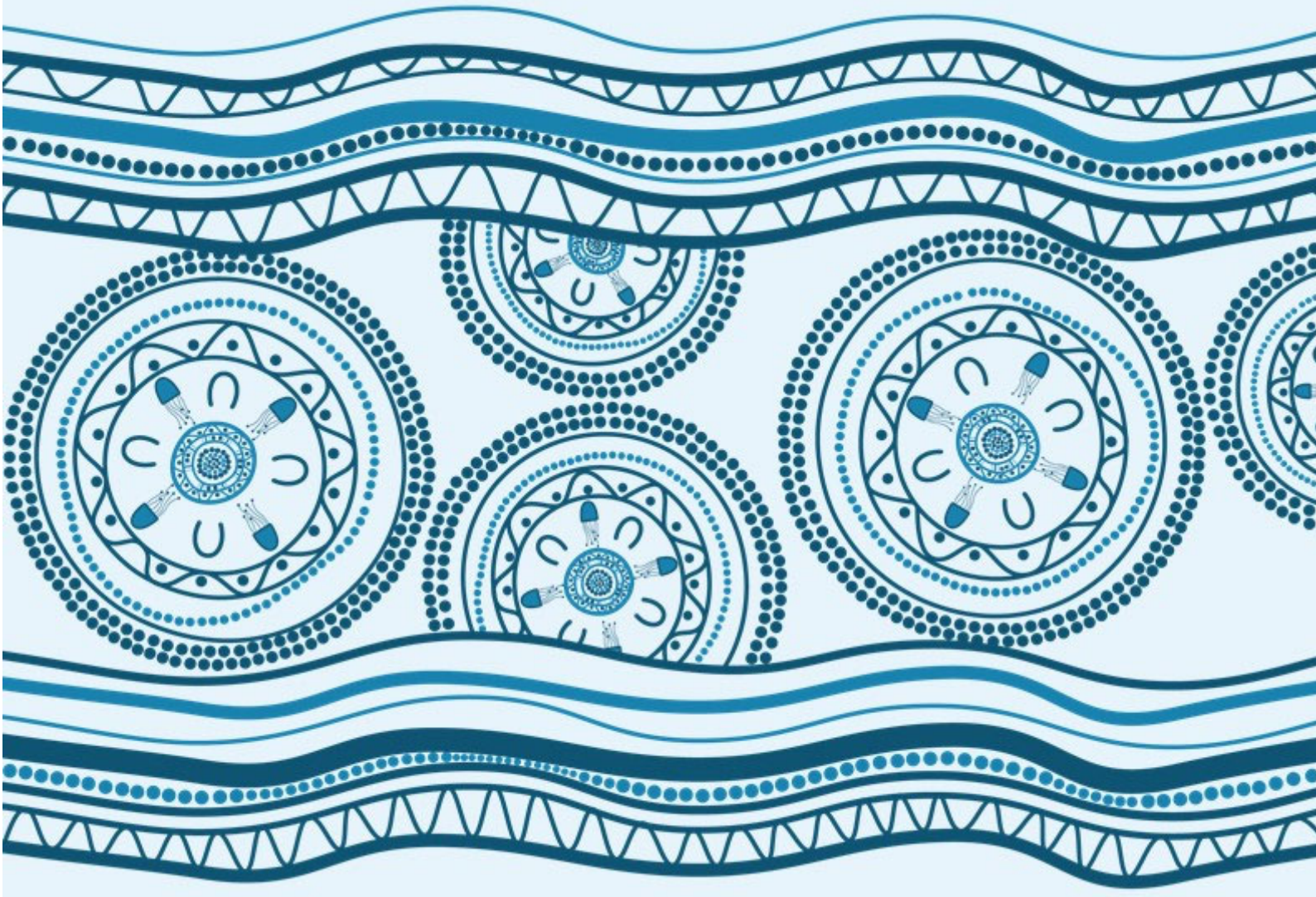
Transport for NSW

Kamay Ferry Wharves

Marine Biodiversity Offset Strategy

November 2021



Acknowledgement of Country
We acknowledge and pay our respects to the Bidjigal and Gweagal clans who traditionally occupied Kamay (Botany Bay). We also wish to acknowledge and pay respects to all Elders, past and present.
Approved by Chris Ingrey, CEO of the La Perouse Local Aboriginal Land Council, June 2021.

Cover artwork
Danielle Leedie-Gray is a self-taught contemporary graphic artist and a descendant of the Bidjara and Wakka Wakka people from south west and east Queensland, Australia. The Illustration tells the story of people coming together to work on a project significant to the local Aboriginal groups, Arup and Transport for NSW. The three main symbols used in the Illustration represent the water flow, people (shown by the U Shapes), and meeting places (shown by concentric circles) around the Kamay Ferry Wharves Project, gathering people together for discussion.

Prepared by
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Executive summary

This document comprises a Marine Biodiversity Offset Strategy (MBOS). It deals with the process of 'offsetting' biodiversity impacts relating to the proposed Kamay Ferry Wharves Project. The process is complicated and has required considered thought and consultation.

It was developed to address restrictions under State and Australian Government policies that only allow proponents to make a financial contribution to offset any unavoidable seagrass impacts.

The MBOS was developed in consultation with the relevant Government agencies responsible for dealing with marine ecology, namely the Fisheries Coastal Systems and Threatened Species Divisions within the NSW Department of Primary Industries and the Australian Government Department of Agriculture, Water, and Environment. The MBOS was also developed in consultation with the Gamay Rangers, who represent the La Perouse Local Aboriginal Land Council and undertake natural and cultural resource management activities on cultural areas within Botany Bay, including patrolling waters, marine mammal awareness and protection, cultural heritage protection and conservation, threatened species management, and cultural and environmental awareness. The MBOS also accounts for the information and feedback received through the consultation and engagement carried out with relevant stakeholders comprised of technical specialists and community representatives. This has allowed a meaningful offset strategy to be developed deal with any unavoidable impacts that would be caused by the Project.

The need to offset certain biodiversity impacts follows a range of investigations and studies carried out to support the Project's environmental impact statement (EIS) that was prepared and exhibited in mid-2021. The EIS described the design development and impact assessment processes and outcomes that were followed to avoid and minimise the Project's ecological impact. Despite this, it would be impossible to fully avoid all marine impacts when building the Project as seagrass and associated communities exist in the Project footprint. Also, because the final construction method and design is still to be confirmed, the EIS consider a worst-case impact on the marine environment. This process is consistent with the ecologically sustainable development principles defined under State and Australian Government environmental laws, which require precaution to be adopted in terms of the impact assessment process where there is uncertainty.

The EIS concluded in identifying the need to offset the following impacts:

- *Posidonia australis* TEC (EPBC Act and FM Act),
- Type 1 and Type 2 habitats (FM Act), and
- White's Seahorse habitats (EPBC Act and FM Act).

The MBOS proposing two ways to offset the Project's ecological impacts:

- Rehabilitating and improving of 2,000 m^2 of seagrass in Botany Bay using methods developed by the EPBC Act to provide adequate offsetting. This would also offset the loss of White's seahorse habitat in the area, while providing an improved habitat and environment for the existing *Posidonia australis* meadow
- Creating independent artificial structures to attach to piles that will form reef habitat for species like seahorses. The structures are predicted to create around 55 m^2 of compensatory habitat.

These two measures would increase the ecological habitat in Botany Bay, as required under State and Australian Government policy when needing to offset an impact of no-net loss.

The MBOS also has a series of indirect benefits, the main one of which is supporting further engagement and research through developed knowledge and understanding in seagrass rehabilitation capabilities. In addition to habitat created by wharf infrastructure, it would also provide an opportunity to install suitable artificial habitat by providing sites for reintroduction of White's seahorse.

The MBOS considered the financial offsetting requirements that are set out under NSW and Australian Government policy. This MBOS proposes that part of the money that would be held in trust under the NSW Fisheries Policy would be reinvested into the above offset measures. The estimate strategy cost to implement the offsets is about 50 per cent of the monetary bond (i.e. $1.4 million AUD) to be paid and the remaining 50 per cent of the bond would feed into the direct offsets (i.e. an additional $1.4 million AUD).

Monitoring and reporting would also be carried out over a five-year period upon completion of construction to ensure the proposed offset measures are successful. This would be supplemented through ongoing consultation and engagement with the State and Commonwealth authorities.

Contents

Glossary of terms and abbreviations

BC Act	*Biodiversity Conservation Act 2016* (NSW)
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and Environment
DPIE	Department of Planning, Industry and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EFM	Environmentally friendly moorings
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FM Act	*Fisheries Management Act 1994* (NSW)
ha	Hectares
Habitat	An area or areas occupied, or periodically or occasionally occupied by a species, population, or ecological community, including any biotic or abiotic component (OEH 2014).
KFH	Key Fish Habitat
KPI	Key Performance Indicators
m	metres
m^2	Square metres
MBAR	Marine Biodiversity Assessment Report
MBOS	Marine Biodiversity Offset Strategy
MNES	Matters of National Environmental Significance. MNES are protected by provision of Part 3 of the EPBC Act.
NSW	New South Wales
NSW Fisheries	New South Wales Department of Primary Industries, Fisheries
NSW Fisheries Policy	Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013)
OEH	Office of Environment and Heritage
Project area/ Proposal site	“The area of land that is directly impacted on by a proposed Major Project that is under the EP&A Act, including access roads, and areas used to store construction materials” (OEH, 2014).
SEARs	Secretary’s Environmental Assessment Requirements
Seagrass rehabilitation	Inclusive of techniques of transplanting, translocation, replanting revegetating, and planting.
SSI	State Significant Infrastructure
Study area	“The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly” (OEH 2014).
TECs	Threatened Ecological Communities
Transport for NSW	Transport for New South Wales
The Project	Kamay Ferry Wharves Project
UNSW	University of New South Wales

1 Introduction

This Marine Biodiversity Offset Strategy (MBOS) has been developed to provide a strategy for managing and mitigating the residual impacts as identified in the environmental impact statement (EIS). This is to provide a better outcome for the project and the environment. The MBOS also identifies appropriate offset requirements under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, Commonwealth) and *Fisheries Management Act 1994* (FM Act, NSW).

This MBOS documents how Transport for New South Wales (Transport for NSW) will meet its marine offset obligations. It also covers how these actions will be implemented in consultation with NSW Fisheries and other stakeholders to result in a net gain in environmental outcomes for Botany Bay and the community.

1.1 Project background

Transport for NSW is seeking approval to reinstate the ferry wharves at La Perouse and Kurnell in Botany Bay (Figure 1-1 and Figure 1-2). 'The Project' was classified State Significant Infrastructure (SSI) under the NSW Planning Framework. It was also confirmed to be a controlled action under the EPBC Act. Accordingly, bilateral approval is being sought from State Government, under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and the Australian Government, under the EPBC Act. A single EIS has been prepared to support the approval process. This is consistent with the Bilateral Agreement made in 2015 under Section 45 of the EPBC Act.

The project would reinstate ferry wharves at La Perouse and Kurnell. The infrastructure would be to enable the return of the public ferry service, provide supplementary temporary mooring for non-ferry commercial vessels (such as whale watching vessels) and recreational boating.

1.1.1 Current phase of the project life cycle

The MBOS was prepared using the assessment carried out to support the EIS. It will directly feed into the approval conditions determined by the Department of Planning, Industry and Environment (DPIE). Section 3.1 explains this process.

1.2 Requirement for a Marine Biodiversity Offset Strategy

Section 10 and Appendix H of the EIS assessed how Project is likely to impact on the area's marine ecology and biodiversity values. Importantly, the EIS considered a worst-case scenario where an area of over 24,000m^2 of Key Fish Habitat will be impacted and or modified. While it concluded that the Project's design and construction methods could be refined to reduce its impacts (refer to Appendix H, Section 6 of the EIS) the EIS confirmed that marine ecology and biodiversity impacts could not be fully avoided. Where this occurs the State and Commonwealth has put in place a process known as 'ecological offsetting'. This is where the worst case scenario of construction, ferry access and usage is accounted for by addressing the residual impact and providing offsets as compensation both through direct and monetary means.

The process for assessing potential marine biodiversity impacts and offsetting these is:

1. Prepare an impact assessment
2. Determine of the impacts
3. Identify and implement controls and mitigation
4. Identify all impacts that could not be avoided and or mitigated, termed residual impacts
5. Investigate of manage residual impacts under State and Commonwealth legislation
6. Set Conditions of Approval
7. Conditions of Approval

8. Complete the offset requirements

The MBOS is Step 5 in the above process. It investigates how to manage residual impacts and determines the appropriate course of action to offset the loss of ecological and biodiversity values protected under State and Commonwealth legislation.

The predicted residual impacts to the marine biodiversity values in the area are:

EPBC Act

- Threatened species:
  - Seagrass Meadows (*Posidonia australis*) of the Manning-Hawkesbury Ecoregion TEC - endangered
  - White's Seahorse (*Hippocampus whitei*) – endangered.

FM Act Listed

- Threatened and Key Fish Habitat (KFH):
  - Type 1[1] KFH
    - *Posidonia australis- Posidonia australis* seagrass habitat endangered population
    - *Zostera, hetero zostera, halophila* and *ruppia* species of seagrass beds >5m^2 in area
    - Estuarine and marine rocky reefs
    - Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act (see note 1) (White's Seahorse habitat– endangered.)
  - Type 2[1] KFH
    - Marine macroalgae such as *ecklonia* and *sargassum* species

The *Posidonia* habitats within the area of impact have multiple values for each habitat type and protected matters, the matters have been allocated to consolidated groups for clearer delineation in this strategy. These are defined in Table 1-1.

The impact assessment concluded the worst case residual impact would be a loss of (in order of priority):

- **683** m^2 of *Posidonia australis* habitat (Type 1 KFH)
- **20,589** m^2 of other seagrass habitat (Type 1 KFH)
- **3,683** m^2 macroalgae habitat (Type 2 KFH)

Other biodiversity values determined not to be impacted and/or species of value but not listed as threatened, which do not require direct offsetting include:

- Black rockcod, which is listed as vulnerable and protected under the EPBC Act and FM Act, was identified in the SEARs (Table 2 of the APPENDIX H (MBAR) of the EIS). However, as concluded in section 5 of the EIS that there was no habitat within the area that would be lost to the Project.
- Cauliflower soft coral, which is listed as endangered under the EPBC Act, was identified as potentially present. However, as concluded in section 4.5 of the EIS there are no records or indications that this species is present within the Project area.
- Syngnathidae[2], including the Weedy seadragon, are protected from illegally taking or possessing the species under FM Act. No Weedy seadragons were observed however (Appendix A of the MBAR), their habitat is often associated with kelp dominated macroalgae assemblages which is present on site the habitat protected under KFH policy and is addressed through the offsetting of KFH.

[1] Type 1 KFH is the most sensitive habitats, Type 2 KFH is moderately sensitive
[2] This is the term for the family of fish that includes seahorses, pipe fish, pipe horses, and seadragons.

Just because it is illegal to take and possess a species does not mean that species is also threatened and protected under the EPBC and FM Acts. This is the case with Syngnathidae. Therefore, while there is no need to offset any impact on them as a species any impact on their habitat needs offsetting as it classifies as KFH.

Section 2 below describes the legislation and policy governing the need to offset under State and Commonwealth legislation.

Table 1-1. Consolidated habitat groups and areas

Habitat and species as identified in the EIS	EPBC Act listing	FM Act	Areas m^2	Consolidated groups and areas
Listed habitat and species				
Posidonia australis	Seagrass meadows (*Posidonia australis*) of the Manning-Hawkesbury Ecoregion - TEC **Endangered Community**	**KFH Type 1** | highly sensitive habitat *Posidonia australis* **Endangered**	259 m^2	***Posidonia australis*** **(Type 1 KFH)** **Total area: 683 m^2**
Posidonia australis mixed with *Halophila* or *Zostera*			424 m^2	
White's seahorse	**Endangered**	**KFH Type 1** | highly sensitive habitat Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act (see note 1) **Endangered**	Contained within the above area	
Unlisted habitat and species				
Zostera and *Halophila mixed*	*Not listed under EPBC Act*	**KFH Type 1** | highly sensitive habitat *Zostera, hetero zostera, halophila* and *ruppia* species of seagrass beds >5m^2 in area	9,000 m^2	**Other seagrass (Type 1 KFH)** **Total area: 20,589 m^2**
Halophila			11,589 m^2	
Marine rocky reefs		**KFH Type 2** | moderately sensitive habitat Estuarine and marine rocky reefs	3,683 m^2	**Macroalgae (Type 2 KFH)**

Habitat and species as identified in the EIS	EPBC Act listing	FM Act	Areas m^2	Consolidated groups and areas
Macroalgae		**KFH Type 2** | moderately sensitive habitat Marine macroalgae such as *ecklonia* and *sargassum* species	Covered in the same area as the rocky reef	**Total area 3,683 m^2**

1.3 Key objectives

The MBOS' key objectives are to:

- Identify and offset residual impacts to ensure there is no net marine biodiversity loss in Botany Bay focussing on values protected under State and Commonwealth legislation
- Meet relevant planning approval conditions
- Be consistent with State and Commonwealth biodiversity offset legislative and policy
- Specify management measures and key performance indicators (KPIs).

