021.63	7,038.82	6,087.71	6,716.05
Subtidal impact (Type 2 Key Fish Habitat) Macroalgae	817.46	817.46	834.57	823.16
Kurnell				
Seagrass impact (Type 1 Key Fish Habitat) See species below	**2,821.96**	**2,811.13**	**2,894.23**	**2,846.11**
Posidonia australis	*37.43*	*45.40*	*45.40*	*42.74*
Posidonia sp. / Zostera sp.	*44.97*	*64.56*	*64.55*	*58.03*
Zostera sp. / Halophila sp.	*2,739.56*	*2,712.17*	*2,784.28*	*2,745.34*


Legend
Development site
Ferry Swept Path Envelope
Concept design wharf location
Scour risk areas
risk
Depth Range likley at risk of ferry access
Highest risk of region likely to be scoured
Potential extent of direct scour
Mapped Marine Habitats December 2020
Halophila
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila
Figure Title
Ferry access and risk ares of scour La Perouse
Figure No 17
Metres
0 30 60 90 120


Legend
Development site
Ferry Swept Path Envelope
Concept design wharf location
Scour risk areas
risk
Depth Range likley at risk of ferry access
Highest risk of region likely to be scoured
Potential extent of direct scour
Mapped Marine Habitats December 2020
Halophila
Posidonia
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila
Figure Title
Ferry access and risk ares of scour Kurnell
Figure No 18
Metres
0 25 50 75 100

5.3 Key Threatening Processes

Key Threatening Processes (KTP) are listed under the FM Act and the EPBC Act and are defined as processes that *adversely affect threatened species, populations or ecological communities*, or *could cause species, populations or ecological communities that are not threatened to become threatened*.

Currently, there are eight listed KTPs under the FM Act and 21 listed under the EPBC Act. Of these KTPs, three have potential to be triggered by the project:

- Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales (FM Act)
- Novel biota and their impact on biodiversity (EPBC Act)
- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris (EPBC Act).

With the influx of construction vessels there is a risk of bringing to site non-indigenous and or novel biota to the region. With disturbance of the seabed may allow for species to take hold and out completed native species. Although this is a moderate risk, it is considered that the risk can be minimised and controlled through appropriate mitigations.

In relation to non-indigenous fish, there few marine fish species that would be considered a risk to Botany Bay. Most introduced fish species are through the aquarium trade, mostly tropical species that might survive through the summer but perish in the winter months. A few marine finfish species known in NSW. The introduction of marine fish is considered a low risk.

A Biosecurity Management Plan will need to be prepared and implemented to minimise the introduction of marine pests to the project region. In addition, maintenance inspections maybe required of the ferry and jetties to ensure no marine pests have become established in the region or on the infrastructure.

The wharves have the potential to increase public access for fishing and recreation to the jetties, which increases the risk of introducing small debris that may be harmful to the vertebrate marine life. With appropriate waste facilities, signage and maintenance this risk can be significantly reduced.

5.4 Assessment of significance

5.4.1 Matters of National Environmental Significance

A Referral under the EPBC Act was prepared and submitted to DAWE in 2020 (Ref 2020/8825). The project was determined to be a controlled action as it has the potential to result in a significant impact on:

- *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion TEC
- Black Rockcod (*Epinephelus damemelii*) – vulnerable

- Cauliflower Soft Coral (*Dendronepthya australis*) – endangered (added while under assessment)
- White's Seahorse (*Hippocampus whitei*) – endangered (added while under assessment).

It has been subsequently assessed that this project is unlikely to impact upon Cauliflower Soft Coral as there were no sightings of the species during any of the surveys completed.

It is anticipated that approximately 682m^2 of TEC *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion will be impacted by the proposed development during construction and operation of the project. This is due to impacts associated with construction, shading and ferry scour. The same area comprises habitat for White's Seahorse, however this impact is not anticipated to be significant due to adjacent areas of habitat availability. In addition, the areas being impacted consist of mixed habit and experience greater exposure to coastal processes.

No Black Rockcod habitat has been identified within the project footprint and there would be no impact to this species.

Table 26 and Table 27 provide a significance assessment of the *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion and White's Seahorse against the EPBC Act significance criteria. As the Black Rockcod and Cauliflower Soft Coral is unlikely to occur, an assessment against the EPBC Act significance criteria is not required.

A number of mitigation measures are recommended in Section 6 to minimise potential impacts to these matters.

Table 26. Significant impact assessment criteria for critically endangered and endangered ecological communities (in relation to *Posidonia australis*)

Significant impact criteria	Threatened Ecological Community *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion
Reduce the extent of an ecological community	The proposal will impact on 682m^2 of *Posidonia australis* seagrass meadows, consisting of 582m^2 of direct impact associated with construction at Kamay and allowance of loss of 100m^2 from indirect impacts associated with shading, also at Kamay. The loss of 682m^2 of *Posidonia australis* seagrass is considered to be significant. These impacts have been minimised and any indirect impacts associated with construction and operation will be managed, with allowance for a monitoring program, with corrective actions to be implemented. A Marine Biodiversity Offset Strategy is also being prepared to result in a net gain of this TEC within suitable areas.
Fragment or increase fragmentation of an ecological community, for example by	The proposed wharf at Kurnell would be located through a transitional zone of a mosaic patchwork *Posidonia australis* seagrass meadows. The wharf would likely further fragment the patches of the extension of the meadow through construction access and indirect effects

Significant impact criteria	Threatened Ecological Community *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion
clearing vegetation for roads or transmission lines	of shading effects on the seafloor and coastal process changes with the direct and indirect impact of the causeway. Although the transition zone does not meet the TEC the changes in coastal processes could impact on the exiting connectivity between these areas, however it will not completely isolate existing patches, with potential for connectivity to be maintained around the wharf structure. The location of the ferry wharf at Kurnell does result in some fragmentation of the *Posidonia australis* TEC. However, this impact is not considered to be significant due to the impact being located in an area that is already a mosaic patch of *Posidonia australis* and other seagrass species.
Adversely affect habitat critical to the survival of an ecological community	The *Posidonia australis* TEC within the wharf footprint is only an extension of a larger well-established community that the wharf that is mostly outside of the well-established habitat. This larger, more intact patch that contains areas of *Posidonia australis* would be considered critical habitat for the survival of the TEC in the wider project area. There will be sufficient areas of *Posidonia australis* seagrass communities retained around the Kurnell wharf to enable the ongoing retention of this TEC in the area. The proposal is not considered to impact habitat critical to the survival of the *Posidonia australis* TEC, as additional indirect impacts to the larger patch are not considered to result in further impacts not assessed as part of the direct impacts.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The impact assessment has considered additional impacts to the TEC associated with ferry wash, water quality and shading from the wharf structures. There will be short term impacts to water quality during construction through mobilisation of sediment. These impacts will be managed through a construction environmental management plan to minimise sediment plumes. The operational impacts associated with ferry wash at Kurnell have been considered as part of the impact assessment, and an additional 100m^2 of loss of *Posidonia australis* TEC is likely. Impacts associated with changes to water quality and ferry wash are not considered to be significant and these indirect impacts have been included in the assessment of total loss of the TEC as a result of the proposal.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	Disturbance associated with the wharf through construction and shading, would likely increase the distance between patches of *Posidonia australis* meadows. The shading would impact on the extent of the habitat as the species is sensitive to changes in reduced light conductions for prolonged periods of time. The impact assessment completed reviewed shading extents and shows that the additional area subject to shading is completely within the areas assessed to be impacted through construction and operation. Beyond the loss of habitat associated with direct loss and ferry wash, the proposal is

Significant impact criteria	Threatened Ecological Community *Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion
	not expected to result in a substantial change to the species composition of the TEC.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	The construction and operation of the proposal has the potential to inhibit the extent and quality of the adjacent *Posidonia australis* TEC through indirect impacts associated with water quality, ferry wash and shading. These indirect impacts have been assessed as part of the direct loss of the TEC, and construction management measures will be included to minimise the magnitude of these impacts. The proposal is not considered likely to cause any additional substantial reduction in the quality or integrity of adjacent, retained areas of the TEC.
Interfere with the recovery of an ecological community	The proposal is unlikely to interfere with the recovery of the *Posidonia australis* TEC. Based on the mapping prepared in this EIS and recent studies in the region (Evans et. al. 2019) it appears that the established large meadow has been extending to the east between the 1 m and 3.5 m depth range connecting through to the reef dominant habitat towards Inscription Point. Based on the previously available mapping the extent of the seagrass ended at the current large meadow. As to be expected there is variation amongst the seagrass mapping as storm, and flood waters would have disturbed the extent and cover within these locations. There is however more *Halophila*, suggesting the area has experienced and increase in seagrass cover. *Halophila* and *Zostera* often colonise first followed by *Posidonia australis* as it is slower growing species. The proposal is not considered likely to interfere with the recovery of the TEC.

Table 27. Significant impact criteria for critically endangered and endangered species (in relation to White's Seahorse)

Significant impact criteria	White's Seahorse
Lead to a long-term decrease in the size of a population	No White's Seahorse individuals were directly observed during field surveys, however potential habitat for the species occurs in the proposal area. The project will result in the direct loss of 682m^2 of *Posidonia australis* seagrass beds that have also been classified as habitat for White's Seahorse, but this would not be a significant impact. There is habitat located adjacent to the wharf location and outside of the protect boundary. Construction noise may result in temporary disturbance to the distribution of White's Seahorse in the wider area, however the impact will be temporary and mitigation measures include the completion of a pre-construction fauna salvage survey to further reduce the likely

Significant impact criteria	White's Seahorse
	presence of these species within the project area for the duration of the piling. The project is not considered likely to lead to a long-term decrease in the size of the population of White's Seahorse.
Reduce the area of occupancy of the species	The proposal will result in a loss of 682m^2 of potential habitat for White's Seahorse. This impact is to an area of habitat that is within a larger patch of seagrass that would support the species. The loss of habitat as a result of the proposal is unlikely to reduce the overall extent of occupancy of White's Seahorse, as the species will still be able to move around the new wharf structures. White's Seahorses have been found on artificial habitats such as the protective swimming net enclosures and also on jetty pylon.
Fragment an existing population into two or more populations	The location, alignment and extent of the wharf structures will not provide a barrier to the movement of White's Seahorses within and between areas of retained suitable habitat. The proposal will not fragment an existing population.
Adversely affect habitat critical to the survival of a species	Although *Posidonia australis* seagrass beds are known preferred habitats for White's Seahorse, natural habitat preferences can be for more complex environments with soft corals and sponges. The area of impact associated with the proposal is largely restricted to seagrass communities and areas of rocky reef or rubble. Due to this relative lack of habitat complexity, the proposal is not considered to cause adverse impacts to habitat critical to the survival of White's Seahorse.
Disrupt the breeding cycle of a population	The proposal is unlikely to disrupt the breeding cycle of White's Seahorse. The species does not have specific breeding habitat requirements, however The proposal will impact on *Posidonia australis* habitat only, which may provide limited shelter for juveniles. Some of the more complex habitat types such with soft corals and sponges are absent from the project footprint, providing limited shelter for juveniles.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The area of White's Seahorse habitat that will be impacted is a relatively small area of 682m^2 that is within a wider patch of suitable habitat. There are larger patches of *Posidonia australis* seagrass, as well as other areas of suitable habitat, retained in the bay around the new proposed wharves.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The construction and operation of the ferry wharves are unlikely to introduce any invasive specie that will cause White's Seahorse to decline. The wharves will be used for ferry's that make local movements only and will not include vessels from outside the Sydney area.
Introduce disease that may cause the species to decline, or	The construction and operation of the ferry wharves are unlikely to introduce any diseases that will cause White's Seahorse to decline. The wharves will be used for ferry's that make local movements only and will not include vessels from outside the Sydney area.

