



# **South Mosman Wharf Upgrade**

Review of Environmental Factors

Transport for NSW

# South Mosman Wharf Upgrade

## Review of Environmental Factors

Transport for NSW | December 2020

Prepared by Cardno (NSW/ACT) Pty Ltd and Transport for NSW



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# Document controls

## Approval and authorisation

<b>Title</b>	South Mosman Wharf Upgrade review of environmental factors
<b>Accepted on behalf of Transport for NSW by:</b>	Bob Rimac Senior Project Manager
<b>Signed:</b>	
<b>Dated:</b>	25/02/2021

## Document status

<b>Document status</b>	<b>Date</b>	<b>Prepared by</b>	<b>Reviewed by</b>
Rev 0 Final REF	26 November 2020	Daniel McCallum	Belinda Crichton
Rev 1 Appendix E updated	18 December 2020		

# Executive summary

## The proposal

Transport for NSW proposes to upgrade the South Mosman wharf (the proposal) as part of the Transport Access Program (TAP) which includes both waterside and landside upgrade works.

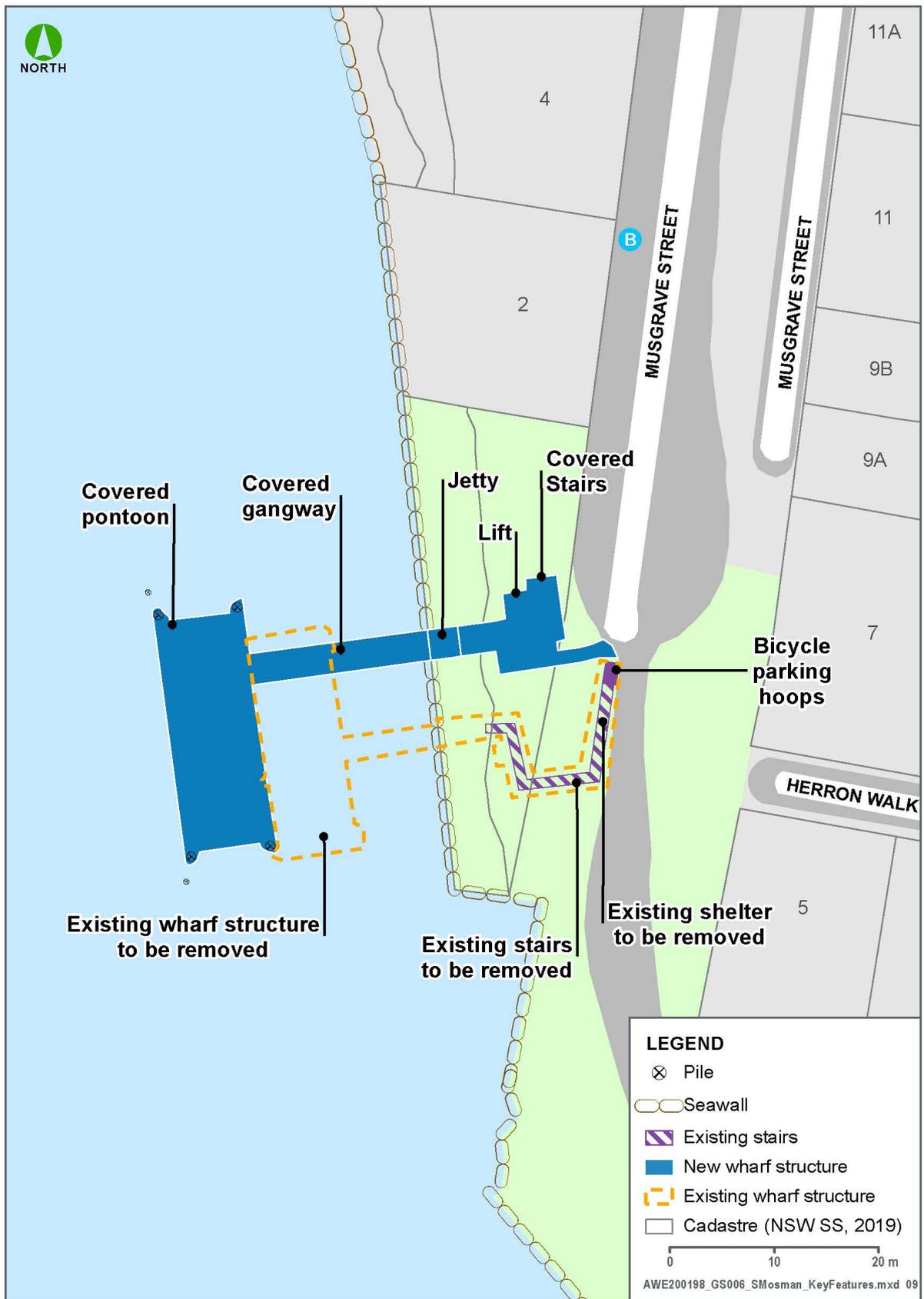
The water based features of the proposal would include:

- Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- Removal of the existing gangway and pontoon including existing piles
- Remediation of the seawall following removal of the existing wharf, if required.

The land based features of the proposal would include:

- Installation of a new 16-metre high lift and new covered stairs
- Installation of a new covered street level waiting area
- Installation of a covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- Installation of three bicycle parking hoops
- Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

The proposal would be constructed over a duration of up to six months starting in late 2021. Key features of the proposal are shown on Figure E-1.



E-1 Overview of the proposal

## Need for the proposal

The need for the proposal was identified in response to the Transport for NSW TAP which is an initiative to provide a better experience for public transport customers by delivering accessible, modern, secure and integrated transport infrastructure.

The primary objective of the TAP is to achieve 100 per cent *Disability Standards for Accessible Public Transport 2002* (DSAPT) compliance for all assets, access paths and transport services within the wharf interchange.

The DSAPT and *Disability Discrimination Act 1992* (DDA) standards require all public transport infrastructure, including wharves, to have fully compliant disabled access by 2022.

South Mosman wharf needs upgrading as it is not compliant with the disability standards as land access to the wharf is currently via stairs only.

## Proposal objectives

The objectives of the proposal include:

- To ensure compliance with legislative, functional and operational requirements, in particular DSAPT and DDA standards that require all public transport infrastructure, including wharves, to have fully compliant disabled access by 2022
- To maximise equity of access for all customers
- To maximise the use of the ferry wharf Kit-of-Parts (standardised design elements) to provide continuity across Sydney Harbour wharves
- To accommodate forecast growth in patronage and changes to travel patterns
- To provide safe berthing and mooring of ferry vessels
- To minimise walking distances, conflict and crowding points and queuing
- To improve security and safety
- To minimise cost of ownership and maintenance.

## Options considered

The following options were considered:

- 'Do nothing' – no upgrade however regular maintenance would continue
- Option 1 – construction of a new 34 metre accessible path from the existing bus stop on Musgrave Street to the proposed lift and stairs
- Option 2 – construction of a new 160 metre accessible switchback ramp set within the land adjacent to the proposed wharf connecting to a new gangway and pontoon
- Option 3 – construction of a new 156 metre accessible switchback ramp set within the land adjacent to the proposed wharf. Similar to Option 2, however the ramp would commence at the end of Musgrave Street and continue down to the waterfront before turning north along the foreshore connecting to a new gangway and pontoon.

A detailed description of these options is included in section 2.4.

Although having the lowest capital cost and least environmental impacts, the 'do nothing option' was discounted as it would not meet the objectives of the proposal to improve accessibility, passenger safety and comfort for future patronage.

Option 1 was identified as the preferred option based on cost and non-cost factors. This option provides accessible access between street level and the proposed wharf, with an accessible connection from the existing bus stop to the new accessible car space, kiss and

ride and new lift and stairs. Whilst the footprint of Option 1 would be larger than the existing, it would be significantly less than Options 2 and 3 and provide a more direct route to the wharf. Option 1 would require less tree removal and has fewer visual impacts than Options 2 and 3.

While Option 1 was the preferred option, stakeholders recommended further design refinements. Option 1 was publicly displayed and as a result of comments received from the community the following changes to the design were incorporated:

- The lift and stair structures have been shifted to the south to reduce visual impacts on local houses and move entrance to the wharf away from the bus turning circle to improve pedestrian safety
- The gangway, stairs and upper and lower platforms of the lift will be covered.

## Statutory and planning framework

The proposed facility is a wharf or boating facility within the meaning of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP).

The proposal is for a wharf or boating facility and is to be carried out by Transport for NSW and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from Mosman Council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974*.

## Community and stakeholder consultation

The community and key stakeholders were invited to provide feedback on the proposal's concept design in May 2020.

Consultation with the Department of Planning, Industry and Environment (DPIE) Housing and Property Group (formerly the Foreshores and Waterways Planning and Development Advisory Committee), Ausgrid, Port Authority of NSW, Department of Primary Industries (DPI) Fisheries and Mosman Council has been undertaken during the preparation of this REF.

Stakeholder consultation will continue during the public display of the Review of Environmental Factors (REF) to capture community feedback. Should the proposal proceed to construction, consultation with the community and stakeholders would continue throughout the construction phase.

## Environment impacts

The main environmental impacts of the proposal and the safeguards and management measures to address the impacts are summarised below.

### Land surface, hydrology and water quality

The proposal involves activities that would cause physical disturbance to the seabed sediments including piling, use of barges and removal of the existing wharf structure. Sediments within the proposal footprint have elevated concentrations of heavy metals and pesticides which may be disturbed.

Construction works on the land side would involve the disturbance of topsoil, bulk earthworks and regrading for construction of the stairs and new lift structure.

Accidental spills within the compound area may occur from storing, handing and/or transferring the required small volumes of welding materials, lubricants, solvents, fuels, oils and diesels. These risks would be greater when undertaking work over, or in, the waterway.

A Soil and Water Management Plan (SWMP) would be prepared to mitigate the risks associated with sedimentation, soil erosion and water pollution. The plan would include the installation of floating silt curtains, landside erosion and sediment controls, further soil investigations (landside), implementation of unexpected finds protocols and spill management plans and procedures.

During operation, there would be negligible impacts to the land surface or hydrology as the operation of the proposal would be consistent with current ferry wharf operations.

## **Biodiversity**

A biodiversity assessment has been completed which investigates the existing coastal and marine environment within the study area to assess impacts to coastal and marine biodiversity as a result of construction and operation of the proposal.

The proposal would include the removal of up to 0.04 hectares of native/exotic garden vegetation on the landside. The removal of habitat resources is unlikely to have a substantial impact on native fauna as there is an abundance of similar habitat across the study locality. At completion the area would be replanted with native vegetation local to the Sydney region.

The proposal would not require large-scale disturbance of the seabed. Four pontoon piles and two pivot piles would be driven into subtidal soft sediment habitat. The area of soft sediment habitat under the footprint of the piles would be permanently lost while the anchor areas for the barge during construction would be temporarily impacted. This would include the direct removal of epifauna and infauna from soft sediment habitats. However, soft sediment habitats in the study area are characteristic of the majority of subtidal habitat in the harbour and community assemblages are generally ubiquitous and quick to recolonise following disturbance.

Removal of the existing wharf structure and piles would result in the removal of about 0.01 hectares of marine vegetation, habitat and sessile/less mobile fauna on the piles and pontoon. These species are common in subtidal rocky reefs and would quickly colonise the piles of the new wharf and pontoon (0.02 hectares of available space) provided suitable materials are used for the new structures. The proposal would not remove any seagrass, mangrove or saltmarsh communities.

The proposal is not likely to significantly impact threatened terrestrial or aquatic species, populations or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation 2016* (BC Act) or the *Fisheries Management Act 1994* (FM Act) and therefore a species impact statement (SIS) is not required.

The proposal is also not likely to significantly impact threatened species, populations, ecological communities or migratory species within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A referral to the Australian Department of the Agriculture, Water and the Environment (DAWE) is therefore not required for biodiversity matters.

## **Noise and vibration**

A noise and vibration impact assessment has been carried out to predict construction and operational noise impacts on nearby sensitive receivers.

Construction noise was assessed in accordance with *the Interim Construction Noise Guidelines* (ICNG) which provides the methodology for deriving recommended noise management levels (NML) from the proposed construction activities. The assessment concluded that:

- Construction noise levels are predicted to exceed the NMLs at nearby residential receivers for all construction scenarios

- There would be exceedances of the night time noise NMLs at times, particularly during the hammering in of piles. These piling works are required to be undertaken during night-time hours due to the need for calm water conditions
- There is potential for vibration impacts at heritage listed structures within close proximity to the works including the Musgrave Street wharf site and the Divided Road on Musgrave Street due to works being undertaken within the theoretical safe working limits recommended for heritage structures.

A Construction Noise and Vibration Management Plan would be prepared prior to construction and implemented throughout the construction period. This management plan would incorporate the best practice mitigation measures outlined in Chapter 7 of this REF.

General noise and vibration impacts on the local community would be mitigated by restricting construction works to daytime hours wherever possible. However, due to the requirement for calm water conditions during pile installation and for intricate lifts, some activities would need to be carried out at night, with about 30 night shifts (from 11 pm to 7 am) proposed across the construction period of up to six months.

To minimise potential noise impact from the piling installation, the noisiest activity of hammering in piles has been restricted to be carried out from 5 am to 7 am only. During hammering, it is anticipated that each pile would be hammered for one minute (about 10 hits with a hammer within one minute). For each pile the activity is likely to occur about five times over a period of one hour.

There would be no expected increases in operational noise from the proposal.

The community would be informed of night-time construction activities at least five days prior to their commencement. A community information email and phone line would be provided throughout the work to take and respond to any enquiries.

### **Landscape character**

A landscape character and visual impact assessment (LCVIA) was prepared to identify the overall impact of the proposed works on each of the Landscape Character Zones (LCZ) and to identify the visual changes and impacts on the site and its surroundings when viewed from key vantage points.

With regards to landscape character, the assessment concluded that the proposal would have a moderate to high impact on the surrounding LCZs. The landscape character within the proximity of the proposal generally consists of residential areas and Sydney Harbour. The proposal would introduce a new visual element to the existing landscape character of the area and would also involve loss of some foreshore trees. However, potential impacts would be managed or mitigated during detailed design through the use of a coordinated palette of materials and colours to respond to the existing maritime and foreshore character of the area.

With regards to visual impact assessment, the proposal would be visible from a number of viewpoints within the vicinity of the site. The visual impact generated by the proposed wharf and lift varies from viewpoint to viewpoint, however overall the impact is considered moderate with the proposal forming part of a broader harbour.

Visual impacts from houses on Musgrave Street adjacent to the new wharf are considered to be high due to close proximity to the proposed works and the level of change that would occur in these views as a result of the proposal. Urban design principles would be integrated throughout the detailed design and construction of the proposal to ensure that impacts to the houses in proximity to the wharf would be mitigated. This would include replacement planting, landscape treatment complimentary to the existing landscape, and a coordinated palette of materials and colours to respond to the existing maritime and foreshore character.

Impacts on views from the water within Mosman Bay are considered to be moderate to high due largely to the loss of existing trees in the view and the construction of the new lift, access stair and street level platform. The impacts on these views would be moderated by the existence of the ferry wharf in the current view and the improvement in design quality and finishes that would result from the implementation of the proposal.

Impacts on views from the Cremorne Point foreshore are considered to be moderate from directly opposite the wharf site and would decline with movement further to the north where the new wharf complex would be viewed over a greater distance and would be a relatively small component of very broad existing views.

### **Non-Aboriginal heritage**

A Statement of Heritage Impact (SOHI) has been prepared to assess the potential impacts to listed heritage items and potential archaeological remains as a result of the proposal. The Musgrave Street wharf site (State Heritage Register, SHI no. 4920109 and *Mosman Local Environmental Plan 2013* (Mosman LEP) no. A491) and Divided road (Mosman LEP no. I411) are within the construction footprint. The assessment concluded:

- Impacts on the identified heritage items within the construction footprint are as follows:
  - Neutral direct, negligible indirect (visual) and negligible potential direct impacts to Musgrave Street wharf site (SHI no. 4920109 and Mosman LEP no. A491)
  - Overall negligible impacts for direct, indirect (visual) and potential direct impacts to the Divided road (Mosman LEP no. I411)
- The proposed works would not impact the overall significance of the heritage items adjacent to the construction footprint, or heritage items within the visual buffer zone
- The preliminary archaeological assessment identified that there is low to high potential (dependent on historical stages) for archaeological remains of local significance to be present within the entire construction footprint. However, as the area of high archaeological potential (extant remains of the original Musgrave Street wharf seawall) is located towards the edge of the construction footprint and would not be directly impacted, it is unlikely significant archaeology would be impacted. The area of direct impact is associated with the second Musgrave Street wharf site. Should any archaeological finds be encountered in this area they would not reach the threshold for local significance
- There is potential for vibration impacts to the retaining wall and seawall in Musgrave Street wharf site (SHI no. 4920109 and Mosman LEP no. A491), the rock face of the Divided road (Mosman LEP no. I411), and the buildings in Group of 2 houses, divided into 3 dwellings (Mosman LEP no. I183) during piling works.

Where works are proposed within the safe working limits for heritage structures, including the original seawall and retaining wall in the Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), specialist advice would be sought from an appropriately qualified structural engineer who is familiar with heritage structure to assess if vibrations associated with the proposed works will potentially result in impacts. When works are being undertaken, regular inspections would be undertaken by engineers and other required specialists to monitor and review the methodology.

There are no items within or in the immediate vicinity of the construction footprint listed on the World Heritage List (WHL), National Heritage List (NHL) or the Commonwealth Heritage List (CHL).

## **Traffic, transport and access**

South Mosman wharf would be closed for up to six months during construction with no access to the wharf or ferry services. There would be impacts from the proposal due to disruption to ferry commuters, construction traffic and construction vessel movements.

Where feasible, plant, equipment and materials would be transported to the construction work site by barge or boat so as to limit impacts to the local road network. A Traffic Management Plan (TMP) and Maritime TMP would be prepared to manage and mitigate impacts to traffic, access, pedestrian movement and vessel movement

Existing bus services would be used to support access to Sydney CBD as bus transport would remain operational. Ferry users travelling to or from the city could catch the existing 236 bus service along Musgrave Street to Spit Junction and then use a connecting bus service to the Sydney CBD.

Following construction, the proposal would result in improved ferry services and a better customer experience.

## **Sustainability**

The design of the proposal has been based on the principles of sustainability, including aiming for a 'Silver' rating under the Transport *Sustainability Design Guidelines (SDG) version 4.0*. Key design elements and strategies developed during concept design will be used to further develop the design and construction.

## **Justification and conclusion**

The need for the proposal was justified under the TAP as the existing structure does not provide access that complies with DDA and DSAPT standards. The assessment of the environmental and social impacts has determined the proposal is not likely to have a significant impact and therefore assessment under Division 5.2 of the EP&A Act is not required.

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# 1 Introduction

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This chapter introduces the proposal, provides the context of the environmental assessment and outlines the purpose of the report.

## 1.1 Proposal identification

Transport for NSW proposes to construct a new wharf at South Mosman (the proposal) as part of the NSW Government's Transport Access Program (TAP, <https://www.transport.nsw.gov.au/projects/tap>, refer section 2.1).

The proposal is located within the local government area (LGA) of Mosman Council. South Mosman wharf is located in Mosman Bay, on the western side of Curraghbeena Point on Sydney's Lower North Shore. South Mosman wharf is accessed from Musgrave Street which runs along the western side of the peninsula and terminates at the wharf.

Figure 1-1 shows the regional setting and Figure 1-2 shows the local setting and existing conditions. The wharf is part of the F6 ferry service that operates between Circular Quay and Mosman Bay. The proposal is to improve access to the wharf, and upgrade and install a gangway and floating pontoon to allow for more efficient passenger services.

The water based features of the proposal would include:

- Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- Removal of the existing gangway and pontoon including existing piles.
- Remediation of the seawall following removal of the existing wharf, if required

The land based features of the proposal would include:

- Installation of a new 16-metre high lift and new covered stairs
- Installation of a new covered street level waiting area
- Installation of a new covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- Installation of three bicycle parking hoops
- Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

The key features of the proposal are shown in Figure 1-3.

Chapter 3 describes the proposal in more detail. The proposal would be constructed over a duration of up to six months starting in late 2021.



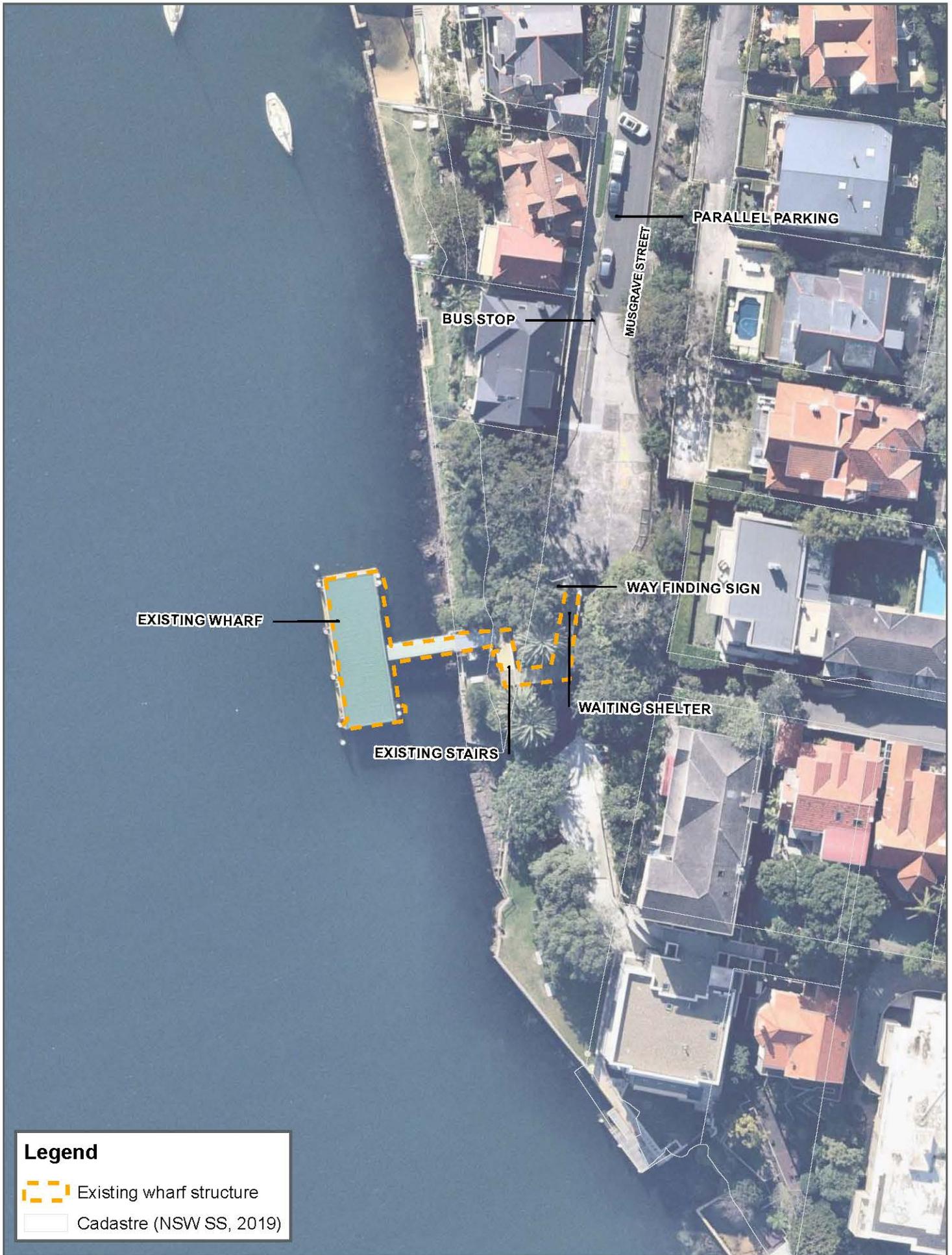
**Legend**

Construction footprint

**FIGURE 1-1**  
 1:12,000 Scale at A4  
 0 50 100 150 200  
 m

**Regional setting**  
 SOUTH MOSMAN

Map Produced by Cardno NSIM & CT Pty Ltd (MOL)  
 Date: 2020-10-05 | Project: AMIE 200198  
 Coordinate System: GDA 1994 MGA Zone 56  
 Map: AMIE200198\_CS003\_2Mosman\_PREF\_RegionalSetting.mxd 01  
 Aerial imagery supplied by HexaGeo (August, 2020)