1.4 Structure

This report includes six Sections.

Section 1 | introduces the purpose and need for the MBOS
Section 2 | provides the legislative context
Section 3 | describes the consultation approach and implementation to derive the MBOS
Section 4 | defines what requires offsetting and what the monetary offset compensation (monetary bond) looks like
Section 5 | details the proposed offset strategy and summarises how its implementation effects the bond
Section 6 | set out the offset strategy implementation.

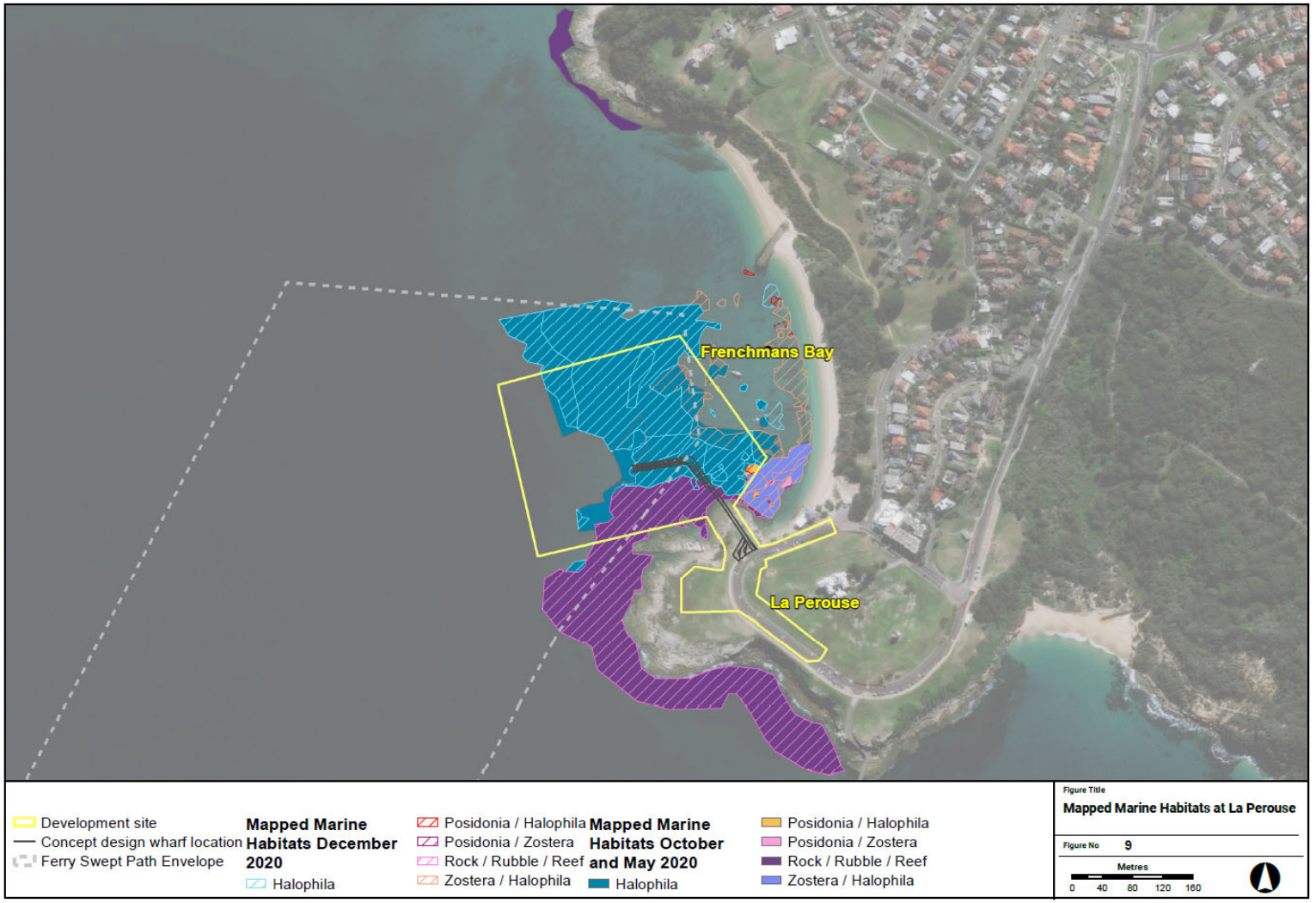


Figure 1-1: Project location at La Perouse

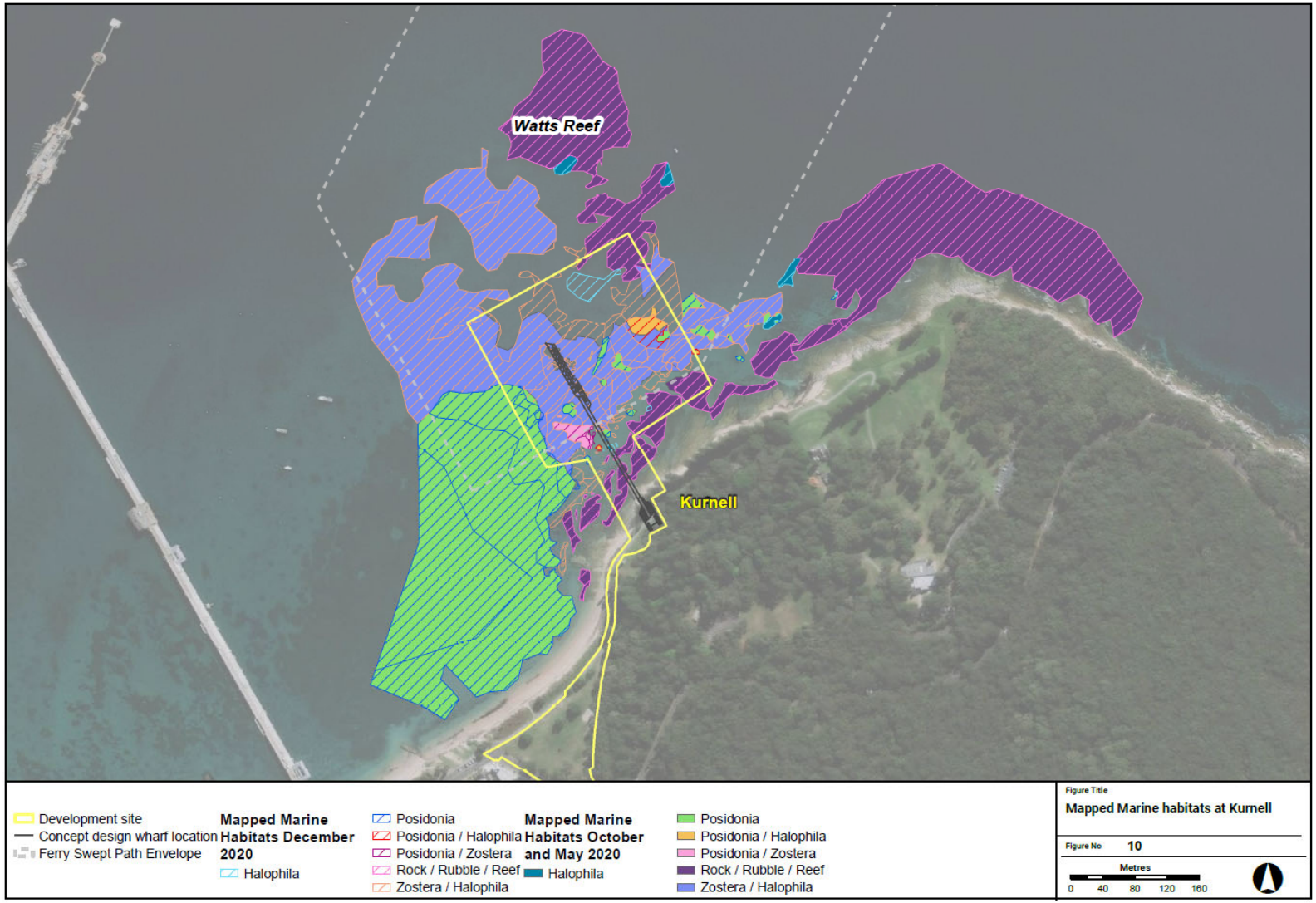


Figure 1-2: Project location at Kurnell

2 Legislation, policy and guidelines

There are two main pieces of legislation that protect marine biodiversity at a State and Commonwealth level. The two pieces of legislation that are relevant to the MBOS are as follows.

- NSW *Fisheries Management Act 1994* makes it an offence to harm estuarine macrophytes, such as seagrass, fisheries, threatened species, and resources without an appropriate assessment, inclusion of safeguards, and/or the appropriate permissions to carry out certain work.
- Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* protects matter of national environmental significance (MNES) and Commonwealth land values. The Act requires project actions to be controlled under the Act's provisions if they are likely to have a significant impact.

The bilateral agreement between the NSW and Australian Governments (Section 1.1) also covers offset agreements. Regarding the Project, the bilateral agreement states that offsets will be completed in accordance with the objective of the EPBC Act and in conjunction with the Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013, the 'NSW Fisheries Policy') Specifically:

- The NSW Fisheries Policy (Section 2.1) provides guidance on addressing and offsetting aquatic impacts
- The offsetting requirements under the EPBC Act are defined under the EPBC Act Environmental Offsets Policy (Section 2.3).

2.1 State offset requirements

The NSW Fisheries Policy requires no net loss of KFH meaning, no overall loss of habitat. Therefore, where "*significant [direct and indirect] environmental impacts [cannot be avoided they] are to be offset by environmental compensation*". Environmental compensation (*non-monetary*) is defined as "*the creation or enhancement of fish habitats or fisheries resources in order to compensate for anticipated adverse or actual environmental effects of proposed developments*."

Environmental compensation is only considered where it is not possible to avoid fisheries resource or habitat loss. This is determined through assessment and consultation. Environmental compensation must also be in the community's best interests.

Any environmental compensation needs to be carried out in accordance with the FM Act, regulations, policies, and guidelines. It also needs to account for direct and indirect impacts to confirm there is no net loss.

The MBOS has been prepared in general accordance with the above Policy (Table 2-1). Where the MBOS differs from the NSW Fisheries Policy is in its view that rehabilitation does not support "*seagrass transplanting as an impact compensation measure as the viability of transplanting methods is yet to be scientifically proven for all species*." The MBOS proposes the inclusion of seagrass rehabilitation as part of the strategy given the recent success and advances in seagrass rehabilitation within the region (e.g. Operation Posidonia[3]). The workshops held were to work through variations from the policy and confirm what was acceptable.

[3] a local research initiative led by the Centre for Marine Science and Innovation, UNSW Sydney. Furthermore, transplanting would provide valuable research into seagrass transplanting technology and future rehabilitation of endangered seagrass communities in NSW.

Table 2-1. The adopted principles of the Policy applied in this MBOS.

Adopted principles as defined in the Policy	Outcome summary	Section
Provision of environmental compensation measures to deliver a no net loss outcome.	The strategy has applied the EPBC Offset calculator (DSEWPC, 2012). to establish a more conservative approach to the area requiring rehabilitation, essentially the result will more than doubled the area impacted . This will meet no net loss for the *Posidonia australis* and white's seahorse habitat by replacing loss habitat due to the proposed works.	2 and 3
Payment of a monetary bond to ensure the work is carried out in accordance with the permit. [4]	A monetary bond will be provided with a proportion of that bond total being directed to funding the direct offset commitments.	7
Preparation of an environmental compensation management plan to: • Document replanting, transplanting, and monitoring methods • Prove the suitability and adequacy of the compensation • Define KPIs to measure success of compensation and corrective actions, where the performance is inadequate.	Strategy was developed in consultation with NSW Fisheries and seagrass specialists (UNSW) on the approach needed to provide more certainty in the methods used for the replanting of seagrass. This MBOS contains the draft offset plans. It also will be finalised in consultation with NSW Fisheries and, the seagrass specialists.	3

The monetary bond is defined in the NSW Fisheries Policy as a payment that is "*required to be lodged with NSW DPI to ensure the works are completed in accordance with the permit conditions*". The rates applied are annually adjusted based on the Consumer Price Index.

Table 2-2 below shows the initial prices set to compensate for the loss of a square metre of marine habitat in 2013. It also shows the same price in 2021. The NSW Fisheries Policy also requires compensation to be paid at a minimum 2:1 to account for direct and indirect impacts.

Table 2-2. Compensation rate for marine vegetation.

2013		2021	
square metre price	minimum compensation ratio 2:1	square metre price	minimum compensation ratio 2:1
$\$51/m^2$	$\$102/m^2$	$\$57/m^2$	$\$114/m^2$

[4]Section 205 - permit to harm (cut, remove, injure, destroy, shade etc) marine vegetation (saltmarshes, mangroves, seagrass and seaweeds) Section 2.2 of the NSW Fisheries Policy.

The degree of environmental compensation also accounts for the sensitivity and value of the impacted habitat. This is defined under the NSW Fisheries Policy. Table 2-3 below includes the relevant definitions used in this MBOS taken from Section 3.2 of the NSW Fisheries Policy.

Table 2-3: Key Fish Habitat Sensitivity

Type 1 **Highly sensitive**	**Type 2** **Moderately sensitive**
Posidonia australis	Estuarine and marine rocky reefs
Zostera, *hetero zostera, halophila* and *ruppia* species of seagrass beds >5m^2 in area	Marine macroalgae such as ecklonia and sargassum species
Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act	

2.2 Intertidal protected area

The Project would cross through the Inscription Point Intertidal Protection Area at Kurnell. This is to protect all species of cunjevoi and invertebrates except abalone, eastern rock lobster (*Sagmariasus verreauxi*) and southern rock lobster (*Jasus edwardsii*). It is defined as the area from the '*mean highwater mark to 10 metres seaward'*. Most of the wharf at Kurnell would be in line with the existing jetty location and there for minimise the impact to this region.

In addition, the Intertidal Protection Areas are currently managed under the fishing closures, which are defined under Part 2, D1 of the FM Act. These closures "*prohibit, absolutely or conditionally, the taking of fish, or of a specified class of fish, from any waters or from specified waters*." The Project will not 'take' any fish from this region and the impact in this region does not constitute and offset requirement. However, the Project has sought to minimise the extent of works and the overall footprint to limit the extent of the impact in the region.

There are no Intertidal Protection Areas at La Perouse.

2.3 Commonwealth offset requirements

The EPBC Act Environmental Offsets Policy outlines the Australian Government's approach to the offsetting significant impacts on MNES. The offsets cover:

- Direct actions focussing on delivering a measurable conservation gain. At least 90 per cent of any offset must involve a direct action. A measurable conservation gain includes:
  - Improving existing habitat for the protected matter
  - Creating new habitat for the protected matter
  - Reducing threats to the protected matter
  - Averting the loss of a protected matter or its habitat that is under threat.
- Indirect actions: Other compensatory measures that are expected to lead to beneficial outcomes. These include things like research and education program funding.

The offset is determined by the:

- Appropriateness of the offset for a given impact
- Specific size and scope of an offsets package.

The Environmental Offsets Policy includes the offsets assessment guide (Appendix 1). This uses a balance sheet to measure impacts and offsets. This creates a decision-making framework to consider the appropriateness and adequacy of proposed offsets (Table 2-4).

Table 2-4. Section 7 of the Environmental Offsets Policy | offset requirements.

The Environmental Offsets Policy identifies that suitable offsets must	Outcome summary	Section
7.1 | Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter.	The strategy has applied the EPBC Offset calculator to establish a more conservative approach to the area requiring rehabilitation, essentially the result will more than doubled the area impacted. This will meet no net loss for the *Posidonia australis* and White's Seahorse habitat by replacing loss habitat due to the proposed works. As such the FM act policy was not directly applied here.	7 and Appendix 1
7.2 | Suitable offsets must be built around direct offsets but may include other compensatory measures.	All offsetting would be based around direct offsets but will have indirect benefits as well through research.	5
7.2.1 | Tenure for direct offsets.	The 'land' within the bay is under 'State land managed by Transport for NSW'	2.4
7.2.2 | Impacting on existing EPBC Act offsets.	Not applicable, there are no other EPBC offsets within the areas proposed for offset locations.	-
7.3 | Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.	Strategy was developed in consultation with NSW Fisheries and seagrass specialists (UNSW) on the approach needed to provide more certainty in the methods used for the replanting of seagrass. This MBOS contains the draft offset plans. It also will be finalised in consultation with NSW Fisheries and, the seagrass specialists.	2 and 3
7.4 | Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.	The EPBC offset calculator doubles the area required for the *Posidonia australis* to meet a conservation gain. Also, previously the NSW Fisheries Policy has not considered rehabilitation work for seagrass suitable until more recent advances in success have been identified.	7 and Appendix 1
7.5 | Suitable offsets must effectively account for and manage the risks of the offset failing.	The proposed offset method has been prepared is in accordance with the proven methods of Operation Posidonia. Where they have had consistent success replanting *Posidonia australis*.	5.1

The Environmental Offsets Policy identifies that suitable offsets must	Outcome summary	Section
7.6 | Suitable offsets must be additional to what is already required, determined by law, or planning regulations, or agreed to under other schemes or programs.	The current FM Act policy is restricted to a monetary bond. This MBOS addresses this and focuses on providing a direct offset and balancing the monetary bond requirements.	2 and 3
7.6.1 | Links with state and territory approval processes.	The MBOS looks to work with the NSW Fisheries Policies while providing a better outcome providing suitable direct offsets beyond the monetary bond requirement	2
7.7 | Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The proposed offset method has been prepared is in accordance with the proven methods of Operation Posidonia. Where they have had consistent success replanting Posidonia australis. The offsets will commence prior to construction and with reporting on the implementation to occur over the life of the MBOS.	2 and 5
7.8 | Suitable offsets must have transparent governance arrangement including being able to be readily measured, monitored, audited and enforced	The MBOS has a transparent governance, monitoring and reporting arrangement to ensure that the implementation of the MBOS can be readily measured.	5

The MBOS reviewed the various policies in conjunction to provide suitable and meaningful offsets that would focus on what could be achieved through direct offsetting rather than relying on the monetary bond component. This process has enabled for an offset strategy that will provide a net gain in *Posidonia australis* and White's seahorse habitat which meets the requirements of the EPBC Act policy and exceeds the requirements of the FM Act.