Significant impact criteria	White's Seahorse
Interfere with the recovery of the species.	Key threats for White's Seahorse include natural habitat loss and cleaning of artificial structures which can be used as habitat. The area of natural habitat loss includes areas of *Posidonia australis* seabeds only, with no impacts to other preferred natural habitats such as soft corals and sponges. Measures to contribute to the recovery of the species will be included in the MBOS, with strategies for artificial seahorse habitat to be included.

5.4.2 State environmental matters

The impact assessment has determined that the project will likely impact on the following State environmental matters, listed as threatened populations or species under the FM Act:

- *Posidonia australis* seagrass, Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie populations (endangered population)
- Habitat of White's Seahorse (endangered species) (generally in association with Posidonia, and sponge gardens).

An assessment of significance of the impacts to these listed threatened species and population against the criteria from 221ZV of the FM Act is provided in Table 28.

The project will also impact on Type 1 habitat (including of *Posidonia australis*, meadows of *Zostera sp.* and *Halophila sp.*) and Type 2 habitat (including macroalgae and reef habitat)

The project will result in the direct loss of *Posidonia australis* (Type 1, at Kurnell) and a loss of habitat of *Halophila sp.* and *Zostera sp.* (Type 1, at both sites) as well as EPBC TEC *Posidonia australis* community (at Kurnell). With the loss of the *Posidonia australis* there will be an impact to habitat for White's Seahorse, but this would not be a significant impact. There is habitat located adjacent to the wharf location and outside of the protect boundary. Construction noise may result in temporary disturbance to the distribution of White's Seahorse in the wider area, however the impact will be temporary and mitigation measures include the completion of a pre-construction fauna salvage survey to further reduce the likely presence of these species within the project area for the duration of the piling.

Black Rockcod will likely be disturbed during construction through construction noise. There is no Black Rockcod habitat within the construction footprint at either site and the impacts would be limited to indirect disturbances through construction noise. The potential effects will be temporary and are highly dependent on the location of the individual fish at the time of the noise occurring. No Black Rockcod were observed during the surveys. Mitigation measures will be implemented during construction to reduce the risk of impact.

Construction may result in temporary disturbances to other species listed under the PM Act and BC Act. The impacts are not expected to have any significant and or adverse effects on the likelihood of extinction. Marine Fauna Observers will be

present during construction to further mitigated and control risk to the species located within the area. Additional mitigation measures may include adjusting timing of work and start procedures which would further reduce the impact of interactions with the species. It is anticipated that the potential impact to these species can be suitably controlled and mitigated.

A number of risks can be mitigated that would further reduce the overall impact (see Section 6). A Marine Biodiversity Offset Strategy will be prepared which will inform potential options to reduce the likelihood of impact on White's Seahorse, and prepare a plan moving forward to address the loss of *Posidonia australis*. Additional management plans in regard to an Underwater Noise Management Plan with validation studies will further indicate the risk and confirm the suitable mitigation that can be deployed for the proposed works.

Table 28. Seven-part Assessment of Significance test as part of the FM Act (section 221ZV of the FM Act) on the listed threatened species and communities

Part	*Posidonia australis*	White's Seahorse
(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	Not applicable for threatened populations.	Unlikely to lead to extinction, however there may be temporary impact due the construction where the species is disturbed and or displaced form the area of works.
b) in the case of an endangered population, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,	Unlikely to increase risk to extinction, there will be edge effects and direct removal of *Posidonia austrlalis* on site but there is not likely to cause an increased risk to extinction. There will however be localised impact to extent of the current population	Not applicable for threatened species
(c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity— (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,	Not applicable for threatened populations.	Not applicable for threatened species

Part	*Posidonia australis*	White's Seahorse
(d) in relation to the habitat of a threatened species, population or ecological community— (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality,	There will be an adverse effect on the extent of the population, but the proposal is unlikely to place the popoulation at risk of extinction. The development will avoid damaging the large intact meadow of Posidonia to the west of the site at Kurnell. The proposed jetty will have an impact of areas of patchy distribution of Posidonia to the east of the large meadow. Approximatley 682m^2 of TEC *Posidonia australis* meadows will be impacted by the proposed development during construction and operation of the project. This is due to impacts associated with construction, shading and ferry scour. Potential for fragmenting patched of habitat, through direct rhizome connection but will still maintain seed dispersal connectivity. The development will occur outside areas of large contiguous *Posidonia austrlais* meadows in parts of the bay areas that have previously disturbed. It is unlikely the development will lead to a decline in the population outside of that area of impact. The areas of greatest impact will be in a section of habitat that is exposed to higher wave, current and wind energy as such this region fluctuates with seasons and storm events.	*Posidonia australis* is known habitat for White's seahorse. Habitat will be remove, modified, fragmented, however there is unlikley to be any long term degradation to habitat for White's Seahorse. The location, alignment and extent of the wharf structures will not provide a barrier to the movement of White's Seahorses within and between areas of retained suitable habitat. The proposal will not fragment an existing population.
(e) whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly),	-	*Posidonia australis* is known habitat for White's seahorse. Habitat will be removed, modified, fragmented and will have long term effects on the ecological community. As such this will impact on the distribution of the White's seahorse. Although *Posidonia australis* seagrass beds are known preferred habitats for White's Seahorse, natural habitat preferences can be for more complex

Part	*Posidonia australis*	White's Seahorse
		environments with soft corals and sponges. The area of impact associated with the proposal is largely restricted to seagrass communities and areas of rocky reef or rubble. Due to this relative lack of habitat complexity, the proposal is not considered to cause adverse impacts to habitat critical to the survival of White's Seahorse.
(f) whether the proposed development or activity is consistent with a Priorities Action Statement	The implemention of the offset strategy will contribute to monitoring and understanding of the species in Botany Bay	
(g) whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	It is anticipated that the development will have little overall impact to contribution to key threatening processes for all species and communities.	Key threats for White's Seahorse include natural habitat loss and cleaning of artificial structures which can be used as habitat. The area of natural habitat loss includes areas of *Posidonia australis* seabeds only, with no impacts to other preferred natural habitats such as soft corals and sponges. Measures to contribute to the recovery of the species will be included in the MBOS, with strategies for artificial seahorse habitat to be included.

5.5 Cumulative impacts

5.5.1 Seagrass loss

Construction of the project will result in a measurable impact to seagrass, particularly to *Posidonia australis*. The footprint and buffer of the jetty will no longer be viable habitat for seagrass habitat. It is anticipated that the seagrass in this area will not be recoverable.

During detailed design, the potential to implement areas of light permeable platforms will be investigated, which may reduce shading impacts and possibly allow for more shade tolerant species to recolonise.

The proposed jetty will be located outside the large, established meadow of the *Posidonia australis*, however will impact on the edges of what is considered part of the TEC as per the EPBC criteria.

Due to the history of Botany Bay and the various large-scale developments, the region has been under continued direct pressure on these seagrass habitats. In addition, water quality of the wider catchment can result in significant impacts on the viability of the seagrass in the bay. The project will likely have a minimal and or negligible influence on the water quality once constructed.

The project is currently investigating options and methods to rehabilitate areas of seagrass and to provide a meaningful compensation for the impacts likely to be caused by this construction and operation of the project.

6 Mitigation

6.1 Table of risks and impacts – mitigation and responsibilities

Table 29. Environmental management measures for marine biodiversity impacts

Impacts	Mitigation	Responsibility	Timing
Habitat loss	A Marine Biodiversity Offset Strategy (MBOS) will be prepared in consultation with NSW DPI Fisheries. As a minimum the MBOS will include: • Pre and post construction seagrass monitoring program to validate construction impacts • A seagrass translocation and rehabilitation plan • Other offset opportunities including artificial marine fauna habitat such as seahorse habitat structures, environmentally friendly moorings, and participation in research trials on environmentally friendly moorings.	Transport for NSW	Pre-construction Construction Operation
Habitat loss and degradation	The following deign and lighting opportunities will be adopted during the detailed design: • Use of light permeable materials for the wharves to minimise shading impacts to marine habitats • Measures in the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds, and Migratory Shorebirds (Australian Government Department of Environment and Energy, 2020).	Transport for NSW	Detailed Design
Marine biodiversity impacts generally	A Construction Biodiversity Management Plan (BMP) will be prepared in accordance with the Biodiversity Assessment Method (NSW DPIE, 2020), the Biodiversity Offsets Agreement	Contractor	Pre-construction Construction

Impacts	Mitigation	Responsibility	Timing
	Management System, and DPIE Guidelines. It will be implemented under the Construction Environmental Management Plan. The BMP will provide details of the measures and procedures to be carried out during construction to minimise and manage construction impacts on marine biodiversity. As a minimum the BMP will: • Map sensitive habitats plans, protection areas, no anchoring zones, and exclusion zones to protect seagrass and threatened species • Define procedures addressing relevant matters specified in the NSW DPI Fisheries Policy and guidelines for fish habitat conservation and management (NSW Department of Primary Industries, 2013). • Include measures to: – Prevent water pollution – Limit sediment disturbance during construction – Limit construction vessel/barge movements, anchoring, and shading – Avoid vessel strike by limiting speeds • Define and implement Marine Ecology Induction to all workers before starting onsite • Marine fauna observer protocol section 5.4.1 of the Underwater Piling Noise Guidelines (Government of South Australia, 2012) • Biosecurity management measures set out by the Department of Primary Industries • Implement other mitigation measures identified in the biodiversity specialist assessment reports to minimise and manage impacts to marine biodiversity.		

Impacts	Mitigation	Responsibility	Timing
Disturbance from underwater noise and vibration for Threatened marine fauna and migratory marine species	• Preparation of an underwater noise management plan to minimise impacts to threatened marine and migratory marine fauna during construction. The plan should include the following measures: • All potential significant underwater noise and vibration generating activities associated with the activity • Measures to be implemented during construction to minimise underwater noise and vibration impacts, such as restrictions on working hours, staging, exclusion zones, passive acoustic monitoring, use of qualified marine mammal observers, operational procedures for night-time or times of poor visibility (should works be occurring), (potentially) use of bubble curtains, and controlling the location and use of underwater noise generating equipment • Feasible and reasonable mitigation measures to be implemented • A monitoring program to assess performance against relevant underwater noise and vibration criteria • Avoid pile driving during October to November to avoid Grey Nurse Shark breeding season. • Avoid and minimise pile driving where possible during whale season May and November. • Soft start measures to piledriving • Use of marine mammal observers to monitor the bay, for marine mega fauna: pre start of works and during and or use of passive acoustics monitoring techniques • Use observational and exclusion zones to help maintain shutdown areas form marine fauna that may be too close to the works to reduce risk of injury	Contractor	Pre-construction Construction

Impacts	Mitigation	Responsibility	Timing
Boat strike and vessel impacts on fauna behaviour	• Vessels should maintain safe distances and approaches as stipulated in Division 2.1 of the Biodiversity Conservation Regulation 2017. • There requirements will be consolidated, and additional mitigations and controls will be included in relevant Environmental Management Plans for construction and operation. Where possible areas of known Black Rockcod habitat will marked and avoided within the ferry swept path, recommendations of areas to avoid will be provided as part of the biodiversity management plan.	Contractor Transport for NSW	Construction Operation
Direct and indirect impacts during construction for all threatened marine fauna and migratory marine species	The biodiversity management plan would also incorporate the following measures for the protection and management of the TEC: • Sediment controls and narrow access and work areas required to limit impacts during construction. • Installation of silt curtains during the installation of the causeway. • Works to avoid poor weather and/ or rough waters to minimise potential for sediment dispersal. • Water quality controls and monitoring. • No go zones and exclusion zones. • Marine fauna vessel distance and right away for construction and operation. • Erosion and sediment control plans. • Seasonal considerations. • All materials where practicable will be completely removable	Contractor	Pre-construction Construction