**Legend**

-  Existing wharf structure
-  Cadastre (NSW SS, 2019)

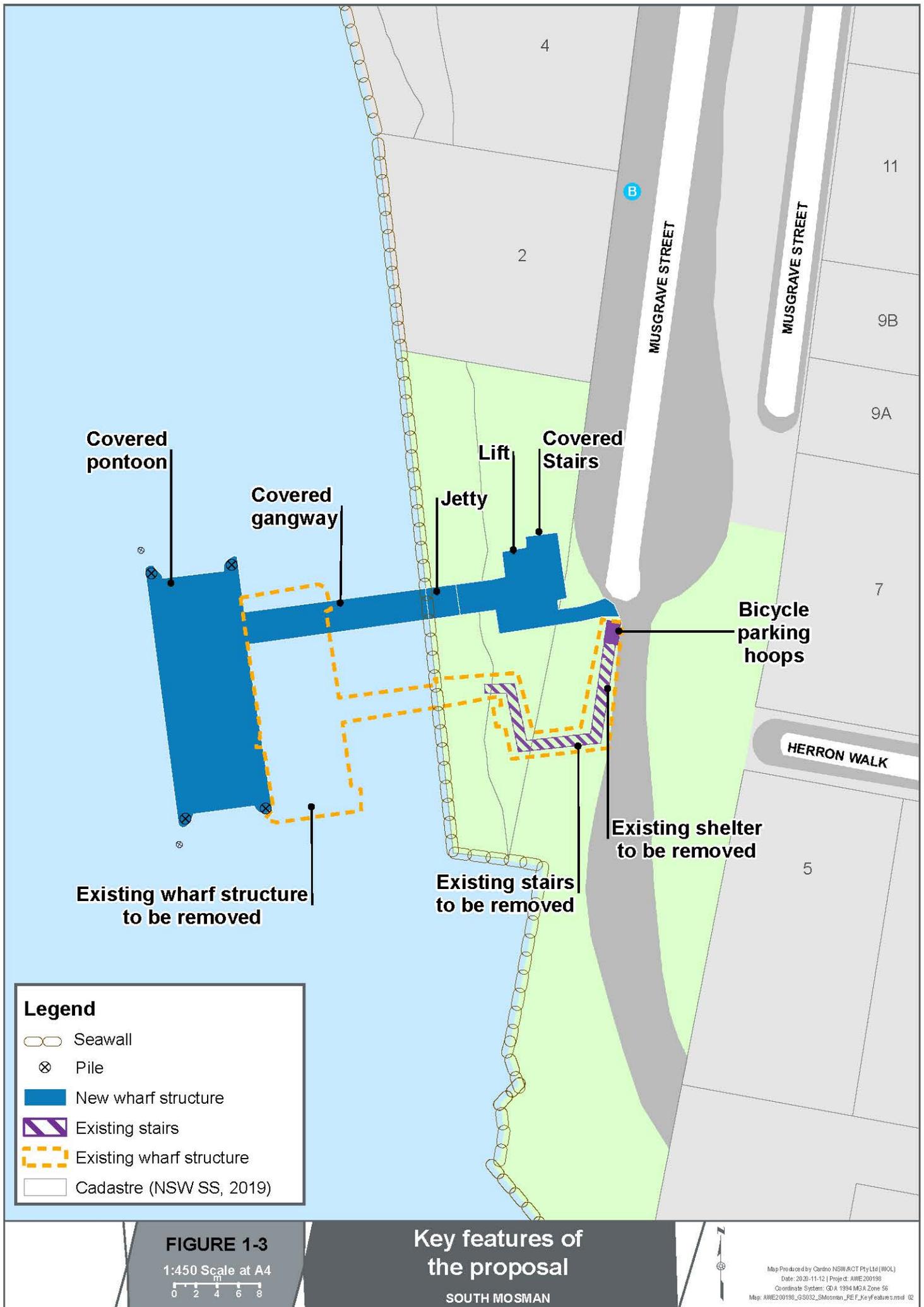
**FIGURE 1-2**

1:700 Scale at A4  
 0 5 10 15 20  
 m

**Local setting**  
**SOUTH MOSMAN**



Map Produced by Carbro NSW/ACT Pty Ltd (WOL)  
 Date: 2020-10-12 | Project: AWE200198  
 Coordinate System: GDA 1994 MGA Zone 56  
 Map: AWE200198\_GSD039\_SMRoman\_REF\_LocalSetting.mxd 01  
 Aerial imagery supplied by Neamap (August, 2020)



## 1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Cardno (NSW/ACT) Pty Ltd on behalf of Transport for NSW. For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts has been undertaken in the context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), and the *Marinas and Related Facilities EIS Guideline* (DUAP, 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the REF helps to fulfil the requirements of Section 5.5 of the EP&A Act including that Transport for NSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- The potential for the proposal to significantly impact any matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Agriculture, Water and Environment (DAWE) for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

## 2 Need and options considered

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This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

### 2.1 Strategic need for the proposal

The TAP is an ongoing 'initiative to deliver modern, safe and accessible transport infrastructure' in NSW (TfNSW, 2015). The focus of the program is improving access to the transport network for less mobile passengers. As a result, Roads and Maritime Services (Roads and Maritime, now Transport for NSW) assessed the condition of all ferry wharves across the transport network in 2009 in terms of:

- Safety and structural integrity
- Access for less mobile and disabled passengers
- Existing and predicted future patronage and use.

The *Disability Standards for Accessible Public Transport 2002* (DSAPT) and *Disability (Access to Premises – Buildings) Standards* (2010) (Disability Standards 2010) made under the *Disability Discrimination Act 1992* (DDA), require all public transport infrastructure, including wharves, to have fully compliant disability access by 2022.

It was concluded that the South Mosman needed upgrading and relocating due to its lack of accessible pathway for passengers on and around the wharf.

The proposal was also developed to respond to the objectives of various Government policies as described below.

#### 2.1.1 Transport Access Program (TAP)

The aims behind the above objective of the TAP are to:

- Improve the accessibility for passengers who use wheelchairs and prams by removing stairs and supplying ramps
- Build facilities for all transport modes to meet the needs of a growing population
- Provide an effective and seamless interchange that supports an integrated transport network
- Deliver safety and signage improvements to help with the customer user experience
- Provide other aesthetic improvements.

#### Ferry Wharf Upgrade Program

The Ferry Wharf Upgrade Program (FWUP) forms part of the TAP. Its objectives are to:

- Improve access for less mobile people
- Improve passenger amenity
- Improve passenger embarking/disembarking times
- Develop an iconic design across the commuting wharf network
- Cater for current and future passenger numbers

- Minimise customer and wharf operator impacts during any refurbishment and upgrade work
- Minimise ownership and maintenance costs
- Ensure the design complies with current safety laws
- Discourage inappropriate activities on public wharves
- Aim to comply with the DDA by 2022.

This proposal has been developed to respond to, and comply with, these objectives.

### 2.1.2 Sydney's Ferry Future

Published in 2013, the *Sydney's Ferry Future* plan acknowledges, and builds on, TAP and the ferry wharf upgrade program by outlining the short and long term initiatives for getting the most out of the "ferry network today while investing in the infrastructure and services to attract more passengers in the future" (TfNSW, 2013). The plan:

- Focuses on short term timetable, service and infrastructure improvements and the long-term expansion of the network
- Reinforces the need to upgrade wharf infrastructure and make it more accessible in line with TAP.

The proposal directly responds to this by analysing how improvements could be made to best achieve the objectives of this plan in relation to the wharf facilities at South Mosman.

### 2.1.3 Future Transport Strategy 2056

The *Future Transport Strategy 2056* (TfNSW, 2018) is an update of the *Long Term Transport Master Plan for NSW* (TfNSW, 2012). It is a 40-year strategy, supported by plans for Greater Sydney and Regional NSW, which sets the vision, directions and outcomes for customer mobility. The *Future Transport Strategy 2056* sets six state-wide outcomes to guide investment, policy and reform and service provision, which includes:

- A customer focus
- Successful places
- A strong economy
- Safety and performance
- Accessible services
- Economic and environmental sustainability.

The upgrade, as part of the Ferry Wharf Upgrade Program (FWUP), would support meeting the above objectives of this Strategy.

Transport for NSW has a key role in working towards economic and environmental sustainability. Addressing the environmental sustainability of the transport system is essential to minimise direct and indirect impacts on the natural environment. To minimise the impacts, all investments across the transport cluster will improve the resilience of the network in a changing climate and support the NSW Governments aspirational target of achieve net-zero green house gas emission by 2050.

The design and construction of the proposal would comply with the Transport for NSW *Sustainability Design Guidelines version 4.0* supporting environmental sustainability, emissions reduction and mitigating significant weather events. Refer sections 6.13 and 6.14 for further information.

#### 2.1.4 Supporting NSW Strategies and policies

The proposal is also supported under the policies, goals, objectives and targets of several other strategic planning documents as summarised in Table 2-1.

**Table 2-1: Supporting NSW strategies and policies**

Strategy / Policy	Description
<i>State Infrastructure Strategy 2018-2038</i> (INSW, 2018)	The strategy identifies the NSW Government’s infrastructure vision for the state over the next 20 years, across all sectors. It is supported by the Future Transport Strategy 2056. As passenger numbers are expected to increase in the future, this proposal responds to the above by improving the wharf infrastructure and access provisions at South Mosman.
<i>Disability Inclusion Action Plan 2018-2022</i> (TfNSW, 2017)	The <i>Disability Inclusion Action Plan 2018–2022</i> is Transport for NSW’s plan for delivering high quality services to all customers including those with disability, including compliance with the disability standards outlined below.
Disability Standards	The <i>Disability Standards for Accessible Public Transport</i> (DSAPT, 2002) and <i>Disability (Access to Premises – Buildings) Standards</i> (2010) form part of the DDA. Each prescribe the minimum accessibility standards for disabled access to public transport services and infrastructure, including a timetable for implementation. The proposal meets the above requirements within the timeframes specified in both standards by providing suitable access for people with a disability.
State Priorities: Making it Happen 2015	The proposal would: <ul style="list-style-type: none"> <li>• Improve the existing transport infrastructure, consistent with the building infrastructure priority</li> <li>• Be built and would operate under environmental safeguards and management measures to avoid and minimise environmental impacts consistent with the keeping our environment clean priority.</li> </ul>
<i>A Plan for Growing Sydney</i> (DPE, 2014)	Focused on the concept of growth centres and transit corridors, the Plan realises the need to strengthen transport connections into and out of central Sydney. A key action of the Plan is to deliver a vision for Sydney Harbour including enabling opportunities to improve ferry services. The proposal therefore responds to this action.

Strategy / Policy	Description
<p><i>A Metropolis of Three Cities – The Greater Sydney Region Plan</i> (Greater Sydney Commission, 2018a)</p>	<p><i>A Metropolis of Three Cities – The Greater Sydney Region Plan</i> is the NSW Government’s regional plan for Greater Sydney which provides key directions and actions to rebalance growth and deliver its benefits equally to residents across Greater Sydney. The plan coordinates with the Future Transport Strategy 2056 and State Infrastructure Strategy 2018-2038 to align land use, transport and infrastructure planning to establish Greater Sydney as three distinct but connected cities.</p> <p>The proposal would directly address the following directions outlined by the plan:</p> <ul style="list-style-type: none"> <li>• Infrastructure use is optimised</li> <li>• Infrastructure aligns with forecast growth</li> <li>• Services and infrastructure meet communities’ changing needs</li> <li>• Integrated land use and transport creates walkable and 30-minute cities.</li> </ul> <p>The NSW Government has prepared five district plans that guide the implementation of <i>A Metropolis of Three Cities – The Greater Sydney Region Plan</i>. The district plans outline objectives and actions for the future development of the relevant district and are structured around the strategies for infrastructure and collaboration, liveability, productivity, sustainability and implementation. The North District Plan is the relevant district plan for Mosman LGA.</p>
<p><i>North District Plan</i> (Greater Sydney Commission, 2018b)</p>	<p>The North District covers Hornsby, Hunter’s Hill, Ku-ring-gai, Lane Cove, Mosman, North Sydney, Northern Beaches, Ryde and Willoughby LGAs. The North District Plan is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision for Greater Sydney. It contains the planning priorities and actions for implementing <i>A Metropolis of Three Cities – The Greater Sydney Region Plan</i> at a district level and is a bridge between regional and local planning. Planning priorities that are relevant to the upgrade include:</p> <ul style="list-style-type: none"> <li>• Priority N1: Planning for a city supported by infrastructure (particularly prioritising infrastructure investment to support the vision of <i>A Metropolis of Three Cities</i>)</li> <li>• Priority N3: Providing services and social infrastructure to meet people’s changing needs (particularly in relation to accessibility, inclusion and safety).</li> </ul> <p>The proposal would support these priorities by providing improved ferry facilities, with a design that provides efficient embarking and disembarking. One of the objectives of the proposal is also to provide DSAPT compliance.</p>

Strategy / Policy	Description
<p><i>MOSPLAN Community Strategic Plan 2018-2028</i> (Mosman Council, 2018a)</p>	<p>Mosman Council's MOSPLAN provides a ten year strategic direction for the LGA which was prepared following input from residents, ratepayers and other stakeholders to determine common issues and interests to prioritise plans for the future. MOSPLAN outlines seven strategic directions for the LGA. The proposal would support the following directions:</p> <ul style="list-style-type: none"> <li>• A culturally rich and vibrant community: the proposal would protect heritage items within the LGA</li> <li>• An attractive and sustainable environment: the proposal would maintain and protect the LGA's natural areas and local biodiversity, and encourage sustainable practices</li> <li>• Well designed, liveable and accessible places: the proposal would provide high quality public infrastructure and improve accessibility.</li> </ul>

## 2.2 Existing infrastructure

The existing infrastructure at South Mosman includes the wharf and land based infrastructure. The existing South Mosman wharf does not currently meet DSAPT or DDA requirements, as it does not allow for equitable access to the wharf or boarding the ferry. The wharf currently enables Transdev to operate a ferry service for passengers between Circular Quay and Mosman Bay.

Table 2-2 summarises the existing wharf elements and descriptions of current infrastructure.

**Table 2-2: Existing wharf infrastructure**

Element	Description
Existing infrastructure	<p>Existing wharf, comprising:</p> <ul style="list-style-type: none"> <li>• A berthing platform consisting of a covered pontoon and canopy about 22 metres long and eight metres wide supported by eight steel piles (approximately 460 millimetres in diameter)</li> <li>• A covered aluminium gangway about 9.6 metres long and two metres wide with timber decking</li> <li>• Land based infrastructure, including: <ul style="list-style-type: none"> <li>○ A covered waiting area (including the main switchboard) located on Musgrave Street at the entrance to the wharf stairs</li> <li>○ Undercover stairs connecting Musgrave Street to the wharf structure</li> <li>○ Wayfinding signs</li> <li>○ Lighting on the stairs, gangway and pontoon.</li> </ul> </li> </ul>

Element	Description
Operation	<ul style="list-style-type: none"> <li>• South Mosman operates as part of the F6 Mosman Bay to Circular Quay ferry route, travelling in a circular direction from Circular Quay to Cremorne Point, South Mosman, Old Cremorne and Mosman Bay and back to Circular Quay.</li> <li>• Ferry services typically operate every 30 minutes during weekdays, and every hour on weekends and public holidays.</li> </ul>
Ancillary services	<ul style="list-style-type: none"> <li>• On-street parking on the western side of Musgrave Street. No stopping on eastern side.</li> <li>• Bus stops located on Musgrave Street about 50 metres from the wharf entrance, which includes a 20 metre bus zone enforced Monday to Saturday. The bus stop is serviced by the 236 bus which travels between South Mosman wharf and the Spit Junction.</li> <li>• Local access is provided through Musgrave Street with available (unrestricted) kerbside parking on the western side.</li> </ul>
Land ownership	<p>Public land and assets owned by Transport for NSW:</p> <ul style="list-style-type: none"> <li>• Wharf structure including pontoon, gangway and jetty</li> <li>• Opal readers, and wayfinding signs</li> </ul> <p>Public land and assets owned by Mosman Council:</p> <ul style="list-style-type: none"> <li>• Roads, pavement and footpath</li> <li>• Bus stop</li> <li>• Stairs and covered waiting area at top of stairs</li> </ul>

### 2.2.1 Patronage

Based on patronage data collected in 2017, the South Mosman wharf had 81 passengers in the busiest peak hour and 109 passengers in the case of a special event.

Future patronage of South Mosman wharf in 2036 was forecast to be 104 in the busiest peak hour and 140 in the case of special events. The patronage was based on population and employment forecasts for areas surrounding the wharf and an additional 15 per cent increase. The Mosman Residential Development Strategy 2016 Update outlines that land near Mosman's commuter ferry wharfs including South Mosman and the Spit/Military Roads 'spine' as areas to concentrate redevelopment opportunities. However, given the existing character, amenity and numerous non-Aboriginal heritage listings in the area, further development intensification is considered unlikely.

The South Mosman wharf's patronage potential is constrained as result of the following:

- The wharf has minimal connectivity to other transport modes
- The surrounding steep topography.

## 2.3 Proposal objectives and development criteria

### 2.3.1 Proposal objectives

The objectives of the proposal include:

- To ensure compliance with legislative, functional and operational requirements, in particular DSAPT and DDA standards that require all public transport infrastructure, including wharves, to have fully compliant disabled access by 2022
- To maximise equity of access for all customers
- To maximise the use of the ferry wharf Kit-of-Parts (standardised design elements) to provide continuity across Sydney Harbour wharves
- To accommodate forecast growth in patronage and changes to travel patterns
- To provide safe berthing and mooring of ferry vessels
- To minimise walking distances, conflict and crowding points and queuing
- To improve security and safety
- To minimise cost of ownership and maintenance.

### 2.3.2 Development criteria

The development criteria for the proposal include:

- Key architectural objectives:
  - ensure compliance with functional and operational requirements
  - balance core operations and customer needs
  - design all elements for easy maintenance with an appropriate human scale
  - maintain elegant simplicity in architectural planning and detailing
  - respond sensitively to current and likely future built environment around the wharf
  - consider sustainable design features such as reusable materials and minimising the use of concrete
  - use Kit-of-Parts elements in designing the wharf
  - integrate sustainable design and construction.
- Key engineering objectives:
  - maximise equity of access for all customers
  - minimise walking distances
  - minimise pedestrian conflict points and crowding points
  - maximise stability (and therefore safety) of the berthing arrangements by taking into consideration the wind, waves and swell that the wharf will experience in its proposed location
  - use Kit-of-Parts elements in designing the wharf
  - minimise queuing at wharf facilities
  - maximise the perception of security and safety
  - minimise cost of ownership and maintenance

- accommodate potential for growth in patronage and changing travel patterns
- consider sustainable design features such as reusable materials and minimising the use of concrete
- integrate sustainable design and construction.

The proposal has also been developed against the following priorities (Ferry Wharf Upgrade Program: Business Requirements Specification, Transport Access Program, 2014).

### **2.3.3 Urban design objectives**

Urban design objectives for the proposal include:

- Integrate the wharf within its local area, taking into consideration the nature of the site, local context and the surrounding biodiversity
- Integrate the wharf with its future urban context
- Create a high quality, secure and positive addition to the public domain.

## **2.4 Options considered**

This section describes the options considered to deliver the proposal.

### **2.4.1 Methodology for selection of the preferred option**

The method by which Transport for NSW developed options for replacing the wharf considered:

- Existing and future passenger use and service demand
- Engineering design requirements and current structural integrity
- Passenger safety
- Environmental and social constraints
- Build cost
- Accessibility offered
- Stakeholder feedback.

### **2.4.2 Identified options**

Three concept design options, in addition to the 'Do nothing' option, were developed for the South Mosman wharf interchange (Source: *Aurecon, 2019a*

Figure 2-1). These options were developed based on the achieving a DSAPT compliant design, future needs analysis and the site-specific requirements.

The following options were considered:

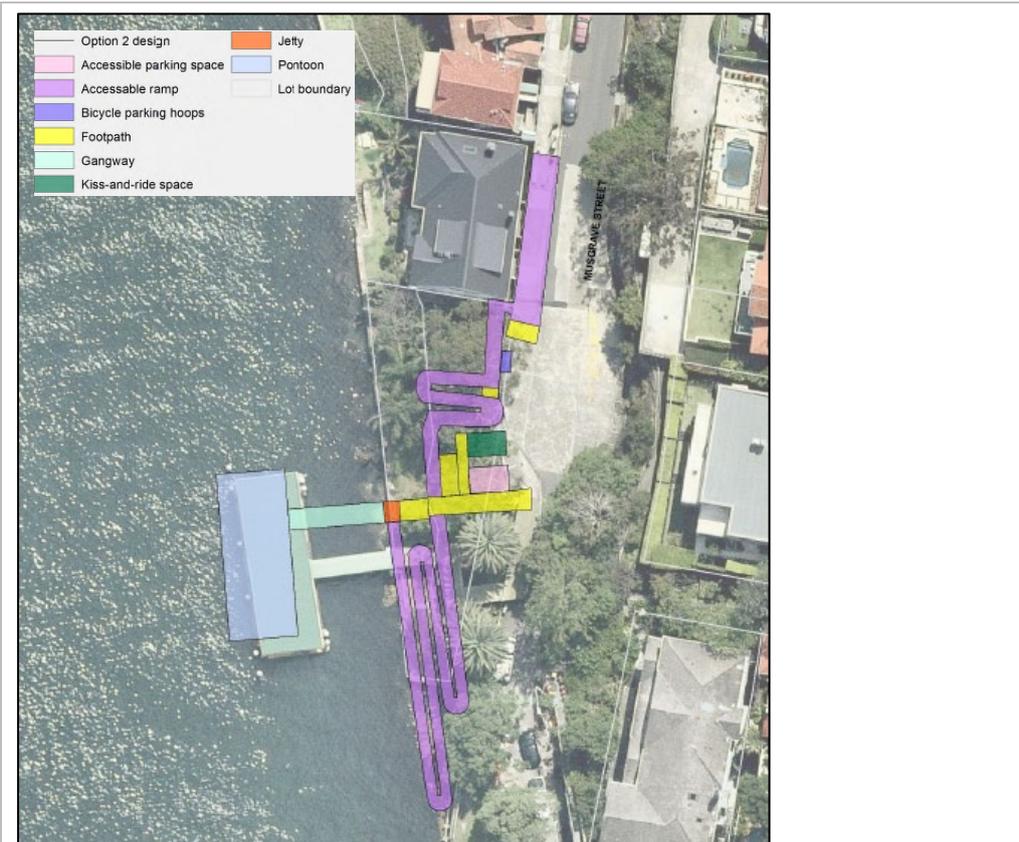
- 'Do nothing' – no upgrade however regular maintenance would continue
- Option 1 – construction of a new 34 metre accessible path from the existing bus stop on Musgrave Street to the proposed lift and stairs

- Option 2 – construction of a new 160 metre accessible switchback ramp set within the land adjacent to the proposed wharf connecting to a new gangway and pontoon
- Option 3 – construction of a new 156 metre accessible switchback ramp set within the land adjacent to the proposed wharf. Similar to Option 2, however the ramp would commence at the end of Musgrave Street and continue down to the waterfront before turning north along the foreshore connecting to a new gangway and pontoon.

Common to options 1 to 3 was a kiss and ride space, accessible parking space and regrading of the existing footpath between nearby Musgrave Street bus stop and the wharf entry point to provide a DSAPT compliant access.

Orientation and location of the new waterside elements was dictated by the narrow navigational channel and moorings at the South Mosman wharf; manoeuvrability of ferries and local heritage items.