2.4 Land ownership and management

The Project is mostly located on State land that is owned and administered by various public authorities depending on its purpose as shown in Table 2-5, Figure 2-1 and Figure 2-2 below. Transport for NSW manages the seabed within the marine environment of Botany Bay, while National Parks and Wildlife Service (NPWS) manages the land within Kamay Botany Bay National Park. At La Perouse, the Project is located on two areas of Crown Land that are set aside for public purposes managed by the State.

Table 2-5. Land ownership

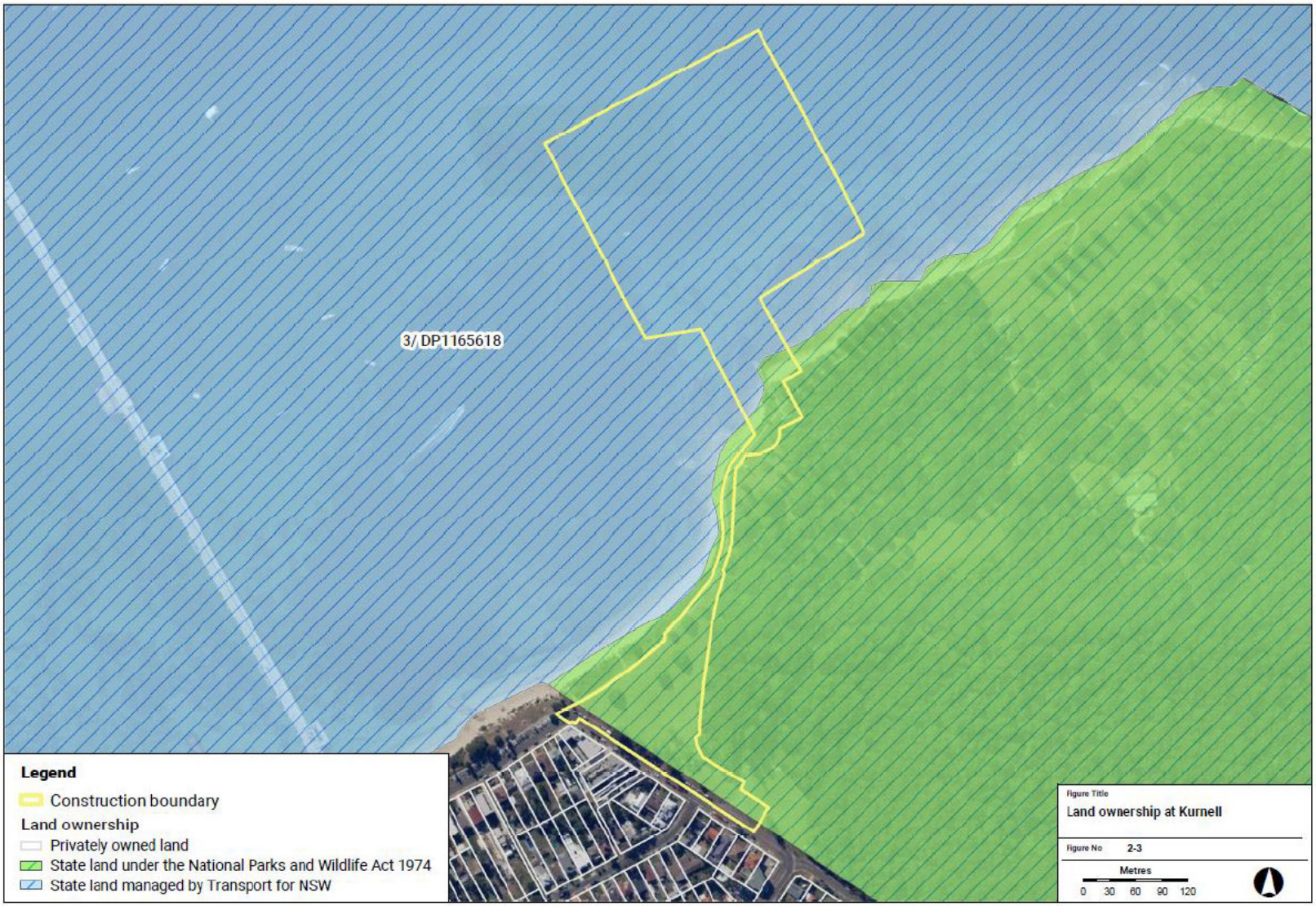
Address	Lot and deposited plan	Ownership
Botany Bay (marine waters)	Lot 3 DP 1165618	State land managed by Transport for NSW.
La Perouse headland	Lot 1 DP 915424	State land managed by National Parks and Wildlife Services.

Address	Lot and deposited plan	Ownership
La Perouse headland	Lot 5113 DP 752015	Crown Land
La Perouse headland	Lot 7045 DP1026891	Crown Land
Kurnell	Not applicable	State land within Kamay Botany Bay National Park is managed by National Parks and Wildlife Services.

All offsets will implemented on State land or on infrastructure owned and managed by Transport for NSW.

* Roads are State Land managed by Randwick City Council

Figure 2-1. Land ownership at La Perouse



* Roads are state land managed by Sutherland Shire Council

Figure 2-2. Land ownership at Kurnell

3 Approach

This Section provides and overview of how the MBOS was developed as well as the where the MBOS sits in context to the overall Project, EIS and approval pathway.

3.1 Stages of MBOS development

The MBOS will be updated, finalised, and implemented once the NSW and Australian Governments give their planning approval. The flow chart below outlines the MBOS process in respect to the Project stages.

No additional approvals and or permits would be needed outside of the Conditions of Approval set by the State and Australian Governments to carry out the offsetting work. However, NSW Fisheries would be consulted with and updated throughout the offset process.

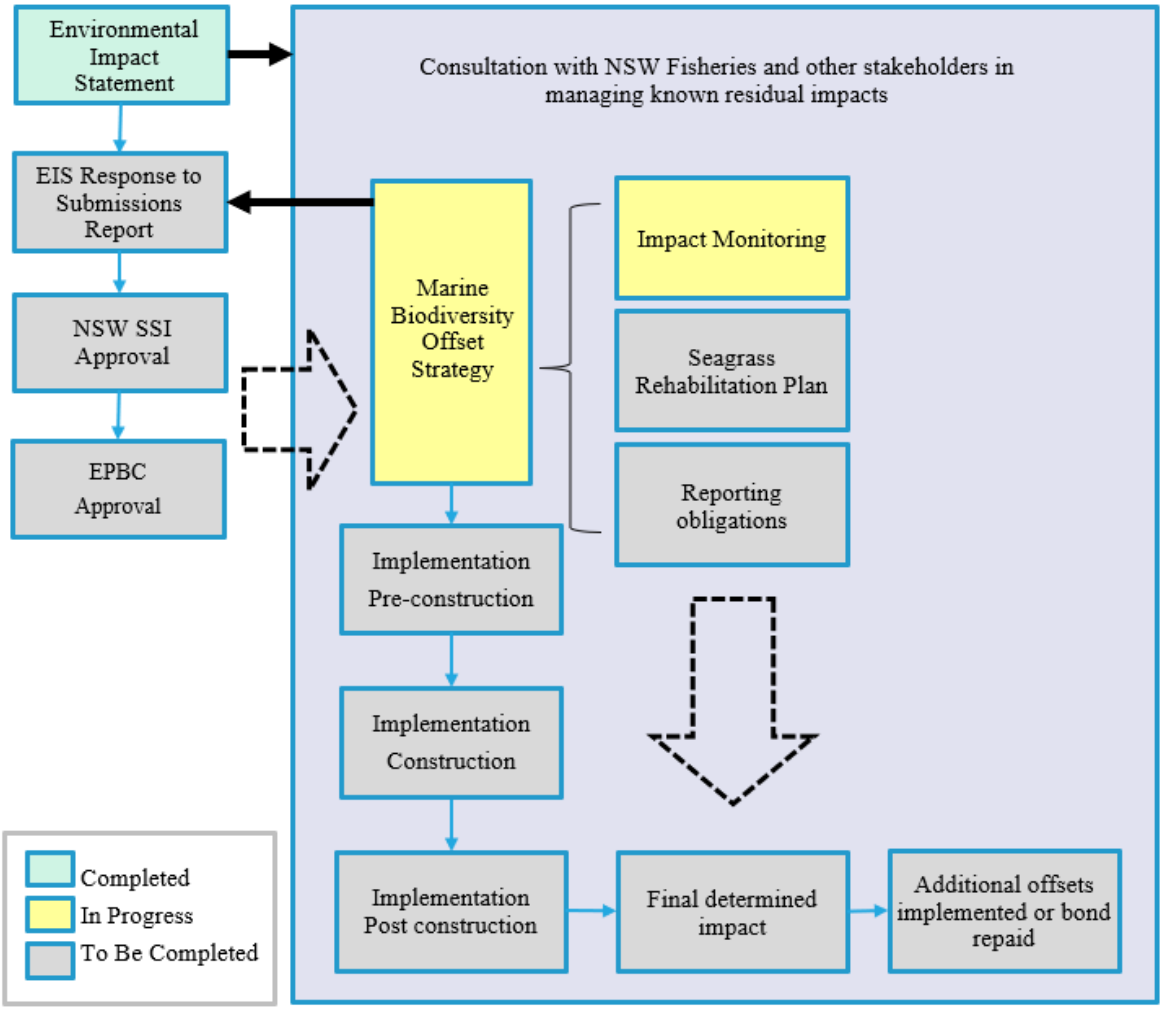


Figure 3-1. The stages of the MBOS development and implementation.

3.2 Consultation and workshops

The MBOS is a live document requiring inputs and guidance from all stakeholders.

Two consultation workshops were held with the Project team and stakeholders (refer to the list below) between February to August 2021 and additional feedback from agencies and specialists. The first workshop was structured to discuss the ability to develop an MBOS and used to discuss

offsetting expectations. The second workshop provided a forum for feedback. This allowed the MBOS to be refined for inclusion in the Response to Submissions Report. Consultation with NSW Fisheries would continue post approval and during implementation of the MBOS

The stakeholders included the following Government agencies and specialists:

- DAWE
- DPIE
- NSW Fisheries
- NPWS
- School of Biological, Earth and Environmental Sciences, University of New South Wales (UNSW)
- La Perouse Aboriginal Land Council, including the Botany Bay Gamay Rangers.

The consultation allowed for options and concerns to be heard as well as develop inputs to how the MBOS would be structured and what would be included. The stakeholders consulted provided technical specialists, government agencies and community representatives that represent the general public's interest. To review the MBOS and provide feedback on the approach taken to deliver suitable direct offsets.

3.3 Limitations and assumptions

The MBOS was prepared against the following limitations and assumptions, which were discussed in the stakeholder consultation (section 3.2):

- The design and construction method are not finalised meaning the final impacts are unconfirmed
- Changes are likely to occur in the habitat present onsite between the time of the EIS completion and starting work onsite. This is expected to be a period of about seven months. Therefore, the before disturbance benchmark is yet to be confirmed. However, before impact monitoring is currently underway to finalise this benchmark.
- Condition criteria required for the EPBC Act offset calculator are estimates as the offset locations need to be finalised with the impact monitoring and the offset locations.

The above uncertainty meant that the discussions focussed on a worst-case residual impact. This comprised construction impacts, permanent structure, and ferry vessel impacts. This approach is recognised as the precautionary principle; one of the ecologically sustainable development (ESD) principles defined under State and Commonwealth legislation. The precautionary principles states that:

> "*If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Public and private decisions should be guided by careful evaluation to avoid serious or irreversible damage to the environment wherever practicable, and an assessment of the risk-weighted consequences of various options*".

The environment of the Project region is highly dynamic. This means its condition and extent of habitat available will change seasonally and after storm events. These changes may be significant. The MBOS attempts to allow for these variations over the Project's life through the implementation of impact monitoring reporting and continued consultation with NSW Fisheries.

4 Offset requirements and implementation

This Section summarises the offset requirements and strategies for implementation.

4.1 Offset requirements

Section 2 above describes those marine ecology and biodiversity values that are protected under State and Commonwealth legislation that would be impacted by the Project and would accordingly need offsetting. Table 1-1 provides a full habitat breakdown.

Table 1-1 summarises the *draft* offset requirements based on the limitations and assumptions described above in Section 3.3. These are based on the Project's predicted direct and indirect impacts (Section 5). Specifically, the:

- Direct impacts account for the construction activities carried out in the Project boundary and the predicted scour likely to occur by operational ferries
- Indirect impacts account for incidental construction mooring and limited sediment disturbances across the construction boundary.

The areas provided assume the impact will not exceed the total area calculated.

Impact monitoring

In addition to the baseline survey conducted during the EIS, impact monitoring of the seagrass and adjacent habitats commenced in July 2021. The purpose of the monitoring is to continue observing the condition, habitat present and potential impacts on site inclusive of pre, during and after construction/operation. This will continue every six months until around five years[5] after construction to confirm the actual losses and to monitor adjacent seagrass areas for unexpected losses due to the Project.

A 'before' baseline will be prepared in consultation with NSW Fisheries, DAWE and approved by DPIE. This 'before' baseline would not impact the implementation of the MBOS but would provide the necessary data for the post construction review to determine actual direct and indirect impact related to the project.

The impact monitoring review of the methods, sites and results will occur two years after construction as there will be a number of monitoring programs running consecutively. Appendix 3 details the Impact Monitoring Program and method.

A review of the monitoring results from the MBOS (including the Impact Monitoring Program) will be undertaken at the five and ten year period in consultation with NSW Fisheries and DAWE to determine the outcomes of the MBOS have been meet and confirm the refund of the bond (section 7). Section 5 discusses the MBOS review in detail.

[5] the five year survey period was established by NSW Fisheries during the consultation process as the minimum monitoring requirements after construction

4.2 Offset strategies

This Section explores the potential opportunities that could be adopted as offsets for the Project. Section 5.4 assesses the suitability of these offsets.

Six potential direct and indirect offsets were reviewed for consideration and presented at the second consultation workshop (3.2). The outcome was that the offsets should focus on the seagrass rehabilitation and providing artificial reef habitat.

Section 5 describes the context of each proposed action and measure.

Appendix 1 works through the original proposed strategies and the finalised outcomes that have been accounted for in the EPBC Offset calculator. These areas and outcomes of the EPBC offset calculator feed into Section 7.

4.3 Program

Table 4-1 below shows the anticipated timeline and duration of the offset works, in relation to the expected approval, construction and monitoring requirements.

Table 4-1. Estimate program.

	2021			2022				2023				2024				2025				2026				2027				2028				2029			
Activity	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Impact monitoring: ***baseline***																																			
Final EIS submission																																			
Tentative release of condiitons and Approval																																			
Identifide period to aquire seagrass within footprint of wharf																																			
Commecement of construction (hand over to contractor)																																			
Impact monitoring: ***during construction***																																			
Additional planting																																			
Seagrass Rehabilition monitoing																																			
Instellations of Artifical Reef Stuctures																																			
Artifical Reef Stuctures monitoring (interval to be confrimed)																																			
Impact monitoring: ***post construction***																																			

Key:
Yellow indicates estimated survey timing
Grey indicates on-going work
Blue indicates construction works
Orange indicates key milestone dates
Red indicates essential timing milestone dates (i.e. work outside these dates would have an impact on project success)

5 Direct offset actions

The following are the proposed direct offset actions.

Direct offsets are defined as, *'those actions that provide a measurable conservation gain for an impacted protected matter'.*

The MBOS focuses on the offsets that will deliver the best and most tangible outcomes. This being invest in seagrass rehabilitation and in artificial reef structures.

5.1 Seagrass offsetting

Previous efforts to transplant seagrasses in NSW and in Botany Bay have not been successful, as highlighted through the consultation. NSW Fisheries Policy has therefore not been supportive of transplanting seagrass direct offset action. However, more recently review of emerging technologies, increased ecological understanding and improved process for seagrass restoration globally indicates ecologically meaningful large-scale seagrass restoration is possible (Tan *et al*., 2020). Research groups around Australia, including UNSW, are making substantial advancements in seagrass restoration, including improvements in transplant success of the endangered *Posidonia australis* seagrass using donor material.