Impacts	Mitigation	Responsibility	Timing
	• Efforts to ensure materials are clean (no risk of contaminants)and where possible and low on fines present in the material Additional protocols for marine fauna observers to ensure underwater noise and construction vessel exclusion zones are active to protect surface visible species.		
Habitat degradation and turbidity on sensitive environments relate to vessel wash and disturbance: Construction	Construction: • Establish and work around NO ANCORING locations to minimise impacts from anchor points within Large TEC seagrass meadow of Posidonia Australis at Kurnell • Establish and work around NO ANCORING locations to minimise impacts from anchor points within small seagrass meadow of Posidonia Australis at La Perouse • Minimise fixed location of barges tot the minimum time at on location to minimise shading impacts Operation: • Establish areas of no wash zones near La Perouse to minimise wash effects on the coastal subtidal and intertidal reef areas. • Establish no was zone near Watts Reef near Kurnell to minimis wash effects on the subtidal habit on the reef. • Establish no wash zones near both jetties to minimis excess wash from the Ferry and recreational vessel access.	Contractor Transport for NSW	Pre-construction Construction Operation
Marine pests	• Vessel location history should be checked prior to coming to site to determine risk of transferring marine pest species • All vessel coming to site should be cleaned and or check for invasive species on the hull.	Contractor Transport for NSW	Pre-construction Construction Operation

Impacts	Mitigation	Responsibility	Timing
Habitat degradation and turbidity on sensitive environments relate to vessel wash and disturbance: Operations	Establish suitable navigation channel to avoid areas of listed species habitat, including; Kurnell • Watts reef (likely Black Rockcod habitat) • Large TEC seagrass meadow of Posidonia Australis La Perouse • Avoid accessing near reef habitat • No access over patch of Posidonia Australis to the east of the wharf At both locations • Reduce approach speed of vessels once beyond the 4.5m contour to a no wake speed.	Transport for NSW	Pre-construction Construction Operation
Increased Marine debris	The design will need to account for suitable waste disposal facilities signage, and onsite maintenance to help reduce the risk of waste entering the water.	Transport for NSW	Detailed design

6.2 Summary of additional management plans and studies

Table 30 provides a list of additional management plans which area likely to be required during future stages of the project.

Table 30. Additional management plans likely to be required.

Management Plan	Description
Underwater Noise Management Plan	The underwater noise technical assessment has provided some estimations around observation zones and exclusion zones. It is highly recommended that validation study is complete to better refine these zones and clarify with the contractor where the approximate location for marine fauna observers should be located and protocols. The plan should also include stop work triggers these may include: • A marine mammal approaching the work site and is within the exclusion zone • Observations of any dead fish • Stressed behaviours of any species under observation of the marine fauna observers.
Underwater Noise validation assessment and or additional monitoring of confirmed piling and construction methods	To inform the contractor of the required observation and exclusion zones to protect marine megafauna.
Biosecurity Management Plan	For the control and mitigation of marine pests for construction and operation phases

7 Offset Strategy

The project will result in residual impacts to *Posidonia australis* TEC (EPBC Act), Type 1 and Type 2 habitats and White's Seahorse. These will result in the requirement for offsets.

A Draft Marine Biodiversity Offset Strategy (MBOS) will be prepared and submitted with the EIS to account for the State offset requirements and to support potential Commonwealth requirements. The Draft MBOS will provide the State with an agreed path forward for how the project will work towards minimising financial offsets and provided a site base solution that is meaningful to the region and particular to the project area. This document will also streamline the process for setting conditions of approvals to the project.

7.1 Commonwealth

Once the project determination has been confirmed the likely offset requirements can be confirmed. Offsets for the Commonwealth will be in accordance with the EPBC *Environmental Offsets Policy* (DSEWPC, 2012). The MBOS will provide oversite to solutions and programs to likely offsets and controls to mitigate residual impacts on MNES.

7.2 State

In NSW, offsets for marine biodiversity will be managed through the Department of Primary Industries (Fisheries) in accordance with the FM Act and related policies such as the *Policy and guidelines for fish habitat conservation and management* (update 2013) and Guidance as described in the *NSW Biodiversity Offsets Policy for Major Projects, Fact sheet: Aquatic biodiversity* (DPI, 2013).

Key Fish habitats classified as a Type 1 and Type 2 sensitivity as described in sections 4.4.4 will require a compensatory offset. The policy and guidelines require a minimum 2:1 offset for Type 1–3 key fish habitats to help redress both direct and indirect impacts of development. TfNSW has commenced discussions with Fisheries to develop a suitable MBOS to address the guidelines and requirements of the relevant marine offsets policy.

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Appendix A

Habitat Assessment Summary Memos

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Excellence in your environment

Andrea McPherson
Senior | Aquatic Ecologist | Environment and Resources
Arup Pty Ltd Brisbane
Via email: Andrea.McPherson@arup.com

04 February 2021

Re: Kamay Ferry project – Survey results

Dear Andrea,

Niche Environment and Heritage has prepared this report for ARUP to support the environmental assessment of the Kamay Ferry Project (the project).

Background

The Kamay Ferry Project aims to connect Kurnell to La Perouse by ferry. ARUP on behalf of Transport for NSW are currently undertaking EIS investigations for the Project. Niche was commissioned to provide additional surveys of the following:

- Seagrass community composition
- Mapping of seagrass distribution

The aim of the additional surveys was to undertake a second survey of seagrasses inside the Project Area, to determine seasonal changes in seagrasses.

Field Survey Methods

Table 1 shows the field methods used as part of the survey and mapping.

Table 1: Field survey methods

Task	Methods	Survey date
Seagrass community composition	Seagrass community composition was quantitatively surveyed at the eight sites previous sampled and two additional sites (that included *Posidonia australis* just outside the project area) (Figure 1, Figure 2). Data was collected via photoquadrats (0.25m^2) using a drop camera system with high definition imagery. Sites were defined as within a 15m radius. Photo quadrats were analysed using Coral Point Count with Excel Extensions (CPCe) to determine percent cover of each seagrass species. A total of 30 photoquadrats stratified to seagrass were analysed for each site.	3-10 December 2020.
Mapping of seagrass distribution	Data was collected using handheld devices operating with GIS based data collection software (Arc Collector) with GPS (+/-3m) Observations of the seabed were made using a combination of a bathoscope and a towed camera system that provided live video feed to the surface. The camera system was towed along transects that traversed the Study Area. Benthic habitat was assigned to categories of soft sediment, seagrass, macroalgae or rock/reef. Other habitats of interest e.g. soft corals and sponge gardens were noted. For seagrass habitat, seagrasses were assigned a species label using the dominant seagrass species, with other species noted when they occurred in mixed beds. In addition to seagrass species, seagrass density (low, medium or high) was assigned.	3-10 December 2020.

	Data collected in the field was digitised onto aerial imagery and interpreted in ArcGIS (geographical mapping software) to determine locations of seagrass boundaries.	

Results

Seagrass Communities

La Perouse

The total density of seagrass at La Perouse (inside Frenchman's Bay) ranged between 15% and 42% in this survey. The seagrass community inside Frenchman's Bay was dominated by *Halophila* sp. *Halophila* sp. was found to be growing in higher densities at Site 1 (LP 1) and 2 (LP2) inside Frenchman's Bay, and was lowest at Site 4 (LP4) (Table 2). At Site 4, adjacent to the proposed wharf finger, *Halophila* sp. was the dominant species with 22% cover while the sparse and very patchy *Zostera capricorni* was less than 1% cover. Very low densities of sparse and patchy *Z. capricorni* were also detected at Sites 1 and 3. Some small patches of low density *Posidonia australis* growing amongst other species of seagrass were found to occur in shallow water in the north-eastern corner of Frenchman's Bay (Site 3, LP3), here *P. australis* had a cover of 10% (Table 2, Figure 1). A new site was established at La Perouse along the north-west shoreline of Frenchman's Bay, just outside the project area (Site 11 (LP11)). This site was dominated by *P. australis* (25% cover) with lower densities of *Halophila sp.* and *Z. capricorni.*

Notable changes compared to August-September 2020 survey included:

- A reduction in density of *Halophila sp.* at Site 1 and Site 4 (Table 2).
- Additional mapping outside the project boundary in December found seagrass beds of mixed *Halophila sp*. and *Z. capricorni* with patches of *P. australis* along the north-west shoreline of Frenchman's Bay.
- Increased distribution of mixed *Halophila sp. and Z. capricorni* seagrass beds within the project boundary (Figure 1.)

Kurnell

In this survey the seagrass community inside the project area at Kurnell was highly variable with densities ranging between 9% and 48% Site 7-9 (K7-K9). A new site was established near the project boundary and south -west of the proposed wharf in the main *P. australis* bed (Site 10, K10. Seagrass here was of much higher density (73%) then that recorded at sites inside the project area (Figure 2). All three species were recorded at all sites, with *P. australis* the dominant seagrass based on density at Site 6, 9 and 10. At Sites 7 and 8, near the proposed wharf, seagrass cover was found to be 17%-28% respectively, with *Halophila* having the highest densities (12% to 14% cover) (Table 2, Figure 2). Site 9, which is located inside, although near the edge of a very large total seagrass cover of 48% with a *P. australis* cover of 37% was found (Table 2).

Notable changes compared to August-September 2020 survey included:

- Increased *Halophila sp*. and *Z. capricorni* density at Sites 7 and 8 (7-10% increase).
- Increased distribution of mixed low density *Halophila sp*. and *Z. capricorni* seagrass within the project area (Figure 2).
- Increased density of *Halophila sp.* in places within the project area (Figure 2).

Table 2: Seagrass data summary

Location	Site	Posidonia		Zostera		Halophila		Total	
		Aut/Sep	Dec	Aut/Sep	Dec	Aut/Sep	Dec	Aut/Sep	Dec
La Perouse	S-LP1	0.00%	0.00%	0.16%	0.40%	47.93%	21.95%	48.09%	22.35%
La Perouse	S-LP2	0.00%	0.00%	0.00%	0.00%	29.20%	23.58%	29.20%	23.58%
La Perouse	S-LP3	10.63%	10.05%	3.85%	2.05%	13.66%	18.99%	28.09%	31.08%
La Perouse	S-LP4	0.00%	0.00%	0.15%	0.53%	27.48%	14.32%	27.63%	14.85%
La Perouse	S -LP11	*	25.22%	*	3.41%	*	12.54%	*	41.16%
Kurnell	S-K6	10.13%	7.51%	1.74%	0.54%	3.38%	1.36%	15.25%	9.41%
Kurnell	S-K7	5.26%	3.62%	1.09%	0.82%	9.24%	12.34%	15.60%	16.78%
Kurnell	S-K8	4.61%	1.27%	2.07%	12.63%	7.17%	14.41%	13.85%	28.31%
Kurnell	S-K9	34.26%	36.47%	1.45%	6.51%	4.15%	5.15%	39.86%	48.14%
Kurnell	S- K10	*	70.35%	*	0.33%	*	2.49%	*	73.17%

* Site not surveyed

336250
336500
336750
6238250
6238000
6237750
6237500
OORANA AVENUE
TASMAN STREET
ELAROO AVENUE
MURRONG PLACE
GOOLAGONG PLACE
ADINA AVENUE
ADINA WAY
S-LP11
S-LP2
S-LP1
S-LP4
S-LP3
ENDEAVOUR AVENUE
GOORAWAHL AVENUE
ANZAC PARADE
ANZAC PARADE
RE ISLAND ROAD

Survey Sites
Project Boundary
Preferred Ferry Design
Ferry Swept Path Envelope
Construction Early Works
Black Rock Cod Habitat

Seagrass Types and Habitats
Halophila
Posidonia
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila

Seagrass Density
High
Medium
Low

niche Environment and Heritage

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m

GDA 1994 MGA Zone 56

Survey Sites and Habitat Mapping: La Perouse
Kamay Ferry Project

Niche PM: Matthew Russell
Niche Proj. #: 5811
Client: Arup Pty Ltd

Figure 1

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MONUMENT TRACK
PRINCE CHARLES PARADE
CAPTAIN COOK LANE
CAPTAIN COOK DRIVE
GANNON STREET
POLO STREET
Survey Sites
Project Boundary
Preferred Ferry Design
Ferry Swept Path Envelope
Construction Early Works
Black Rock Cod Habitat
Seagrass Types and Habitats
Halophila
Posidonia
Posidonia / Halophila
Posidonia / Zostera
Rock / Rubble / Reef
Zostera / Halophila
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GDA 1994 MGA Zone 56
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Survey Sites and Habitat Mapping: Kurnell:
Kamay Ferry Project
Figure 2

v2.0

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Please do not hesitate to contact me if you have any questions.