Option 2 – Switchback ramp



Option 3 – Switchback ramp alongside driveway

Source: Aurecon, 2019a

**Figure 2-1 Identified options**

### 2.4.3 Analysis of options

#### Do nothing

The option of 'do nothing' would be to limit the scope of work to carrying out activities consistent with those required to maintain operation of the existing wharf, including undertaking regular maintenance.

The current waterside portion of the South Mosman wharf does not:

- Provide a functional, distinctive and iconic design theme that identifies Sydney Harbour Commuter Wharves
- Have amenity to Transport for NSW standards
- Maximise the ability of customers to embark on and disembark from the ferry
- Provide DSAPT compliance access.

The current landside portion of the South Mosman wharf has the following insufficiencies:

- The wharf is not easy to locate and access from its surrounding catchment area
- There is limited wayfinding
- The stairway from Musgrave Street to the wharf structure is not Building Code of Australia compliant and an obstacle for people with accessible needs.
- The current South Mosman wharf does not meet DSAPT compliance.
- Although it would present the lowest initial capital cost and environmental impact, the 'do nothing option' was discounted as it would not meet the objectives of the proposal to improve accessibility, passenger safety and comfort for future patronage.

#### Option 1, Option 2 and Option 3

Advantages and disadvantages of Options 1, 2 and 3 are presented in Table2-3.

Options 1, 2 and 3 were presented to stakeholders (Transport for NSW, Roads and Maritime and TransDev) at a workshop on 15 January 2019. The relative performance of each option was assessed using multi-criteria analysis process, which included consideration of:

- Accessibility
- Infrastructure
- Wharf interchange operation
- Wharf interchange maintenance
- Deliverability
- Customer experience
- Transport integration
- Urban design and precinct planning
- Environment, sustainability and heritage.

**Table 2-3: Options analysis**

Option	Advantages	Disadvantages
Option 1	<ul style="list-style-type: none"> <li>• Accessible connection to bus stop</li> <li>• Better natural surveillance of lift and stairs than existing access path</li> <li>• No impact to existing parking spaces</li> <li>• No impact to bus turning circle</li> <li>• Lift and stairs provide fairly direct route to the wharf</li> <li>• Accessible connection to accessible parking and kiss-n-ride space</li> <li>• Existing access to 1, 3 and 5 Musgrave Street maintained.</li> </ul>	<ul style="list-style-type: none"> <li>• Access to 2A Musgrave Street requires redevelopment</li> <li>• Removal of trees (but far fewer than options 2 and 3)</li> <li>• Greater visual impact from land than existing but less than options 2 and 3</li> <li>• Greater visual impact from water than existing but less than options 2 and 3</li> <li>• Existing wharf closed during construction</li> <li>• Existing wharf and all associated access infrastructure to be demolished</li> <li>• Footprint of the new infrastructure is larger than existing but far smaller than option 2 and 3</li> <li>• 90 degree parking is slower to exit/less safe than parallel parking</li> <li>• Lift requires specialist maintenance.</li> </ul>
Option 2	<ul style="list-style-type: none"> <li>• Accessible connection to bus stop</li> <li>• No impact to existing parking spaces</li> <li>• Accessible connection to accessible parking and kiss-n-ride spaces</li> <li>• No impact to bus turning circle</li> <li>• Existing access to 1, 3 and 5 Musgrave Street maintained</li> <li>• Accessible ramp, requires minimal maintenance.</li> </ul>	<ul style="list-style-type: none"> <li>• Access to 2A Musgrave Street requires redevelopment</li> <li>• Removal of trees (more than options 1 and 3)</li> <li>• Greater visual impact from land than existing and option 1</li> <li>• Greater visual impact from water than existing and options 1 and 3</li> <li>• Better natural surveillance of ramp and stairs than existing access path, but worse than options 1 and 3</li> <li>• Existing wharf closed during construction</li> <li>• Existing wharf and all associated access infrastructure to be demolished</li> <li>• Footprint of the new infrastructure is larger than existing and option 1</li> </ul>

Option	Advantages	Disadvantages
		<ul style="list-style-type: none"> <li>• 90 degree parking is slower to exit/less safe than parallel parking</li> <li>• Switchback ramp provides a less direct route to the wharf than option 1.</li> </ul>
Option 3	<ul style="list-style-type: none"> <li>• Accessible connection to bus stop</li> <li>• No existing impact to existing parking spaces</li> <li>• No impact to bus turning circle</li> <li>• Accessible connection to accessible parking and kiss-n-ride spaces</li> <li>• Accessible ramp, requires minimal maintenance</li> <li>• Existing access to 1, 3 and 5 Musgrave Street maintained.</li> </ul>	<ul style="list-style-type: none"> <li>• Existing wharf and all associated access infrastructure to be demolished</li> <li>• Existing wharf closed during construction</li> <li>• Better natural surveillance of ramp and stairs than existing access path, but worse than options 1 and 2</li> <li>• Greater visual impact from land than existing and option 1</li> <li>• Removal of trees (but fewer than option 2)</li> <li>• Access to 2A Musgrave Street requires redevelopment</li> <li>• Footprint of the new infrastructure is larger than existing and option 1</li> <li>• 90 degree parking is slower to exit/less safe than parallel parking</li> <li>• Switchback ramp provides a less direct route to the wharf than option 1.</li> </ul>

## 2.5 Preferred option

Option 1 was identified as the preferred option based on cost and non-cost evaluation, with an accessible connection from the existing bus stop to the new accessible car space and kiss and ride and new lift and stairs. The footprint of the option was larger than the existing but far less than Option 2 and 3 while providing a much more direct route to the wharf. Option 1 subsequently included less tree removal and had fewer visual impacts.

## 2.6 Design refinements

### 2.6.1 Refinements of Option 1

While Option 1 was the preferred option, stakeholders recommended further design refinements, particularly to reduce impact to the bus stop on Musgrave Street.

Stakeholder comments on the preferred option included:

- Review compliance for bus customers using back door of bus
- Design to consider moving the proposed skybridge between the bus stop and lift further away from the bus turning circle
- Design to consider minimising impacts of skybridge on 2A Musgrave Street
- Design to check impact of proposed infrastructure on the bus turning circle.

Further design development was undertaken to address these comments, with Option 1 also presented to Mosman Council who supported the design refinements identified. The following feedback was obtained from Mosman Council:

- Consider upgrading the lighting on the stairs between Musgrave Street and Herron Walk
- Had no objection to the demolition of the Council-maintained shelter at the top of the wharf access stairs.

There was general agreement between key stakeholders (Roads and Maritime, TransDev, Transport for NSW) over the modifications to the design at a second workshop on 28 March 2019. However, it was suggested that the location of the bike parking hoops be reconsidered to avoid potential conflict with bus movements.

The final concept design is shown in Source: *Aurecon, 2019a*

Figure 2-2.

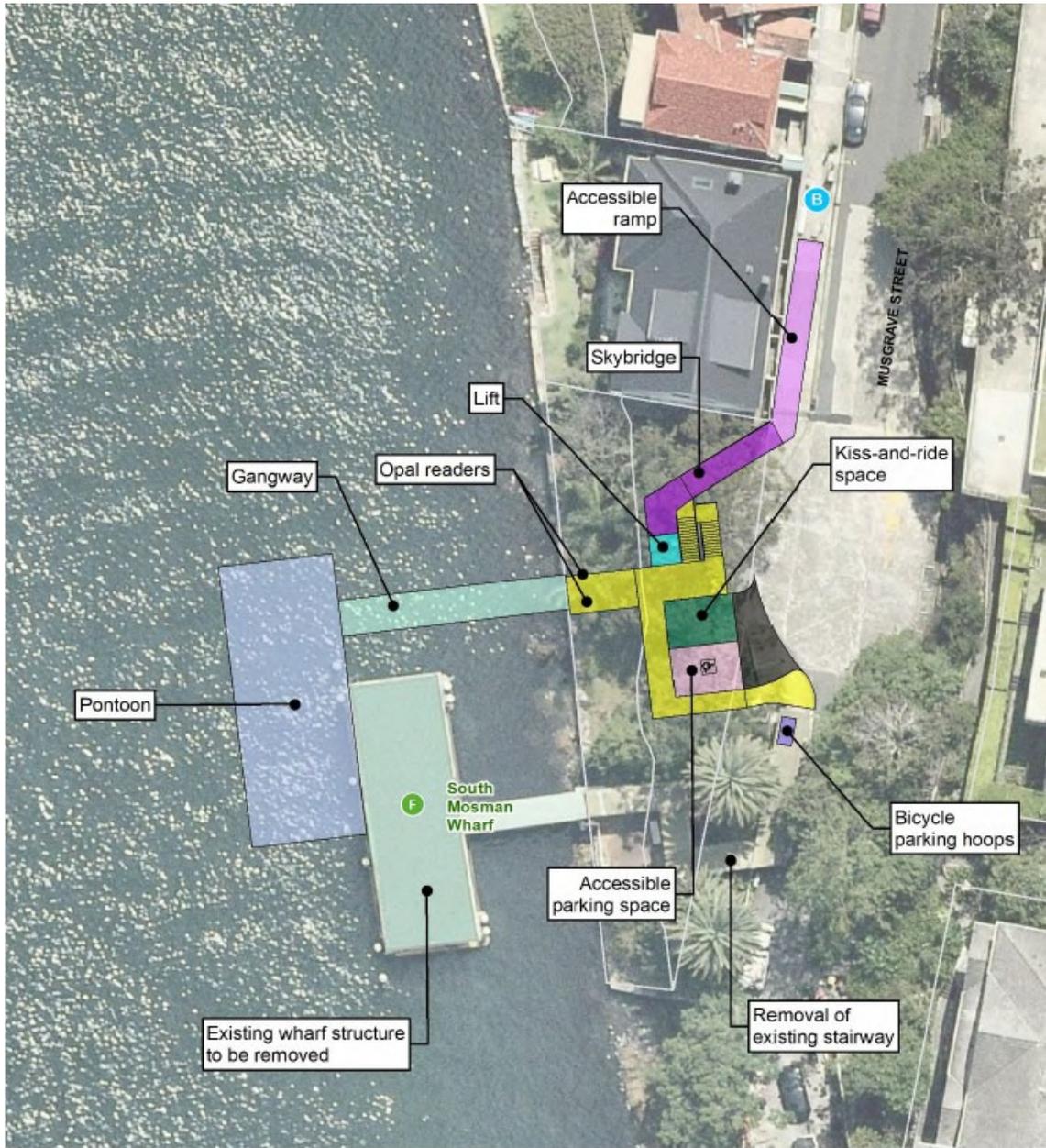
### 2.6.2 Refinements to concept design

Refinements to the concept design included removal of the proposed accessible ramp and skybridge to the bus stop, the kiss and ride space and accessible parking space. These design elements were considered desirable, and subsequently removed based on an evaluation taking account of costs and general impact to the local area.

The refined concept design was placed on public exhibition in May 2020 for comment. Following consideration of comments received from the community a number of changes to the design were incorporated:

- The lift and stair structures have been shifted to the south to reduce visual impacts on local houses and move entrance to the wharf away from the bus turning circle to improve pedestrian safety
- The gangway, stairs and upper and lower platforms of the lift will be covered.

The current design is described in detail in Chapter 3, this design will be further refined during the detailed design phase.



Source: Aurecon, 2019a

**Figure 2-2 Concept design**

## 3 Description of the proposal

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This chapter describes the proposal and provides descriptions of the design parameters including major design features, the construction method and associated infrastructure and activities.

### 3.1 The proposal

The proposal is to upgrade the South Mosman wharf as part of the TAP.

The water based features of the proposal would include:

- Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- Removal of the existing gangway and pontoon including existing piles
- Remediation of the seawall following removal of the existing wharf, if required.

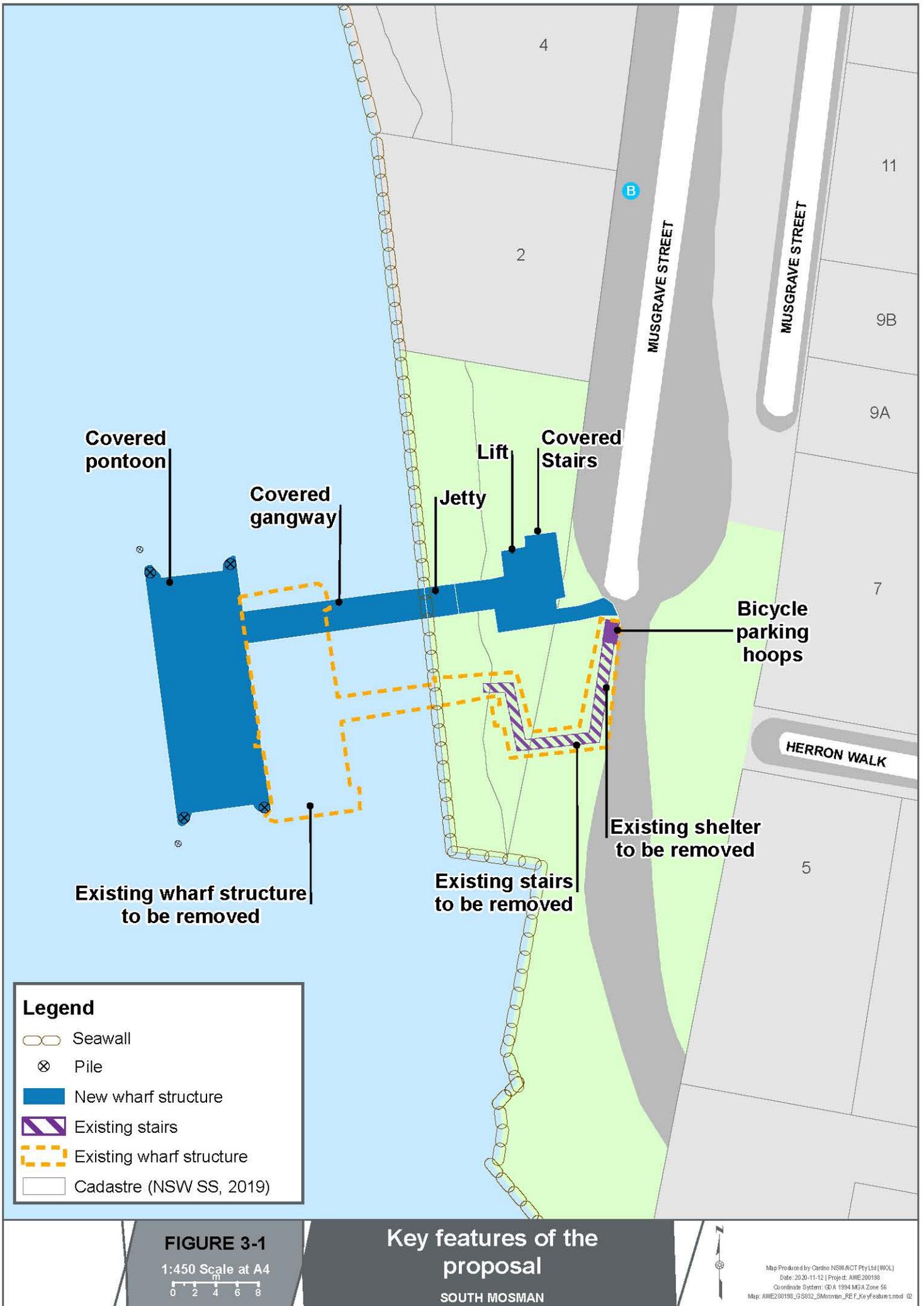
The land based features of the proposal would include:

- Installation of a new 16 metre high lift and new covered stairs
- Installation of a new covered street level waiting area
- Installation of a covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- Installation of three bicycle parking hoops
- Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

Figure 3-1 shows the key features of the proposal including the water-based and land-based features. For the purposes of the REF the proposal and construction footprint have been defined as follows (refer Figure 3-2):

- Proposal footprint –The area directly impacted by proposed works, including the installation and removal of structures
- Construction footprint – Area around the proposal footprint required for construction including the compound area
- Compound area - Temporary facility required for construction, including for example an office and amenities compound, construction compound and materials storage compound.

Study areas for specialist disciplines are defined in Chapter 6.



**Legend**

- Seawall
- Pile
- New wharf structure
- Existing stairs
- Existing wharf structure
- Cadastre (NSW SS, 2019)

**FIGURE 3-1**  
 1:450 Scale at A4  
 0 2 4 6 8

**Key features of the proposal**  
 SOUTH MOSMAN

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)  
 Date: 2020-11-12 | Project: AWE200198  
 Coordinate System: GDA 1994 MGA Zone 56  
 Map: AWE200198\_G5032\_SMosman\_REF\_KeysFeatures.mxd | 02



Existing wharf structure to be removed

Covered pontoon

Covered gangway

Jetty

Lift

Covered Stairs

Bicycle parking hoops

Existing stairs to be removed

Existing shelter to be removed

MUSGRAVE STREET

**Legend**

- Proposal footprint
- Construction footprint
- Compound area

**FIGURE 3-2**  
1:500 Scale at A4  
0 2 4 6 8

**Construction and proposal footprint**  
SOUTH MOSMAN



Mip Produced by Canino NSM/ACT Pty Ltd (WOL)  
Date: 20.10.10-06 | Project: ANWE200198  
Coordinate System: GD A 1994 MSA Zone 56  
Mip: ANWE200198\_GS03\_Simo sman\_REF\_ProjectAreas.mxd 01  
Aerial imagery supplied by Neatmap (August, 2020)

## 3.2 Design

### 3.2.1 Design criteria

The proposal has been designed to NSW and Australian engineering and safety standards, including:

- Roads and Maritime: *Guidelines for the Assessment of Public Ferry Wharf Safety 2016*
- DSAPT and amendments
- *Disability Discrimination Act 1992 (DDA)*
- *National Construction Code (NCC) 2016 Volumes 1, 2 and 3* (Formerly Building Code of Australia- BCA)
- Australian Maritime Safety Authority (ASMA): navigation and safety
- Standards Australia: *AS4997: 2005 Guidelines for the Design of Maritime Structures*.

These standards provide guidance on:

- Overall height of the wharf above the water to allow for operation during extreme low and high tide, whilst also considering climate change impacts
- Maintaining vessel navigational channel
- Access and safety requirements
- Operation and stability during extreme storms, accounting for wind, wave and current conditions
- Sufficient water depths at extreme low tide to allow ferries to safely berth without the risk of either grounding or causing notable sediment disturbance and scour from propeller wash
- Appropriate materials selection and durability to support the operational design life of the wharf for minimum of 50 years
- Additional safety and security measures consistent with the provisions of Crime Prevention through Environmental Design (DPE, 2001).

Overall, the wharf has been designed:

- With a 50-year design life, where achievable and on structural elements
- To cater for low mobility passengers and expected passenger growth in the future
- To operate in different tidal conditions over its design life and take into account climate change and predicted sea level rise
- To be regarded as an attractive, safe and secure piece of public transport infrastructure.

Figure 3-3, Figure 3-4 and Figure 3-5 show views of the proposal from various angles.



Source: TfNSW

**Figure 3-3: View of proposal from water side perspective (Sydney Harbour)**



Source: TfNSW

**Figure 3-4: View of proposal from landside perspective (Musgrave Street)**



Source: TfNSW

**Figure 3-5: View of proposal from waterside perspective (Cremorne Point)**

### 3.2.2 Engineering and development constraints

Table 3-1 lists the main constraints to development and describes how they have been addressed in the concept design.

**Table 3-1: Engineering and development constraints**

Constraint	Concept design provision
Local heritage items: Musgrave Street road reserve and Musgrave Street wharf	Various design options were considered. Impacts to the divided road at Musgrave and the site of the original 1870's Musgrave Street wharf (both local heritage items) have been minimised.
Wind, wave, current and climate change	The design allows the wharf to be used in all tidal 'states' (i.e. Highest Astronomical Tide (HAT) and Lowest Astronomical Tide (LAT), with an additional allowance and climate change adaptation and sea level rise).
Disabled access	The new wharf and landside infrastructure upgrades are required to be accessible to people with a disability to meet the standards of the DDA, DSAP and current legislative standards for disabled access.
Bus turning area	Location of the lift and stairs has considered the bus stop and bus turning area at the cul-de-sac end of Musgrave Street.
Property access requirements	Consideration of access to dwelling at 2A Musgrave Street and access to 1, 3 and 5 Musgrave Street which is via the shared driveway off the cul-de-sac.

### **3.2.3 Major design features**

This section describes the proposals main design features.

#### **Major water based features**

##### ***Jetty***

A new jetty would be constructed behind the seawall. The new jetty would consist of a short concrete deck slab supported by concrete headstock on steel piles. The new jetty length and width would be about four metres and the deck level would be a minimum +1.975 metres AHD to account for future sea level rise. The seaward side of the abutment would provide the support to the gangway to provide access to the pontoon.

##### ***Gangway***

A covered aluminium gangway would be constructed to connect the jetty with the pontoon. It would be 18.9 metres in length and 2.5 metres wide. A transition plate would be installed over the join between the landside connection and the gangway. The gradient of the gangway would vary according to the tides to be almost horizontal at high tide and maximum 1 in 14 for a minimum of 80 per cent of the tide levels.

##### ***Pontoon***

The pontoon would be a rectangular shaped steel floating structure 22.5 metres long and nine metres wide. The pontoon would be used as both ferry boarding and waiting area and would be held in place by four steel 760 millimetres diameter guide piles.

The pontoon would have a curved zinc roof (canopy) supported by steel columns that provides the shelter structure. The covered waiting area would contain stainless steel handrails, glass screens arranged in a curve on the northern and southern ends, providing weather protection for the centrally located seating. On the north-eastern end, part of the edge would be protected by glass screen and the remainder would be a service pod.

The services pod would contain items such as a life buoy, help point, repeat last message button, waste bins, information screens and data/electrical cabinets.

A range of associated safety and security facilities would also be installed, including lighting, CCTV, ladders to the water, life buoy on the pontoon, glass weather protective screens and tactile floor treatments.

The pontoon is made up of a number of independent cells which would be ballasted to provide a freeboard of around one metre to match the ferry still level.

The pontoon cells are independent and not interconnected to ensure redundancy within structure, such that if one cell is punctured or damaged, that the pontoon is not compromised for stability. The pontoon is orientated parallel to the shoreline, to match the dominate wave direction for both wind waves and vessel wash to match the navigation channel. This alignment enables the seaward side of the pontoon to be used as a sweep berth. To assist with ferry movements at the wharf, 457 millimetres diameter pivot piles are provided at each end of the pontoon berth face (two in total).

Four fenders are provided along the berth face of the pontoon. The fender units would comprise 500 millimetre outer diameter cylindrical fenders with steel fender panels that are 2000 millimetres above the pontoon deck level. Timber whalers would connect vertical steel fender beams, slightly below the pontoon deck level to prevent vessels nosing in and impacting the pontoon or fender units. Pontoon mounted 20 tonne bollards are provided for ferry mooring lines. The berthing and mooring loads are ultimately resisted by the four pontoon guide piles, which also act to restrain the pontoon.

### ***Optional recreational berthing***

The wharf design currently considers the use of the wharf for Transdev vessels. The concept design has nominally identified that recreational berthing could be accommodated on the back of the pontoon, with some rearrangement of the furniture on the pontoon. Any desirable requirements for recreational berthing would be developed by Transport for NSW during detailed design in consultation with stakeholders and community groups.

### **Major land based features**

#### ***Pedestrian access***

The concept design requires the development of a new pedestrian interface between street level and the pontoon. A new lift and covered staircase would be constructed to provide access to the proposed wharf.

The lift would be of steel framed construction. The lift walls and car would be likely be made of glass and the overall height of the lift (seen from water) would be around 15 metres. Around 7.5 metres of this structure would be seen from street level. The staircase would be of concrete construction and would contain five flights of 1.5 metre wide stairs between Musgrave Street and the wharf.

Metal balustrades and handrails would be installed on the staircases and lift platform. A pier would be constructed to support the staircase structure and would be located on the foreshore near the wharf entry. The pier would be around nine metres tall.