Transplanting of seagrass remains the only way to replace and re-establish seagrasses in areas where it has been lost. The Project presents a unique opportunity to harvest donor material, which is expected to be impacted during construction, and attempt for it to be transplanted using the latest technologies and approaches. This strategy will build on the success of *Operation Posidonia,* a local research initiative led by the Centre for Marine Science and Innovation, UNSW Sydney. Furthermore, transplanting would provide valuable research into seagrass transplanting technology and future rehabilitation of endangered seagrass communities in NSW.

The proposal is to locate the transplanted material near the Project area in an around the existing *Posidonia australis* meadows, in areas damaged from historical disturbance and other areas within Botany Bay that have experienced damage and require donor material. All rehabilitation offset locations would be agreed in consultation with NSW Fisheries.

By transplanting seagrass, it may be possible to relocated and improve 2,000m^2 of *Posidonia australis* habitat based on success of the Operation *Posidonia* technique and advances.

Due to a number of logistics, it is not feasible to rehabilitate all seagrass that would be disturbed. Therefore, the focus will be on rehabilitating *Posidonia australis* because of its increased value and importance (Section 2). Where possible, viable patches of *Zostera* that are collected with the *Posidonia australis* will be transplanted where possible. It is anticipated that *halophila* seagrass and macroalgae that is disturbed would recover over shorter timeframes post-construction. It is therefore not proposed to transplant either habitat.

The implemented would start as soon as possible after State and Commonwealth approval.

5.1.1 Proposed offset locations

All proposed offset locations associated with this MBOS would occur on the land that is allocated to State that is managed by Transport for NSW (Section 2.4).

The location of seagrass rehabilitation sites would be confirmed in consultation with DPI Fisheries and other stakeholders (including the Port Authority of New South Wales) as appropriate, following detailed *in situ* surveys and mapping of potential recipient sites.

The following four sites are recommended for rehabilitation, in order of decreasing priority:

(A) **Remaining sections of the Ausgrid trenches in Kurnell** (Figures 5-1 and 5-2), prioritising shallower inshore parts of the trenches, as transplantation success appears to decrease with depth.

(B) **Old boat mooring scars and meadow edges in Kurnell** (Figures 5-1 and 5-2), prioritising shallower parts of the meadow.

(C) **Areas elsewhere in Botany Bay where *Posidonia australis* is present but rare**. This could include areas in Frenchman's Bay outside of the development site (Figure 5-3), for example, but where swing boat moorings would not be installed.

(D) **Areas in Botany Bay where *Posidonia australis* used to be abundant but from where it disappeared**. This may include areas in Foreshore Beach (Figure 5-3), where the instalment of groynes by the Port Authority of NSW has stabilised sediments, and where *Zostera muelleri* is starting to expand.

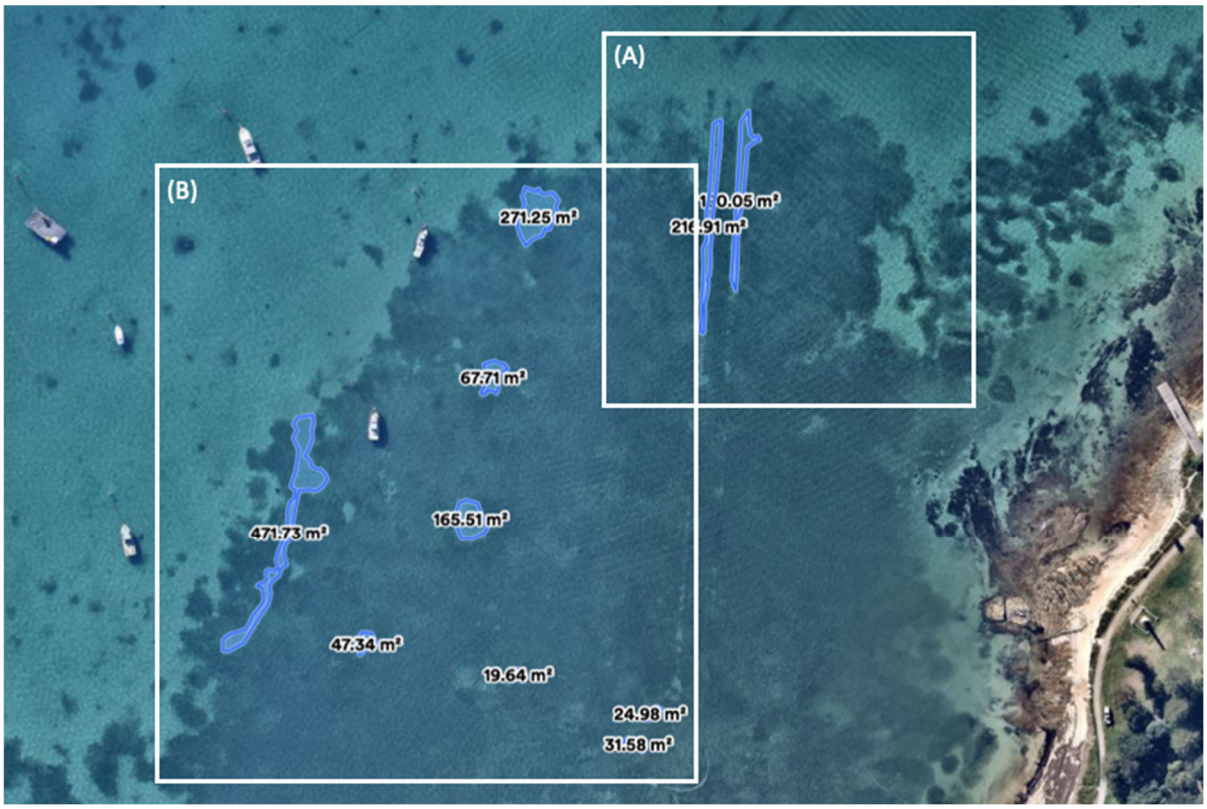


Figure 5-1. Nearmap aerial image of Kurnell indicating potential rehabilitation sites. Seagrass scars are identified in blue outline, displayed as m^2. Inset areas (A) and (B) are displayed with higher resolution in Figure 5-2.

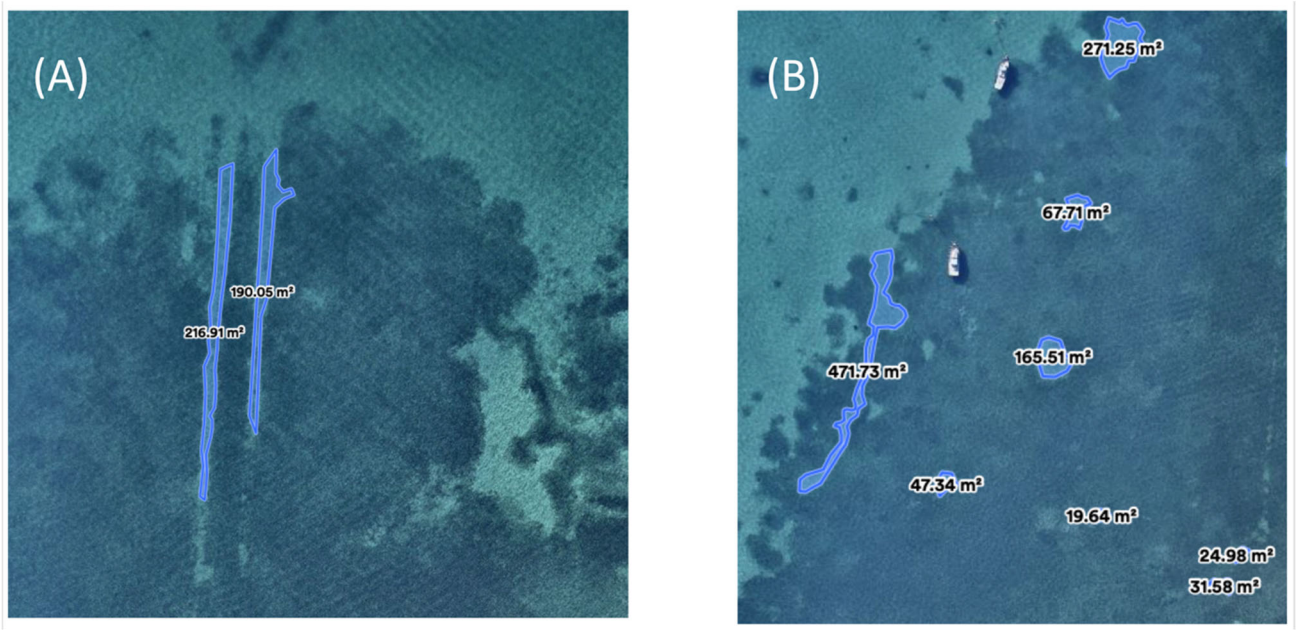


Figure 5-2. Zoomed in Nearmap aerial images of inset areas (A) and (B) from Figure 5-1 displaying potential rehabilitation sites in Kurnell.

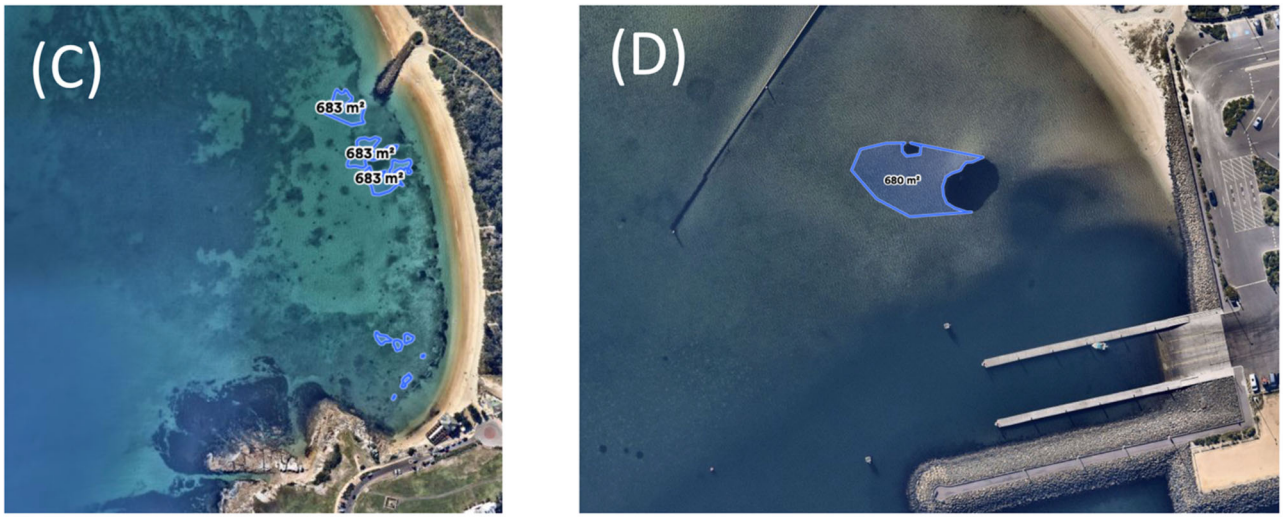


Figure 5-3. Nearmap aerial images displaying potential rehabilitation sites within Frenchman's Bay (C) and Penrhyn Estuary (D). The blue outline areas in (C) are adjacent to small remaining patches of *Posidonia australis*. The blue outline area in (D) is adjacent to a growing *Zostera muelleri* meadow that may now be suitable for the rehabilitation of *Posidonia australis*, following sediment stabilisation facilitated by recently constructed groynes.

5.1.2 Methodology relocation/planting

The method would be consistent with the current techniques used by Operation Posidonia. The methods would be formally drafted by the seagrass specialists and completed in consultation with NSW Fisheries.

Initial surveys

Prior to any transplantation, detailed diver-operated video underwater surveys would be undertaken at the wharf locations to accurately quantify the exact area of *Posidonia australis* likely to be impacted. *Posidonia australis* shoot density and morphometric data (e.g. maximum shoot length, levels of herbivory, levels of epibiosis) should also be quantified *in situ* using 0.25m^2 quadrats (number of quadrats to be determined based on meadow area impacted).

Likely impacts related to the construction of the project include direct piling impacts, long-term shading impacts and propeller scour impacts from operation of vessels. A staged transplantation approach would be adopted, including:

- Stage 1: Transplant any *Posidonia australis* that would be directly impacted by shading from the wharves, or likely to be damaged by wharf construction
- Stage 2: Transplant *Posidonia australis* that might be affected by operation of the ferry vessels. This could be done when nearing the completion of wharf construction or once the full details on the types of ferry vessels and final modelling of the impact areas are available.

Transplantation of *Posidonia australis* from impact site(s)

Posidonia australis from intact meadows that have been identified within the impact zone(s) would be used as the donor material for revegetating damaged seagrass meadows within Botany Bay. The plants would be removed by hand by divers and placed in netted catch bags. Particular care would be given to ensure that the rhizome is kept intact to ensure maximum survival potential. Removed *Posidonia australis* plants would be replanted at the identified target rehabilitation sites within 48-72 hours of collection if possible. The removed fragments may be stored underwater in catch bags if replanting within 72 hours is possible. Alternatively, a storage solution (e.g. shaded floating tanks to avoid direct sunlight) would need to be set up if the fragments cannot be planted within a few days.

Jute mats would be deployed and pegged out in the selected rehabilitation sites using biodegradable materials. *Posidonia australis* fragments would be threaded through the jute's loosely-woven mesh and planted into sand using methods developed by Glasby et al. (2015) and Ferretto et al. (2021). The perimeter of the replanted area would be marked to facilitate monitoring efforts.

Additional rehabilitation using naturally detached *Posidonia australis* fragments

Because *Posidonia australis* is a protected species that is declining in Botany Bay, one of the greatest challenges for additional rehabilitation is finding suitable donor shoots without damaging the existing meadows.

The methods developed by *Operation Posidonia* provide a new approach to source and transplant additional *Posidonia australis* fragments (Ferretto et al. 2021). This approach includes a major community engagement and educational component. Local citizen scientists are recruited through a science communication and outreach campaign. These members of the general public become involved in the rehabilitation by collecting beach-cast *Posidonia australis* fragments that are naturally detached after strong winds or wave action.

Seagrass fragments collected by citizen scientists are initially deployed in collection stations, which would be installed near popular beaches or coastal amenities. These fragments are subsequently transported to storage tanks, to be installed within Botany Bay (location to be confirmed) and subsequently replanted underwater using the same methods described above.

This approach not only provides donor shoots for the rehabilitation but also engages with local communities to increase awareness about the importance of seagrasses, enhance local stewardship of the marine environment, and foster general care of the rehabilitation works.

5.1.3 Monitoring program and seagrass assessment criteria

The success of the rehabilitation would be assessed through time by comparing the rehabilitated site(s) with two types of reference *Posidonia australis* populations:

- **Initial reference site**: *Posidonia australis* in impacted areas prior to translocation
- **Unimpacted reference sites** (n=3): Existing *Posidonia australis* meadows in Botany Bay not impacted by the project's construction.

At each rehabilitee and reference site, surveys would include mapping the extent of seagrass habitat, recording species composition and quantifying *Posidonia australis* density and morphological traits using quadrats deployed in situ (number of quadrats to be determined based on site area). Additional monitoring may include assessment of ecosystem processes such as sedimentation, habitat-provision and productivity at each site.

All sites (including reference sites and potential rehabilitation sites) would be surveyed twice prior to construction and every six months following rehabilitation works for the first five years, and yearly subsequently.

Mortality of *Posidonia australis* transplants can be high during the first months (Evans et al. 2018; Ferretto et al. 2021), but surviving transplanted shoots are expected to start producing new shoots within 12 months after initial transplantation (Glasby et al. 2015; Ferretto et al. 2021).

Measures of success need to account for the slow growth of *Posidonia australis* (Meehan & West 2000). Rehabilitated areas are expected to take at least five to ten years to achieve shoot densities similar to natural undisturbed meadows (Bastyan & Cambridge 2008), and hence monitoring is recommended for a period of a minimum of five years..

Rehabilitation efforts may be considered successful based on the number of *Posidonia australis* shoots in rehabilitated plots matching or doubling (if a 2:1 compensation is required) the number of *Posidonia australis* shoots translocated from the impacted areas. Additional desirable measures of success include evidence that the ecosystem functions of rehabilitated plots (e.g. in terms of habitat provision and productivity) are equivalent to the ecosystem functions provided by unimpacted reference sites.

5.2 Creation of artificial habitat – seahorse hotels

Artificial habitats have increasingly been adopted to supplement aquatic habitat and recreational Fisheries in NSW. In highly modified and developed estuaries such as Botany Bay, many species, including the endangered White's seahorse, will colonise artificial habitats, including jetty piles (DPI, 2019). The development and trial of artificial habitats to promote recovery of White's seahorse populations were identified as a high priority action for the recovery of the species (DPI, 2019). Habitat replacement, through artificial habitat devices, has been carried out to replace habitat and or increase habitat availability in Lake Macquarie, Botany Bay and St Georges Basin. This has been through joint effort research by UNSW Sydney, NSW Fisheries and the Sydney Institute of Marine Science (SIMS). These reef structures are further validated in NSW Fisheries artificial reef program (SIMS, 2020).