Kind Regards,

Matthew Russell

Senior Aquatic Ecologist

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Andrea McPherson
Senior | Aquatic Ecologist | Environment and Resources
Arup Pty Ltd Brisbane
Via email: Andrea.McPherson@arup.com

13 October 2020

Re: Kamay Ferry project – Survey results

Dear Andrea,

Niche Environment and Heritage has prepared this report for ARUP to support the environmental assessment of the Kamay Ferry Project (the project).

Background

ARUP are currently working on the project, which aims to connect Kurnell to La Perouse by ferry. Niche was commissioned to provide additional surveys of the following:

- Seagrass community composition
- Detailed mapping of *Posidonia australis* beds in close proximity to the proposed Kurnell Wharf footprint
- Rocky reef Community composition
- Potential threatened species habitat.

The aim of the additional surveys was to:

- Determine and quantify the composition of seagrass communities.
- Map in further detail smaller patchy beds of the endangered seagrass *P. australis* within the footprint and in close proximity to the proposed wharf at Kurnell.
- Determine and quantify the composition of macroalgal communities associated with rocky reef habitat.
- Undertake targeted searches and survey oof potential habitat for threatened black rockcod *Epinephelus daemelii*.
- Make opportunistic observations of associated subtidal habitats, threatened species and temporal changes in communities and their distribution since the first survey.

Field Survey Methods

Table 1 shows the field methods used as part of the survey and mapping.

Table 1: Field survey methods

Task	Methods	Survey date
Seagrass community composition	Seagrass community composition was quantitatively surveyed at eight representative sites within and adjacent to the project area (Figure 1, Figure 2). Data was collected via photoquadrats (0.25m^2) using a drop camera system with high definition imagery. Sites were defined as within a 15m radius. Photo quadrats were analysed using Coral Point Count with Excel Extensions (CPCe) to	4 - 7 August 2020.

	determine percent cover of each seagrass species. A total of 30 photoquadrats stratified to seagrass were analysed for each site.	
Detailed mapping of *Posidonia australis* beds at Kurnell	Detailed mapping of small patches of *P. australis* beds was undertaken within 10m of the proposed footprint of the Kurnell Wharf. A combination of drop-camera and in-water inspection via snorkeler was used to map seagrasses. Additional patches of seagrass were recorded using ArcCollector with GPS (+/- 3m accuracy). Seagrass mapping was updated in ArcMap to reflect this additional detail. Opportunistic observations of temporal changes since previous mapping and evidence of storm damage were also noted during these works.	4- 7 August 2020, 17 September 2020.
Rocky reef community composition	Rocky reef community composition was quantitatively surveyed at nine sites representative of habitat within and adjacent to the project area (Figure 1, Figure 2). Survey transects 30m in length were randomly positioned in two depth zones (shallow: 1-3m and deep:4-6m). Depending on site between two and four transects were surveyed for each depth zone. Surveys data was collected by ADAS Scientific divers. Data collected included: • Counts of kelp (*Ecklonia radiata*) frond within 1m of the transect; • Counts of and long-spined sea urchins (*Centrostephanus rodgersii*) within 1m of the transect; and • High resolution photoquadrats (0.25m^2) of the reef community were recorded using a custom designed diver operated frame every 1m along the transect. Photo quadrats were analysed using Coral Point Count with Excel Extensions (CPCe) to determine percent cover of macroalgae species and other fauna sessile groups. A total of 25 photoquadrats were randomly selected for analysis along each transect.	31 August -2 September 2020
Potential threatened species habitat	Diver searches for black rockcod of rocky reef habitat was undertaken by ADAS Scientific Divers experienced in fish identification. Searches targeted areas of high reef complexity and steep drop-offs. Searches include visual inspection of caves, gutters, deep cracks and around drop-offs. Targeted search effort included approximately 30mins search time at each reef community site (total search effort = 4.5hrs), as well as an additional two x 90-minute (approximate) dives with two divers (total search effort = 6 hrs). The additional dives targeted areas with potential habitat not visited as part of the reef community surveys. Areas with high habitat attributes (gutters, deep cracks, caves, overhangs, drop-offs) for adult Black Rockcod were recorded and mapped in ArcGIS. These additional dives also provided opportunity for opportunistic observation of other species and deeper communities such as some sponge and soft corals.	4 September 2020

Results

Seagrass Communities

La Perouse

The total density of seagrass at La Perouse (inside Frenchman's Bay) ranged between 27% and 48%. The seagrass community inside Frenchman's Bay was dominated by *Halophila* sp. *Halophila* sp. was found to be growing in higher densities on the northern side of Frenchman's Bay, where at Site 1 it neared 50% cover

(Table 2).At Site 4, adjacent to the proposed wharf finger, *Halophila* sp. was the dominant species with 27% cover in comparison to less than 1% cover of the sparse and very patchy *Zostera capricorni*. Very low densities of sparse and patchy *Z. capricorni* were also detected at Sites 1 and 3. Some small patches of low density *Posidonia australis* growing amongst other species of seagrass were found to occur in shallow water in the South-Eastern corner of Frenchman's Bay, where at Site 3, *P. australis* was found to have a cover of 10% (Table 2).

Kurnell

The seagrass cover was typically less at Kurnell (ranging between 13 to 40%), although the community was much more variable in species composition and density. All three species of seagrass were recorded at all sites, *P. australis* the highest densities at Site 6 and 9, and *Halophila* sp. at sites 7 and 8, which were also located adjacent (on opposing sides) to the proposed wharf, while *Z. capricorni* had the lesser cover at all sites (Table 2). At sites 6 and 7, and near to the proposed wharf, seagrass cover was found to be 15% in total, with *Halophila* accounting for between 7% and 10% of cover. At Site 9, which is located inside, although near the edge of the large *P. australis* meadow to the west of the project area , the density of *P. australis* was found to 34%, with a total seagrass cover of 40% (Table 2).

During the surveys in August and September there was anecdotal evidence (based on visual observations) that *Halophila* seagrasses at Kurnell were reduced in distribution in deeper areas, approximately 300m from shore, where it had been mapped previously during May. In shallower areas closer to shore, some large sand patches were noted where seagrass was previously mapped, while some areas of *Posidonia* appeared to have reduced, and in some cases disappeared, or only plants that have been defoliated (e.g. fronds broken away at the base of the shoot) remained (see Plate 1). This is likely a result of storm damage during three low-pressure systems, which impacted the Sydney Coast during late June and July. During mapping works, review of aerial imagery from various dates over recent years indicates that areas near the shore at Kurnell are very dynamic and seagrass distribution may be constantly changing as a result of these storm events.

Updated maps of seagrass distribution and density are provided in Figure 2**.**

Table 2: Seagrass data summary

Location	Site	*Posidonia*	*Zostera*	*Halophila*	Total
La Perouse	S-LP1	0.00%	0.16%	47.93%	48.09%
La Perouse	S-LP2	0.00%	0.00%	29.20%	29.20%
La Perouse	S-LP3	10.63%	3.85%	13.66%	28.09%
La Perouse	S-LP4	0.00%	0.15%	27.48%	27.63%
Kurnell	S-K6	10.13%	1.74%	3.38%	15.25%
Kurnell	S-K7	5.26%	1.09%	9.24%	15.60%
Kurnell	S-K8	4.61%	2.07%	7.17%	13.85%
Kurnell	S-K9	34.26%	1.45%	4.15%	39.86%

Rocky Reef Communities

La Perouse

At La Perouse the rocky reef is most expansive on the western side of La Perouse Headland and towards Bare Island. Inside Frenchman's Bay and along the northerly face of the rock platform where the wharf is proposed subtidal rocky reef is minimal. The majority of rocky substrate occurs in the intertidal area and above the Mean Low Water Mark (MLWM). The majority of subtidal reef in this area is confined to a rocky ledge 1-2m in height that drops on to sand habitat, with some occasional rocky outcrops and areas of rubble accumulations in places. Rocky reef surveys in this area were limited to shallow transects along the bottom of the rocky drop-off, In this area patches of sand and silt were common and the rocky reef was dominated by turfing algae and macroalgae (Table 3). In this area (Site 1), the brown macroalgae *Sargassum* sp. with 18% was the most common macroalgae, while geniculate coralline algae (*Amphiroa anceps* and *Corallina officinalis*) and kelp (*Ecklonia radiata*) were much lesser contributors, accounting for less than 5 % cover (Table 4). This corresponded with findings of the kelp frond counts of 2 plants per m^2 (Table 5). The closest area of expansive subtidal rocky reef community to the proposed wharf at La Perouse is approximately 50m to the south-west (Site 2). This rocky reef area consists of gradually sloping and shallow sandstone rock formations and boulders that extends up to 100m from the shore, where it meets the sand in relatively shallow water (approximately 4m depth). In this area, macroalgae accounted for 59% to 77% of cover (Table 3), with kelp accounting for 40% and *Sargassum* sp. 19% of cover (Table 4). This also corresponded with increased density counts of kelp, which was measured at 7 fronds per m^2 (Table 5). At the other sites around La Perouse (Sites 3 and 4), macroalgae represented up to 87% cover in rocky reef areas (Table 3), of which kelp was the major contributor (Table 4). Other alga species that were common within subtidal areas of the La Perouse rocky reef community included geniculate coralline algae, the red *Plocamium* sp., the brown *Colpomenia* sp. and encrusting algae including encrusting coralline algae (Table 4).

The fifth La Perouse site (Site 5) was located on the north western side of Frenchman's Bay, adjacent to Yarra Point. The subtidal reef here was refined to shallow ledges and rubble accumulations that typically did not extend more then 5m seaward of the rock platform. At this site the rocky reef habitat consisted of 24 % to 54% macroalgae cover (Table 3), with *Sargassum* spp. the highest contributor to this cover, followed by geniculate coralline algae. Kelp contributed less than 5% cover in this area (Table 4) and occurred at densities of less than 1 plant m^2 (Table 5).

The barren forming urchin *Centrostephanus rodgersii*, which is known to graze and remove kelp cover quickly on temperate coastal reefs was only found, and in very low numbers at Site 3, in this area (Table 5).

Kurnell

Along the shoreline at Kurnell, near Captain Cooks Landing the subtidal rocky reef is typically very patchy, confined to shallow areas less than 2m in depth, and does not extend more than 50m beyond the MLWM. At the sites in this area (Sites 1 and 2), the rocky reef habitat beyond the -1m contour was typically broken areas of reef consisting of sand scoured sandstone rockshelf and areas of rubble. In this area accumulations of sand silt still accounted for a large proportion of benthic habitat, with macroalgae typically limited to less than 50% cover (Table 3). The brown macroalga *Sargassum* spp. was the dominant macroalga, with other brown macroalgae of *Colpomenia* sp. and *Dictyota dichotoma* notable contributors in this area (Table 5). At the time of survey kelp and urchins were rare, and not recorded during counts in this area (Table 5).

During the surveys in August and September there was anecdotal evidence that areas of kelp had reduced in shallow areas around Captain Cooks Landing and towards Sutherland Point. This appears to be indicative of storm damage mentioned above.