#### ***Cyclist facilities***

South Mosman wharf upgrade would include three new bicycle hoops. The proposed location of the bicycle hoops adjoins Musgrave Street and is located to the north of the existing staircase.

#### ***Parking***

Parking would not be provided at the wharf due to constraints on Musgrave Street such as access for bus services.

### **Supporting infrastructure**

While the specifics of the supporting infrastructure, lighting, signage, and furniture would be confirmed during the detailed design, they would be consistent with the provisions included on the other wharves on the network. It would therefore include:

- Opal Fixed Location Readers (tap on/off machines) to be relocated at the entrance to the wharf
- Safety and security lighting in the waiting shelter and on the pontoon wharf
- Passenger information boards, notices, and (electronic and display board) timetables
- Safety ladders around the walkway and wharf pontoon
- Strung cabling and ducting to provide power and communications
- CCTV
- Passenger facilities
- Tactile flooring
- New signage to assist with information and navigation (wayfinding).

The above would be developed in accordance with Transport for NSW design specifications.

### 3.3 Construction activities

The appointed contractor would confirm the final construction activities in discussion with Transport for NSW. As such, this section only indicates a likely method and work plan as it may vary due to the identification of additional constraints before work starts, detailed design refinements, community and stakeholder consultation feedback, and contractor requirements/limitations. Should the work method differ from what is proposed in this REF, the contractor would consult Transport for NSW to determine if additional assessment is needed. Some additional land would be needed temporarily to support construction, as described in section 3.4.

#### 3.3.1 Work methodology

The proposal would be built under Transport for NSW specifications as managed by a contractor under a construction environmental management plan (CEMP). These specifications cover environmental performance and management supplemented by aspects such as materials storage and management, and erosion and sediment control. The proposal would likely comprise a sequence of work activities similar to that summarised in Table 3-2.

**Table 3-2: Construction activities**

Activity	Associated work
Site establishment	<ul style="list-style-type: none"> <li>• The existing wharf would be closed.</li> <li>• Given that there is little space available on land it is likely that the majority of the site compound (materials storage, laydown, site sheds, ablutions, etc) would need to be established on a construction barge moored adjacent to the existing wharf. It may be possible to use the existing wharf for site offices and ablutions once the wharf is closed to the public.</li> <li>• Traffic control measures (including for vehicles, watercraft, pedestrians and cyclists) would be established in accordance with the traffic management plan. Appropriate wayfinding signage would be installed advising of alternative transport options where necessary.</li> <li>• Environmental controls would be established in accordance with the CEMP.</li> <li>• A small excavator (about eight tonnes) would be installed at water's edge by crane barge, to undertake clearing and grubbing of water's edge and rock face areas. Spoil would be removed by barge.</li> </ul>
Construction of works on the water's edge	<ul style="list-style-type: none"> <li>• Install a medium sized excavator (about 13 tonne) with rock hammer at water's edge by crane barge.</li> <li>• Excavate stair well and lift slot. The excavation may require rock bolting and/or shotcrete to support the face. This would require specialised equipment to be lifted into position and removed by a large crane barge. Spoil would be removed by barge.</li> </ul>

Activity	Associated work
	<ul style="list-style-type: none"> <li>• Install a small excavator-mounted piling rig at water's edge by barge crane.</li> <li>• Install piles for platform, lift shaft and gantry abutment foundations. It is assumed piles would be five to ten metres in depth and 600 – 750 millimetres in diameter. Concrete and reinforcement can be delivered from Musgrave Street. Spoil would be removed by barge.</li> <li>• Remove piling rig by barge crane.</li> <li>• Break down piles. Spoil would be removed by barge.</li> </ul>
Construction of superstructure works	<ul style="list-style-type: none"> <li>• Construct base slab and pile caps for stairs, lift platform and lift tower. Formwork, concrete and reinforcement would be delivered from Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked.</li> <li>• Construct piers and headstocks for stairs and lift platform. Formwork, concrete and reinforcement would be delivered from Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked.</li> <li>• Lift precast column capping beams (for platform) using large mobile crane on Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked.</li> <li>• Install precast concrete stairs units by large mobile crane installed in Musgrave Street.</li> <li>• Saw cut Musgrave Street concrete pavement and excavate to abutment foundation level (assuming rock is within one metre of pavement level, otherwise piles will also be required). Musgrave Street would be closed to buses at this time as there would be no provision for turning around. Steel road plates would be required to allow cul-de-sac to be opened to buses between works.</li> <li>• Construct platform abutment in Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around. Steel road plates would be required to allow cul-de-sac to be opened to buses between works.</li> <li>• Demolish existing Musgrave Street pavement below platform. Musgrave Street would be closed to buses at this time as there would be no provision for turning around.</li> <li>• Install precast planks between abutment and columns using large mobile crane on Musgrave Street. A detailed lift study would be required to confirm that planks can be delivered to site (probably by reversing trucks) and lifted into position by crane within the limited footprint. Musgrave Street would be closed to buses at this time as there would be no provision for turning around. Alternate access to buses would be made available.</li> <li>• Construct concrete deck slab on platform. Formwork, concrete and reinforcement would be delivered from Musgrave Street.</li> </ul>

Activity	Associated work
	<p>Musgrave Street would be closed to buses at this time as there would be no provision for turning around.</p> <ul style="list-style-type: none"> <li>• Construct tie-in pavement between platform and Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around.</li> <li>• Install lift tower and lift car using large mobile crane on Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave street would be blocked.</li> <li>• Demolition of the existing stairs. Spoil would be removed by barge.</li> <li>• Finishing works (landscaping, paving, handrails, etc) and demobilisation.</li> <li>• It is likely that a new electricity supply would need to be installed to power the lifts. This may require the installation of a new electrical cable (either underground or overhead) along streets accessing the site. This could require extensive works.</li> </ul>
Demolition of the existing wharf	<ul style="list-style-type: none"> <li>• The construction work area would be delineated using floating booms. This would make allowance for the outward reach of the construction barge's four anchorage points, over which marine vessels may not cross for safety reasons. The anticipated size of the barges is up to about 20 metres by 30 metres in size.</li> <li>• Up to three barges would travel to the site from the off-site facility. One barge would be fitted with a crane. When on-site, it would be anchored by four points but would reposition around the site during the work, as required.</li> <li>• The existing shelter, wharf furniture and gantry would be cut away from the piles and loaded onto a barge by crane to be transported to an appropriately approved and licensed facility for reuse and/or disposal.</li> <li>• The existing pontoon would be floated away for disposal.</li> <li>• The existing steel piles would be removed by vibratory methods. If a pile is unable to be extracted by vibratory methods, it would be cut off level with the harbour bed. Divers would cut the pile at seabed level using appropriate underwater equipment. Piles would be transported by barge to an appropriately approved and licensed facility for reuse and/or disposal.</li> <li>• Remediation of the seawall following removal of the existing wharf, if required.</li> </ul>
Installation of steel piles	<ul style="list-style-type: none"> <li>• Steel locator piles for the pontoon and foundation piles for the jetty would be installed into bedrock. These piles would be transported by barge to the site from the off-site facility</li> <li>• The installation of the piles for the jetty would likely be undertaken by a barge mounted piling rig. The jetty would be an independent structure to the seawall.</li> <li>• Construct pile foundation systems in bedrock as follows: <ul style="list-style-type: none"> <li>○ Pre-drilling into rock</li> </ul> </li> </ul>

Activity	Associated work
	<ul style="list-style-type: none"> <li>○ Positioning steel pile casing with crane mounted driving unit and piling guide</li> <li>○ Driving or screwing the steel pile casings into position</li> <li>○ Cutting the steel pile casings to length and backfilling with concrete.</li> </ul>
Installation of the pontoon and gangway	<ul style="list-style-type: none"> <li>• Lifting and placement of components for the new wharf would be carried out using a barge mounted crane.</li> <li>• The new pontoon structure would be fabricated at an off-site facility and floated to site. The pontoon would be secured to the locator piles and packing plates used to trim the plan position. The roof structure may be installed in a separate lift.</li> <li>• The new gangway would be fabricated at an off-site facility and floated to site by barge. The gangway would be lifted into position a large barge mounted crane.</li> <li>• Finishing works completed (architectural, services, handrails, etc).</li> </ul>
Installation of new or improved facilities	<ul style="list-style-type: none"> <li>• Installation of way-finding signage.</li> <li>• Re-landscaping of the construction areas.</li> </ul>
Site clean up	<ul style="list-style-type: none"> <li>• The site would be cleaned up and restored to its previous state.</li> <li>• Sedimentation controls and temporary structures would be removed.</li> </ul>

### 3.3.2 Construction hours and duration

This section describes the time it would take to build the proposal and the working hours.

#### Start date and length of construction

The proposal would be built over a duration of up to six months starting in late 2021. Construction may not be continuous as it would rely on materials delivery and the manufacture of the prefabricated components. The construction program would be affected by the need to coordinate with Mosman Council, residents, and other key stakeholders (refer to Chapter 5).

#### Working hours

The work would take place within and outside of standard working hours. Standard working hours are as follows:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm.

For safety reasons the piling, lifting and concrete work in the harbour may need to take place at night or early in the morning when the water is calm and still and the harbour is least busy. Piling is estimated to occur intermittently over an eight week period and

outside standard working hours. During piling activities, a work schedule similar to the following may be adopted:

- Drilling of piles (preferred method)
  - Setup: 11pm to 12am (approximately)
  - Drilling: 12am to 6am (approximately)
  - Pack up: generally, 6am to 7am (approximately)
- Hammering of piles (Alternative method)
  - Setup: 4am to 5am (approximately)
  - Hammering: 5am to 7am (approximately).

Pile drilling or hammering, and lifting would take place intermittently during the above periods. On average, a pile would be drilled or hammered for about 10 minutes followed by a relatively quiet period for the next 30 minutes or more before the next stage is progressed.

Due to the requirement for calm water conditions, the new pontoon and gangway would be lifted into position by a barge-mounted crane over a two to three day period between approximately between 11pm and 7am. There would be approximately 30 night shifts across the six month period to complete the proposed works.

Landside works undertaken near the bus turning circle may occur outside of standard working hours to minimise the impact on the bus operations.

### 3.3.3 Workforce

While about 25 people would be needed to carry out the main construction activities it is expected that there would be about 10-15 people onsite at any time on average.

### 3.3.4 Plant and equipment

The plant and equipment needed to build the proposal would be typical of any construction site. It would vary depending on the construction activity. The largest and most complex equipment needed would be to lift and install the prefabricated units and undertake the piling work. Table 3-3 indicates the plant and equipment that would be likely used to build the proposal, however this would be confirmed by the contractor.

**Table 3-3: Indicative plant and equipment**

Activity	Equipment	
Water based construction	<ul style="list-style-type: none"> <li>• Barge (up to 20 metres by 30 metres)</li> <li>• Barge mounted crane</li> <li>• Barge mounted piling rig</li> <li>• Excavator</li> <li>• Concrete truck</li> <li>• Concrete pump</li> <li>• Floating boom (crane)</li> <li>• Hand tools</li> </ul>	<ul style="list-style-type: none"> <li>• Generator</li> <li>• Oxey Acet Cutting</li> <li>• Workboat</li> <li>• Daymaker</li> <li>• Pneumatic drill/hammer</li> <li>• Rock breaker (mounted)</li> <li>• Tug boat</li> </ul>

Activity	Equipment
Land based construction	<ul style="list-style-type: none"> <li>• Excavator</li> <li>• Trucks</li> <li>• Generator</li> <li>• Concrete truck</li> <li>• Concrete pump</li> <li>• Piling rig</li> <li>• Franna crane</li> <li>• Crane</li> <li>• Hand tools</li> <li>• Bobcat</li> <li>• Elevated Work Platform</li> <li>• Pneumatic drill/hammer</li> <li>• Crane</li> </ul>

### 3.3.5 Earthworks

There would be limited earthworks associated with the proposal. A small amount of seabed sediment would be disturbed during the piling work, and demolition of the existing wharf, however, no sediment would be removed. Earthworks during construction of the land based elements would include demolition of existing stairway and excavation for the construction of the stair well and lift slot. Construction of the pavement and kerbs may also involve limited earthworks. Earthwork volumes are expected to be minimal.

Any materials collected would be tested and waste classified. Where possible, the materials would be reused under an exception, unless they classify as a non-exempt waste, in which case they would be shipped (barged) offsite for collection and disposal at a licenced waste management facility.

### 3.3.6 Source and quantity of materials

Various standard construction materials that are readily available across the Sydney Metropolitan region would be needed to build the proposal. They would be either transported or shipped (barged) to site as prefabricated units ready for installation, or delivered in small quantities for use as needed. The main materials needed to build the proposal would comprise:

- Marine-grade steel, aluminium and zinc for the superstructure (floating pontoon and wharf, barriers and roof), substructure (piles) and land side work (stairs and lift)
- Precast concrete
- Prefabricated signage, light fittings, barriers and fencing
- Prefabricated glazing units
- Electrical cabling and other electronic infrastructure
- Additional materials such as relatively small quantities of paint, oils, fuels and other materials.

Materials would be sourced from overseas and local commercial suppliers, using local suppliers wherever feasible and cost effective.

### **3.3.7 Traffic management and access**

Maritime and road traffic management would be required while certain elements of the proposal are being built and installed. This may involve:

- Creation of a maritime navigation exclusion zone around the proposal footprint for most of the construction work to prevent both commercial and recreational traffic entering the area
- Closure of the wharf, with no ferry services running from South Mosman wharf. Bus and train services would be used by commuters. If required, extended operating hours for the existing bus service would be required during the construction period
- Changes to the F6 Mosman Bay route to avoid the construction site
- Potential temporary partial closure of Musgrave Street
- Introduction of construction traffic along Musgrave Street
- Changes to the 236 bus route.

Private property access may be impacted during construction, primarily to 2A Musgrave Street and 1, 3 and 5 Musgrave Street which have a shared driveway off the cul-de-sac of Musgrave Street.

Due to restricted turning area at the cul-de-sac end of Musgrave Street the number of light and heavy vehicles accessing the site via Musgrave Street during construction would be limited.

Where feasible, materials and equipment for water based elements of the proposal would be shipped (barged) into and out of the area to limit any impact on Musgrave Street and surrounds. This would provide the best method to build the marine components. It may also be the best method to deliver materials to the land based areas providing there is adequate access for loading and unloading, however it is anticipated that most materials and equipment required for land based elements of the proposal would be delivered by road. The amount of materials shipped to site, over being delivered by road, would be confirmed during detailed design.

## **3.4 Ancillary facilities**

Given the limited space and road access, the preference would be to ship any major machinery, equipment and prefabricated units to site, potentially making use of an offshore storage barge. However, it is also likely that a small site compound (to be confirmed by the contractor) would be needed within the construction footprint to store equipment, machinery and some limited materials. The preferred location for the site compound is shown in Figure 3-2. While the specific requirements for this site would be confirmed by the contractor, it would most likely comprise a shipping container with a supporting site office and toilet.

The marshalling and storage of most waterside construction equipment, plant and materials, and the pre-fabrication of parts, pre-casting of headstocks and fit outs for the wharf, would be carried out by a contractor at an approved off-site facility. The operation of this off-site facility does not form part of this proposal but would have the necessary approvals in place for such activities to be undertaken.

### **3.5 Public utility adjustment**

A preliminary assessment of existing utilities near the wharf was undertaken through a Dial Before You Dig (DBYD) search in February 2019 (Aurecon, 2019a). Utilities within proximity to the proposed works include:

- Low voltage (LV) cables (Ausgrid)
- 210 KPa gas cable (Jemena)
- Communication cable (NBN)
- Underground communications cable (Telstra)
- Aqueduct and sewer (Sydney Water).

It is assumed that there are additional LV cables that run in this area, providing electricity to the lights on the existing stairs and wharf that have not been provided with the DBYD information (likely to be Council utilities)(Aurecon, 2019a). During detail design, further assessment of impacts to local utilities would be undertaken including on-site services locating.

The existing electrical switchboard (located at the entrance to the existing wharf stairs) would require an upgrade to supply the new wharf design (including power for lighting and the lift). Power would be reticulated from the switchboard to the gangway via an electrical trench. This would require excavation of the existing pathway to allow construction of the trench which would also allow for power supply to the new lift. Power would be reticulated from the shoreline to the pontoon in marine grade stainless steel conduits affixed on the underside of the gangway and pontoon. Flexible stainless-steel conduits would be used at the gangway connection to the landside and to the pontoon (Aurecon, 2019a).

There are water mains connections available from the end of Musgrave Street (Aurecon, 2019a). The provisions for a water connection would be developed during detailed design.

### **3.6 Property acquisition**

No property would be acquired under the proposal. The additional land needed to support construction would be either leased from, or used under agreement with Council.

## 4 Statutory planning framework

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This chapter provides the statutory and planning framework for the proposal and considers the provisions of relevant state environmental planning policies, local environmental plans and other legislation.

### 4.1 Environmental Planning and Assessment Act 1979

#### 4.1.1 State Environmental Planning Policies

##### **State Environmental Planning Policy (Infrastructure) 2007**

*State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 68(4A) of ISEPP permits development on any land for the purposes of associated public transport facilities for a public ferry wharf to be carried out on any land may be carried out by or on behalf of a public authority without consent. However, such development may only be carried out on land reserved under the *National Parks and Wildlife Act 1974* if the development is authorised by or under that Act.

As the proposal is for the purposes of associated public transport facilities for a public ferry wharf and is to be carried out by Transport for NSW, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from council is not required. The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974*.

The proposal does not trigger an approval or development consent under *State Environmental Planning Policy (Coastal Management) 2018* (Coastal Management SEPP) or *State Environmental Planning Policy (State Significant Precincts) 2005*.

##### **State Environmental Planning Policy (State and Regional Development) 2011**

*State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) identifies development that is State significant infrastructure and critical State significant infrastructure.

Clause 14(1) of the SRD SEPP declares development to be State significant infrastructure if the development is, by the operation of a State environmental planning policy, permissible without development consent and the development is specified in schedule 3 of the SEPP.

Schedule 3 specifies that development for the purpose of port and wharf facilities or boating facilities (not including marinas) by or on behalf of a public authority that has a capital investment value of more than \$30 million is State significant infrastructure.

The proposal has a capital investment value of less than \$30 million so does not become State significant infrastructure as declared by the SRD SEPP.

##### **State Environmental Planning Policy (Coastal Management) 2018**

The Coastal Management SEPP aims to update and consolidate into one integrated policy, a series of previous SEPPs including *State Environmental Planning Policy 14 (Coastal Wetlands)*, *State Environmental Planning Policy 26 (Littoral Rainforests)* and *State Environmental Planning Policy 71 (Coastal Protection)*. The Coastal Management SEPP gives effect to the objectives of the new *Coastal Management Act*

2016 from a land use planning perspective, specifying how development proposals are to be assessed if they fall within the coastal zone.

The proposal does not fall within land identified as coastal wetlands under clause 10 of the Coastal Management SEPP. As such, the provisions of the Coastal Management SEPP have not been considered further.

### State Environmental Planning Policy (Sydney Harbour Catchment) 2005

The proposal is located within the Sydney Harbour Catchment and is subject to the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (Sydney Harbour SREP), which is a deemed SEPP. The aims of the Sydney Harbour SREP from clause 2 are considered in Table 4-1.

**Table 4-1 Aims of the Sydney Harbour SREP**

Aim	Comment
<p>(a) To ensure that the catchment, foreshores, waterways and islands of Sydney Harbour are recognised, protected, enhanced and maintained:</p> <p>(i) as an outstanding natural asset</p> <p>(ii) as a public asset of national and heritage significance, for existing and future generations.</p>	<p>Chapter 7 of this REF includes safeguards to protect and maintain the area's natural and heritage values, including those associated with the existing wharf (refer to section 6.6). This would ensure the values of Sydney Harbour are recognised, protected, enhanced and maintained.</p>
<p>(b) To ensure a healthy, sustainable environment on land and water.</p>	<p>Providing relevant standard controls are implemented and monitored, as set out in Transport for NSW guidelines (refer to Chapter 7), the Proposal's environmental impact is expected to be minimised.</p>
<p>(c) To achieve a high quality and ecologically sustainable urban environment.</p>	<p>The design of the proposal has been based on the principles of sustainability outlined in the Transport for NSW <i>Sustainability Design Guidelines</i>.</p> <p>The proposal's urban design includes high quality, durable and low impact materials to minimise ongoing maintenance requirements.</p> <p>The design also provides thematic consistency across the entire network (refer to Chapter 3). Both factors provide for a sustainable urban environment over its 50-year design life.</p>
<p>(d) To ensure a prosperous working harbour and an effective transport corridor.</p>	<p>With a 50-year design life, the proposal would allow for the operation of a ferry wharf at South Mosman for future generations. The work also forms part of a network-wide upgrade program to help sustain the ferry service in its role as part of an effective and integrated transport corridor and system.</p> <p>The existing wharf would be closed during the construction of the proposal. Existing nearby bus and train transport would be available. Land</p>

Aim	Comment
	transport is discussed further in section 6.8. Passengers would be notified ahead of time as detailed in Chapter 5.
(e) To encourage a culturally rich and vibrant place for people.	The proposal would continue to provide Mosman residents with access to the ferry network and interchange with other public transport provisions. This would sustain Mosman as a vibrant place to live.
(f) To ensure accessibility to and along Sydney Harbour and its foreshores.	<p>The upgrade would ensure that Mosman residents and other users are provided with ongoing access to Sydney Harbour and its foreshore areas over the next 50 years. It would also improve access for low mobility passengers.</p> <p>The existing wharf would be closed during the construction of the proposal. Passengers would be notified ahead of time about the works as detailed in Chapter 5.</p>
(g) To ensure the protection, maintenance and rehabilitation of watercourses, wetlands, riparian lands, remnant vegetation and ecological connectivity.	The proposal would not have a significant impact on notable terrestrial or marine environments or values in the area. Additional standard controls would be implemented to prevent any indirect impact on the wider ecological environment from spills and sediment disturbance, mobilisation and smothering.
(h) To provide a consolidated, simplified and updated legislative framework for future planning.	The proposal is being delivered under the relevant planning provisions covering waterfront and marine development set at a State and Commonwealth level.

The proposal has been considered in respect of the objectives from clause 17 of the SREP Sydney Harbour zones: W1 Maritime Waters in Table 4-2 and W7 Scenic Waters Casual Use in Table 4-3. The proposal footprint is within W7 zone whilst the construction footprint includes areas within the W1 zone.