Seahorse hotels have become an effective design to provide artificial habitat for White's seahorse (Simpson, *et al*. 2020). The basic design is an alloy frame with a metal/rope mesh and or other permeable material that allows access into the middle of the frame to provide an area of protected shelter. They allow marine growth to cover the 'hotel' therefore providing suitable habitat for syngnathids. More recent designs use a metal grid mesh around the frame that would offer longevity to the hotel.

The design of the wharves includes piles that could provide potential artificial habitat. The seahorse hotels would be attached to these piles to provide increased habitat coverage as a fixed offset. Implementing these structures around the wharf piles would also encourage habitat connectivity. These structures would improve the habitat availability under the wharves and the structures would encourage biological growth (e.g. via epifauna and epibiotic growth) that would provide increased biodiversity to the region.

By using artificial reef structures and their associated known successes (Simpson, *et al*. 2020), it may be possible to increase suitable habitat for White's seahorse, other Syngnathidae and encourage macroalgae growth.

5.2.1 Location of seahorse hotels

Between the La Perouse Wharf and the Kurnell wharf the project is proposing over 90 piles to be installed to support the wharf structures. It is proposed that the seahorse hotels be fixed to the piles and installed after construction.

The number of seahorse hotels required is calculated in relation of the number of piles installed. It is estimated that two hotels (approximate dimensions are 50x50x40cm[6]) would be fixed to each suitable pile (Table 5-1). For the purposes of this assessment, all piles are considered to impact on potential White's seahorse habitat. While this would not be the case, as some piles are not located within suitable habitat, this assumption provides a conservative outcome. This calculation does not account for any marine growth on the piles that may be considered habitat for the seahorses.

The following calculations are estimates and will be confirmed if the Project is approved. The sizes of seahorse hotels are estimated to be the minimum area that could be achieved. As it is yet unknown how the hotels would be mounted, the final sizes may change. However, it is estimated the area available would still exceed the area lost by the piles.

Table 5-1. Size to area conversions.

Item	How area was calculated	Dimensions	Areas
Seahorse hotel	Dimensions to surface area in m^2	Estimated 50l x 50w x40h	1.3m^2
Pile	Diameter to m^2	762 mm	0.456m^2

La Perouse

At La Perouse there would be in total 47 piles (area totalling 21.43m^2). All piles are not suitable as locations for seahorse hotels (Figure 5-4). The likely piles need to account for:

- Suitable water depth below mean low water spring tides (this excludes four piles)
- Piles with suitable depth cover away from the ferry and or recreational boat access (this excludes 25 piles)

Therefore, there would be 18 piles suitable for installing hotels. With two hotels mounted on each pile **46.8m^2** of habitat could be created.

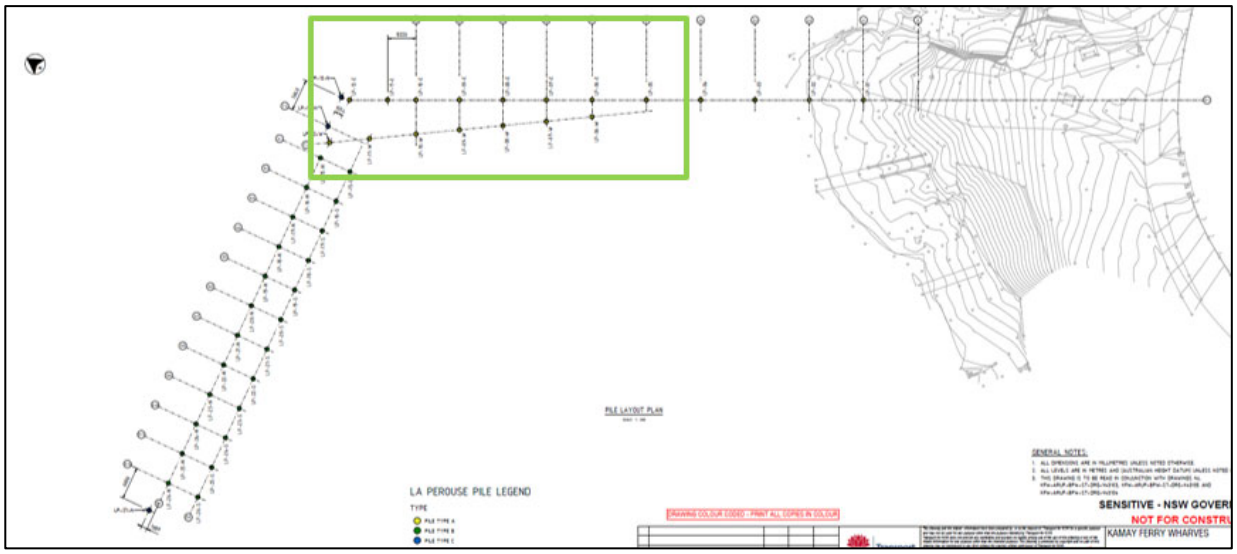


Figure 5-4. La Perouse pile layout

[6] Areas are converted to and calculated in square meters to maintain consistency of reporting.

Kurnell

At Kurnell there would be 45 piles (area totalling 20.52 m^2). Not all piles are suitable for the same reasons as above. Therefore, there would be 21 piles suitable for installing hotels. With two hotels mounted on each pile the hotels could provide **54.6m^2** of habitat.

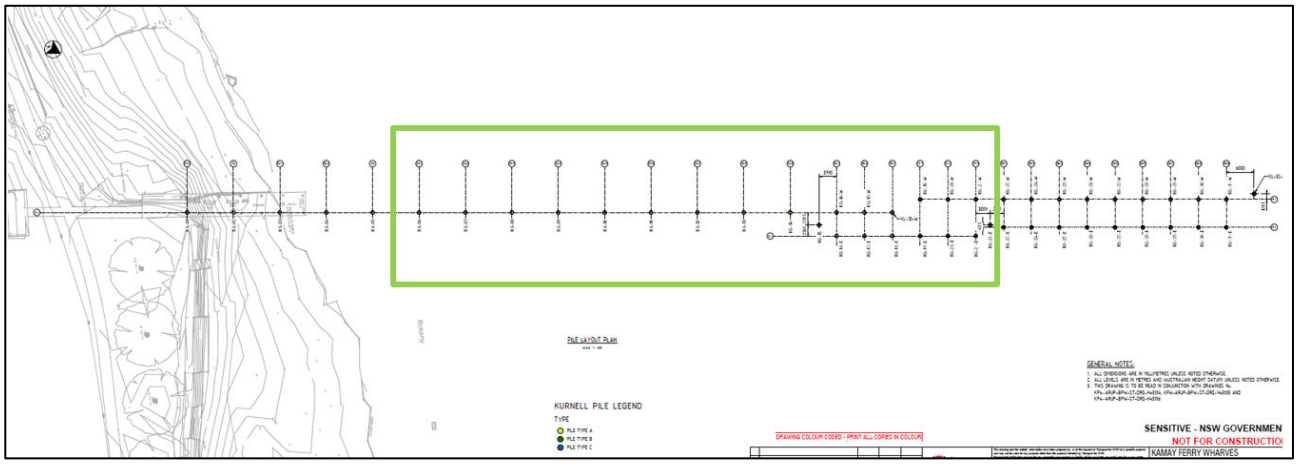


Figure 5-5. Kurnell pile layout

Based on the combined assessment there would be a gain of habitat for White's seahorses of **59.45m^2**

Table 5-2. Area calculations of gained sea horse habitat

Location	Area lost to piles	Area gained by seahorse hotels	Area gained
Kurnell	20.52 m^2	54.6 m^2	34.08 m^2
La Perouse	21.43 m^2	46.8 m^2	25.37 m^2
		Total gain	**59.45 m^2**

5.2.2 Method, design, and installation

The following establishes the process from design to installation:

- Once the Conditions of Approval have been received, the design and fabrication of the seahorse hotels would start
- Designs would be done in consultation with NSW Fisheries
- Mounting and materials of the hotels would be confirmed to provide suitable longevity without risk of leaching toxic materials
- Installation would commence no later than three months after the wharves are built.

5.2.3 Monitoring

Periodic monitoring to establish effectiveness of the seahorse hotels would be undertaken. Monitoring of seahorse hotels would involve visual inspections of use by seahorses or other marine fauna, and underwater photographs taken as evidence and to track algal growth over time. Monitoring would run for the duration of the post construction monitoring once the seahorse hotels

are installed. Monitoring will include recording any presence/abundance of seahorses and other cryptic species (not limited to White's Seahorse).

Table 5-3 Monitoring frequency post construction

Monitoring Year	Monitoring frequency
Year 1	Quarterly
Year 2-5	Annually*

*Annually after the five year period is the success criteria has not been meet. This would be determined at the five year review ref Section 5.5.3.

5.2.4 Additional considerations

It was identified that the wharf locations could provide host locations for rehomed/release of White's Seahorses. Transport for NSW will work with NSW Fisheries for any potential release of White Seahorse surrounding the project.

5.2.5 Success criteria

The following are the proposed criteria that would be used to measure if the hotels are successful;

- A 60 per cent cover of the seahorse hotel by suitable epifauna and epibiotic growth. While there are no guidelines for suitable growth, Simpson et al. (2020) trialled seahorse hotels in the Port Stephens-Great Lakes Marine Park and found over 90 per cent growth on all hotel types.
- Population analysis (once individuals have established) using statistical analyses such as analysis of variance (ANOVA) and permutational analysis of variance (PERMAOVA). Population analyses will be developed as part of the monitoring program.

Considerations for the natural settlement of the seahorse hotels would depend on the species present in the region, as such timing of settlement on to the structures is unknown. It is suggested that success of the structures not be limited to presence of White's Seahorse but be inclusive of suitable habitat conditions and benefits to other species present.

5.3 Project controls, mitigations, and contractual deterrents

The Project is committed to maintaining minimal impact to the *Posidonia australis* and other seagrass habitat outside the impact area. This would be achieved by:

- Setting exclusion zones
- Setting speed limits and access points
- Defining specific procedures for marine protection focused on:
  - A seahorse relocation plan (inclusive of White's seahorse and weedy seadragons)
  - Procedures for marine mammal spotters.

A Construction Environmental Management Plan (CEMP) would be prepared that includes a Marine Biodiversity Management sub plan (BMP). This BMP includes controls and mitigation measures aligned to the above bullet points.

Additional control measures would also be included into the documentation used to engage the contractor who would build the wharves. These would require the contractor to avoid impacts on marine biodiversity. These measures are likely to include the contractor being financially penalised if it causes any additional impact beyond that approved by the State and Commonwealth. The terms of the financial penalty the contractor is obligated to not increase the financial offset obligation (or monetary bond value).

By working under a CEMP, setting specific contractor specifications, and including financial penalties, it may be possible reduce impacts within the proposed 15 metre buffer area based on the applications as described above.

5.4 Reporting

A Marine Biodiversity Offset Report would be prepared each year for five years post construction. As a minimum the report would include:

- A progress report on the implementation of the MBOS:
- A review of seagrass monitoring results including:
- Success criteria reporting

The Marine Biodiversity Offset Report would be submitted to NSW Fisheries, DAWE and DPIE.

5.5 Review and improvement

This section described the commitments around adaptive management and continued consultation with stakeholders

5.5.1 Continuous improvement

The MBOS would be adaptive, meaning it would be reviewed and analysed to determine its effectiveness. It would be updated where needed to allow for continual improvement.

Continuous improvement would be achieved by ongoing evaluation site specific, this may include updating the MBOS, the development of procedures and plans to be attached to the MBOS to ensure the effective implementation.

When updated the consultation with be undertaken with NSW Fishers, DAWE and DPIE to ensure the updates are consistent with the offset policies and their implementation (Section 5.5.2).

5.5.2 MBOS update and amendment

The processes described in Section 3.1 above may result in the need to update or revise the MBOS. This would occur in response to:

- Site specific requirements such as locations, collection, holding, transplanting, and rehabilitate seagrass
- Results of monitoring.
- Conditions of the approval that may conflict with the MBOS
- Monitoring requirements in addition to the proposed MBOS monitoring
- Any additional permits not covered by the EIS and MBOS approval

Transport for NSW would review and update the MBOS in consultation with NSW Fisheries, DAWE and DPIE.

Where significant changes to the MBOS have occurred, a copy of the updated plan and changes would be distributed to all relevant stakeholders (Section 3.2) and additional parties as needed.

5.5.3 MBOS reviews

A review of the MBOS (including the Impact Monitoring Program) will be undertaken at five and then at ten year implementation periods. This time period will include both the construction and operational phases of the project. The review will be in consultation with NSW Fisheries, DPIE and DAWE.

This review would include: to determine the following:

- Reviewing seagrass impact monitoring (Appendix 3);
- Success criteria (section 5.1.3 and 5.2.5);
- Monitoring (Section 5.1.3 and section 5.2.3);
- Determine if offset have been meet or if additional measures are to be implemented; and
- Refund of the bond (section 7).

This review would ensure that Transport for NSW has meet is offset requirements under Commonwealth and State legislation.

6 Additional beneficial outcomes

Other compensatory measures are those actions that do not create a direct offset, but are anticipated to lead to benefits for identified offset species such as funding for research or educational programs. The compensatory measures should be established to quantify the effectiveness of compensation measures.

The MBOS would be delivered to provide direct offsets discussed in Section 5, however the implementation and monitoring of the MBOS by a research institute would provide for the further research on the seagrass translocation and artificial habitat for syngnathids.

The compensatory measures for research and education are outlined in the Commonwealth Environmental Offset Policy and the NSW Fisheries Policy.

6.1 Aboriginal engagement

Throughout this process opportunities have been sought to include, and consult with, the Gamay Rangers and the La Perouse Aboriginal Land Council to ensure their inputs are addressed, including:

- Invitation to the second workshop to review and discuss the MBOS
- Invitation/access to tender for the rehabilitation work
- Continue ongoing communication.

In line with the NSW Government Aboriginal Procurement Policy, Transport for NSW is intending to include a weighted requirement in the tender for the completion of the transplant and rehabilitation work so that the local Aboriginal community involvement continues.

6.2 Research

The completion of the offset work would support further research into transplanting seagrass The successful translocation of seagrass would provide valuable information for the development of feasible restoration programs for the endangered *Posidonia australis* community in Sydney.

The general expenditure of the rehabilitation work would provide research opportunities through the methods applied, the collection of data over time, and application of a physical direct offset for managing impacts to *Posidonia australis.*

Delivery of the rehabilitation work would be carried out by a research institute that would use results to provide peer reviewed research.

This offset would be implemented through financial contributions that could be bolstered through grants and collaboration, with potential for attraction of and securing additional Government research funding. The effort in carrying out the rehabilitation work would directly benefit the development of better understanding in *Posidonia australis* and other seagrass research. As such, the cost of completing the proposed rehabilitation would provide the direct seagrass offset and the indirect research contribution as allowed in the EPBC Offset Calculator.

The full breakdown of how the EPBC commitments have been made can be found in section 2.3 and Appendix 1.

7 Monetary bond offset approach and costs

Section 2 above explains the legislation, policy, and guidelines used to inform the MBOS. When calculating monetary bond, the:

- NSW Fisheries Policy is limited in its flexibility to include additional strategies outside of the bond contribution
- EPBC Act Environmental Offsets Policy, and supporting calculator, provides a structure in which to provide meaningful offsets while weighting the contribution outcome of each strategy.

To provide a more robust approach, the MBOS is based on what are considered acceptable methods to achieve no-net loss of *Posidonia australis* and white's seahorse habitat. These gains are achieved through direct actions and beneficial outcomes as compensatory measures defined under the EBPC Act. Rather than defaulting to a financial offset, and to achieve a no-net loss outcome as defined under the NSW Fisheries Policy (Section 2.3) where the EPBC Act provides a positive gain outcome. Appendix 1 includes the estimated offset gains, determined under the EPBC Offset Calculator and the suitability assessments. Appendix 2 includes the quality criteria developed for seagrass.

The EPBC Offset Calculator provides a more conservative value and offsetting obligation where the calculation accounts for an estimate loss and looks to include additional factors beyond just an area based calculation. As such, the EPBC Offset Calculator was used to determine the State and Commonwealth MBOS offset requirements for *Posidonia australis.*

The section below provides an offset monetary bond estimate accounting for the limitations described above in Section 3.3. In summary, the table accounts for:

- Areas provided in the EIS are considered worst-case
- As the mapping process has a coarser level (not counting individual strands) for assessing percentage cover. Also, the total areas provided are more conservative and the areas with very low percentage (even sparse cover) are included in the mapping. This approach helped to address the seasonal and annual fluctuations within seagrass present as it allows for the fluctuation in die back and growth with the seasons.
- A more conservative application for areas of *Posidonia australis* is reflective through the EPBC offset calculation.