The remaining rocky reef survey sites at Kurnell were located of Sutherland Point along the shoreline east of the project area (Site 3), and on Watts Reef, approximately 500m offshore (Site 4). The reef of Sutherland Point is much more extensive extending over 100m from the shore. The reef includes a series of sandstone rock shelves with numerous drop-offs and overhangs. In places vertical drop-offs of 4 to 5 m occur into deeper water and boulder field habitat that extends to the north and out into the main channel of Botany Bay. In this area macroalgae accounted for up to 65% of cover, while some corals and sessile invertebrates (Table 3) such as sponges and ascidians (near where transects approached the sponge gardens, described below) were recorded. The most common macroalgae species at this site was found to be kelp, irrespective of depth zone. This corresponded with kelp count finding of 3 plants per m^2, while urchin density was very low (Table 5). The brown macroalgae *Sargassum* spp., *Colpomenia* sp., the red macroalga *Plocamium* sp. and encrusting algae were almost found to be notable contributors to the macroalgae assemblage.

Between Sutherland Point and Inscription Point between the 6 and 12m depth contours diverse sponge gardens were found associated with the deeper reef habitats. The community consisted of a mixture of sponges (encrusting, tubular, arborescent and papillate growth forms), stalked ascidians, and branching soft corals (*Capnella gaboensis*). (See Plate 2).

The final Kurnell site was confined to the deeper survey zone on the outer section of Watts Reef (Site 4). This reef consisted of steep rises on its north and easterly sides, where habitat complexity, of gutters, overhangs, drop-offs, caves, and steep rises was the greatest, with deep gutters continuing across the crest of the reef (Plate 3). At this site macroalgae represented up to 87% of benthic cover (Table 3), with kelp representing up to 52% of cover. This corresponded with kelp count finding of close to 4 plants per m^2, while urchin density was typically less than $1m^2$ (Table 5). The brown macroalgae *D. dichotoma and Sargassum* spp., and red macroalga *Plocamium* sp. were also notable contributors to the macroalgae assemblage.

Table 3: Rocky reef community composition

Site	Transect	Depth Zone	Rock and Rubble	Gravel and Shell	Sand and Silt	Corals	Sessile Invertebrates	Turfing Algae	Macroalgae	Seagrass
R-LP1	T1	Shallow	2.61%	9.31%	27.61%	0.00%	0.65%	35.46%	24.35%	0.00%
R-LP1	T2	Shallow	0.82%	1.96%	26.92%	0.00%	0.00%	31.97%	38.34%	0.00%
R-LP2	T1	Shallow	0.50%	1.49%	25.91%	0.00%	0.17%	13.04%	58.91%	0.00%
R-LP2	T2	Shallow	4.60%	1.31%	18.06%	0.00%	0.16%	13.79%	62.07%	0.00%
R-LP2	T3	Shallow	2.40%	3.84%	13.60%	0.00%	0.00%	3.36%	76.64%	0.16%
R-LP3	T1	Deep	1.60%	4.79%	5.67%	0.00%	0.00%	0.71%	87.23%	0.00%
R-LP3	T2	Deep	1.46%	1.46%	10.40%	0.00%	0.00%	6.02%	80.66%	0.00%

R-LP3	T3	Shallow	2.28%	2.77%	1.63%	0.00%	0.16%	66.39%	26.75%	0.00%
R-LP3	T4	Shallow	0.70%	5.75%	0.00%	0.00%	0.70%	35.71%	57.14%	0.00%
R-LP4	T1	Deep	2.33%	1.00%	19.17%	0.00%	0.17%	4.50%	72.83%	0.00%
R-LP4	T2	Deep	2.55%	1.02%	34.69%	0.17%	1.19%	6.63%	53.74%	0.00%
R-LP4	T3	Shallow	1.15%	1.15%	13.79%	0.00%	0.49%	7.72%	75.70%	0.00%
R-LP4	T4	Shallow	0.84%	2.35%	17.95%	0.00%	1.17%	8.89%	68.79%	0.00%
R-LP5	T1	Shallow	5.97%	2.49%	14.76%	0.00%	2.32%	30.02%	44.44%	0.00%
R-LP5	T2	Shallow	0.67%	1.17%	3.17%	0.00%	0.83%	40.57%	53.59%	0.00%
R-LP5	T3	Shallow	22.99%	7.06%	18.72%	0.00%	0.99%	25.94%	24.30%	0.00%
R-K1	T1	Shallow	0.00%	0.18%	29.21%	0.00%	0.55%	24.77%	45.10%	0.18%
R-K1	T2	Shallow	0.00%	0.55%	43.25%	0.00%	0.00%	27.17%	28.84%	0.18%
R-K1	T3	Shallow	0.00%	0.17%	58.64%	0.00%	0.00%	30.68%	10.34%	0.17%
R-K2	T1	Shallow	0.00%	0.34%	53.49%	0.00%	0.00%	36.29%	9.54%	0.34%
R-K2	T2	Shallow	0.00%	0.00%	53.52%	0.00%	0.00%	27.18%	19.30%	0.00%
R-K2	T3	Shallow	0.34%	6.20%	28.31%	0.00%	0.00%	42.71%	22.45%	0.00%
R-K3	T1	Shallow	0.34%	1.36%	19.32%	0.00%	0.00%	36.27%	42.71%	0.00%
R-K3	T2	Shallow	0.17%	1.01%	10.64%	0.00%	10.14%	62.84%	15.20%	0.00%
R-K3	T3	Deep	0.65%	7.98%	11.40%	0.00%	0.16%	15.31%	64.50%	0.00%
R-K3	T4	Deep	1.64%	6.39%	26.39%	0.82%	0.16%	17.21%	46.23%	1.15%
R-K4	T1	Deep	1.79%	1.95%	0.49%	0.00%	0.00%	41.53%	54.23%	0.00%
R-K4	T2	Deep	3.71%	3.20%	4.22%	0.00%	0.84%	35.58%	52.45%	0.00%
R-K4	T3	Deep	5.23%	1.31%	2.94%	0.00%	0.00%	4.25%	86.27%	0.00%
R-K4	T4	Deep	3.01%	1.17%	25.59%	0.00%	0.33%	45.65%	24.25%	0.00%

Table 4: Macroalgae groupings/ species contributing to the majority of cover at each site/ depth zone.

Site	Depth Zone	Species 1	Cover	Specie 2	Cover	Species 3	Cover
R-LP1	Shallow	Sargassum	17.79%	Geniculate Coralline	4.33%	Ecklonia	3.67%
R-LP2	Shallow	Ecklonia	40.52	Sargassum	19.29%	Geniculate Coralline	1.92%
R-LP3	Deep	Ecklonia	77.41%	Plocamium	5.73%	Other Encrusting Algae	0.44%
R-LP3	Shallow	Ecklonia	17.80%	Sargassum	13.54%	Colpomenia	3.79%

R-LP4	Deep	Ecklonia	55.24%	Encrusting Coralline	2.61%	Plocamium	1.68%
R-LP4	Shallow	Ecklonia	49.74%	Zonaria	6.61%	Sargassum	4.78%
R-LP5	Shallow	Sargassum	18.93%	Geniculate Coralline	8.28%	Ecklonia	3.84%
R-K1	Shallow	Sargassum	21.05%	Dictyota	2.74%	Colpomenia	1.38%
R-K2	Shallow	Sargassum	8.70%	Colpomenia	3.13%	Dictyota	2.58%
R-K3	Deep	Ecklonia	42.79%	Plocamium	6.53%	Sargassum	3.35%
R-K4	Deep	Ecklonia	51.13%	Plocamium	0.88%	Dictyota	0.67%

Table 5: Average abundance of kelp community indicator species and macroalgae with the highest density at each site.

Location	Site	Kelp m^2	Urchins m^2
La Perouse	R-LP1	2.27	0.00
La Perouse	R-LP2	7.04	0.00
La Perouse	R-LP3	10.06	0.03
La Perouse	R-LP4	8.29	0.00
La Perouse	R-LP5	0.79	0.00
Kurnell	R-K1	0.00	0.00
Kurnell	R-K2	0.00	0.00
Kurnell	R-K3	3.32	0.01
Kurnell	R-K4	3.75	0.09

Threatened and protected fish habitat

Black Rockcod

No black rockcod were observed during the surveys.

There was minimal potential habitat for adult for black rockcod in the immediate vicinity of the proposed wharf at La Perouse as subtidal reef in this area was minimal and typically confined to one shallow ledge. Potential habitat for adult black rockcod was found in areas on the western and south-western side of the La Perouse (Figure 1). This subtidal reef habitat with suitable, gutters, ledges, caves etc that could be used by adult black rockcod (Plate 4) commenced approximately 150m to the south-west of the proposed La Perouse wharf footprint. In general, the black rockcod habitat was confined to areas between the 5m depth contour and sand line at 8-12m depth.

The reef at Yarra Point had a minimal potential habitat for black rockcod as it typically lacked enough complexity, however, some deep caves were noted in shallow (approximate 2m depth) water near its most south-westerly extent that provided a small amount of potential habitat for black rockcod (Figure 1).

There was minimal potential habitat for adult for black rockcod in the immediate vicinity of the proposed wharf at Kurnell as subtidal reef was confined to shallow areas, typical of low relief and/or consisted of sand scoured areas of broken reef. Potential habitat for adult black rockcod was found in areas adjacent to Sutherland Point and extending east and on the outer areas of Watts Reef (Figure 2).

Whites seahorse

No Whites seahorse were observed during surveys. Although they are known to occur in the area.

Whites seahorse is known inhabit structures, seagrass, canopy forming macroalgae (e.g. kelp) and soft coral habitats. Artificial structures in the proximity to the proposal are confined to vessel moorings, which provide moderate- low habitat.

At La Perouse seagrasses provide minimal habitat as they are predominately the smaller *Halophila* sp., while the longer and more habitat forming species of *Zostera* and *P. australis* are typically of low density and of very patchy occurrence. Isolated denser stands of *Zostera* and *P. australis*, canopy forming kelp and macroalgae, as well as soft corals in deeper water likely offer the most suitable habitat for Whites seahorse around La Perouse.

At Kurnell, seagrasses, especially stands of medium to high density *P. australis* are likely to provide good quality habitat for Whites seahorse in this area. Areas with canopy forming kelp and soft corals in deeper areas to the east of the project area and on Watts Reef are also likely to provide good quality habitat for Whites seahorse. Although storm effects may impact establishment of this species in shallow areas around Kurnell.

Weedy Seadragon

No weedy seadragons were observed during surveys. Although they are reported to occur in the area.

Potential habitat for the weedy seadragon appeared to be of the better quality in rocky reef areas where kelp was the dominant species (see Table 5). These areas in general were on the western and south-western side of La Perouse, and around Sutherland Point and Watts Reef near Kurnell.

Other syngnathids

No other syngnathids were observed during surveys.

The higher density and more expansive beds of *P. australis* seagrass around Kurnell (Figure 2) are likely to provide the most significant habitat in shallow water for other syngnathid fishes.