**Table 4-2 Zone W1 Maritime Waters objectives**

Objective	Comment
(a) To give preference to and protect waters required for the effective and efficient movement of commercial shipping, public water transport and maritime industrial operations generally.	<p>Navigational exclusion zones would be installed while the work is taking place.</p> <p>No commercial shipping activity, or maritime industrial operations occur near South Mosman wharf, and no impact is anticipated. Transport is discussed further in section 6.6.</p> <p>The Ports Authority of NSW would be consulted prior to and during the works. Where required,</p>

Objective	Comment
	<p>nautical charts would be updated once the wharf is upgraded.</p> <p>Operation of the proposal would allow for more effective and efficient public water transport for its 50-year design life.</p>
(b) To allow development only where it is demonstrated that it is compatible with, and will not adversely affect the effective and efficient movement of, commercial shipping public water transport and maritime industry operations.	<p>Navigational exclusion zones would be installed while the work is taking place.</p> <p>The existing wharf may be closed during the construction of the proposal. Public transport ferries would be unable to access the wharf.</p> <p>The Port Authority of NSW would be consulted during the works.</p>
(c) To promote the equitable use of the waterway, including use by passive recreation craft.	<p>Minor disruption would be caused during construction, which would be communicated to water users before starting work.</p> <p>The proposal would involve the construction of a new wharf at South Mosman, retaining the existing wharf for public recreation use. The new wharf will allow for more effective and efficient public water transport for its 50-year design life.</p>

**Table 4-3 Zone W7 Scenic Waters Casual Use objectives**

Objective	Comment
(a) To allow certain water-dependent development close to shore to meet casual boating needs and other water access needs.	<p>The proposal would involve the construction of a new wharf at South Mosman to meet access needs. The new wharf would allow for more effective and efficient public water transport for its 50-year design life.</p> <p>The upgrade of the stairs and construction of the lift from Musgrave Street to the South Mosman wharf would improve access to the water.</p>
(b) To allow such development only where it can be demonstrated that it achieves a predominantly open and unobstructed waterway and does not dominate the landscape setting.	<p>The upgrade of South Mosman wharf and lift / stair complex would introduce a new built element on the foreshore. The new pontoon would extend further out than the existing pontoon, however the waterway would not be obstructed.</p>
(c) To restrict development for permanent boat storage in locations that are unsuitable due to the adverse visual impact of such development or to physical	<p>The proposal does not include permanent boat storage.</p>

Objective	Comment
constraints such as shallow water depth, severe wave action or unsafe navigation.	
(d) To ensure that the scale and size of development are appropriate to the location and protect and improve the natural and cultural scenic quality of the surrounding area, particularly when viewed from waters in this zone and areas of public access.	<p>The upgrade of South Mosman wharf and lift / stair complex would introduce a new built element on the foreshore.</p> <p>Some trees would be removed; however replanting would occur to mitigate these changes.</p> <p>The proposal is not anticipated to impact on the cultural scenic quality of the surrounding area.</p>
(e) To maintain and enhance views to and from waters in this zone.	<p>The upgrade of South Mosman wharf and lift / stair complex would introduce a new built element on the foreshore.</p> <p>The proposal is not anticipated to impact on the cultural scenic quality of the surrounding area.</p>
(f) To minimise the number and extent of structures over waters in this zone through mechanisms such as the sharing of structures between adjoining waterfront property owners.	No additional structures will be constructed over waters.
(g) To ensure remnant natural features, aquatic habitat (including wetlands) and public access along the intertidal zone are not damaged or impaired in any way by development.	<p>The works are not anticipated to have a significant impact on aquatic habitat in the area.</p> <p>Public access would be temporarily impacted during construction, however this would be improved following completion of the proposal.</p>

Under clause 18 of the Sydney Harbour SREP, the proposal is permissible with development consent in the W1 and W7 zone. In any case, the development is permissible without development consent pursuant to the provisions of ISEPP which override the zoning provisions of the Sydney Harbour SREP (see clause 7(5) of the Sydney Harbour SREP).

The matters for consideration listed in Division 2 at clauses 21-27 of the Sydney Harbour SREP are provided in Table 4-4.

**Table 4-4 Division 2 matters**

Division 2 matter	Comment
Clause 21 Biodiversity, ecology and environment protection	Section 6.3 describes the terrestrial and marine environmental impacts associated with the proposal. With the implementation of the environmental management measures, impacts would be minimised and/or managed.

Division 2 matter	Comment
Clause 22 Public access to, and use of, foreshores and waterways	<p>The wharf would be closed during the construction period.</p> <p>Access to the stairs and wharf would be impeded during construction works. The local community and ferry passengers would be notified ahead of the commencement of work.</p>
Clause 23 Maintenance of a working harbour	<p>The upgrade would ensure that Mosman residents and other users would be provided with access to a ferry service (and public transport) over the next 50 years.</p>
Clause 24 Interrelationship of waterway and foreshore uses	<p>The upgrade would allow the social and cultural association of a wharf in this location to be retained, including the relationship it provides for people between the harbour and foreshore.</p>
Clause 25 Foreshores and waterways scenic quality	<p>Upgrading the wharf in a similar location as the existing wharf would limit the visual impact of introducing infrastructure in a new location, including any impact on areas zoned as 'scenic waters'.</p> <p>There would be a minor adverse visual impact from increasing the mass, scale, form, composition, design and structure of the wharf, as discussed in section 6.6.</p>
Clause 26 Maintenance, protection and enhancement of views	<p>Section 6.6 describes the landscape character and visual impacts associated with the Proposal. As described above, the new wharf would have a minor visual impact for the surrounding properties that overlook this part of the river. However, the overall impact is likely to be less compared to building a new structure in a different location.</p>
Clause 27 Boat storage facilities	<p>There is no boat storage works associated with, or impacted by, the proposal.</p>

Clause 31 of the Sydney Harbour SREP requires consultation for certain development proposals not requiring development consent. Consultation, including under the Sydney Harbour SREP (if applicable) is discussed in Chapter 5 of this REF.

Part 5 of the Sydney Harbour SREP contains heritage provisions that are to be taken into account in respect of Division 5.1 activities. Heritage items near the proposal include:

- Musgrave Street wharf site (remains and sea wall)
- Divided road
- Herron Walk steps
- Group of 2 houses, divided into 3 dwellings
- Chinese boatshed.

Heritage items are discussed further in sections 6.6 and 6.7. The heritage objectives from the Sydney Harbour SREP in clauses 53(1) and (2) are considered in Table 4-5.

**Table 4-5 Heritage objectives**

Objective	Comment
1(a) To conserve the environmental heritage of the land to which this Part applies.	The proposal has been designed to be sympathetic to the area's heritage values.  A statement of heritage impact (SOHI) prepared to support this REF concludes that the proposal would have neutral or negligible impact on heritage items in proximity to the wharf and within the one kilometre visual buffer zone (refer to section 6.6).
1(b) To conserve the heritage significance of existing significant fabric, relics, settings and views associated with the heritage significance of heritage items.	As above, the proposal has been designed to preserve the heritage and conservation values of surrounding heritage items.
1(c) To ensure that archaeological sites and places of Aboriginal heritage significance are conserved.	As described in section 6.7, the proposal would not impact known archaeological site or places of Aboriginal heritage.
1(d) To allow for the protection of places which have the potential to have heritage significance but are not identified as heritage items.	There is almost little to no potential for in situ sites to exist in the vicinity of the study area, due to its highly disturbed nature.
2(a) To establish a buffer zone around the Sydney Opera House so as to give added protection to its world heritage value.	The proposal is not located in the Sydney Opera House buffer zone.
2(b) To recognise that views and vistas between the Sydney Opera House and other public places within that zone contribute to its world heritage value.	The proposal would not impact on the views and vistas from the Sydney Opera House.

Clause 54 to Clause 60 of the Sydney Harbour SREP provide for the protection of heritage items and places, including requirements for development consent. Due diligence assessment of the *Stage 1 Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI)* for the proposal was prepared in accordance with Clause 54 to Clause 60 of the Sydney Harbour SREP. As noted above, the proposal would have neutral or lesser impact on heritage items and it would not impact on known archaeological sites or places of Aboriginal heritage. As such, there is no need to either seek permission or secure development consent for the work on heritage related grounds.

Part 6 of the Sydney Harbour SREP relates to wetlands protection. The site is not identified as being located within a Wetland Protection Area under the SREP.

#### 4.1.2 Local Environmental Plan

##### Mosman Local Environmental Plan 2012

The landside component of the proposal is located within the Mosman local government area (LGA). Local development control and land use zoning and planning in this LGA is currently governed under the *Mosman Local Environmental Plan 2012* (Mosman LEP).

As development without consent, the proposal is not subject to local environmental planning policy or development control. However, the Mosman LEP is useful in identifying the proposal's consistency with its land use and planning policy as described in Table 4-6.

**Table 4-6 Relevant Mosman LEP land use zoning policies**

Objective	Proposal consistency
SP2 Infrastructure (Existing wharf and waterfront)	
<ul style="list-style-type: none"> <li>• To provide for infrastructure and related uses.</li> <li>• To prevent development that is not compatible with or that may detract from the provision of infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Provides improvement as use as a ferry wharf</li> <li>• Short-term impacts to infrastructure</li> </ul>
R3 Medium Density Residential	
<ul style="list-style-type: none"> <li>• To provide for the housing needs of the community within a medium density residential environment.</li> <li>• To provide a variety of housing types within a medium density residential environment.</li> <li>• To enable other land uses that provide facilities or services to meet the day to day needs of the residents.</li> <li>• To provide for housing that is compatible with the desired future character of the area in terms of bulk, height and scale.</li> <li>• To encourage residential development that has regard to local amenity and, in particular, public and private views.</li> </ul>	<ul style="list-style-type: none"> <li>• Improves facilities to meet the day to day needs of the residents</li> <li>• Short-term impacts to services</li> </ul>

## 4.2 Other relevant NSW legislation

Table 4-7 lists the NSW legislation relevant to the proposal or the land on which the proposal would be built.

**Table 4-7 Other relevant NSW legislation**

Legislation and application	Relevance to proposal and further requirements
<p><i>National Parks and Wildlife Act 1974:</i> provides for the protection of Aboriginal heritage values, national parks and ecological values. Makes it an offence to harm Aboriginal objects, places or sites without permission.</p>	<p>A Stage 1 PACHI assessment confirmed that the proposal would avoid impacts to known Aboriginal heritage items (Appendix H). An Aboriginal heritage impact permit (AHIP) is not required for the Proposal.</p> <p>Section 6.7 provides further details.</p>
<p><i>Heritage Act 1977:</i> provides for the protection of conservation of buildings, works, maritime heritage (wrecks), archaeological relics and places of heritage value through their listing on various State and local registers. Makes it an offence to harm any non-Aboriginal heritage values without permission.</p>	<p>Two heritage items are located within the construction footprint: Musgrave Street wharf site and Divided road.</p> <p>A small portion of the retaining wall associated with Musgrave Street wharf is within the construction footprint, however it would not be modified. It is anticipated that there would be neutral/negligible impacts to the heritage item.</p> <p>The significance of the Musgrave Street Divided road is largely associated with the structure and form of the road as a divided road, rather than the fabric of the road surface. It is anticipated that there would be negligible impacts to the heritage item.</p> <p>Section 6.6 provides further details.</p>
<p><i>Roads Act 1993:</i> provides for the construction and maintenance of public roads. Requires consent to dig up, erect a structure or carry out work in, on or over a road.</p>	<p>The proposal includes impacts to Musgrave Street, a local road managed by Mosman Council.</p> <p>Notification to, and consent from, Mosman Council is required for works on Musgrave Street.</p>
<p><i>Fisheries Management Act 1994:</i> provides for the protection of fishery resources and values for current and future generations. Makes it an offence to harm fisheries and resources without an appropriate assessment, inclusion of safeguards and/or the appropriate permissions to carry out certain work.</p>	<p>The aquatic ecology assessment (refer to section 6.3) carried out to support the REF, noted removal of the existing wharf structure would result in the removal of marine vegetation, habitat and sessile/less mobile fauna on the piles and wharf which constitutes about 0.01 hectares of vertically colonised marine vegetation. The assessment concluded that the proposal would trigger the need for a permit to harm marine vegetation</p>

Legislation and application	Relevance to proposal and further requirements
	<p>under section 205 of the FM Act, however, consultation with DPI Fisheries has confirmed that no permit is required (refer Table 5-4).</p> <p>The aquatic ecology assessment identified two threatened species under the FM Act were considered to have a moderate to high likelihood of occurrence in the study area. Assessments of significance concluded the proposal is unlikely to significantly impact the threatened species and an SIS is not required.</p> <p>A permit under section 37 of the FM Act to relocate Syngnathids collected during targeted pre-clearance surveys would be required (refer Table 5-4).</p> <p>A permit to carry out dredging or reclamation is not required. Notification has occurred in accordance with Section 199 of the FM Act and a response from DPI Fisheries has been provided (refer Table 5-4).</p>
<p><i>Biodiversity Conservation Act 2016:</i> provides for a strategic approach to conservation in NSW. It includes provisions for risk based assessment of native plant and animal impacts, including a Biodiversity Assessment Method (BAM) to assess the impact of actions on threatened species, threatened ecological communities and their habitats.</p>	<p>Under the BC Act, an assessment of significance must be completed to determine the significance of impacts to threatened species, populations and/or communities or their habitat.</p> <p>The aquatic ecology assessment (refer to section 6.3), carried out to support the REF, identified that eight threatened species under the BC Act were considered to have a moderate to high likelihood of occurrence in the study area. As such, assessments of significance under the BC Act were prepared for these species. The assessments concluded the proposal is unlikely to significantly impact the threatened species and an SIS is not required.</p> <p>The proposal would remove up to 0.04 hectares of native/exotic gardens. The area would be restored and landscaped following construction completion. Proposed impacts on vegetation and terrestrial habitat are considered to be largely temporary and would not substantially fragment or isolate existing</p>

Legislation and application	Relevance to proposal and further requirements
	<p>habitat. The proposal does not require further assessment under the Biodiversity Assessment Method.</p> <p>Refer to section 6.3 for detailed assessment.</p>
<p><i>Protection of the Environment Operations Act 1997</i>: focuses on environmental protection and provisions for the reduction of water, noise and air pollutions and the storage, treatment and disposal of waste. Introduces licencing provisions for scheduled activities that are of a nature and scale that have potential to cause environmental pollution. Also includes measures to limit pollution and manage waste.</p>	<p>The proposal would not involve undertaking or carrying out a scheduled activity.</p> <p>If standard controls set out in Transport for NSW guidelines and quality assurance specification are implemented and monitored, there is unlikely to be any material water, noise or air pollution impact (refer to Chapter 7). Appropriate waste management controls would be introduced to classify, store, transport, and dispose of all construction and work-generated waste.</p>
<p><i>Marine Pollution Act 2012</i>: sets out provisions to prevent pollution in the marine environment.</p>	<p>The proposal is unlikely to result in any oil, noxious liquid, pollutant, sewage or garbage discharge as controlled under this Act, providing relevant standard controls are implemented and monitored (refer to Chapter 7).</p>
<p><i>Ports and Maritime Administration Regulations 2012</i>: requires Harbour Master permissions to alter any structure of disturb the harbour floor within Sydney Port</p>	<p>The proposal is likely to disturb sediment within Sydney Harbour (section 67ZN of the Regulation). Written permission of the Harbour Master is required. Chapter 5 details the consultation that has taken place.</p>
<p><i>Marine Safety Act 1998</i> and <i>Marine Safety Regulation 2016</i>: sets out the requirements for marine safety and the roles of the Harbour Master and marine pilots. Includes provisions relating to marine and navigational safety including: collision prevention, spill limits, no-wash zones, shipping operations, and controls on reckless, dangerous or negligent navigation.</p>	<p>The proposal is located in the harbour (a navigable water under the terms of the Act) and would restrict its used by the public, it is subject to licencing under the terms of section 97 of the Regulation.</p> <p>Navigational exclusion zones would be installed while the work is taking place. This would include updating the Port Authority of NSW. Where required, nautical charts would be updated once the wharf is upgraded.</p>
<p><i>Crown Lands Management Act 2016</i>: to provide for the ownership, use and management of the Crown land of New South Wales, to provide clarity concerning the law applicable to Crown land, to require environmental, social,</p>	<p>Land below mean high water mark in the harbour is Crown Land. DPIE Crown Land has indicated that works below mean high water mark are the responsibility of the Maritime Authority.</p>

Legislation and application	Relevance to proposal and further requirements
<p>cultural heritage and economic considerations to be taken into account in decision-making about Crown land, to provide for the consistent, efficient, fair and transparent management of Crown land for the benefit of the people of NSW, and to provide for the management of Crown land having regard to the principles of Crown land management.</p>	
<p><i>Contaminated Land Management Act 1997</i>: Must report to EPA if contaminated land is encountered during the works that meets the duty to report contamination requirements under Section 60 of this Act</p> <p>Aims to establish a process for investigating and (where appropriate) remediating land that the EPA considers to be contaminated significantly enough to require regulation under Division 2 of Part 3.</p> <p>The Act aims to set out accountabilities for managing contamination if the EPA considers the contamination is significant enough to require regulation under Division 2 of Part 3.</p>	<p>The proposal may have impacts on contaminated land. A Preliminary Site Investigation (PSI) for the proposal details the site history and potential contaminants of concern. Further details are provided in section 6.1.</p>
<p><i>Biosecurity Act 2015</i>: The object of this Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.</p>	<p>Four priority weeds listed under the <i>Biosecurity Act 2015</i> were recorded in the biodiversity study area. These priority weeds would be managed in accordance with the <i>Biosecurity Act 2015</i>. Further details are provided in section 6.3.2.</p> <p>Reporting and managing biosecurity risks in the marine environment is considered a general biosecurity duty under the <i>Biosecurity Act 2015</i>.</p>

The proposal is mapped as Coastal Use Area and Coastal Environment Area under the Coastal Management SEPP. The Coastal Management SEPP gives effect to the objectives of the *Coastal Management Act 2016*.

Table 4-8 lists the objectives of the *Coastal Management Act 2016* and whether the proposal is consistent with the objectives.

**Table 4-8 Coastal Management Act Clauses 8 and 9 objectives**

Objectives	Relevance to proposal
8 (2)(a) to protect and enhance the coastal environmental values and natural processes of coastal waters, estuaries, coastal lakes and coastal lagoons, and enhance natural character, scenic value, biological diversity and ecosystem integrity	The proposal would not significantly impact on the coastal environmental values and natural processes of coastal waters. Biological diversity and ecosystem integrity are unlikely to be impacted.
8 (2)(b) to reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change	The proposal would have a neutral impact to coastal waters and estuaries.
8 (2)(c) to maintain and improve water quality and estuary health	The proposal would maintain the long term water quality and ecological environment provided the mitigation measures in this Chapter 7 of this REF are implemented.
8 (2)(d) to support the social and cultural values of coastal waters, estuaries, coastal lakes and coastal lagoons	Social and cultural values have been considered in the design process by providing safe and equitable access to public transport on coastal waters.
8 (2)(e) to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place	Beaches and dunes would not be impacted by the proposal.
8 (2)(f) to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms	The proposal would have short term impacts to public access to the foreshore, however the proposal would provide long term improvements to access and amenity.
9(2)(a) to accommodate both urbanised and natural stretches of coastline. (i) the type, bulk, scale and size of development is appropriate for the location and natural scenic quality of the coast, and	The proposal is appropriate for the location.
(ii) adverse impacts of development on cultural and built environment heritage are avoided or mitigated, and	Heritage impacts have been considered in sections 6.6 and 6.7, and mitigation measures are detailed in Chapter 7.
(iii) urban design, including water sensitive urban design, is supported and incorporated into development activities, and	Urban design has been considered during the design process.

Objectives	Relevance to proposal
(iv) adequate public open space is provided, including for recreational activities and associated infrastructure, and	During construction, the proposal would impact to users of the wharf and limit access to the area for fishing and recreation. The wharf would continue to allow fishing for recreational use during operation.
(v) the use of the surf zone is considered	The proposal would not impact the surf zone
9 (2)(b) to accommodate both urbanised and natural stretches of coastline.	The proposal would retain a coastline similar to the existing environment.

## 4.3 Commonwealth legislation

### 4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix A and Chapter 6 of the REF.

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of Agriculture, Water and Environment (DAWE) under the EPBC Act.

### 4.3.2 Disability Discrimination Act 1992

The *Disability Discrimination Act 1992* (DDA) is the Commonwealth legislation that seeks to provide equity for people with disabilities. The main objects of the DDA include the elimination, as far as possible, of discrimination against persons on the grounds of disability in relation to access to premises and the provision of facilities and services. The proposal has been designed to respond to the requirements of this Act.

### 4.3.3 Disability Standards for Accessible Public Transport (DSAPT) 2002

The *Disability Standards for Accessible Public Transport 2002* (DSAPT), made under the DDA, prescribes minimum standards of accessibility in relation to both public transport buildings and conveyances to remove discrimination from public transport services. The proposal has been designed to respond to the development standards identified under the DSAPT.

#### **4.4 Confirmation of statutory position**

The proposal is categorised as development for the purpose of a wharf and is being carried out by or on behalf of a public authority. Under clause 68(4A) of the ISEPP, the proposal is permissible without consent. The proposal is not State significant infrastructure and is subject to environmental impact assessment under Division 5.1 of the EP&A Act.

Accordingly, Transport for NSW is the determining authority for the proposal, with this REF fulfilling the obligation under Section 5.5 of the EP&A Act 'to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity'.

## 5 Consultation

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This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

### 5.1 Communications and Stakeholder Engagement Plan

A community and stakeholder engagement plan (Cardno, 2020f) has been prepared for the proposal in accordance with the International Association for Public Participation Spectrum and the Stakeholder Engagement Toolkit. The overall objectives are:

- To keep the local community and other key stakeholders regularly informed
- To provide the community and stakeholders with regular and targeted information to build awareness
- To be transparent in all that we do
- To encourage participation from communities and other stakeholders
- To listen to feedback, investigate suggestions and report back
- To engage in a manner that is collaborative, innovative, adaptive and sustainable
- To increase stakeholder understanding of the program and its objectives
- To ensure that community and stakeholder enquiries are managed and resolved effectively
- To ensure that project information is distributed in an effective and timely manner.

### 5.2 Community involvement

The community and key stakeholders were invited to provide feedback on the proposal's concept design from Monday 4 May 2020 to Friday 29 May 2020.

The purpose of this consultation was to:

- Display the proposed concept design (site plan and artist impression)
- Obtain feedback from the community on the proposal
- Consider and provide responses to feedback and questions received.

Community members and stakeholders were encouraged to provide feedback, leave comments and make submissions via phone, email, or online.

To reach community members within the Mosman, Balmoral, Clifton Gardens and the Georges Heights area a social media campaign was used. A four-page community update was also distributed to around 400 residents and businesses in the area at the start of the consultation. A postcard was also sent to the same distribution zone in mid-May to remind the community to have their say. Addressed letters were delivered in the initial week of consultation to directly affected residents in Musgrave Street in replacement of door knocking due to COVID-19 social distancing measures.

Given the environment of COVID-19, public meetings were not held to safeguard the health and safety of the community and our staff.

We received 119 comments during the consultation period. The comments received have been summarised and responded to in Table 5-1.

**Table 5-1: Summary of issues raised by the community: concept design (NSW Government, 2020)**

Issue raised	Response
<b>Wharf design</b>	
The relocation of the wharf entrance will create more congestion in the turning circle.	The proposed concept design does not change the function of the turning circle and pedestrian path, however this will be taken into consideration as the design is further developed.
<p>The gangway should be covered in the wharf design to protect ferry users from wind, sun and rain.</p> <p>The upper platform, stairs and bridge all require a roof as these areas will get very slippery in bad weather.</p> <p>There needs to be sufficient shelter at the base of the lift for commuters to wait under while the lift descends from street level.</p>	<p>We are investigating options to provide cover to the gangway, stairs and upper and lower platforms of the lift.</p> <p>These details will be included in our next round of community consultation where the community will have the opportunity to view and make a submission on the REF.</p>
The lift is unnecessary and costly; why not build a ramp instead?	As part of concept design, a ramp was considered. However, due to the length of the ramp required to achieve the required grade it was ruled out as a feasible option.
Access to the new lift should be by opal card to operate it, otherwise it will be misused by the wrong people. Incorporate it into the 'swipe on' function at the wharf and the overall ferry fare.	Restricting access to the lift is not something we would consider as part of the project. The lift is intended to be used by all, as it provides access to the wharf and water frontage.
The lift should be hydraulic rather than a pulley-system. A hydraulic lift would not need double-height cover for mechanisms above the lift-platform.	The design of the lift internals has not been determined and will be refined during detailed design under the advice of technical experts.
<p>Is the lift going to be reliable?</p> <p>What are the reliability statistics on similar lifts at other transport spots?</p>	The design and manufacture of the lifts will be based on advice by technical experts and previous experience within the transport cluster. The intention is for the lifts to be reliable and regularly maintained by a specialist contractor.