Table 7-1. Monetary bond offset as estimated in 2021 (refer to Table 1-1 for the consolidated groups)

Habitat	Offset size determination method	Estimated maximum impact (m^2)	Required offset size (m^2)	Cost (per m^2) the 2:1 ratio	Monetary Bond Requirement
Posidonia australis	EPBC offset calculator	683	**2,000***	$114.00	$114,000*
Other seagrass	2:1 requirement for KFH	20,589	**20,589**	$114.00	$2,347,146
Type 1 habitat					**$2,461,146**
Macroalgae	2:1 requirement for KFH	3,683	**3,683**	$114.00	$419,862
Type 2 habitat					**$419,862**
				Total	**$2,881,008**

Habitat	Offset size determination method	Estimated maximum impact (m^2)	Required offset size (m^2)	Cost (per m^2) the 2:1 ratio	Monetary Bond Requirement
*Area and value calculated by EPBC offset calculator the rate applied was from the NSW Fisheries Policy					

Based on the proposed MBOS, the Project would meet all of the offset requirements under the EPBC Act (Section 2.3) and the strategy cost[7] is about 50 per cent of the monetary bond requirements under the FM Act (Section 2.1) summarised in Figure 7-1. The remaining 50 per cent would be paid as the adjusted monetary bond of about $1.4 million to NSW Fisheries (Table 7-2).

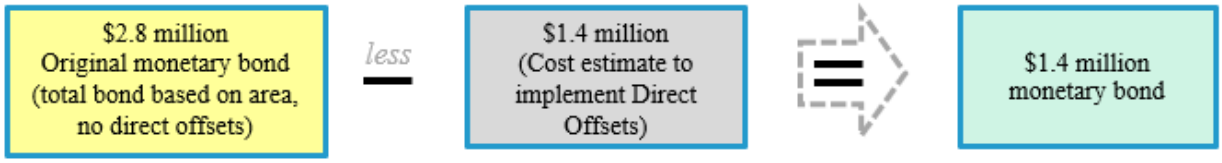


Figure 7-1. Explanation of adjustment in monetary bond.

Table 7-2. Offsetting cost estimate and reinvested bond contribution.

Offset	Type and Benefit	Location	Estimated value ($)	% of Impact offset for EPBC Act and FM Act Requirements
Rehabilitate and improve existing *Posidonia australis* habitat, including transplanting materials from the project area.	Directly improving existing habitat for the protected matter/ *Posidonia australis* KFH.	Ideally near project area of the existing meadow of *Posidonia australis*. Consult with NSW Fisheries. Proposed locations in section 5.1.1.	$114,000[a] direct contribution to rehabilitation effort Calculated using | EPBC Calculated Offset Cost	**100%** endangered *Posidonia australis* habitat listed under EPBC and FM Acts. **100%** endangered White's seahorse habitat listed under EPBC and FM Acts. **3.9%** of original monetary bond requirement for KFH.
Enhancement of the proposed wharfs/ artificial habitat to improve threatened species habitat (eg seahorse hotels for White's seahorse).	Direct - improving habitat and reducing threats to a protected matters/ macroalgae KFH.	Subject site, namely the proposed La Perouse and/or Kurnell wharves.	$225,000[b]	**7.8%** of original monetary bond requirement for KFH Net gain of **59.45m²** of potential White's seahorse habitat (Section 5.2)

[7] The cost provided is still in development, some costs will not be confirmed until the strategy is through a tendering process to understand the final cost implications. However, at a minimum the estimates costs look to reinvest 50 percent of the monetary bond directly back into protecting and improving seagrass habitat within Botany Bay

Offset	Type and Benefit	Location	Estimated value ($)	% of Impact offset for EPBC Act and FM Act Requirements
Support important research (e.g., seagrass transplanting and rehabilitation)	Direct and Indirect – enhancement of KFH through and/or threatened population through supporting important research	NA	$1,150,000[c]	**39.4%** of original monetary bond requirement for KFH
Total			$1,489,000	Combine **51.1%** of original monetary bond requirement for KFH (50% of the $2.8 million original bond cost, Table 7-1)

[a] EPBC Offset calculation cost requirement to be added directly to rehabilitation work
[b] Design, cost of artificial reef structures and installation monitoring and related
[c] Based on estimate provided by UNSW at upwards of $200/m^2 with the assumption that the program runs for several years.

7.1.1 Summary

To meet the obligations of the EPBC Act and the NSW Fisheries policy a combination of direct offsetting and monetary bond is proposed. The bond is to provide financial insurance on the potential impact of the proposed works. Transport for NSW will honour that bond commitment but reduce the initial bond cost through reinvesting that money into the proposed direct offsets.

Based on the proposed strategy the Project would meet all of the offset requirements under the EPBC Act (Section 2.3) for *Posidonia australis* and White's seahorse and the estimate strategy cost to implement the Direct offsets is about 50 per cent of the monetary bond requirements under the FM Act (Section 2.1) this is summarised in Table 7-2. The remaining 50 per cent would be paid as the bond of about $1.4 million to NSW Fisheries (break down in Table 2-2) as described in Figure 7-1.

With the outcome of the second workshop as part of the consultation process, a revised approach for what strategies would be accepted by NSW Fisheries, it is Transport for NSW intension to maintain the bond contribution as proposed. The cost allocated to the other strategies would be reinvested to the seagrass rehabilitation and artificial reef structures.

Through this approach a number of outcomes will achieve:

- The EPBC Act requirements through direct offsetting for *Posidonia* Australia and White's seahorse
- There will be a net gain of improved *Posidonia australis* habitat
- The monetary bond requirements will be met for the NSW Fisheries policy
- There will be additional net gain for White's seahorse habitat.
- Additional benefits will come out of the proposed strategies indirectly through gains in knowledge and research, and
- Continued commitments of consultation and community involvement.

The offsetting will overall reduce risk of significant residual impacts on threatened listed species and communities.

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Appendix 1 – EPBC Offset Tool Calculations and Assessment

Assessment of Suitability

The potential offsets that have been considered against the selection criteria identified in Section 5.4 are detailed in Table A1-1.

The strategy proposed has undertaken a number of reviews through Transport for NSW, Arup and specialist inputs as well as through the consultation with NSW Fisheries and DAWE. As such the approach has been modified to focus on the preferred offsetting methods of seagrass rehabilitation and provision of artificial reef structures.

Previous considerations have been left in the table below to show process of other considerations.

The calculated offset provided below are fully achieved through providing direct offsetting of rehabilitation and to not require additional offsets to balance the outcome.

The following offset strategies are considered the most appropriate for the Project:

- Rehabilitation of seagrass habitat – (*Posidonia australis*)
- Creation of artificial habitat (under the proposed wharves for White's Seahorse)
- Support for further research into transplanting seagrass (through grants and collaboration which feeds into the rehabilitation work)

Strategy Assessment

Proposed Strategy

The considered strategies and suitability is assessed in Table A1-1, the draft Offset strategy is presented in Table A1-2.

The strategy has an estimated gain of 2.0 ha of KFH (or equivalent financial compensation) (table A1-3. This amounts to 115% of the 2:1 minimum estimated offset requirement for KFH under the FM Act. This additional 15% will provide buffer for unexpected or additional impacts detected during monitoring.

The proposed strategy also provides in excess of 40 times the required direct offset requirements (Appendix 1), plus additional indirect offsets through research support, under the EPBC Act Policy for the Endangered *Posidonia australis* Ecological Community and potential habitat for the Endangered White's Seahorse (Table A1-4), associated with the *Posidonia australis* Ecological Community. The substantial additional offsets to that required under the EPBC Act Policy will provide assurances, should estimate inputs used to determine the offset requirement (EPBC calculator inputs) be found to be not as favourable as expected and/or additional impacts occur.

Additional information on the EPBC Calculator and inputs can be found here https://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-how-use.pdf

Table A1-1. Assessment of suitability matrix based on EPBC offsetting requirements.

	Rehabilitation of Seagrass Habitat - Transplanting	~~Rehabilitation of Other Aquatic habitats~~	~~Installation of signage and EFM~~	Creation of Artificial Habitat	Support for further research into transplanting seagrass	~~Seagrass Habitat Improvements – Catchment Water Quality and Pollution~~	~~Conservation agreements to protect intertidal and shoreline areas~~
Type of offset	Direct	~~Direct~~	~~Direct~~	Direct	Indirect	~~Direct~~	~~Indirect~~
Location of the offset	Can be implemented in Botany Bay	~~Opportunities within Botany Bay~~	~~Can be implemented in Botany Bay~~	Botany Bay (Project Area)	Preferable Botany Bay	~~Botany Bay Catchment~~	~~Botany Bay (Taren Point)~~
Like-for-like offsets	Yes	~~No~~	~~Yes~~	No	Yes, but not directly	~~No~~	~~No~~
Ability for measurable conservation gain	Yes	~~Yes~~	~~Yes~~	Yes	Yes	~~Difficult~~	~~Difficult~~
Timeframe required to achieve conservation gain	3-5 Years	~~3-5 years~~	~~3-5 years~~	3-5 years	3-5 years	~~5-10 years~~	~~5-10 years~~
Level of offset uncertainty	Moderate*	~~Low~~	~~Moderate~~	Moderate	Moderate	~~Moderate~~	~~Low~~

*Based on recent success in Port Stephens

Table A1-2. Draft Offset Strategy

Offset	Type	Location	Offset Size / Habitat Gain	Requirement
Seagrass habitat improvements – catchment water quality and pollution (*Posidonia australis* habitat)	Direct – reducing threats to a protected matter + improving existing habitat for the protected matter	Consult with NSW Fisheries - Investigate further recent losses in Quibray Bay	5 ha of *Posidonia australis* with current stressors from water quality and stormwater. Estimated gain (Net present value) = 0.67 ha*	Meets and exceeds requirement for direct offsets under the EPBC Act for *Posidonia australis* and White's Seahorse gain to meet offsetting requirements under the FM Act KFH
Rehabilitation of seagrass habitat – transplanting (*Posidonia australis* and *Zostera*)	Direct - creating new habitat for the protected matter	Consult with NSW Fisheries and UNSW – Consider aligning in area with habitat improvements.	Creation of approx. 650 m^2 of new habitat via transplanting. Assuming 70% success rate, estimated gain = 0.05 ha of seagrass.	To meet offsetting requirements under the FM Act for KFH
~~**Installation of signage and EFM**~~	~~Direct - creating new habitat for the protected matter and reducing threats to a protected matter + improving existing habitat for the protected matter~~	~~Consult with NSW Fisheries and UNSW on preferences on types of moorings, private mooring owners, Port of Botany.~~	~~Area dependent on the location and current mooring in place and or if casual moorings have been used. Based on upgrade of 10 moorings (Assumed average impact on KFH per mooring = 255m^2), estimated gain = 0.26 ha.~~	~~To meet offsetting requirements under the FM Act for KFH~~
Creation of artificial habitat (under the proposed wharfs for White's Seahorse)	Direct - creating new habitat for the protected matter	Subject site (proposed La Perouse and Kurnell wharfs)	Approx. 0.1 ha. To be determined following review of detailed design. Estimated gain = 0.1 ha	To meet offsetting requirements under the FM Act for KFH
Support for further research into transplanting (through grants and collaboration)	Indirect – would be linked to assisting in delivery and monitoring success of transplant program	NA	$500,000. would be equivalent to financial compensation for 0.96 ha of KFH.	Provides additional indirect offsets under the EPBC Act for *Posidonia australis* and White's Seahorse. To meet offsetting requirements under the FM Act for KFH.

* refer to Appendix 1 and 2 for quality assumptions used in the EPBC Offset Tool.

Table A1-2. Draft Cost estimate table of offset (now revised in main report).

Offset	Type and Benefit	Location	Estimated value ($)	% of Impact offset for EPBC Act and FM Act Requirements
Rehabilitate and improve existing *Posidonia australis* habitat (including transplanting of materials from the project area).	Direct improving existing habitat for the protected matter/ *Posidonia Australis* KFH	Ideally near project area. Consult with NSW Fisheries	$114,000[a] Direct contribution to rehabilitation effort (EPBC Calculated Offset Cost)	100% endangered *Posidonia australis* habitat listed under EPBC and FM Acts. 100% endangered White's seahorse habitat listed under EPBC and FM Acts. 3.9% of original monetary bond requirement for KF
~~Installation of signage and EFM~~	~~Direct - improving habitat and reducing threats to a protected matters/ all KFH.~~	~~Consult with NSW Fisheries on preferences for types of moorings, private mooring owners, Port of Botany.~~	~~$325,000[b]~~	~~11.2% of original monetary bond requirement for KFH~~
~~Provision of infrastructure to improve water quality (eg vessel pump out facility)~~	~~Direct – improving water quality, habitat and reducing threats to a protected matters / all KFH.~~	~~Subject site (proposed La Perouse and/or Kurnell wharfs)~~	~~$325,000[c]~~	~~11.2% of original monetary bond requirement for KFH~~
Enhancement of the proposed wharfs/artificial habitat to improve threatened species habitat (eg seahorse hotels for White's seahorse).	Direct - improving habitat and reducing threats to a protected matters / macroalgae KFH.	Subject site (proposed La Perouse and/or Kurnell wharfs)	$225,000[d]	7.8% of original monetary bond requirement for KFH
Support important research e.g. seagrass transplanting and rehabilitation	Direct and Indirect – enhancement of KFH through and/or threatened population through supporting important research	NA	$500,000[e]	17% of original monetary bond requirement for KFH
Total			$1,489,000	Combine 51% of original monetary bond requirement for KFH

Performance against KPIs

A quality measure for seagrass has been developed as part of this MBOS for determining the size of offsets required (Appendix 2). This quality measure will be used as the main tool to assess performance of the offsets where appropriate as shown in Table A1-3.

Table A1-3: KPIs and monitoring for offsets

Offset	Indicators	Performance Requirements	Required Monitoring
Seagrass habitat improvements – catchment water quality and pollution (*Posidonia australis* habitat)	Seagrass quality measure Seagrass density Seagrass distribution	Seagrass quality measure of no decrease from baseline No decrease in seagrass density No decrease in seagrass distribution (aerial imagery).	Annually Baseline + minimum of 5 years post improvements Monitoring will be required to ensure that conditions of approval are implemented effectively
Rehabilitation of seagrass habitat – transplanting (*Posidonia australis* and *Zostera*)	Seagrass quality measure Seagrass density Success (%)	Seagrass quality measure increase of 2 points or more from baseline Significant increase in seagrass density Increase in seagrass distribution	Four time per year for the first 24 months post transplanting Annually after 24 months Monitoring will be required to ensure that conditions of approval are implemented effectively
~~Installation of signage and EFM~~	~~Seagrass quality measure~~ ~~Seagrass density~~ ~~Seagrass establishment~~	~~Seagrass quality measure increase of 2 points or more from baseline (where seagrass is present at baseline)~~ ~~Significant increase in seagrass density (where seagrass is present at baseline)~~ ~~Seagrass establishment (where no seagrass is present at baseline)~~	~~Annually~~ ~~Baseline + minimum of 5 years post improvements~~ ~~Monitoring will be required to ensure that conditions of approval are implemented effectively~~
Creation of artificial habitat (under the proposed wharfs for White's Seahorse)	Target species presence	Use of target species equivalent to use of adjacent natural habitats	Annual Inspections Additional inspection before operational maintenance

Offset	Indicators	Performance Requirements	Required Monitoring
Support for further research into transplanting (through grants and collaboration)	Ability to provide technical input into transplanting works Ability to monitor success of transplanting Ability to publish findings	Safely facilitate transplanting works to aid rehabilitation offset On time delivery of required monitoring of the transplant sites Publication of materials that advance the knowledge of seagrass restoration in NSW	Not Applicable

Table A1-4. EPBC Offset Calculator for *Posidonia australis* for only direct offsetting

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Posidonia australis
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community Clear row	Yes	Loss	**Area**	0.068	Hectares	EIS Chapter + Condition thresholds
			Quality	**5**	Scale 0-10	
			Total quantum of impact	0.03	Adjusted hectares	
Threatened species habitat						
Area of habitat Clear row	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees Clear row	No					
Condition of habitat Change in habitat condition, but no change in extent Clear row	No					
Threatened species						
Birth rate e.g. Change in nest success Clear row	No					
Mortality rate e.g Change in number of road kills per year Clear row	No					
Number of individuals e.g. Individual plants/animals Clear row	No					

Quality = Rounded up to 5 from 4.55.