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Survey Sites and Habitat Mapping: La Perouse
Kamay Ferry Project

Figure 1

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Survey Sites and Habitat Mapping: Kurnell:
Kamay Ferry Project

Figure 2

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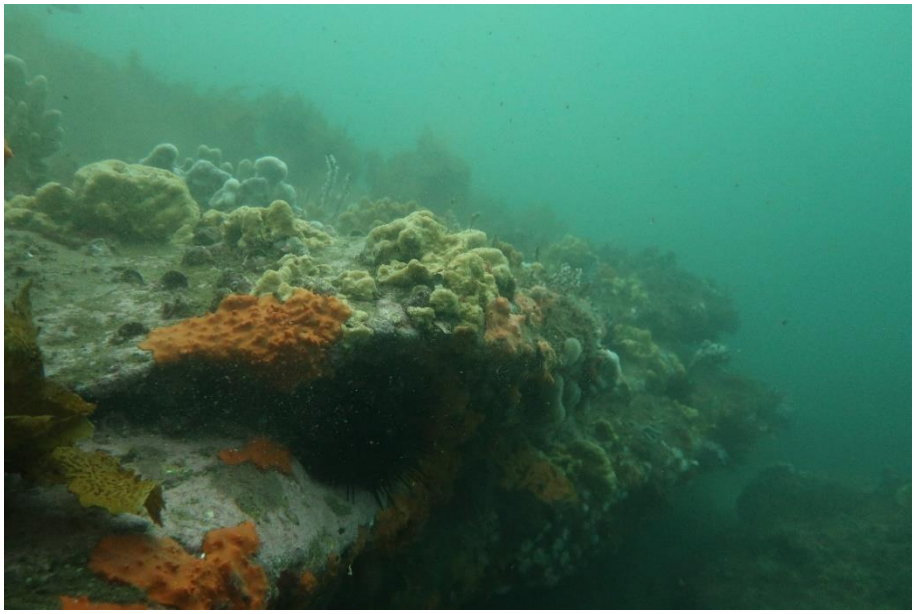
Plate 1: Storm damaged *Posidonia australis* at Kurnell



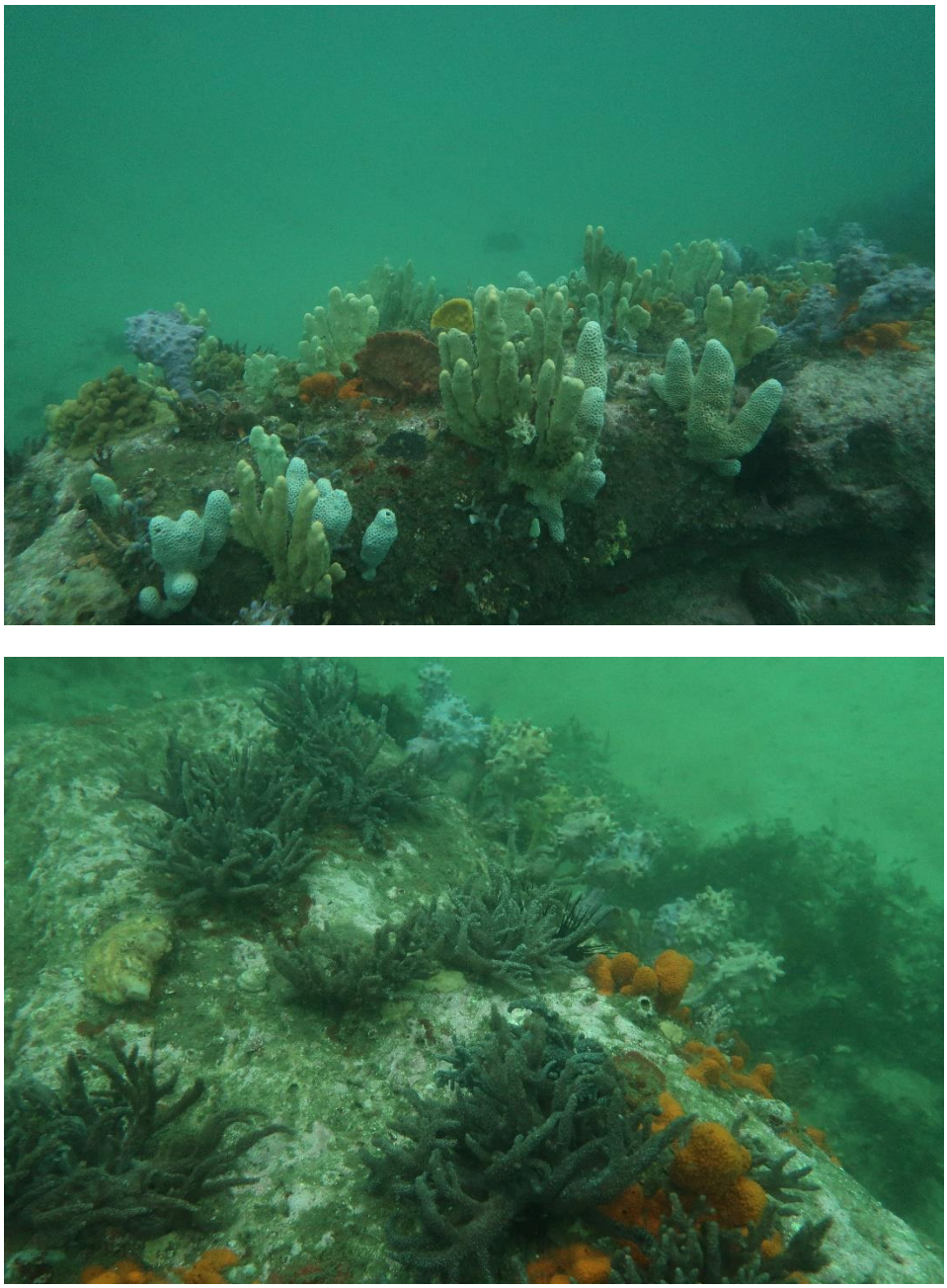


Plate 2: Sponge gardens and soft coral near Sutherland Point.

Plate 3: Photos of Watts Reef.

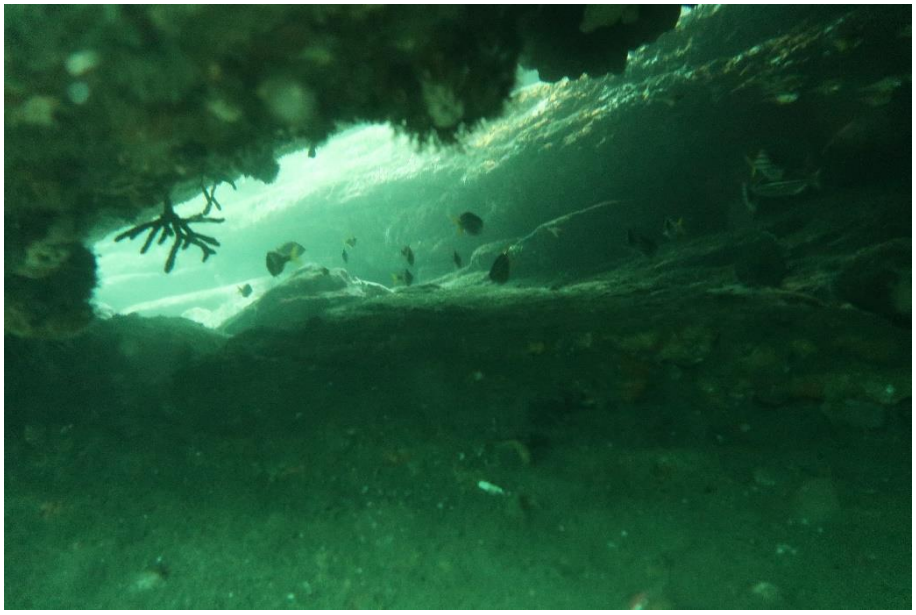


Plate 4: Caves and gutters providing potential Black Rockcod habitat.

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Please do not hesitate to contact me if you have any questions.

Kind Regards,

Matthew Russell

Senior Aquatic Ecologist

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Andrea McPherson
Senior | Aquatic Ecologist | Environment and Resources
Arup Pty Ltd Brisbane
Via email: Andrea.McPherson@arup.com

12 June 2020

Re: Kamay Ferry project – Survey results

Dear Andrea,

Niche Environment and Heritage has prepared this report for ARUP to support the environmental assessment of the Kamay Ferry Project (the project).

Background

ARUP are currently working on the project, which aims to connect Kurnell to La Perouse by ferry. Niche was commissioned to conduct an aquatic habitat survey and mapping of potential terminal locations at both Kurnell and La Perouse (Figure 1, Figure 2). The Study Area includes subtidal and intertidal habitat within the area identified in Figure 1 and Figure 2.

The aim of the aquatic survey was to:

- Confirm the habitat present to identify the likelihood of occurrence, and risks to, threatened species.
- Confirm if the *Posidonia australis* Threatened Ecological Community and Population in Botany Bay is present and if so, the extent at both locations.
- Ground truth the benthic communities/ habitats for mapping purposes.
- Describe the condition of habitats present.

Field Survey Methods

Table 1 shows the field methods used as part of the survey and mapping.

Table 1: Field survey methods

Task	Methods
Mapping and characterisation of sub-tidal habitat	Data was collected using handheld devices operating with GIS based data collection software (Arc Collector) with GPS (+/-3m) Observations of the seabed were made using a combination of a bathoscope and a towed camera system that provided live video feed to the surface. The camera system was towed along transects that traversed the Study Area. Benthic habitat was assigned to categories of soft sediment, seagrass, macroalgae or rock/reef. Other habitats of interest e.g. soft corals and sponge gardens were noted. For seagrass habitat, seagrasses were assigned a species label using the dominant seagrass species, with other species noted when they occurred in mixed beds. In addition to seagrass species, seagrass density (low, medium or high) was assigned. Data collected in the field was digitised onto aerial

	imagery and interpreted in ArcGIS (geographical mapping software) to determine locations of seagrass boundaries.
Description of foreshore habitat	The intertidal zone was surveyed during low tide, recording habitat and common species in each zone.
Benthic infauna and sediment sampling	Sediment samples were collected using a Ponar Grab deployed from a small vessel. Following collection, samples were homogenised in a bucket in preparation for chemical and infauna analysis.
Benthic infauna	Five sediment samples of 2L volume were taken at each proposed wharf location for benthic infauna (Figure 1 and Figure 2. Samples were sieved through a one-millimetre gauge sieve on site to collect benthic infauna specimens. The remaining material was carefully washed into a labelled container and preserved in 100% ethanol. Once preserved, samples were shipped with Chain of Custody (CoC) forms to a specialised laboratory for identification and quantification of fauna present by a specialist infaunal taxonomist.
Particle size distribution	One sample was taken at each location. Samples for PSD analysis were bagged, labelled, and shipped to a National Association of Testing Authorities (NATA) accredited laboratory with CoC forms.
Fish	Opportunistic description of the fish assemblage at the time of survey were made.

Results

Field surveys were conducted 6 May 2020 to 8 May 2020.

Habitat Descriptions

Kurnell

Subtidal habitat mapping and location of benthic sampling at Kurnell is provided in Figure 1.

Intertidal area

The intertidal area at Kurnell consisted of a rocky shoreline along the majority of the Study Area and extended around Inscription Point to the east. This included sandy beach that forms the eastern end of Silver Beach to the west.

The rocky shoreline was a partially protected rock-shelf comprised of typically a gradually sloping and eroded sandstone rock shelf. It ranges in width between 10 and 30m and included sandy gutters and rubble accumulations, especially in areas to the west with less influence from swells wrapping around Inscription Point.

The high intertidal zone on the Kurnell side consisted of typically sands and a modified shoreline where shore stabilization works have occurred. As a result, natural rocky formations in the high intertidal zone were minimal. Common and abundant species in the high intertidal zone were the little blue periwinkle (*Nodilittorina unifasciata*) and the stripe-mouth conniwink (*Bembicium nanum*).

Common and abundant species in the mid-intertidal zone included the Sydney rock oyster (*Saccostrea glomerata*), *B. nanum*, variegated limpet (*Cellana tramoserica*), zebra snail (*Austrocochlea porcata*), black

nerites (*Nerita atramentosa*), purple four plated barnacle (*Tetraclitella purpurascens*) and the honeycomb barnacle (*Chamaesipho tasmanica*). Given the more gradual sloping rock shelf, pooling of water at its rear and the modified higher shoreline the mid intertidal zone was not as defined at this site in comparison with the La Perouse site. As a result, there is substantial overlap of these species with the other intertidal zones.

In the low zone the Sydney rock oyster (*Saccostrea glomerata*) was the most visually abundant sessile fauna species. Other common sessile fauna species included the owl limpet (*Patella peronii*), rose barnacle (*Tesseropora rosea*), *B. nanum*, *A. porcata*, *C. tramoserica* and the mulberry whelk (*Morula marginalba*). Near the low water mark cunjevoi (*Pyura stolonifera*), brown macroalgae *Hormosira banksii* and coralline algae (*Amphiroa sp*.) also formed dense mats in areas.

Subtidal rocky reef

The subtidal rocky reef of the Kurnell side included three district areas. These were:

- Broken reef and rock amongst sandy sediments
- Fringing subtidal reef along the shoreline
- Offshore rocky reef rises.