Issue raised	Response
<p>The proposed gangway is too long making the whole structure more prominent than the existing wharf.</p>	<p>Gangway length is determined by the minimum gradients required to make the wharf accessible.</p> <p>The design of the wharf is consistent with others across the Sydney Harbour. In comparison to other wharves, South Mosman wharf is a relatively small structure.</p>
<p>Include a small café or food/coffee cart on the wharf for commuters and people waiting for the ferry.</p>	<p>The primary objective of the upgrade is to make the wharf accessible. Adding retail facilities to the wharf is not part of the scope for an accessibility upgrade.</p>
<p>Toilet facilities should be included in the wharf design.</p>	<p>The primary objective of the upgrade is to make the wharf accessible. As the project is being delivered as part of the Transport Access Program, additional infrastructure such as public toilets do not form part of the project scope.</p> <p>The ferries have toilets on board available to customers reducing the need for toilet facilities at the individual wharves.</p>
<p>There should be regular maintenance to keep the wharf clean.</p>	<p>All wharf facilities on the network are regularly cleaned and maintained. Feedback regarding maintenance can be reported at <a href="https://transportnsw.info/contact-us/feedback/ferry-feedback">https://transportnsw.info/contact-us/feedback/ferry-feedback</a></p>
<p>The name of the wharf should change back to Musgrave Street Wharf.</p> <p>The name of the wharf should change back to Mosman South Wharf.</p>	<p>The objective of the project is to make the wharf accessible. As such, we are not considering a name change as part of this project.</p>
<p>The stairs are difficult when carrying luggage or other heavy items.</p> <p>The stairs are dangerous and slippery when they are wet.</p> <p>The stairs are a hazard at night due to no lighting.</p> <p>The stairs are difficult to use for the elderly and people with accessibility issues.</p> <p>The stairs should have a roof cover.</p>	<p>The proposed wharf would include a new lift and new stairs providing a safer accessible route from street-level to the wharf. The existing stairs will be removed.</p> <p>The new stairs will be lit in accordance with Transport for NSW lighting guidelines and those details will be included in the upcoming REF. The community will have the opportunity to view these plans and make a submission.</p> <p>We are investigating options to provide cover to the gangway, stairs and upper and lower platforms of the lift. These details will also be included in the REF, which the community will have the opportunity to view and make a submission on.</p>
<p>Why does the curved roof have to be so high?</p>	<p>The Wharf Upgrade program has been designed to create a recognisable theme for Sydney Harbour.</p>

Issue raised	Response
	<p>The design aims to identify the harbour wharves and the ferry commuter transport system.</p> <p>The design of wharf including the height of the curved roof are consistent design across all upgraded wharves on the network.</p>
<b>Project justification</b>	
<p>Why is there an upgrade when there is low use of the ferry?</p> <p>What is the justification for this upgrade?</p> <p>The wharf upgrade is a waste of taxpayers' money.</p> <p>Why is this wharf being prioritised over other wharves?</p>	<p>South Mosman wharf upgrade is a part of a Transport for NSW program across Sydney to make all public transport accessible. The Wharf Upgrade Program has been ongoing since 2012.</p> <p>South Mosman wharf is part of the program's third package of work as part of the Transport Access Program and is one of the last wharves to be upgraded on the ferry network.</p> <p>Customers with mobility needs are currently unable to access Musgrave Street from South Mosman wharf. The existing wharf at South Mosman is a pontoon with connecting gangway and stairs leading up to the cul-de-sac at the end of Musgrave Street. Upgrading the wharf would improve the efficiency and safety of wharves, improving the public transport experience for our customers.</p>
<p>What is the current service life of the wharf?</p> <p>Is it due to be upgraded regardless?</p> <p>Is the upgrade design future proof and can it cope with the possibility of increased demand in the future?</p>	<p>The wharf is approaching the end of its design life. The new wharf would have a design life of 50 years with maintenance.</p> <p>The size of waiting areas, the lift, stairs and other choke points have been designed to cater for 2036 projections of patronage at South Mosman wharf.</p>
<p>Has there been proper analysis of the costs and benefits of the project?</p>	<p>As an operator of public transport under the DDA, Transport for NSW is required to upgrade the public transport precincts to ensure equitable access is provided for all customers.</p> <p>Transport for NSW determines the priority of upgrades using evidence-based criteria, including:</p> <ul style="list-style-type: none"> <li>• current and future patronage</li> <li>• the needs and demographics of customers who use the location</li> <li>• whether important services such as hospitals or educational facilities are nearby</li> <li>• cumulative impacts of other construction projects</li> <li>• the accessibility of other nearby transport interchanges and facilities.</li> </ul>

Issue raised	Response
	<p>More information about this process is available at <a href="http://www.transport.nsw.gov.au/projects/current-projects/tap-3">www.transport.nsw.gov.au/projects/current-projects/tap-3</a>.</p>
<p>When the feedback from this stage has been collated there should be an actual community meeting/forum.</p>	<p>No public meetings were held during the consultation to safeguard the health and safety of the community and Transport for NSW staff during the circumstances of COVID-19. However, there were several other ways the community could find out more about the project and speak with members of the project team. This included an option to meet the team through a phone or online meeting.</p> <p>We sent out around 400 community notifications as well as a follow up post card halfway through the four week consultation period. We also installed signage at the wharf and posted social media advertisements to ensure the community was aware of the consultation and ways they could contact the team.</p> <p>The next stage of the planning process is for the project team to prepare an REF. The community will have the opportunity to view and make a submission on the REF. Typically, this would include a community information session where the community can meet the project team face to face and ask questions.</p> <p>The project team will determine if a community information session can be held during the display of the REF. This will be determined according to the NSW Government and Transport for NSW guidance surrounding COVID-19 at the time. The community will be given the opportunity to speak to the project team through other channels such as phone or online meeting if an information session cannot be held.</p>
<p><b>Existing wharf structure</b></p>	
<p>The existing wharf structure should be retained.</p> <p>There is nothing wrong with the existing wharf, it shouldn't be changed.</p>	<p>The existing wharf at South Mosman is a pontoon with a connecting gangway and stairs leading up to the cul-de-sac at the end of Musgrave Street. It cannot be cost-effectively modified to meet accessibility standards.</p> <p>For example, the existing stairs are not accessible for people in wheelchairs.</p> <p>The existing gangway is shorter than the length required to meet disability access standards. At lowest tides the gangway is too steep.</p>

Issue raised	Response
<p>Will the existing shelter at the south end of the cul-de-sac be removed?</p>	<p>The shelter leading to the existing stairs would be removed as part of the current proposal. The existing stairs would also be removed. The footpath beneath the shelter would remain.</p> <p>We are considering adding a shelter to the new upper and lower lift platforms to provide shelter from the rain while waiting for a bus or waiting to be picked up. This will be investigated the design develops.</p>
<p>There is a lack of parking around the existing wharf. If you can find a park, you then must walk up and down the steep hill to the wharf.</p>	<p>No commuter parking is being provided as part of the upgrade. There are no opportunities for providing commuter parking at the location.</p>
<p><b>Fishing activities at the wharf</b></p>	
<p>A review is needed on the current fishing practices at the wharf.</p> <p>There needs to be more signage and education on fishing guidelines.</p> <p>There is a problem with fishermen who leave bait and fish guts on the wharf area.</p> <p>There should be no fishing or a hose to wash area down after fishing.</p>	<p>Signage would be installed as part of the upgrade to inform and remind the fishing community of the requirements of responsible fishing at South Mosman wharf which includes; consideration of nearby residents, other wharf and park users, keeping noise to a minimum and not leaving hooks, bait and fishing lines at the wharf.</p> <p>Recreational fishing in Sydney Harbour is regulated by the NSW Department of Primary Industries (DPI) and is currently permissible at South Mosman wharf.</p> <p>Illegal or suspect fishing activities can be reported to the DPI.</p> <p>Report suspicious fishing activity to the Fishers Watch Phone line on 1800 043 536 or contact NSW Police to report any anti-social behaviour.</p> <p>For general fishing information, call the DPI Fisheries Information Line on 1300 550 474.</p>
<p><b>Ticketing and services</b></p>	
<p>Will ferry services be stopped during the construction of the wharf?</p>	<p>Ferry services to South Mosman wharf will be impacted during the construction of the proposed upgrade and the wharf would be closed for up to six months. Alternative transport options would be considered and presented to the community when the Review of Environmental Factors is put on display for community comment.</p>
<p>Why is the existing bus stop still located further up Musgrave Street?</p>	<p>The location of the bus stop was considered however the current position is driven by the alignment of the bus to the kerb. Moving the bus stop further away from the wharf makes it more</p>

Issue raised	Response
	difficult for commuters to transfer from ferry to bus and vice versa.
Buses run far too infrequently and rarely line up with the times the ferry runs.	Timetabling and services are outside the project scope, but the project team will provide this feedback to the bus and ferry service teams.
Payment information should be easily available for people who don't use the wharf regularly.	Ticketing information is available at transportnsw.info or by calling 131 500.
An opal card charger should be included in the new wharf design.	An opal card charger was installed at South Mosman wharf when Opal was introduced to the wharf several years ago. However due to low usage, TfNSW removed this facility leaving only the tap-on/tap-off readers.  Other payment options include (credit card) and top-up (auto top up, web site, 131 500).

### 5.3 Aboriginal community involvement

Aboriginal heritage impacts have been considered under the four-stage Procedure for Aboriginal Heritage Cultural Heritage Consultation and Investigation (PACHCI)(RMS, 2011). The PACHCI is outlined in Table 5-2.

**Table 5-2: Summary of Transport for NSW PACHCI**

Stage	Description
Stage 1	Initial Transport for NSW assessment
Stage 2	Site survey and further assessment
Stage 3	Formal consultation and preparation of a cultural heritage assessment report
Stage 4	Implement environmental impact assessment recommendations

Stage 1 of the PACHCI process was completed for the proposal, which confirmed that there is unlikely to be any impact on Aboriginal cultural heritage (refer to section 6.7). The Transport for NSW Aboriginal Cultural Heritage Officer has issued a Stage 1 clearance letter for the proposal in accordance with PACHCI (refer to Appendix H). An Aboriginal heritage impact permit (AHIP) under the *National Parks and Wildlife Act 1974* is not needed for the proposal.

## 5.4 ISEPP consultation

Under the provisions of Part 2 of ISEPP, Transport for NSW is required to notify local councils and other relevant Government agencies where development has the potential to impact on assets or environmental values managed by these authorities. Appendix B contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered.

In the case of this proposal, it triggers the notification requirements under Clauses 13 as it:

- Would involve the installation of a temporary structure on, or the enclosing of, a public place
- Would involve excavation of a road or adjacent footpath.

Transport for NSW has been consulting with Mosman Council since 2019 to develop a design which is acceptable to Council as owners and operators of the landside elements of the proposal.

A formal ISEPP letter was issued for the proposal in 6 November 2020 to Mosman Council. Mosman Council will be further consulted during the public exhibition period of the REF. Any issues raised as a result of the consultation will be responded to in the submissions report.

## 5.5 SREP (Sydney Harbour Catchment) 2005 consultation

The Department of Planning, Industry and Environment (DPIE) Housing and Property Group (formerly Foreshores and Waterways Planning and Development Advisory Committee) and Ausgrid have been consulted about the proposal as per the requirements of clause 31 of the SREP (Sydney Harbour Catchment). Appendix B contains a SREP (Sydney Harbour Catchment) consultation checklist that documents how the SREP consultation requirements have been considered.

In the case of the proposal, it triggers the consultation provisions of Part 3: Division 3, clause 31 of the SREP (Sydney Harbour Catchment) due to the following reasons, it:

- Involves the development of public water transport facilities (Schedule 2) within the Sydney Harbour Foreshore Area
- Would require the provision of services in the form of electricity, as required by the existing wharf.

Accordingly, the DPIE (Housing and Property Group) and Ausgrid were consulted in regards to the proposal.

Issues that have been raised as a result of this consultation are outlined below in Table 5-3.

**Table 5-3: Issues raised through SREP (Sydney Harbour Catchment) consultation**

Agency	Issue raised	Response/where addressed in REF
Ausgrid (22 September 2020)	No objections to the proposal at this time.	Noted
DPIE (Housing and Property Group)(30 October 2020)	The proposal must be directed to the Foreshores and Waterways Planning and Development Advisory Committee.	Further consultation will be undertaken during the public exhibition period of the REF. Any issues raised will be responded to in the submissions report.
	The Housing and Property Group has no property interests at the South Mosman wharf locality.	

## 5.6 Government agency and stakeholder involvement

Various government agencies and stakeholders have been consulted about the proposal, including:

- DPI Fisheries
- Port Authority of NSW (Harbour Master).

Issues that have been raised as a result of consultation with these agencies and stakeholders are outlined below in Table 5-4.

**Table 5-4: Issues raised through government agency and stakeholder consultation**

Agency	Issue raised	Response/where addressed in REF
DPI Fisheries (16 October and 16 November 2020)	The REF will need to consider the potential for Whites seahorses to exist in this location. If the site is deemed to be potential habitat, a pre-work inspection for Syngnathids must be undertaken (during the 24 hour period prior to work starting in the water). Any seahorses found must be relocated to like-for-like adjacent habitat, out of harms way.	There is potential for Whites seahorse in the biodiversity study area. As such pre-clearance targeted surveys for White's Seahorse would be undertaken prior to construction. Details are provided in Section 6.3 and Appendix D.
	Any seahorses found must be relocated to like-for-like adjacent habitat, out of harms way.	A White's Seahorse relocation plan would be developed in consultation with DPI Fisheries as outlined in Section 6.3 and Appendix D.
	A permit under section 37 of the FM Act would be required to relocate seahorses, or if a section 205 permit is triggered for harming marine vegetation, then seahorse	The requirements for a permit to relocate seahorses would be considered in consultation with DPI Fisheries.

Agency	Issue raised	Response/where addressed in REF
	relocations can be covered under that permit.	
	A sediment curtain should be installed to encapsulate the work area and contain suspended sediments.	A sediment curtain would be installed during construction works. Management of sediments is addressed in section 6.1.
	A section 205 permit under the FM Act would not be required for the pile installation and removal works.	Noted, no permit is required for harm to marine vegetation
Port Authority of NSW (Harbour Master) (23 October 2020)	The Port Authority have no issues at this stage of the project. The Port Authority would like to a Disturbance of Seabed Application and Traffic Management Plan at a later stage.	Noted

## 5.7 Ongoing or future consultation

This REF would be placed on public display for comment by Government agencies, stakeholders and the community. Following the public display period, Transport for NSW would collate and consider the submissions received then determine whether the proposal should proceed as described or whether any changes are needed are required. It would also decide if any additional environmental assessment, safeguards or management measures are needed.

A submissions report would be published, which would respond to the comments received. Transport for NSW would notify those who made submissions and distribute a community update. The update would summarise the submissions report process and the actions Transport for NSW took to address these comments. Transport for NSW would also meet with affected residents, businesses and other stakeholders.

## 6 Environmental assessment

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This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of the factors specified in the guidelines *Is an EIS required?* (DUAP, 1995/1996) as required under clause 228(1) of the Environmental Planning and Assessment Regulation 2000 and the *Marinas and Related Facilities EIS Guideline* (DUAP, 1996). The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

### 6.1 Land surface and hydrology

This section describes the existing land surface and hydrology and potential impacts associated with the proposal.

#### 6.1.1 Methodology

##### Water based

Published mapping and data were used to define the hydrodynamic and physical characteristics of the aquatic environment. This included:

- Hydrographic and bathymetric mapping and data, including navigational charts
- NSW Tide Tables (BoM, 2020a)  
<http://www.bom.gov.au/oceanography/projects/ntc/monthly/>
- Climate data (BoM, 2020b)
- Ocean and Tidal Summary 2018-2019 (MHL, 2019)  
<https://mhl.nsw.gov.au/Publications/publications.php?content=oe2019annualsummary>
- Preliminary Site Investigation (Cardno, 2020a)
- Stage 2 Contamination Assessment (Coffey, 2016b)
- Geotechnical Desktop Investigation (Aurecon, 2019b)
- Tidemap: Sydney Harbour  
[https://maps.tidetech.org/?layer=tidal\\_currents\\_sydney](https://maps.tidetech.org/?layer=tidal_currents_sydney)

##### Land based

Published mapping and data were used to define physical characteristics of the terrestrial environment. This included review of:

- Sydney 1:100,000 Geological Series Sheet 9130 (Herbert, 1983)
- NSW Planning Portal
- NSW EPA online contaminated land register
- Environmental Protection Licences (EPL) under the *Protection of the Environment Operations Act 1997*
- Preliminary Site Investigation (PSI) (Cardno, 2020a), provided as Appendix C

- Geotechnical Desktop Investigation (Coffey 2016a)
- Stage 2 Contamination Assessment (Coffey, 2016b).

### **Construction assessment**

The assessment considered how the proposed construction activities, work methods, and required management controls (refer to section 3.3) would temporarily affect the physical characteristics of the aquatic environment including localised sediment and pollutant disturbance and dispersion.

### **Operational assessment**

The operational assessment considered how the final aquatic infrastructure would potentially result in hydrodynamic changes in terms of erosion, scour and water quality changes.

## **6.1.2 Existing environment**

### **Water based**

The proposal is located within Port Jackson. Port Jackson is a tide dominated drowned valley estuary with an open entrance.

#### ***Tides***

The proposal is located on the northern side of Port Jackson. Water levels of Port Jackson are subject to ocean tides and the site has similar tides to Fort Denison where the conditions are as follows (BoM, 2020a):

- Tides are semi-diurnal meaning that two high and two low tides normally occur each day
- Chart datum (0.0 m CD) is 0.925 metres below Australian Height Datum (AHD)
- Mean sea level is 0.936 metres AHD (between 1914 and 2020)
- Maximum recorded sea level of 2.4 metres AHD
- Minimum recorded sea level of -0.19 metres AHD
- Highest astrological tide (HAT) is 2.07 metres AHD (1.15 metres CD) (period 1995-2014) (MHL, 2019)
- Lowest astrological tide (LAT) is 0.03 metres AHD (-0.9 metres CD) (period 1995-2014) (MHL, 2019).

#### ***Currents***

The main tidally influenced water movement in the harbour occurs in the main channel. Closer to the edge of the harbour, tidal-generated current speeds reduce due to the shallower waters. As such, the tidal-generated current speeds close to the foreshore, and the proposal footprint, are very low (i.e. the waters are typically calm).

Local currents may be attributed to tidal flows, wind shear, propeller wash and localised flows at stormwater outlets. Currents may also be generated by the passing nearby of other vessels. Wind shear on the water surface generates the strongest currents in the location of the proposal.

#### ***Waves***

The location of the existing South Mosman wharf is most exposed to the south-west (Aurecon, 2019a). The proposal footprint is subjected to wind waves and boat-

generated waves. Primary wind waves are likely to emanate from the south/south-east with 1 in 5 year average recurrence interval (ARI) heights of up to 0.7 metres (Aurecon, 2019a).

Swell waves are not likely to propagate at this location in Sydney Harbour (Aurecon, 2019a).

### **Storm surge**

During extreme events, the water level can be elevated higher than the predicted tidal level due to barometric pressure, and wind and wave setup. This increase in water level due to reduced barometric pressure and wind setup is known as storm surge. The 100 year ARI storm surge level at Fort Denison in Sydney Harbour is 2.4 metre CD (or 1.5 metres AHD), based on measurements taken during the severe 1974 storms (Aurecon, 2019a).

### **Bathymetry (water depth)**

The bathymetry at the proposed wharf site slopes steeply down from 0 metres CD at the seawall to -5.5 metres CD about 18 metres off the seawall at the end of the existing wharf (Aurecon, 2019a). Compared to areas to the north and south of the wharf and an equivalent distance from the foreshore, the berth pocket is marginally deeper at -6.0 metres CD. The deeper water pocket may be a result of propeller scour (Aurecon, 2019a).

### **Wind conditions**

Three common wind patterns are known on Sydney Harbour. The strongest of the three originate from the south (southerlies) and occur about 17 per cent of the time. The most frequent of the three (about 22 per cent of the time) are north-easterlies while the least common of the three patterns are westerlies which usually occur during the winter months (Sydney Institute of Marine Science, 2014).

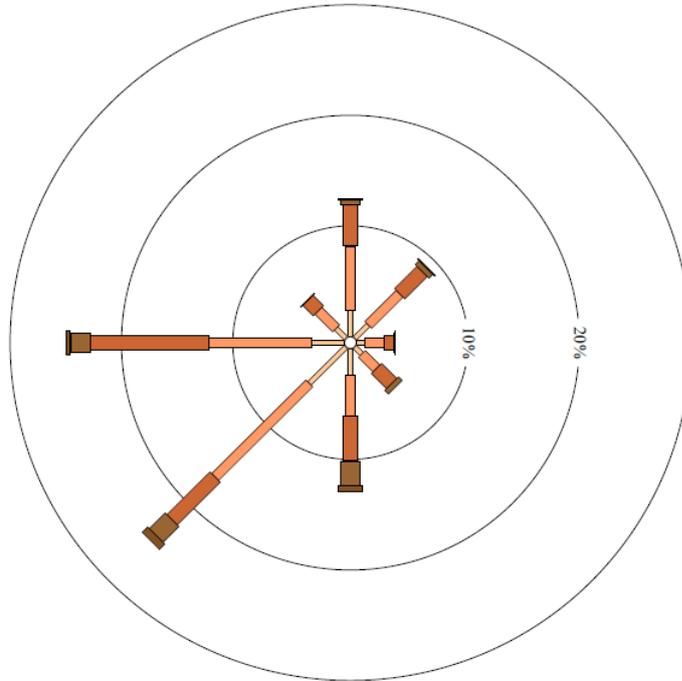
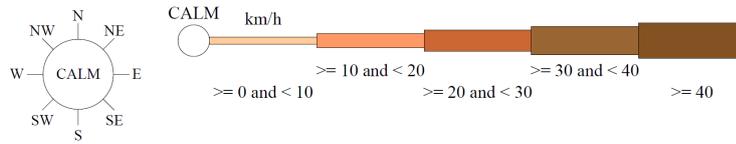
Sydney Harbour (Wedding Cake West) weather station (station number 066196) is located about three kilometres to the east of the proposal. Morning and afternoon wind rose directional data is summarised in Table 6-1 and shown on *Source: BoM, 2020b*

Figure 6-1 (BoM, 2020b). Afternoon winds are generally stronger than morning winds tending towards 20-40 kilometres per hour with morning winds generally 10-30 kilometres per hour (BoM, 2020b).

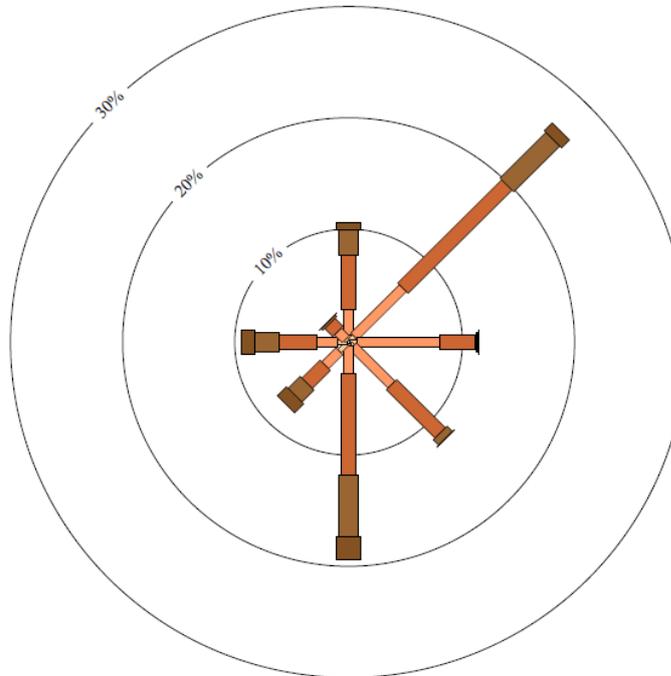
**Table 6-1: Wind conditions at Sydney Harbour (Wedding Cake West) weather station (Source: BoM, 2020b)**

	N	NE	E	SE	S	SW	W	NW	Calm
9am	12%	9%	4%	5%	12%	25%	25%	5%	3%
3pm	11%	27%	12%	12%	19%	7%	9%	2%	1%

Sydney Harbour (Wedding Cake West) Site No. 066196  
 18 September 1997 to 11 August 2019



9am (Calm 3%)



3pm (Calm 1%)

Source: BoM, 2020b

**Figure 6-1: Sydney Harbour rose of wind direction versus wind speed**

## Geology and sedimentology

Sydney Harbour is a flooded river valley.