Impacts assessed against estimated loss of *Posidonia australis* communit

Estimated quality score only. To be determined following baseline survey

Offset calculator																					
Offset calculator	**Protected matter attributes**	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**		**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value (adjusted hectares)**		**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
	Ecological Communities																					
	Area of community	Yes	FALSE	Adjusted hectares	Seagrass Habitat (P. australis) Improvements – Catchment Water Quality and Pollution e.g. WSUD etc	**Risk-related time horizon (max. 20 years)**	10	**Start area (hectares)**	0.2	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	25%	0.05	50%	0.03	0.02	0.03	101.99%	Yes	$114,000.00	DPI Fisheries
										Future area without offset (adjusted hectares)	0.1	**Future area with offset (adjusted hectares)**	0.2									
						Time until ecological benefit	3	**Start quality (scale of 0-10)**	5	**Future quality without offset (scale of 0-10)**	3	**Future quality with offset (scale of 0-10)**	7	4.00	50%	2.00	1.93					
	Threatened species habitat																					
	Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**										
										Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0									
						Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**										
	Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**		**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
	Number of features e.g. Nest hollows, habitat trees	No																				
	Condition of habitat Change in habitat condition, but no change in extent	No																				
	Threatened species																					
	Birth rate e.g. Change in nest success	No																				
	Mortality rate e.g Change in number of road kills per year	No																				
	Number of individuals e.g. Individual plants/animals	No																				

Table A1-5. EPBC Offset Calculator for *White's seahorse*

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Whites Seahorse
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community Clear row	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat Clear row	Yes	Potential habitat loss	**Area**	0.068	Hectares	EIS Chapter + Condition thresholds for PS
			Quality	**5**	Scale 0-10	
			Total quantum of impact	0.03	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees Clear row	No					
Condition of habitat Change in habitat condition, but no change in extent Clear row	No					
Threatened species						
Birth rate e.g. Change in nest success Clear row	No					
Mortality rate e.g Change in number of road kills per year Clear row	No					
Number of individuals e.g. Individual plants/animals Clear row	No					

Quality = Rounded up to 5 from 4.55.

Output Calculator

Offset calculator																				
Offset calculator	**Protected matter attributes**	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**		**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value (adjusted hectares)**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
	Ecological Communities																				
	Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
										Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
						Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
	Threatened species habitat																				
	Area of habitat	Yes	FALSE	Adjusted hectares	Seagrass Habitat (P. australis) artifical reef habitats	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	0.2	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	25%	0.05	50%	0.03	0.02	101.99%	Yes	$114,000.00	DPI Fisheries
										Future area without offset (adjusted hectares)	0.1	**Future area with offset (adjusted hectares)**	0.2				0.03				
						Time until ecological benefit	3	**Start quality (scale of 0-10)**	**5**	**Future quality without offset (scale of 0-10)**	**3**	**Future quality with offset (scale of 0-10)**	**7**	4.00	50%	2.00	1.93				
	Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
	Number of features e.g. Nest hollows, habitat trees	No																			
	Condition of habitat Change in habitat condition, but no change in extent	No																			
	Threatened species																				
	Birth rate e.g. Change in nest success	No																			
	Mortality rate e.g Change in number of road kills per year	No																			
	Number of individuals e.g. Individual plants/animals	No																			

Offset Calculator Assumptions

Criteria	Comments
Offset Input Quality = 5	This is an estimate derived from qualitative observations and mapping works done for the EIS. The final values will be determined from a combination of quantitative sampling and mapping at the completion of the baseline surveys.
Risk Related Time Horizon = 10 years	Given that the offset is located within the most heavily populated developed catchment in Australia assigning a maximum offset life span of 20 years is unlikely to be achievable. Based on the, the highly developed and populated catchment, numerous and heavy industrial uses of the estuary and likely future expansions of catchment development and upgrade works to infrastructure within the estuary a more moderate risk related time horizon has been assigned.
Time to ecological benefit = 3 years.	Recent aerial imagery and current mapping works indicate seagrasses are responding and increasing in distribution to favorable environmental conditions in the south-eastern areas of Botany Bay within timeframes as little as 12 months. Consideration was also given to current knowledge that the establishment and growth rates of *Posidonia australis* seagrass are substantially slower than other seagrasses so any ecological benefit reliant on *Posidonia australis* are likely to be substantially slower.
Risk of Loss Without offset = 50% With Offset = 40%	These values are indicative of a potential example of offset risk use by the calculator only. They have been selected as a potential example as they provide a conservative estimate of risk of loss. The final values will be dependent on the site chosen for rehabilitation. With risks determined by its locality, current causes and/or pressures, and potential to be rehabilitated.
Offset Quality Start = 5 Without offset = 3 With offset = 7	These values are indicative of a potential example of offset quality use by the calculator only. They have been selected as a potential example as they represent a bed of seagrass in moderate condition under pressures resulting in continued gradual decline, which has potential to be rehabilitated and the decline reverted into an improvement of similar magnitude. The final values will be dependent on the site chosen for rehabilitation. With values determined by its locality, current causes and/or pressures, and potential to be rehabilitated.
Confidence in Result = 50%	As mentioned above Botany Bay is an estuary located within a very densely populated catchment and is vulnerable to a wide range of heavy industrial uses and infrastructure requirements to support the surrounding population. Given the vulnerability of *Posidonia australis* to disturbance and slower growth rates risk of loss over long term timeframes will remain high within Botany Bay. Furthermore, the viability of rehabilitating and transplanting seagrasses in NSW has not been scientifically proven.

Appendix 2 – Seagrass Quality Criteria

Quality Criteria (Including estimate of offset input)

Quality criteria have been derived based on guidance within the EPBC Offset Calculator guidelines regarding quality, descriptions within the EPBC Listing for P. australis and consideration of ecological attributes of P. australis beds in NSW and commonly applied survey methodologies.

Attribute	Measure	Categories	Descriptors	Score	Comments	Weighting	*Estimated Scores of Quality (Within Impact Area)* Score	Weighted Score
Site Condition	Shoot density (shoots per m2)	Very Low	1-5	1			3	0.6
		Low	5-10	2				
		Moderate	10-55	3-5	Scale accordingly	20%		
		High	55-90	6-9	Scale accordingly			
		Very High	>100	10				
Site Condition	Leaf length (cm)	Very Short	<10	1			6	0.6
		Short	10-20	2-3	Scale accordingly			
		Moderate	20-30	4-5	Scale accordingly	10%		
		Long	30-50	6-9	Scale accordingly			
		Very Long	>50	10				
Site Condition	Epiphytic algae cover (%)	Very Low	<10	10			5	0.5
		Low	10-30	9-8				
		Moderate	30-70	7-4	Scale accordingly	10%		
		High	70-90	3-2	Scale accordingly			
		Very High	>90	1				
Site Context	Patchiness - Percentage *P. australis* cover of total meadow/ bed/patch (%)	Very Low	1-10	1			3	0.45
		Low	10-40	2-4	Scale accordingly			
		Moderate	40-80	5-7	Scale accordingly	15%		
		High	70-90	8-9	Scale accordingly			
		Very High	90-100	10				
Site Context	Size of seagrass meadow (ha)	Patch not associated with bed	<1 (not associated withs larger beds)	1-4	Scale accordingly		4	0.6
		Patch associated with bed	<1 (associated with larger beds)	4-6	Scale accordingly			
		Small	1-10	7-8	Scale accordingly	15%		
		Medium	10-100	9				
		Large	>100	10				
Ecological attributes	Ecological attributes	Threatened species habitat		2			6	1.8
		Part of an Endangered Population		2				
		Inside a MPA		2		30%		
		Assemblage includes other seagrass species	(*Zostera* and *Halophila*)	1-2	Scale accordingly			
		One of a few remnant stands in the locality	few = 3 or less locality = bay / 5km	2				

Quality **4.55**

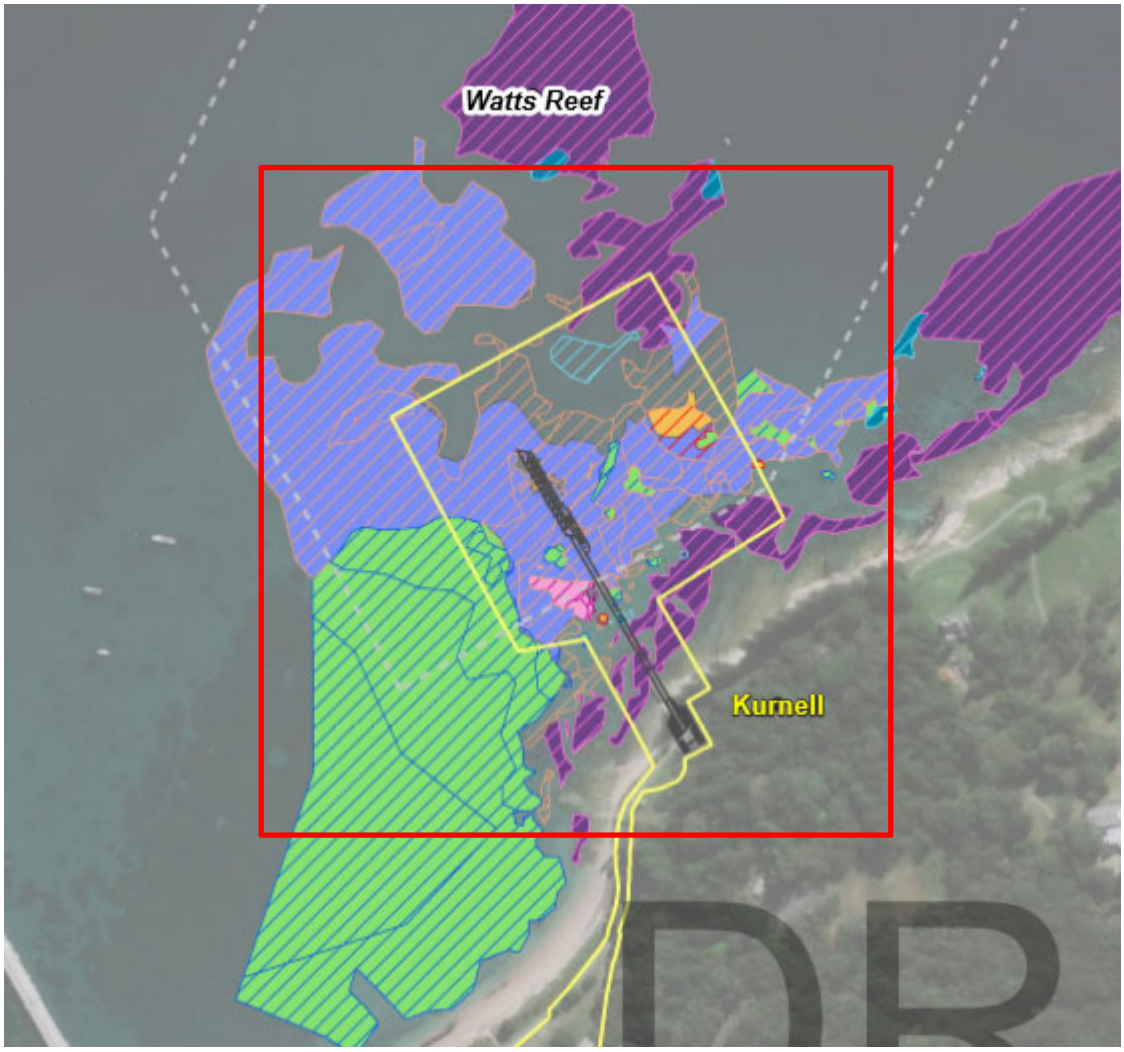
Further information on calculator inputs can be found
https://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-how-use.pdf

Appendix 3 - Impact Monitoring Program

Seagrass Monitoring Methodology
It proposed to utilize a combination of the following:

- Seagrass distribution mapping;
- *Halophila* / *Zostera* bed drop camera surveys;
- Diver seagrass morphology surveys of *Posidonia* beds; and
- Detailed survey of *Posidonia* patches

Seagrass distribution mapping
Objective
To identify any large-scale changes in seagrass composition and distribution within the development area.
Survey Area
Map seagrass composition, distribution and estimated densities within red box. Areas outside development area will assist with understanding changes unrelated to activities within the development area.



Survey Frequency

Every 6 months or within four weeks following a major storm event that has potential to impact on seagrasses in the study area. This will likely result on average 3 surveys each year and potential within season duplication of surveys.

Before	During	After
Every 6 months with a minimum of two surveys before construction commences	Every 6 months with surveys scheduled to occur before and after piling works	Every 6 months after construction for up to 5 years, with review after 2 years.

Methodology

Preliminary desktop mapping should be undertaken using the latest near map imagery to identify the extend of potential shallow seagrass beds.

Field mapping to include verification of potential shallow seagrass beds identified from aerial imagery, mapping of deeper areas and updating of seagrass boundaries using transect methods e.g. towed camera and GPS accuracy.

Survey effort should include recorded verification with an average distribution of no less than one verification point per 100m^2 with no greater than 30m between two verification points in known seagrass habitat.

Success Criteria

Seagrass distribution within the Project area has not decreased (at rates above acceptable decreases) in comparison with areas outside of the development area.

Posidonia australis distribution has not decreased (at rates above acceptable decreases) in comparison with areas outside the development area.

Acceptable decreases or rates off change should be selected following review of baseline data and any other available data at the completion of baseline surveys to estimate natural / existing variability between the assemblages.

***Halophila* / *Zostera* bed drop camera surveys**

Objective

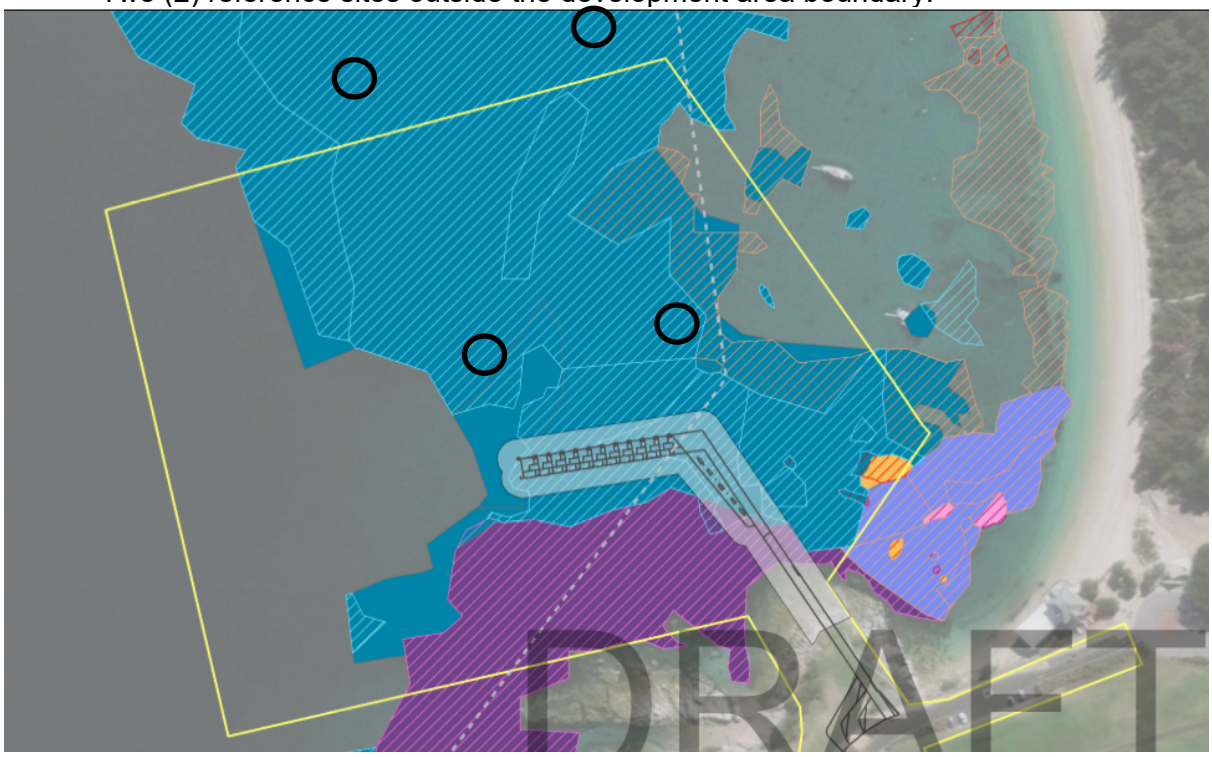
To identify any small-scale changes in community composition and density of *Halophila* dominated seagrass beds (outside of known *Posidonia australis* beds) in the development area during construction and operation of the wharves.

Survey Sites

La Perouse

Establishment of four (4) monitoring sites of approximately 700m^2. To include

- Two (2) potential impact sites within the development area boundary.
- Two (2) reference sites outside the development area boundary.