Broken reef and rock amongst sandy sediments

This area was confined to areas at the end of Silver Beach and adjacent to the shore in the Study Area. These areas typically occurred above the 2m depth contour and consisted of isolated rocks and rock shelf creating kelp dominated patches of reef (*Ecklonia radiata*) near the shore. It also included some low relief sections of sand scoured rock shelf with sections dominated by turfing brown algae.

Fringing subtidal reef along the shoreline

The fringing subtidal reefs were confined to areas to the east of the Study Area near Sutherland Point and where steep benthic gradients occurred. This area was typically a more complex and higher relief rocky reef with some ledges, gutters, caves and potential overhangs, which typically terminated with steep drop-offs on to deeper soft sediments. This area was dominated by kelp, with storm damage (frond removal leaving stipes and stalks) evident in patches. Other common macroalgae included the brown seaweeds *Padina* sp. and Sargassum sp. and red seaweeds *Amphiroa sp*. and *Plocamium sp*.

This area also included some sponge gardens that consisted of encrusting, massive, tubular and arborescent sponges.

Offshore Rocky reef rise

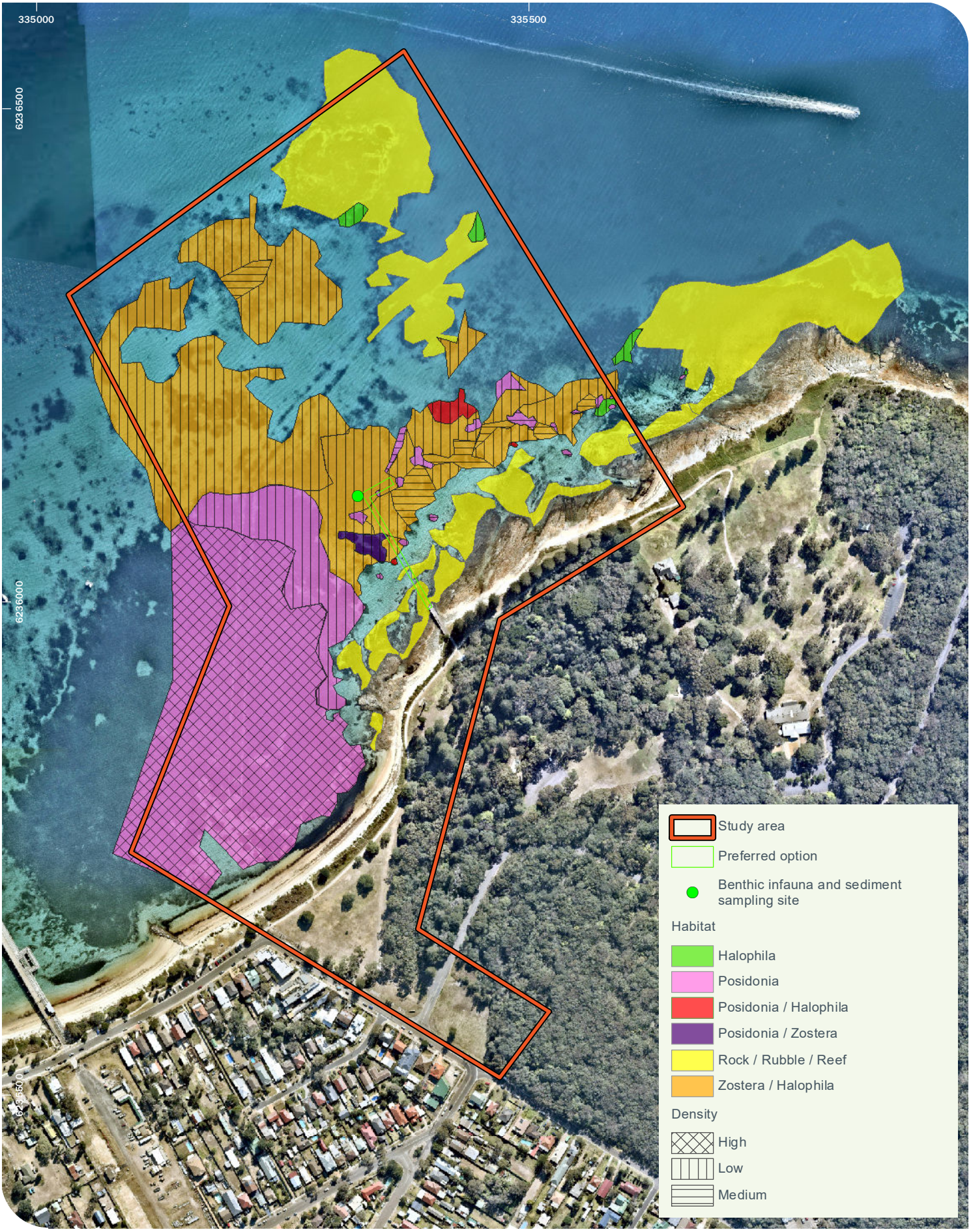
An offshore area that rises up with a high relief rocky reef occurs in the north-eastern section of the Study Area. On its eastern side this reef rises rapidly from 6 to 8m depths to 2-3m depth at its crest, providing a complex and high relief area of reef with boulders, gutters, and ledges. In this area and on the crest of the reef, kelp was the most abundant species, with red macroalgae (*Plocamium sp*. and *Laurencia sp*.) notable in the understory. The complexity and steepness in gradient was typically less on the reefs western side and areas to the south, where the benthic habitat is more typical of a mixed rocky reef and sand habitat. In these areas the brown macroalgae *Padina* sp. and *Sargassum* sp. were the most common species.

Seagrasses

Seagrasses on the Kurnell side were widespread throughout the Study Area and included *Posidonia australis*, *Zostera capricorni* and *Halophila spp* (likely mostly consisting of *H. ovalis*).

Posidonia australis was typically confined to a large medium (15-50% cover) to high (>50% cover) density bed on the western side of the Study Area. Smaller and what appeared to be typically isolated patches of low (<15% cover) to medium density *P. australis* continued amongst other seagrasses along the shoreline to the east. In general *P. australis* was typically confined to depths of less than 3m at Kurnell.

Mixed patchy seagrass beds of low to medium density *Z. capricorni* and Halophila spp. extended into deeper areas, beyond the large *P. australis* bed and towards the east. In shallower areas closer to shore, *Z. capricorni* was typically the more abundant species with higher densities, while in deeper areas (especially beyond the 5m depth contour) *Halophila spp.* was typically more abundant with higher density.



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Benthic habitat surveys - Kurnell

Kamay Ferry Project

Niche PM: Matthew Russell
Niche Proj. #: 5811
Client: Arup Pty Ltd

Figure 1

La Perouse

Subtidal habitat mapping and location of benthic sampling at Kurnell is provided in Figure 2.

Intertidal area

The intertidal area in the Study Area at La Perouse consisted of a rocky shoreline on the western side of La Perouse Headland and a sandy beach along the shore of Frenchmans Bay.

The rocky shoreline was a typical weathered sandstone rock-shelf shoreline of the Hawkesbury-Shelf bioregion. It ranges in width between 10 and 40m and becomes steeper with higher relief and more complexity (e.g. cervices, gutters and cracks and ledges) in more exposed areas towards the south-west.

Common and abundant species in the high intertidal zone where the little blue periwinkle (*Nodilittorina unifasciata)* and the pyramid periwinkle (*N. pyramidalis*) and the six-plated barnacle (*Chthamalus antennatus*).

Common and abundant species in the mid-intertidal zone were the rose barnacle (*Tesseropora rosea*) and honeycomb barnacle (*Chamaesipho tasmanica*). The variegated limpet (*Cellana tramoserica*), sea snail black nerites (*Nerita atramentosa*), zebra snail (*Austrocochlea porcata*) and stripe-mouth conniwink (*Bembicium nanum*). Some waratah anemones (*Actinia tenebrosa*) were also noted in the rock pools in the mid intertidal zone.

In the low zone the Sydney rock oyster (*Saccostrea glomerata*) was the most abundant sessile fauna species. Other common sessile fauna species included *B. nanum*, *A. porcata*, *C. tramoserica* and the mulberry whelk (*Morula marginalba*). Near the low water mark cunjevoi (*Pyura stolonifera*) and coralline algae (*Amphiroa sp*.) also formed dense mats in areas.

A notable observation was a pair of sooty oystercatchers (*Haematopus fuliginosus*) foraging on the rock platform at low tide.

Subtidal rocky reef

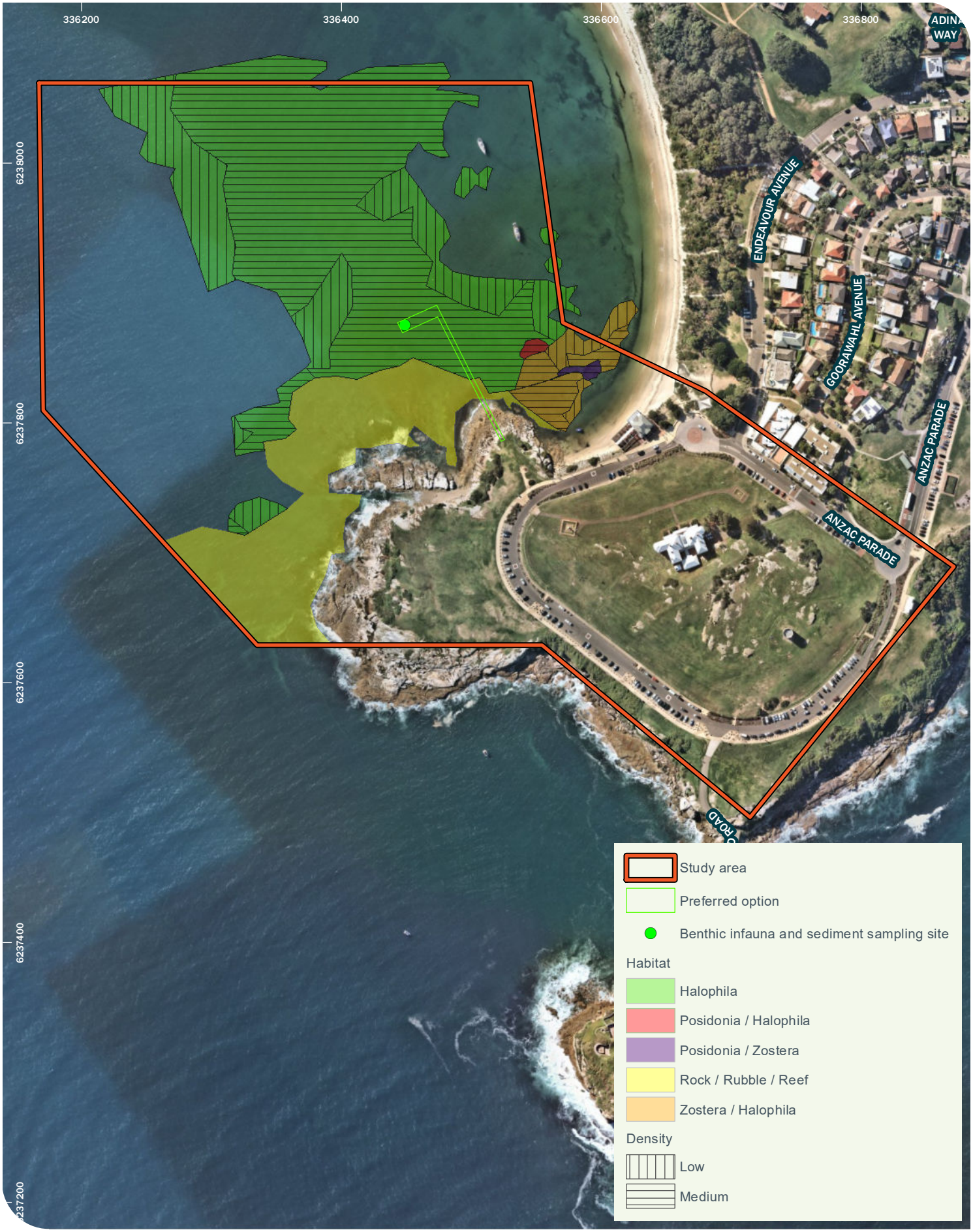
A fringing rocky reef occurred around the foreshore of the La Perouse Headland. This rocky reef typically extended 50m seaward to soft sandy sediments, where in many places steep drop-offs occurred. The rocky reef was observed to have areas of high relief and substantial complexity from the presence of gutters, crevices, large boulders and drop-offs.