The Sydney 1:100,000 Geological Series Sheet 9130 (Herbert, 1983) indicates the proposal footprint is underlain by the Hawkesbury Sandstone Formation, comprising medium to coarse grained sandstone with very minor shale and laminate lenses.

## Soils

Soils at the proposal footprint are likely to comprise alluvial deposits (comprising sands, sandy clays and clayey sands) of variable depths overlying weathered sandstone.

Most of the estuarine plane layer is likely to be composed of clay and silt, with variable shell content, however the shallow margins close to the shoreline are likely to contain high sand content (Aurecon, 2019a). The high silt and clay content in a marine environment could create concerns with water turbidity associated with construction and low particle settlement rates. The thickness of this layer is variable, with estimates to be made based on available previous investigations (Aurecon, 2019a).

A geotechnical assessment (Coffey, 2016a), including completion of two boreholes near the wharf, confirmed the sub-surface profile at the proposal footprint comprises fill material / deposited sediments (from two to six metres thick and likely to consist of sandy clay, silty sand and clay) overlying alluvial sediments and weathered sandstone.

The immediate land-based landscape has been significantly disturbed by human activity, with significant residential development in the area and construction of sea walls along the waterfront. There is the potential for material to have been imported to site to recontour the landscape (Cardno, 2020a).

## Contamination

Sydney Harbour has extensive areas of polluted sediments mainly associated with the historical industrial character of the catchment. Key potential contamination sources at and near the site includes contaminated nearshore sediments and stormwater discharge and surface water runoff.

A Stage 2 Contamination assessment was undertaken in 2016 for South Mosman wharf interchange (Coffey, 2016b). Under water contamination samples found:

- The shallow sediments within the top 20 centimetre of the investigation area reported elevated contamination, with copper, lead, mercury, zinc, dichlorodiphenyldichloroethane and endrin detected above trigger levels.
- Heavy metals and polycyclic aromatic hydrocarbons (PAH) are known to be present in this part of the Sydney Harbour due to historical industrial activity in the region. Total PAH concentration exceeded the trigger level in one sample and may be attributable to the former gasworks operation to the north of the site.

A PSI was undertaken in 2020 for the South Mosman wharf (Cardno, 2020a) to identify potential sources of contamination or potentially contaminating activities that may have taken place on or adjacent to the proposal footprint. The PSI is provided in Appendix C. A review of the site history identified historical contaminating activities with potential to result in contamination from the construction and operation of the South Mosman Wharf (Cardno, 2020a, Appendix C).

A risk assessment conducted as part of the preliminary site investigation (Cardno, 2020a) identified that the proposal area represents a medium residual risk for potential contaminants in sub-surface materials, groundwater and sediment.

A search of the NSW EPA online contaminated land register in April 2020 did not identify any listed contaminated sites within 500 metres of the proposal footprint.

There is one premise, Taronga Zoo, located approximately 400 metres to the east of the wharf which is operating under a licence issued under the *Protection of the Environment Operations Act 1997*. The licence is for activities relating to sewage treatment processing by small plants. The premises is located on Bradleys Head, Mosman, and is unlikely to impact the proposal.

### **Acid sulfate soils**

The Mosman LEP risk map indicated that the site was not within an area of known acid sulfate soils (ASS) for the landside elements.

A review of the Australian Atlas of Acid Sulfate Soils (ASRIS) on 5 April 2020 indicated that there is a high probability of occurrence for ASS in the subtidal marine environments.

A study was conducted by Coffey (2016b) to test for the presence of acid sulfate soils within the marine excavation zone. These results showed reducible sulphur concentrations lower than the minimum action criteria stipulated by the *Acid Sulfate Soils Manual* (Stone *et al.*, 1998).

## **6.1.3 Potential impacts**

### **Construction**

#### **Water based**

##### **Hydrodynamic effects**

The proposal involves activities that would cause physical disturbance to the aquatic environment. This includes piling and the installation of the prefabricated superstructure elements using a barge mounted crane. The scale of the disturbance would be minimal and insufficient to cause any dynamic changes in current speed, wave characteristics, saline/freshwater mixing or flushing.

##### **Localised sediment disturbance and smothering**

Potential impacts would be limited by the requirement to undertake the piling work during calm conditions, when there would be the least water movement in the harbor (refer to section 3.3.2). Potential disturbance of seabed sediments during removal of the existing wharf structure would be localised and temporary in nature.

Locally, the distributed coarser sediments would settle out of suspension almost immediately while the finer sediments could mobilise over a greater area as they would remain buoyant in the water column. Disturbance of sediments would be minimised through the work methodology, including progressing the work in sections which would allow sediments to settle between works.

A silt boom and curtain would be deployed around the waterside works of the construction footprint, with further additional safeguards to be detailed environmental work method statement (EWMS), discussed further in section 6.1.4.

## Erosion and scour

Any work taking place in the aquatic environment has the potential to cause erosion and scour impacts. This is caused from introducing new structures typically on, or close to, the seabed, as this may alter sediment transport patterns.

Under construction of the proposal, the temporary use of jack-ups/anchors during lifting and piling work would be the only equipment that would impact on the seabed. However, the equipment would typically only be in place for a few weeks. Some localised impacts are expected within a few metres of where jack and/or anchor point would be temporarily installed, however this would be an insufficient amount of time to cause any material scour or erosional impacts. The number of jackups/ anchors would be reduced to the minimum required, with the placement of these locations selected to avoid any areas of sensitive habitat. With the introduction of this safeguard and the other standard safeguards described in section 6.1.4, it is concluded that any impacts and be avoided and/or minimised.

## Contamination and localised pollutant disturbance

Sediments containing elevated concentrations of selected heavy metals and pesticides have been identified within the proposal footprint (Coffey, 2016a). Other pollutants which may be encountered include:

- Surfactants, oils, fuels, diesels and metals due to stormwater runoff
- Pesticides and heavy metals from stormwater runoff from the surrounding areas.

Notwithstanding the presence of contaminated sediments at the proposal footprint, potential impact would be minimal due to the limited disturbance of the seabed sediments, and the limited sediment depth on the seabed across the proposal footprint.

As such, despite there being known elevated concentrations of contaminants locally, the scale of disturbance would mean that any additional impacts would be negligible with the implementation of safeguards in section 6.1.4.

## **Land based**

### Erosion and sedimentation

Minor earthworks are proposed along the foreshore for construction of the lift, stairs and footpath on Musgrave Street.

During construction, soils would be exposed along Musgrave Street for the footpath, along the steep slope to the north for the stairs and on the foreshore for the excavation of the lift well. In the event of rainfall, erosion of these areas could occur, and may deposit sediment into the stormwater system and Mosman Bay. The potential for causing soil erosion or sediment laden runoff would be minor with the implementation of safeguards in section 6.1.4.

### Contamination

Potential for contaminated sub-surface soils and sediment was identified

Excavated soil and rock for the lift and stairs upgrade works would be temporarily stockpiled on site and backfilled upon completion provided it is not contaminated or weed infested.

Accidental material spill within the compound area may occur from storing, handing and/or transferring the required small volumes of welding materials, lubricants, solvents, fuels, oils and diesels. Mitigation measures are outlined in section 6.2.4.

## Operation

### **Water based**

#### Erosion and scour

Under the proposal, piles for the pontoon would be installed in the seabed. As water flows around these structures there is the potential to create local scour and erosion. In this location, the only expected impacts would be limited to within a few metres of each pile given that:

- The low dynamic character close to the bed around the piles located within the sub-benthic sediments
- The limited amount of sediment substrate locally.

Local sediment conditions would adjust over time.

A climate change risk assessment has been completed which identifies climate variables that are a risk to the proposal including sea level rise and increased coastal erosion. Refer section 6.13 for further information. These risks will be addressed in detailed design through the implementation of adaptation measures.

#### Sedimentation

Ferry services would resume during operation, with minimal change in ferry movements required to service the new wharf. As such, no significant impacts from sedimentation are anticipated.

### **Land based**

As described in section 3.1, there are various landside site modifications proposed including

- Construction of a lift on the foreshore, to the north of South Mosman wharf.
- Construction of new stairs between Musgrave Street and South Mosman wharf.

No significant impacts to the terrestrial land surface are anticipated during operation as no significant change to existing operations are proposed.

#### 6.1.4 Safeguards and management measures

Table 6-2 lists the safeguards and management measures that would be implemented to protect the land surface and hydrology to account for the impacts identified in section 6.1.3.

**Table 6-2: Land surface and hydrology safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
LS1	Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion, contamination and water pollution and describe how these risks will be addressed during construction.	Contractor	Pre-construction
LS2	Soil and water	Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's <i>Waste Classification Guidelines: Part 1 Classifying Waste</i> (EPA, 2014) prior to being disposed of at a waste facility licensed to accept the relevant class of waste. Any materials classified as Hazardous Waste may require treatment or an immobilisation approach in accordance with Part 10 of the Protection of the Environment Operations (Waste) Regulation 2014 prior to off-site disposal.	Contractor	Construction
LS3	Soil and water	Clean and suitable topsoil will be stockpiled and reused on site where appropriate.	Contractor	Construction
LS4	Contaminated land	An intrusive soil investigation to the depth of excavation will be undertaken to ensure the safety of construction workers and provide waste classification of the materials to be removed.	Contractor	Construction
LS5	Contaminated land	If unexpected contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
LS6	Contaminated land	The piling methodology shall seek to mitigate the risk of sediment dispersal.	Contractor	Construction
LS7	Erosion and sedimentation	<p>Site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the SWMP. Control measures are to be implemented and maintained (in accordance with the Landcom/Department of <i>Housing Managing Urban Stormwater, Soils and Construction Guidelines</i>, the Blue Book) to:</p> <ul style="list-style-type: none"> <li>• Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets</li> <li>• Reduce water velocity and capture sediment on site</li> <li>• Minimise the amount of material transported from site to surrounding pavement surfaces</li> <li>• Divert clean water around the site.</li> </ul>	Contractor	Pre-construction
LS8	Erosion and sedimentation	<p>Prior to commencement of construction activities, sediment control device (such as sediment boom and curtain) will be installed around the construction footprint to contain disturbed sediment from the water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will extend from a minimum of 100 millimetres above the water line to a minimum of 2.5 metres below the water line before starting work.</p> <p>Installation should be undertaken during high tide periods from a boat. The device should be designed to rise and fall with the tide to prevent disturbance. Inspection of the device should be undertaken on a daily basis after ebbing tides, with additional inspection be carried following storm events. Monitoring of turbidity inside and outside of the device should also be performed, using a portable turbidity meter/logger. Prior to removing the sediment control device, conditions within the curtain will be assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.</p>	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
LS9	Erosion and sedimentation	<p>Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be undertaken on a regular basis to identify any potential spills or deficient silt curtains or erosion and sediment controls.</p> <p>Results of the observations are required to be recorded. Records are required to be kept on the site and to be made available for inspection by persons authorised by Transport for NSW.</p>	Contractor	Construction
LS10	Erosion and scour	The number of jack-ups/anchor points will be minimised where possible. The locations will be selected to avoid areas of sensitive habitat.	Contractor	Construction
LS11	Erosion and scour	Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts.	Contractor	Construction

## 6.2 Water quality

This section describes the existing water quality and waste management at the wharf and potential impacts associated with the proposal.

### 6.2.1 Methodology

Published mapping and data were used to define the hydrodynamic and physical characteristics of the aquatic environment. This included:

- Sydney Harbour Water Quality Improvement Plan (LLS, 2015)
- State of the Beaches Annual Reports 2009-2019 (DECCW, 2019, 2010a; OEH, 2011a, 2012, 2013, 2014a, 2015, 2016a, 2017, 2018; DPIE, 2019a)
- Beachwatch Enterococci data download (DPIE, 2020a).

### 6.2.2 Existing environment

South Mosman is in the Port Jackson catchment of Sydney Harbour (LLS, 2015). The majority of this catchment is residential land use (40 per cent), with roads (20 per cent), commercial (17 per cent) and parklands (11 per cent) making up the majority of the catchment (LLS, 2015). Sewer overflows are also a substantial issue in the catchment. These overflows generally operate during high flow events and discharge a mix of stormwater and untreated sewage (LLS, 2015).

The hydrodynamics of Sydney Harbour play an important role in the state of its water quality. Stormwater is mainly generated under high rainfall events. Sydney Harbour is well flushed near the entrance but poorly flushed in the upper reaches. During high rainfall and consequential stormwater events, pollutants that are discharged near to the outlet can be flushed to the ocean, but otherwise they will linger within the estuaries (LLS, 2015).

In Port Jackson, industrialisation in the Sydney area has caused marine pollution and anthropogenic sediment to be deposited into the harbour. There are several sewer overflow points and stormwater drain discharges throughout the region, thus water quality compliance is varied across the Port Jackson region (LLS, 2015).

Pollutants commonly associated with stormwater discharge include:

- Sediment from erosion and stormwater inflows, impacting turbidity
- Pathogens such as faecal coliforms
- Litter and other wastes
- Pesticides from agricultural land uses
- Nutrients and pathogens from fertilizers and sewage overflows
- Heavy metals (in river sediments)
- Other contaminants such as hydrocarbons from oil and fuel leaks.

A review of beach water quality data for the last 10 years for Hayes Street Beach in North Sydney LGA (DECCW, 2009, 2010a; OEH, 2011a, 2012, 2013, 2014a, 2015, 2016a, 2017, 2018; DPIE, 2019a) indicates that water quality is generally safe for swimming most of the time but can be susceptible to pollution from several potential sources of contamination. Enterococci levels generally increase with increasing rainfall,

regularly exceeding the safe swimming limit in response to 5-10 millimetres of rainfall or more.

### **6.2.3 Potential impacts**

#### **Construction**

##### ***Pollutants***

The main impact to water quality would be from the disturbance to sediments during piling, removal of the existing wharf and associated piles. Impacts associated with the works and potential pollutants are discussed in section 6.1.3.

##### ***Accidental spills***

The materials required to upgrade the wharf would be generally inert and harmless except for the small quantities of welding materials, lubricants, solvents, fuels and oils. As such, there would be some potential for accidental spills, including:

- Accidents during loading, unloading and installation work
- Leaks and drips from poorly maintained machinery and equipment
- The mismanaged storage of waste materials, including potential for debris to enter the water.

These risks would be greater when undertaking work over, or in, the waterway namely:

- Drilling / hammering the piles
- Transferring equipment and machinery
- Installing the substructures and superstructures.

The primary impact from spills would be a decline in water quality which would have an impact upon the aquatic environment. The impact would depend on the quantity and type of material spilt. However, providing relevant standard controls, such as those identified in section 6.1.4 and section 6.2.4 are implemented the impacts are expected to be minimised.

Accidental material spill within the compound area may occur from storing, handing and/or transferring the required small volumes of welding materials, lubricants, solvents, fuels, oils and diesels. Potential impacts would be mitigated through the appropriate management of the storage of such materials, and inclusion of spill kits as noted in section 6.2.4.

#### **Operation**

No significant impacts to water quality are anticipated during operation of the proposal, as ferries would operate similarly to the current movements. No additional sediment disturbance is anticipated.

Any impacted stormwater drainage would be reinstalled within the construction footprint to maintain the existing drainage regime, no impact to stormwater quality is anticipated.

There is the potential for an accidental spill or discharge during operation. This would be most likely during berthing at the wharf. While this is the case, the same potential exists from the current wharf and would be managed under the standard controls already in place across the ferry network. As such, the impacts are expected to be safeguarded against and therefore minimised.

## 6.2.4 Safeguards and management measures

Table 6-3 lists the safeguards and management measures that would be implemented to protect the water quality to account for the impacts identified in section 6.2.3.

**Table 6-3: Water quality safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
WQ1	Accidental spill	<ul style="list-style-type: none"> <li>A spill management plan will be developed and communicated to all staff working on site.</li> <li>Appropriate land and aquatic spill kits are to be maintained on site and on barges. Aquatic spill kits must be specific for working within the marine environment. The spill kit must be appropriately sized for the volume of substances at the work site.</li> <li>All workers will be advised of the location of the spill kit and trained in its use.</li> </ul>	Contractor	Pre-construction / Construction
WQ2	Accidental spill	If an incident (e.g. spill) occurs, the Transport for NSW <i>Environmental Incident Classification and Reporting Procedure</i> is to be followed and the Transport for NSW Contract Manager notified as soon as practicable.	Contractor	Construction
WQ3	Accidental spill	In the event of a maritime spill, the incident emergency plan will be implemented in accordance with Port Authority of NSW's response to shipping incidents and emergencies outlined in the <i>NSW State Waters Marine Oil and Chemical Spill Contingency Plan</i> (RMS, 2016c).	Contractor	Construction
WQ4	Accidental spill	Emergency contacts will be kept in an easily accessible location on vehicles, vessels, plant and site office. All workers will be advised of these contact details and procedures.	Contractor	Pre-construction / Construction
WQ5	Accidental spill	Vehicles, vessels and plant must be properly maintained and regularly inspected for fluid leaks.	Contractor	Construction
WQ6	Accidental spill	No vehicle or vessel wash-down or re-fuelling will occur on-site.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
WQ7	Accidental spill	Any chemicals or fuels stored at the site or equipment barges will be stored in a bunded area.	Contractor	Construction
WQ8	Pollution	An environmental work method statement (EWMS) will be developed for the removal of the existing wharf structure to minimise the risk of pollutants and debris entering the waterway. The EWMS must be approved by Transport for NSW prior to the demolition of the existing wharf structure.	Contractor	Pre-construction
WQ9	Water quality	Consideration of water sensitive urban design (WSUD) principles in line with the <i>Water sensitive urban design guideline</i> (RMS, 2017).	Transport for NSW	Detailed design

## 6.3 Biodiversity

This section summarises the proposal's aquatic and terrestrial biodiversity. Appendix D contains a supporting paper prepared by Cardno (Cardno, 2020b).

### 6.3.1 Methodology

The assessment included a desktop review of published State and Commonwealth records, data and literature to confirm the likely presence of threatened flora, fauna and endangered communities in the local environment. This was followed by a site walkover and aquatic survey of the marine environment covering an area extending to about 50 metres from the proposal footprint. The biodiversity study area (referred to as the 'study area' in the section 6.3) is shown on Figure 6-2. The study locality refers to an area within five kilometres of the proposal footprint (for the purpose of the background search).

The following published records were reviewed:

- Soil Landscapes of the Sydney 1:100, 000 Sheet (Chapman and Murphy, 1989)
- Native Vegetation of the Sydney Metropolitan Area – version 3.1 VIS\_ID 4489 (OEH, 2016b)
- DPIE – Environment, Energy and Science (DPIE-EES) vegetation information system (VIS) Classification
- BioNet: containing information on threatened and protected species
- DPIE-EES Threatened Biodiversity Data Collection
- DPI Fish Communities and Threatened Species Distribution of NSW (DPI, 2016a)
- DPI Threatened species lists and Listed Protected Fish Species
- DPI Mapping the Habitats of NSW Estuaries (Creese, *et al.*, 2009)
- Commonwealth DAWE Protected Matters Search Tool (PMST) containing information on Commonwealth protected species
- Atlas of Living Australia
- National System for the Prevention and Management of Marine Pest Incursions: for information on marine pests.

The impact assessment was prepared in accordance with *Environmental Impact Assessment Practice Note: Biodiversity Assessment* (EIA-N06)(RMS, 2016d) with consideration of the:

- *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011)
- *Guidelines for Biodiversity Offsets* (RMS, 2016a).

Further detail on the methodology for the assessment of aquatic biodiversity is provided in Appendix D.

## 6.3.2 Existing environment

### Water based

#### **Protected areas**

There are no Coastal Wetland or Littoral Rainforests, as defined in the Coastal Management SEPP, in the study area. The closest Coastal Wetland is over four kilometres west of the study area at Gore Cove Reserve. The closest Littoral Rainforest is about 400 metres north-east of the study area at Little Sirius Cove.

There are no nationally important wetlands or Ramsar Wetlands in the study area or the wider study locality. The Parramatta Estuary is considered an estuarine wetland (Kingsford, *et al.*, 2004).

No Aquatic Reserves or Marine Parks occur within the study area or the study locality.

#### **Marine vegetation and habitat**

The marine study area was comprised of the artificial seawall and the intertidal and subtidal areas surrounding the existing South Mosman wharf. The harbour is mapped as Key Fish Habitat (KFH) and is estuarine thus, considered a Class 1 waterway – Major KFH (DPI, 2013; DPI, 2020).

No seagrass, mangroves or saltmarsh were recorded within the study area.

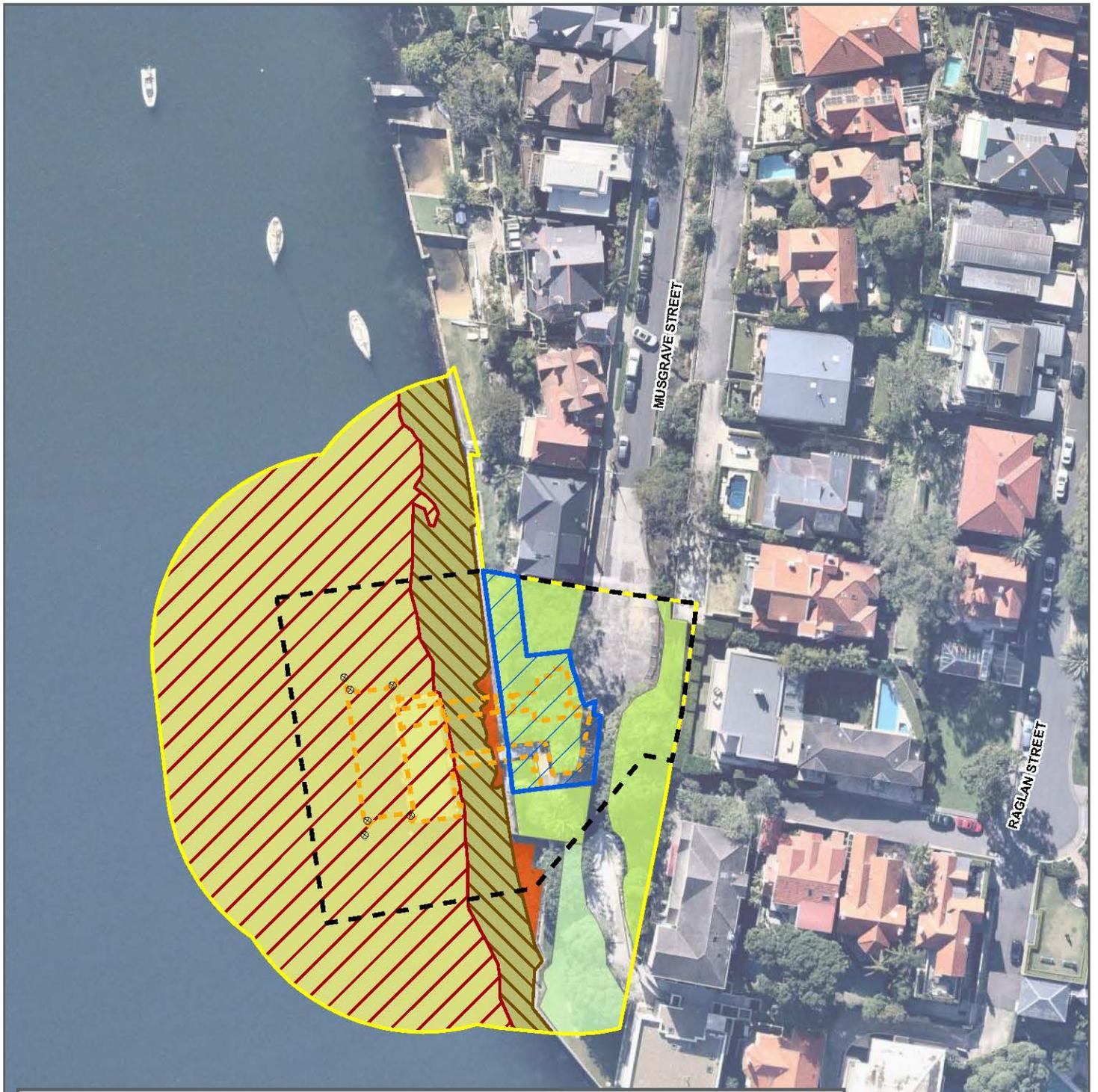
DPI Fisheries identify three types of key fish habitat (KFH) in their *Policy and Guidelines for Fish Habitat Conservation and Management* comprising:

- Type 1 (highly sensitive KFH)
- Type 2 (moderately sensitive KFH)
- Type 3 (minimally sensitive KFH).