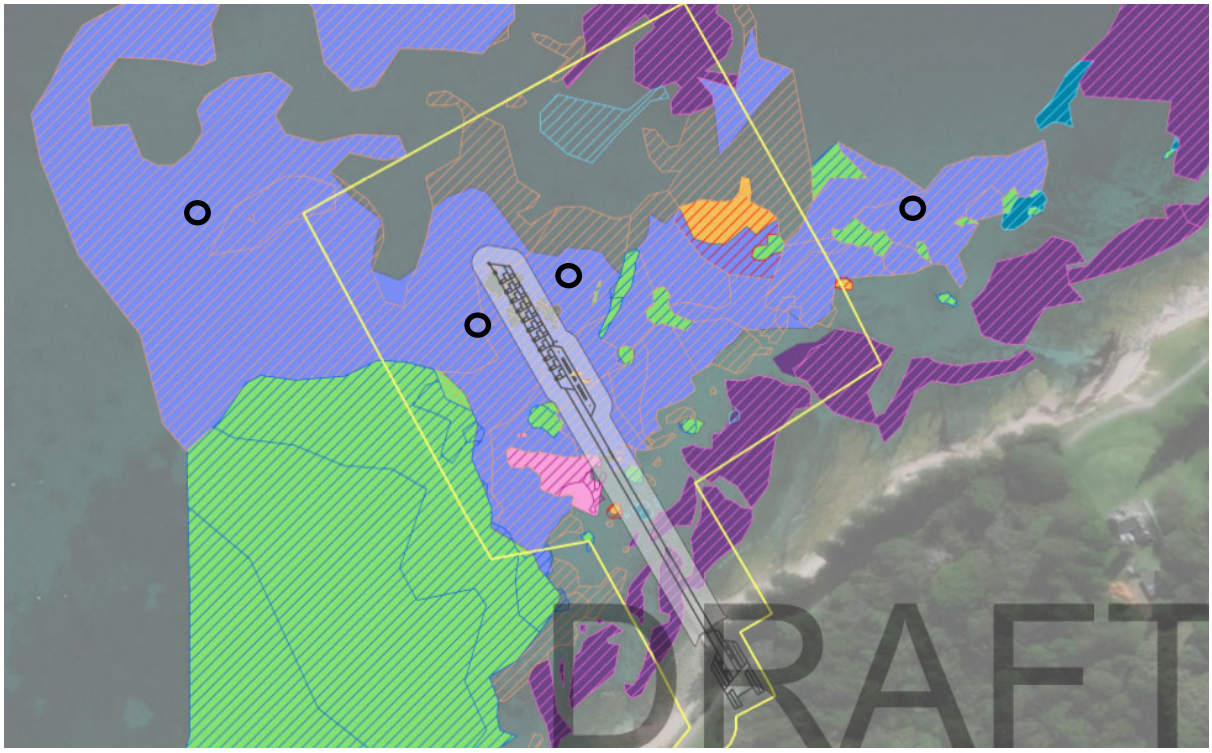


Circles indicate potential monitoring sites.

Kurnell

Establishment of four (4) monitoring sites of approximately 700m^2. To include

- Two (2) potential impact sites within the development area boundary.
- Two (2) reference sites outside the development area boundary.



Circles indicate potential monitoring sites.

Methodology

Seagrass density to be determined via percent cover method targeting *Halophila* dominated areas with low and sparse *Zostera*.

Data collection should include 30 randomly collected 0.25m^2 quadrats. Photo quadrats should not be stratified to seagrass habitat to allow for any seagrass declines to be detected.

Data to be recorded and reported should include:

- Seagrass cover by type
- Sediment/ silt cover
- Macroalgae cover
- Turfing epiphytic algae cover

Differences should be investigated using BACI (Before-After-Control-Impact) framework and appropriate statistical procedures to test statistical significance of any differences.

Power analysis should be undertaken at the completion of the baseline survey to determine the detectable effect size.

Survey Frequency

Before	During	After
Every 6 months with a minimum of two surveys before construction commences	Every 6 months with surveys scheduled to occur before and after piling works	Every 6 months after construction for up to 5 years, with review after 2 years.

Success Criteria

Seagrass density at sites within the Project area has not significantly decreased in comparison with comparable areas outside of the development area.

Turfing epiphytic algae cover has not significantly increased in comparison with comparable areas and species outside the development area.

Seagrass morphology surveys of *Posidonia* beds

Objective

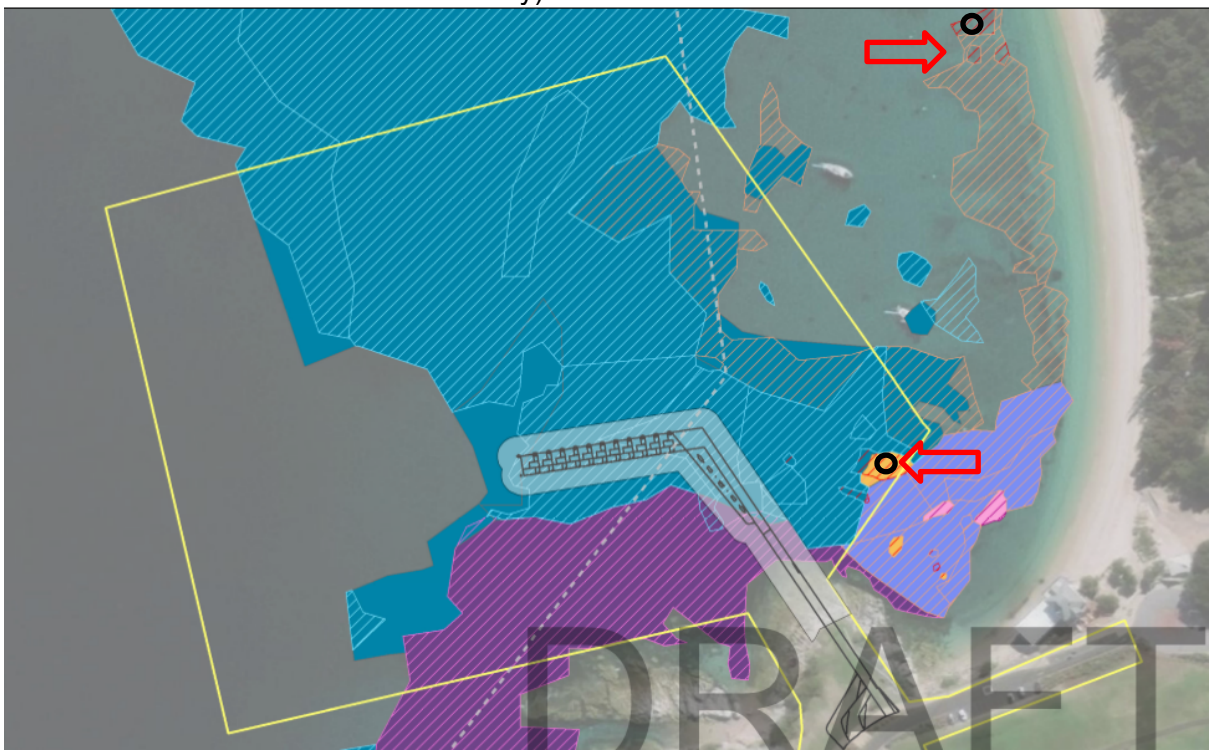
To identify any small-scale changes in community composition biomass and epiphyte cover of areas with *Posidonia australis* in the development area during construction and operation of the wharves.

Survey Sites

La Perouse

Establishment of two (2) monitoring sites with a radius of 15m. To include:

- One (1) potential impact site within the mixed *Posidonia australis* bed within the development area boundary.
- One (1) reference site outside the development area boundary (potentially within the north-eastern area of Frenchman's Bay).

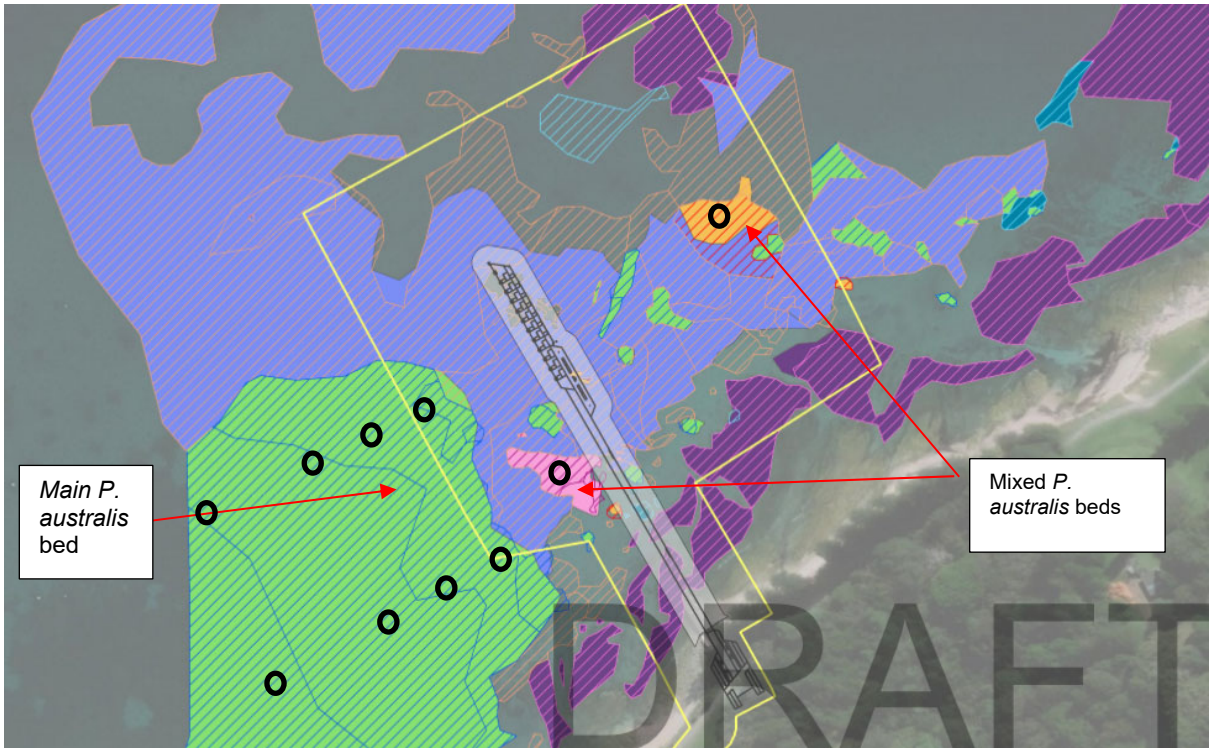


Red arrows indicate potential monitoring sites. Black circles indicate potential monitoring sites in main Posidonia australis bed.

Kurnell

Establishment of eight (8) monitoring sites with a radius of 10m. To include:

- Two (2) potential impact site within the mixed *Posidonia australis* beds (or areas that incorporate more than 1 species of seagrass) within the development area boundary.
- Two (2) reference sites outside the development area boundary within the mixed *Posidonia australis* beds.
- Six (8) monitoring sites within (at least 10m inside) the adjacent main *Posidonia australis* bed along the western boundary of the development area. This will include:
    - Sites spread across two depth transects to allow for sampling to be stratified for depth.
    - Sites to be positioned at four distances (~50m, 80m, 120m and 200m) to allow for investigation of gradient impacts on main *Posidonia australis* bed.
    - Sites at 200m may potentially be used as controls.



Red arrows indicate potential monitoring sites of mixed Posidonia australis beds. Black circles indicate potential monitoring sites in main Posidonia australis bed.

Survey Frequency

Before	**During**	**After**
Every 6 months with a minimum of two surveys before construction commences	Every 6 months with surveys scheduled to occur before and after piling works	Every 6 months after construction for up to 5 years, with review after 2 years.

Methodology

Surveys to be undertaken using 0.25m^2 quadrats with data collected *in situ* by experienced Scientific Divers undertaking surveys to ADAS diving safety standards.
Data to be collected from 5randomly elected quadrats within the site.
Data to be collected from each quadrat to include the following:

- Number of shoots for each species present
- Leaf length for each species present (10 randomly selected leaves)
- Epiphyte load each species present (10 randomly selected leaves)
- Measure burial of the leaf sheath (10 randomly selected stalks)
- Still image of the entire quadrat.

Three depth of disturbance (DoD) rods are to be installed in each bed to measure any changes in sediment accretion between monitoring surveys.
Differences should be investigated using BACI (Before-After-Control-Impact) framework and appropriate statistical procedures to test statistical significance of any differences.
Power analysis should be undertaken at the completion of the baseline survey to determine the detectable effect size.

Success Criteria

Posidonia australis biomass at sites within the Project area has not significantly decreased in comparison with comparable areas outside of the development area.
Seagrass epiphyte cover has not significantly increased in comparison with comparable areas and species outside the development area.

Detailed survey of *Posidonia* patches

Objective

To track changes in the boundaries and composition of individual patches of *Posidonia australis* inside or within 20m of the construction area during construction and operation of the wharves at Kurnell.

Survey Sites

Only patches that meet the following criteria should be considered for this monitoring component:

- inside or with 15m of the construction footprint
- Shoot density at baseline of at least 2 shoots per $1m^2$
- has a size of at least $10m^2$ and minimum average width of 2m
- *Posidonia australis* is the dominant species
- is not part of the seagrass morphology monitoring.

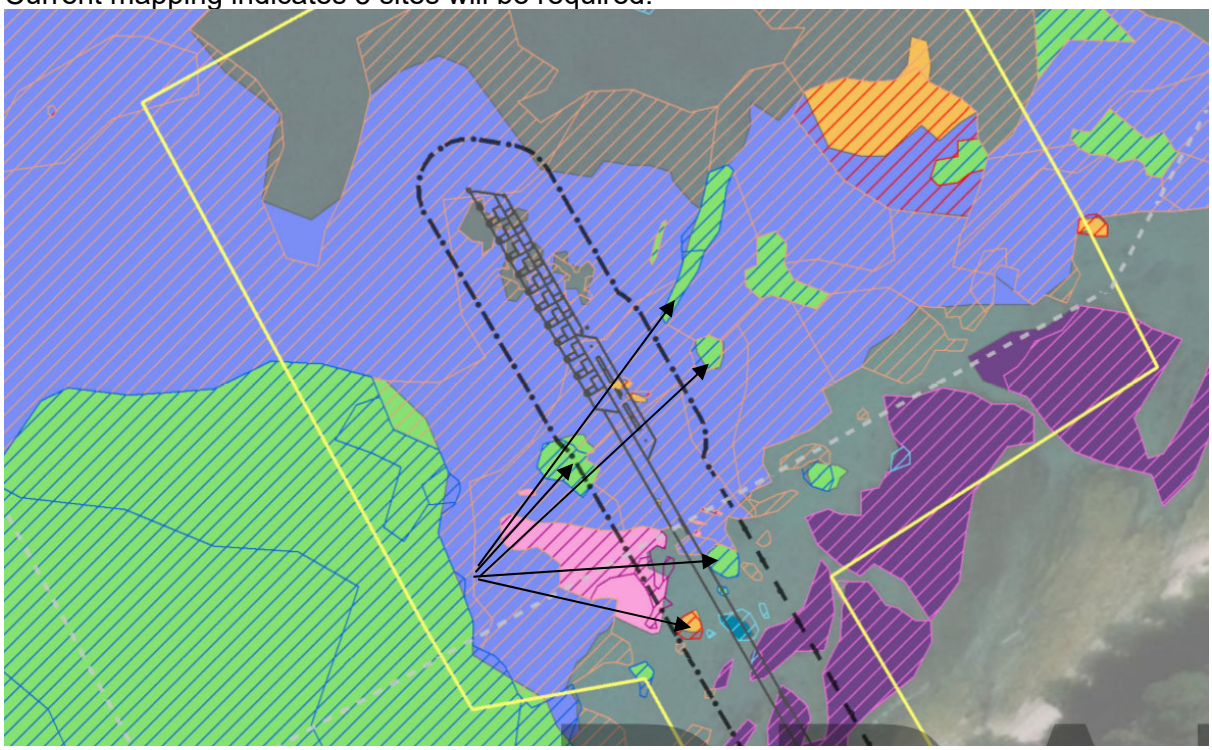
Any additional patches found during baseline mapping which meet the above criteria should be included for *Posidonia* Patch Monitoring

La Perouse

Current mapping indicates 1 site will be required.

Kurnell

Current mapping indicates 5 sites will be required.



Methodology

Preliminary desktop investigations should be undertaken using the latest near map imagery to measure patches with GIS software.

Centre point of patches are to be marked with a depth of disturbance (DoD) rod, which shall also allow for measure of any changes in sediment accretion between monitoring surveys.

Patch sizes to be verified by an in-water measurements from the marked center point. An edge will be identified where no live *Posidonia australis* is found to occur for 2 consecutive metres.

Seagrass morphology will be undertaken in each patch to determine any change sin composition. These surveys to be undertaken using $0.25m^2$ quadrats with data collected *in situ* by experienced Scientific Divers undertaking surveys to ADAS diving safety standards.

Data to be collected from up to 5 randomly elected quadrats within the patch. For small patches replication should be reduced to a rate of 1 x $0.25m^2$ survey quadrat every $3m^2$.

Data to be collected from each quadrat to include the following:

- Number of shoots for each species present
- Leaf length for each species present (10 randomly selected leaves)

- Epiphyte load each species present (10 randomly selected leaves)
- Measure burial of the leaf sheath (10 randomly selected stalks)
- Still image of the entire quadrat
-

Differences between surveys for each patch should be investigated using appropriate statistical procedures to test statistical significance of any differences.

Survey Frequency

Before	During	After
Every 6 months with a minimum of two surveys before construction commences	Every 6 months with surveys scheduled to occur before and after piling works	Every 6 months after construction for up to 5 years, with review after 2 years.

Success Criteria

Patch size of *Posidonia australis* has not decreased (at rates above acceptable decreases).
Shoot density of *Posidonia australis* has not decreased (at rates above acceptable decreases)..
Acceptable decreases or rates off change should be selected following review of baseline data and any other available data at the completion of baseline surveys to estimate natural / existing variability between the assemblages.