The rocky reef was dominated by kelp (*Ecklonia radiata*) in shallower areas and turfing brown algae, in deeper areas. Other abundant macroalgal species included *Dictyota dichotoma*, *Amphiroa sp*. and *Saragssum sp*.

Some barrens were also observed likely as a result of the common temperate grazing species, the long-spined sea urchin (*Centrostephanus rodgersii*). In some areas patches of kelp appeared to be defoliated, with fronds being removed and leaving only the holdfast and stipes, likely as a result of disturbance from storms and large swells.

Seagrasses

Seagrasses were widespread from the edge of the rocky reef to approximately the 6 m contour. These seagrasses were growing with a patchy distribution in low (<15%) to medium (15-50%) cover. *Halophila* spp. (likely mostly consisting of *H. ovalis*) was the dominant species throughout much of soft sediment habitat, especially in the deeper areas. *Zostera capricorni* was typically confined to the southern corner along Frenchmans Bay Beach and was growing with *Halophila* spp. Some small isolated patches of *Posidonia australis* were also found growing amongst other seagrasses in this area.



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Benthic habitat surveys - La Perouse

Kamay Ferry Project

Niche PM: Matthew Russell
Niche Proj. #: 5811
Client: Arup Pty Ltd

Figure 2

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Fish Observed during surveys

Table 2 shows the fish observed during the field surveys.

Table 2: Fish observed

Common Name	Species	La Perouse	Kurnell
Blue groper	*Achoerodus viridis*	Observed	Likely to occur
Yellowfin bream	*Acanthopagrus australis*	Observed	Observed
Luderick	*Girella tricuspidata*	Observed	Observed
Black drummer	*Kyphosus sydneyanus*	Observed	Likely to occur
Blackspot goatfish	*Parupeneus spilurus*	Likely to occur	Observed
Red morwong	*Cheilodactylus fuscus*	Observed	Likely to occur
Rockcale	*Aplodactylus lophodon*	Observed	Observed
Estuary stingray	*Hemitrygon fluviorum*	Observed	Observed
Mullet	*Mugil cephalus*	Observed	Likely to occur
Crimson-banded wrasse	*Notolabrus gymnogenis*	Likely to occur	Observed
Eastern hulafish	*Trachinops taeniatus*	Likely to occur	Observed

Benthic Infauna

A summary of the benthic infauna assemblage at phylum level is provided in Table 3 with the full data set provided in Attachment 1. Overall Kurnell samples were more diverse (36 species) compared to La Perouse (20 species). La Perouse had higher total abundance (278 individuals) compared to Kurnell (115 individuals). Kurnell was dominated by polychaetes, crustaceans, and molluscs while La Perouse characterised by predominately crustaceans and polychaetes.

Table 3: Summary of results

Taxa	Kurnell	La Perouse
Annelida / Polychaeta	9	5
Crustacea	12	9
Echinodermata	2	1
Mollusca	12	3
Nemertea	1	0

Sediment sampling

Both sites were primarily dominated by sand sized particles (Table 4). Kurnell was composed almost entirely of sand while La Perouse had a coarser substrate present with 23% gravel.

Table 4: Particle size

EA150: Particle Sizing	Kurnell (%)	La Perouse (%)
+75Âµm	97	97
+150Âµm	68	87
+300Âµm	12	56
+425Âµm	3	46
+600Âµm	1	40
+1180Âµm	<1	34
+2.36mm	<1	19
+4.75mm	<1	8
+9.5mm	<1	4
+19.0mm	<1	<1
+37.5mm	<1	<1
+75.0mm	<1	<1
EA150: Soil Classification based on Particle Size		
Clay (<2 Âµm)	1	<1
Silt (2-60 Âµm)	1	2
Sand (0.06-2.00 mm)	97	75
Gravel (>2mm)	1	23
Cobbles (>6cm)	<1	<1

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Kind Regards,

Matthew Russell

Senior Aquatic Ecologist

Appendix B

Potential Species List

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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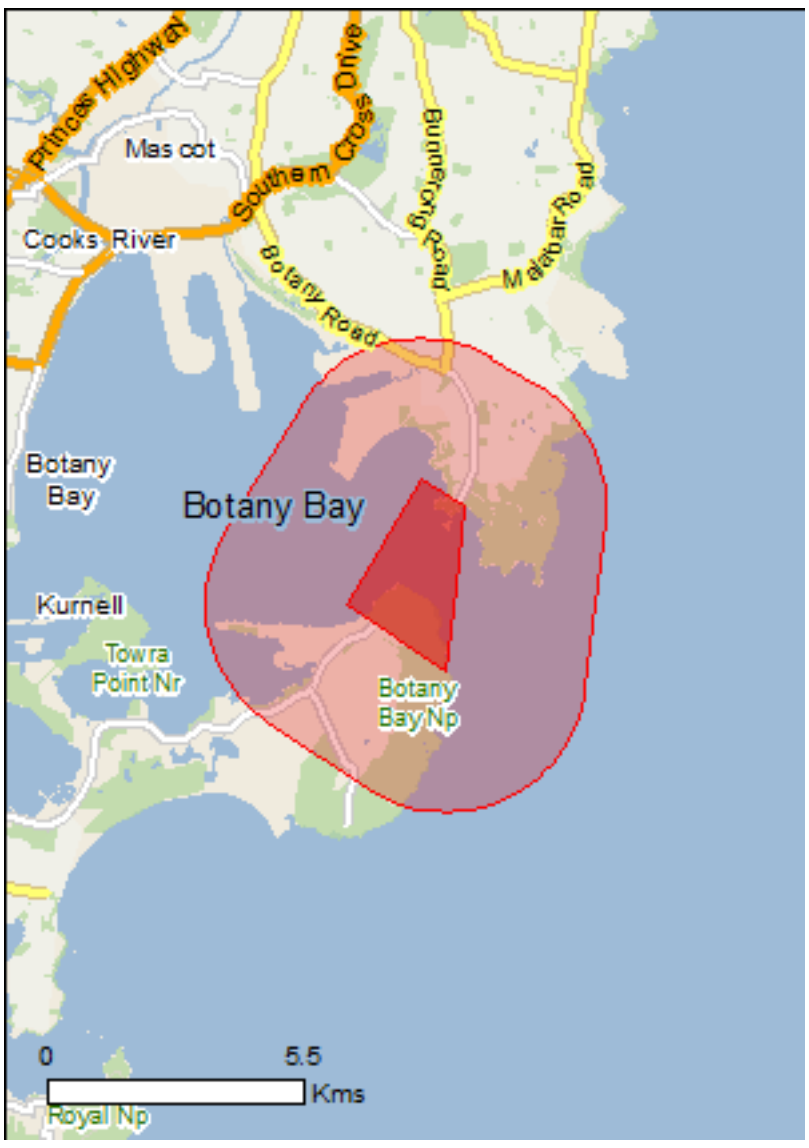

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Coordinates

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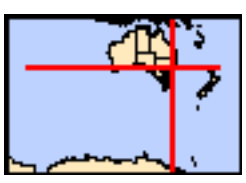

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	2
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	75
Listed Migratory Species:	80

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	8
Commonwealth Heritage Places:	1
Listed Marine Species:	103
Whales and Other Cetaceans:	16
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	49
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Historic		
Kamay Botany Bay: botanical collection sites	NSW	Listed place
Kurnell Peninsula Headland	NSW	Listed place

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Towra point nature reserve	Within Ramsar site

Listed Threatened Ecological Communities		[Resource Information]

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

Name	Status	Type of Presence
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community likely to occur within area
Eastern Suburbs Banksia Scrub of the Sydney Region	Endangered	Community known to occur within area
Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion	Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known

Name	Status	Type of Presence
		to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence within area
Mammals		
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Species or species habitat may occur within area
[Balaenoptera physalus](#) Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Chalinolobus dwyeri](#) Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
[Dasyurus maculatus maculatus (SE mainland population)](#) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
[Eubalaena australis](#) Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
[Isoodon obesulus obesulus](#) Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat likely to occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
[Petauroides volans](#) Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
[Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)](#) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
[Pseudomys novaehollandiae](#) New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
[Pteropus poliocephalus](#) Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
[Acacia terminalis subsp. terminalis MS](#) Sunshine Wattle (Sydney region) [88882]	Endangered	Species or species habitat known to occur within area
[Caladenia tessellata](#) Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
[Cryptostylis hunteriana](#) Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
[Eucalyptus camfieldii](#) Camfield's Stringybark [15460]	Vulnerable	Species or species habitat may occur within area
[Genoplesium baueri](#) Yellow Gnat-orchid [7528]	Endangered	Species or species habitat may occur within area
[Melaleuca biconvexa](#) Biconvex Paperbark [5583]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat may occur within area
Pterostylis sp. Botany Bay (A.Bishop J221/1-13) Botany Bay Bearded Greenhood, Botany Bay Bearded Orchid [64965]	Endangered	Species or species habitat likely to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat likely to occur within area
[Rhincodon typus](#) Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
[Sousa chinensis](#) Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Cuculus optatus](#) Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat known to occur within area
[Monarcha trivirgatus](#) Spectacled Monarch [610]		Species or species habitat may occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat known to occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat likely to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat known to occur within area
[Arenaria interpres](#) Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
[Calidris alba](#) Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
[Calidris canutus](#) Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
[Calidris ruficollis](#) Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
[Calidris subminuta](#) Long-toed Stint [861]		Foraging, feeding or related behaviour known to occur within area
[Calidris tenuirostris](#) Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
[Charadrius bicinctus](#) Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Charadrius mongolus](#) Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Foraging, feeding or related behaviour known to occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour may occur within area
[Gallinago megala](#) Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
[Gallinago stenura](#) Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
[Limicola falcinellus](#) Broad-billed Sandpiper [842]		Foraging, feeding or related behaviour known to occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area
[Limosa limosa](#) Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
[Numenius minutus](#) Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
[Numenius phaeopus](#) Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat known to occur within area
[Pluvialis fulva](#) Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area
Tringa incana Wandering Tattler [831]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -
Commonwealth Land - Airservices Australia
Commonwealth Land - Australian & Overseas Telecommunications Corporation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Cape Baily Lighthouse	NSW	Listed place

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour known to occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
[Calidris alba](#) Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
[Calidris canutus](#) Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Calidris ruficollis](#) Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
[Calidris subminuta](#) Long-toed Stint [861]		Foraging, feeding or related behaviour known to occur within area
[Calidris tenuirostris](#) Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
[Calonectris leucomelas](#) Streaked Shearwater [1077]		Species or species habitat known to occur within area
[Catharacta skua](#) Great Skua [59472]		Species or species habitat may occur within area
[Charadrius bicinctus](#) Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Charadrius mongolus](#) Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Charadrius ruficapillus](#) Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Foraging, feeding or related behaviour known to occur within area
[Diomedea antipodensis](#) Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea exulans](#) Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour may occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Foraging, feeding or related behaviour known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Foraging, feeding or related behaviour known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna albifrons Little Tern [813]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat known to occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Dugong dugon		
Dugong [28]		Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis		
Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Grampus griseus		
Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area

Name	Status	Type of Presence
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata		
Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus		
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Kamay Botany Bay	NSW
Towra Point	NSW

Invasive Species	[Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris		
European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata		
Nutmeg Mannikin [399]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Towra Point Estuarine Wetlands	NSW

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-34.004474 151.211641,-33.984478 151.226061,-33.988677 151.234644,-34.015075 151.230868,-34.004474 151.211641

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

Please feel free to provide feedback via the Contact Us page.

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