Two distinct fish habitat zones were mapped during the field survey:

- Intertidal and subtidal rocky reefs (Type 2 KFH) – The intertidal areas were limited to the vertical sandstone seawall. Subtidal rocky reefs abutted the sandstone seawall, where there was no intertidal platform, and extended from the intertidal platforms in other areas. The piles of the existing wharf also formed a platform for colonisation for intertidal and subtidal habitat-forming species.
- Soft sediments (Type 3 KFH) – Soft sediment habitats were sparsely littered with rock rubble, shell grit and solid waste materials.

Aquatic habitat within the study area is shown in Figure 6-2.



**Legend**

Construction footprint

Pile

Biodiversity study area

Proposal footprint

Compound area

**KFH Type**

Type 2 KFH: Low - medium relief rocky reef

Type 3 KFH: Soft sediment

**Terrestrial Vegetation**

Landscaped gardens and parks

Native/exotic gardens

**Aquatic Habitat Type**

Low - medium relief rocky reef

Intertidal rocky reef

Soft sediment

**FIGURE 6-2**

1:1,000 Scale at A4

**Aquatic habitat and terrestrial vegetation within the study area**  
**SOUTH MOSMAN**



### **Threatened and protected flora**

No threatened flora species were observed during the field survey.

All marine vegetation, including seagrass, saltmarsh, mangroves and macroalgae, are protected under the FM Act. The study area does not encompass seagrass, saltmarsh or mangroves however, macroalgae colonised the intertidal and subtidal rocky reefs. Macroalgae are considered as marine vegetation and Division 4 of the FM Act protects marine vegetation from 'harm' in the form of gathering, cutting, pulling up, destroying, poisoning, digging up, removing, injuring or preventing light from reaching or otherwise harm marine vegetation or any part of it.

The closest occurrences of these types of marine vegetation were a mapped patch of *Zostera* south of the Sydney Amateur Sailing Club on the western side of Great Sirius Cove and another patch about 330 metres north of the study area along the eastern side of Great Sirius Cove (Creese, *et al.*, 2009; OEH, 2016b)

### **Threatened and protected fauna**

A review of the DPIE-EES BioNet database, DPI Threatened species list and the DAWE PMST revealed 40 aquatic-related threatened species with potential to occur in the study locality. A full list is provided in Appendix D.

No threatened species were observed during the field survey, however, potential habitat for some threatened species occurs in the study area. An assessment of the likelihood of occurrence of all threatened species based on the study area habitat was carried out to determine the potential for these species to occur within the study area.

Due to the presence of suitable habitat in the study area and/or known populations in the harbour, two aquatic species were considered to have a moderate to high likelihood of occurrence. These include:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act
- Black Rockcod (*Epinephelus daemeli*) listed as endangered under the FM Act and vulnerable under the EPBC Act.

Some species of fish have been formally protected because they are naturally scarce or their numbers have been substantially reduced over recent decades. These species are protected to help prevent them becoming threatened in the future. Twenty-five marine fauna protected under the FM Act have potential to occur within the study locality. These are listed in section 3.11 of Appendix D.

The marine vegetation and subtidal areas of the study area form potential habitat however, marine vegetation and subtidal habitat features are not unique to the study area and are widespread throughout the harbour, similar to the distribution of these species.

### **Pests**

Like a great number of other estuaries and waterways, Sydney Harbour is at risk of infestation from the marine pest *Caulerpa taxifolia* (DPI, 2016b). *Caulerpa taxifolia* is a fast-growing marine alga native to tropical Australia and the South Pacific (DPI, 2016b). This species is known to alter physical and chemical habitat affecting biodiversity. Populations have been recorded in Port Jackson at Neutral Bay, Mosman, Clifton Gardens, Rushcutters Bay, Double Bay, Rose Bay and many locations in North Harbour and Middle Harbour. This species has not been mapped in Great Sirius Cove and was not detected in the study area during the field survey. *Caulerpa taxifolia* is known to spread via fishing and boating activities as well as natural hydrology and has potential to occur in the study area.

### ***Underwater noise sensitivity***

Large megafauna and fish are sensitive to the impacts of underwater noise. While they can perceive piling generated noise up to 400 metres from its source, they typically avoid coming within 30 metres (Engell-Sorensen, 2000). If they do come within 30 metres of any piling work, then they could be injured or harmed through hearing loss or in extreme instances they can be killed (a term known as acoustic shock).

## **Terrestrial**

### ***Protected areas***

The study area does not fall in or is next to any National Parks, Conservation Reserves, Nature Reserves or Regional Parks. The closest National Parks estate is the Fort Denison, which forms part of Sydney Harbour National Park, about 1.3 kilometres south-west of the study area.

### ***Terrestrial vegetation and habitat***

The study area is located on reclaimed land. The vegetation in this area is not remnant or able to be classified as a plant community type (PCT). The eastern foreshore of Great Sirius Cove is highly urbanised with little to no areas of natural shoreline or remnant foreshore vegetation. Residential buildings and recreational space closely fringe the eastern foreshore and are mostly surrounded by hardstands, landscaped gardens, street plantings or open parks. The western foreshore, from the Mosman Bay Marina southward, is mostly a natural shoreline bound by a thin corridor of vegetation and a track which leads to Cremorne Reserve at the southern tip of Cremorne Point.

The extent of vegetation within the study area was limited by the cul-de-sac hardstand at the end of Musgrave Street, the shoreline, private property boundaries, footpaths and the existing South Mosman wharf interchange structures. The steep escarpment along the foreshore was densely colonised by native/exotic planted vegetation and ornamental escapees and occupied about 0.06 hectares. Terrestrial vegetation in the study area is shown on Figure 6-2.

Trees, in varying life stages, included native Sydney Blue Gum (*Eucalyptus saligna*), Bangalay (*Eucalyptus botryoides*), Smooth-barked Apple (*Angophora costata*), Norfolk Island Pine (*Araucaria heterophylla*), Swamp Oak (*Casuarina glauca*), Flame Tree (*Brachychiton acerifolius*) and Cedar Wattle (*Acacia elata*); and exotic/ornamental Canary Island Date Palm (*Phoenix canariensis*), Jacaranda (*Jacaranda mimosifolia*), Silky Oak (*Grevillea robusta*), Travellers Palm (*Ravenala madagascariensis*) and Japanese Hackberry (*Celtis sinensis*). The midstorey and shrub species included native Sydney Green Wattle (*Acacia decurrens*), Coastal Wattle (*Acacia longifolia* subsp. *sophorae*), Weeping Bottlebrush (*Callistemon viminalis*), Brush Cherry (*Syzygium australe*), Sweet Pittosporum (*Pittosporum undulatum*); and exotic/ornamental Frangipani (*Plumeria alba*), Olive (*Olea* sp.), Cotoneaster (*Cotoneaster glaucophyllus*), Murraya (*Murraya paniculata*) and Lantana (*Lantana camara*).

The majority of these species are commonly used as garden, street or park plantings or are widespread priority weeds. The exotic Creeping Fig (*Ficus pumila*) was the most abundant on the escarpment slope while the remaining understorey vegetation on the slope and on foreshore flats was mostly exotic with the exception of a few native species, namely *Carex* sp., Climbing Guinea Flower (*Hibbertia scandens*), Spiny-headed Mat-rush (*Lomandra longifolia*) and Couch (*Cynodon dactylon*).

A full list of flora species recorded in the study area is provided in Appendix D.

The gardens and park areas form potential habitat for a number of species. Trees and shrubs provide potential foraging habitat for birds and arboreal and aerial mammals, particularly when in bloom/fruited. Birds and arboreal mammals may also roost in mature trees and shrubs. The trees and shrubs can also provide breeding habitat for birds common to urban areas. No tree hollows were observed during the field survey.

Disturbance-tolerant birds may forage in the open park areas and the majority of the study area is likely foraging habitat for microchiropteran bats (microbats). Microbats may also roost in the crevices of existing wharf and terminal structures and in fissures in the sandstone escarpment during the day.

### **Threatened species and population**

A review of the DPIE-EES BioNet database, DPI Threatened species list and the DAWE PMST identified 109 threatened and protected species with potential to occur in the study locality. A full list is provided in Appendix D.

Due to the presence of suitable habitat in the study area and/or known populations in the harbour, eight species were considered to have a moderate to high likelihood of occurrence. These are:

- Seven microbats listed as vulnerable under the BC Act:
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
  - Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
  - Little Bent-winged Bat (*Miniopterus australis*)
  - Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
  - Southern Myotis (*Myotis macropus*)
  - Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

### **Weeds**

Four priority weeds listed under the *Biosecurity Act 2015* for the Greater Sydney region were recorded in the vegetated areas within the study area shown in Table 6-4.

**Table 6-4 Priority weeds recorded in the study area and their associated duty**

Scientific name	Common name	Extent of infestation	Duty
<i>Asparagus aethiopicus</i>	Ground Asparagus	Some individuals in the understorey	Prohibition on dealings (must not be imported into the State or sold)
<i>Senecio madagascariensis</i>	Fireweed	Some individuals in the understorey	Prohibition on dealings (must not be imported into the State or sold)
<i>Anredera cordifolia</i>	Madeira Vine	Many occurrences wrapped around trunks and climbing up the escarpment/terrace	Prohibition on dealings (must not be imported into the State or sold)

Scientific name	Common name	Extent of infestation	Duty
<i>Lantana camara</i>	Lantana	Some individuals in the understorey	Prohibition on dealings (must not be imported into the State or sold)

### 6.3.3 Potential impacts

#### Construction

##### Aquatic

##### Direct loss of aquatic vegetation and habitat

The proposal would not require large-scale disturbance of the seabed. To install the jetty and pontoon components of the new wharf, six piles would be installed in the subtidal habitat in the harbour. All of these piles (two at 467 millimetres in diameter and four at 760 millimetres in diameter) would be driven into subtidal soft sediment habitat.

The area of soft sediment habitat (Type 3 KFH) under the footprint of the piles would be permanently lost while the anchor areas for the barge during construction would be temporarily impacted. This would include the direct removal of epifauna and infauna from soft sediment habitats. However, soft sediment habitats in the study area are characteristic of the majority of subtidal habitat in the harbour and community assemblages are generally ubiquitous and quick to recolonise following disturbance. Thus, the loss of these small areas would not be a substantial loss and anchor areas in soft sediment would quickly recolonise following the removal of anchors.

The removal of the existing structure would also result in the removal of marine vegetation, habitat and sessile/less mobile fauna on the piles and pontoon. This constitutes a total vertical marine vegetation/habitat area of about 0.01 hectares. These existing structures are currently densely colonised and the majority of these species are common in other intertidal areas and subtidal rocky reefs and would quickly colonise the piles and pontoon of the new wharf. The total vertical submerged area of the new wharf available for colonisation is about double the vertical area to be removed (about 0.02 hectares). There is potential that the materials proposed for the new piles may not be suitable for colonisation in which case, the marine assemblage on the removed structures could be permanently lost.

A summary of the area of aquatic habitat directly or indirectly impacted by the proposal is provided in Table 6-5.

**Table 6-5 Area of marine vegetation and habitat impacted by the proposal**

Vegetation and habitat	Area to be directly and indirectly impacted (ha)
Intertidal rocky reef	0.01
Vertical submerged marine vegetation/habitat (intertidal and subtidal)	0.01 (vertical area on existing structures)
Low - medium relief subtidal rocky reef (Type 2 – Moderately sensitive KFH)	<0.01
Soft sediment (Type 3 – Minimally sensitive KFH)	0.04

There is potential for fragments of the existing seawall to dislodge during the installation of the land-based jetty piles or removal of the existing wharf structure. An area of <0.01 hectares of the rocky reef platform and the vertical rocky reef has potential to be crushed (injury/mortality) or dislodged. If this were to happen, the seawall would be remediated to a similar or better condition and habitat-forming species are likely to recolonise these areas following construction completion.

#### Indirect impacts to aquatic vegetation and habitat

There is potential for coarse and fine debris to be mobilised during piling, removal of existing structures and vessel movement. This can crush, damage and/or smother marine vegetation and habitat depending on the size of debris. Larger debris would be disposed offsite and should not cause any impacts to marine biodiversity. Mobilisation of finer debris (i.e. sediments) can also result in the mobilisation of contamination known to persist in study area sediments. Depending on the volume and the size of fine debris, wave, tide and current actions, finer particles may not reside in the area for long and this may only be a temporary nuisance to marine assemblages. Furthermore, Great Sirius Cove and the wider harbour periodically experiences impacts from elevated turbidity, usually as a result of rainfall, tides and swell. Thus, marine assemblages in the study area are likely to be frequently exposed to these conditions and the proposal is unlikely to introduce vastly different conditions.

Water-based construction activities would result in vessel and barge movements in and around the study area. This has potential to temporarily increase the frequency of vessel wash impact on intertidal and subtidal rocky reefs and the scour of soft sediment areas. Marine vegetation and sessile fauna can be scoured from the rocky reefs and epifauna, including scattered colonies of macroalgae on hard substratum, and infauna in soft sediment habitats can be removed/relocated. As large and small vessels currently frequent the study area, the community assemblages are likely to be well-adapted to vessel wash and scour. Thus, impacts as a result of vessel and barge movements are unlikely to substantially impact marine biodiversity in the study area.

Water-based activities have potential to impact habitat for the Southern Myotis, Black Rockcod and White's Seahorse. The foraging resource that the study area represents would be made available for these species following the completion of construction thus, proposal impacts to potential foraging habitat for these species are only temporary. The impact from the removal of the existing structure is considered minimal for Black Rockcod and White's Seahorse. This is a very small proportion of available habitat in their distribution and the installation of new piles and structures would provide similar, if not the same habitat for these species during operation. Additional controls would be implemented to survey for Black Rockcod and White's Seahorse at the start of construction so that individuals in the area are not harmed.

#### Injury and mortality

Proposed construction activities are unlikely to substantially impact on mobile marine fauna occurring within the study area. Fish are highly mobile and temporary disturbance from the movement of vessels, piling and removal of structures would be minor, as similar and higher condition habitat are abundant and wide-ranging in the harbour.

A temporary increase in vessel and barge activity during construction is associated with an increased risk of vessel strikes with marine turtles and mammals. The proposal footprint is considered suboptimal habitat for most marine mammals and very few individuals, if any, would occur during construction. The increased risk, however, is proportional to the increase in vessel traffic for the proposal relative to overall vessel traffic. This proportional increase is considered to be small.

## Underwater noise and vibration

Tolerance to changes in noise, vibration and water quality may vary among species, but the response is generally similar to these types of activities in a busy harbour (i.e. movement away from unfavourable conditions). Marine fauna in the harbour are likely to be exposed to an ambient level of noise from existing marine activities. These species are also likely to recolonise the study area once conditions return to pre-construction levels.

## Pests

Construction activities over water have a small potential to introduce marine pests if vessels, equipment or plant are used if controls are not implemented.

## **Terrestrial**

### Loss of vegetation and habitat

The proposal would remove up to 0.04 hectares of native/exotic gardens. This includes some native planted trees and a mostly exotic understorey along the foreshore of the study area.

Vegetation to be removed does not form part of any remnant PCT but does form potential habitat for some highly mobile, disturbance tolerant native fauna. This would result in the removal of potential habitat for native fauna. The removal of habitat resources is unlikely to have a significant impact on native fauna as there is an abundance of similar habitat across the study locality of which the study area only forms a small proportion. The majority of vegetation to be cleared is associated with the establishment of the compound site. Thus, following the decommissioning of the compound site (i.e. completion of construction) the area would be restored and landscaped with native species.

### Weed invasion

Disturbance of vegetation can result in the introduction or spread of exotic flora (i.e. weeds). This can occur by the spread of opportunistic exotic vegetation from adjacent private properties or new species can be introduced via equipment, plant and footwear. Any foreign equipment or materials brought onto the construction site also has potential to introduce diseases such as *Phytophthora* (*Phytophthora cinnamomi*) and Myrtle Rust (*Puccinia psidii*). The vegetation and habitat in the study area and the surrounding areas are susceptible to weeds and diseases if not managed during construction.

### Erosion and sedimentation

Vegetation clearing and grubbing would expose soils and components of landfill which can then be easily mobilised. Contaminants in the soil and landfill can also be subsequently released into the surrounding environment. Erosion and sedimentation is most likely to impact harbour waters, particular during inclement weather (e.g. rainfall, high winds) if controls are not implemented. This could result in unfavourable, turbid conditions, the smothering of sessile marine vegetation, habitat and fauna and water, sediment and biota contamination in Great Sirius Cove and even the wider harbour.

## Operation

### **Aquatic**

The gangway and pontoon components of the proposal would sit permanently on or above the water's surface and avoid impacts to the seabed. However, these structures would shade a portion of intertidal rocky reef, subtidal rocky reef and subtidal soft sediment habitat. As a result, less than 0.01 hectares of subtidal rocky reef habitat

assemblage may change and manifest in a reduction of macroalgae. This impact area is a very small proportion of subtidal rocky reef habitat in the study area and the wider harbour and is not considered ecologically significant. Shading of intertidal (<0.01 hectares horizontal and vertical areas) and soft sediment habitat (about 0.04 hectares) is not expected to substantially change community assemblages as these areas generally lack marine vegetation. The removal of part of the existing wharf interchange would leave portions of intertidal rocky reef (<0.01 hectares) and subtidal rocky reef (<0.01 hectares) and soft sediment habitat (0.02 hectares) exposed to sunlight. This is not expected to have any substantial impacts to soft sediment communities.

The relocation of the wharf also translates to the relocation of localised ferry wash and underwater turbulence. Great Sirius Cove currently experiences substantial vessel traffic and ferry routes are likely to vary from time to time. Impacts from the small changes to the docking and departing ferry route at the new terminal are unlikely to be detectable in the highly variable boating environment of Great Sirius Cove. There is potential for soft sediment habitat to be scoured from ferry jets while docking and departing the new terminal. However, these habitats are quick to recover. Sediment mobilisation from ferry jets may affect nearby rocky reef habitat, however, communities in the study area are likely to be well-adapted to turbidity and sedimentation from existing vessel traffic.

The structures of the new terminal are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. The proposal would install six piles and a floating pontoon while removing the existing wharf interchange structures (piles and pontoon). The size of these structures are small in comparison to the extent of the estuary thus would not interfere with fish passage. Due to the size of these structures in proportion to the estuary, alterations to hydrodynamics are likely to be localised and unlikely to produce substantial impacts to marine biodiversity.

### ***Terrestrial***

As there is not expected to be any change to passenger numbers or operational activities around the wharf there is limited potential for any operational terrestrial ecology impacts.

### **Conclusion on significance of impacts**

The proposal is not likely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the BC Act or FM Act and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.

The proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the EPBC Act. A referral to the Australian Government Department of Agriculture, Water and Environment (DAWE) is not required for biodiversity matters.

### 6.3.4 Safeguards and management measures

Table 6-6 lists the biodiversity safeguards and management measures that would be implemented to account for the impacts identified in section 6.3.3.

**Table 6-6: Biodiversity safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
B1	All project impacts	<p>Integrate the management of flora and fauna into the construction environmental management plan (either as a standalone flora and fauna management plan or a subplan). This is to include all terrestrial and marine flora and fauna and include but not be limited to such measures as:</p> <ul style="list-style-type: none"> <li>• Documenting and establishing site clearing limits</li> <li>• Establishment of no go zones</li> <li>• Implementation of tree protection measures</li> <li>• Pre-clearing surveys, vegetation removal, unexpected finds measures in line with the <i>Biodiversity Guidelines</i> (RTA, 2011).</li> </ul>	Contractor	Pre-construction
B2	Removal of native vegetation, habitat and habitat features	Native vegetation and habitat removal will be minimised through detailed design with focus to retain vegetation along the boundary of the compound site and 2 Musgrave Street.	Transport for NSW	Detailed design
B3	Removal of native vegetation, habitat and habitat features	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). Any roosting microbats in the vegetation and wharf structures to be removed and the escarpment area to be impacted will be captured and relocated to similar or higher condition habitat. Release will only be done at dusk and roosting individuals should be kept in a secure, dark and warm location until then. Injured individuals or unfurred juveniles are to be transported to a veterinarian.	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B4	Removal of native vegetation, habitat and habitat features	Vegetation and habitat removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction
B5	Removal of native vegetation, habitat and habitat features	Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). Replacement plantings (species and number) will be determined in consultation with Mosman Council to reinstate habitat and minimise visual impacts.	Contractor	Detailed design / Post construction
B6	Removal of native vegetation, habitat and habitat features	The unexpected species find procedure is to be followed <i>under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the construction footprint.	Contractor	Construction
B7	Removal of marine vegetation and habitat	Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).	Contractor	Detailed design
B8	Removal of marine vegetation and habitat	Minimise anchoring were possible and avoid anchoring on subtidal rocky reef habitat.	Contractor	Construction
B9	Removal of marine vegetation and habitat	Complete a targeted survey for Black Rockcod and White's Seahorse within 24 hours prior to the commencement of water-based construction activities. Black Rockcod individuals will be encouraged to move away from the study area and White's Seahorse will be captured and relocated to nearby similar habitat. A White's Seahorse relocation plan will be developed in consultation with NSW DPI (Fisheries) to dictate this activity.	Transport for NSW	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B10	Removal of threatened species habitat and habitat features	A Section 37 permit under the FM Act to relocate Syngnathids collected during the targeted pre-clearance survey will be required as part of the White's Seahorse relocation.	Transport for NSW	Construction
B11	Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013 (NSW DPI, 2013).	Contractor	Construction
LS8	Aquatic impacts	<p>Prior to commencement of construction activities, sediment control device (such as sediment boom and curtain) will be installed around the construction footprint to contain disturbed sediment from the water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will extend from a minimum of 100 millimetres above the water line to a minimum of 2.5 metres below the water line before starting work.</p> <p>Installation should be undertaken during high tide periods from a boat. The device should be designed to rise and fall with the tide to prevent disturbance. Inspection of the device should be undertaken on a daily basis after ebbing tides, with additional inspection be carried following storm events. Monitoring of turbidity inside and outside of the device should also be performed, using a portable turbidity meter/logger. Prior to removing the sediment control device, conditions within the curtain will be assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.</p>	Contractor	Construction
LS11	Aquatic impacts	Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
WQ1	Aquatic impacts	<ul style="list-style-type: none"> <li>A spill management plan will be developed and communicated to all staff working on site.</li> <li>Appropriate land and aquatic spill kits are to be maintained on site and on barges. Aquatic spill kits must be specific for working within the marine environment. The spill kit must be appropriately sized for the volume of substances at the work site.</li> <li>All workers will be advised of the location of the spill kit and trained in its use.</li> </ul>	Contractor	Construction
B12	Aquatic impacts	Piling to stop if marine mammals are observed within 100 metres of the project area and only to recommence once they have moved beyond 100 metres of the project or are not seen for at least 20 minutes.	Contractor	Construction
B13	Changes to coastal processes	The detailed design will aim to avoid/minimise any impact to coastal processes and hydrology.	Transport for NSW	Detailed design
B14	Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction
B15	Invasion and spread of weeds, pests and diseases	Weed species will be managed in accordance with Guide 6: Weed management of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction
B16	Invasion and spread of weeds, pests and diseases	Marine pest species will be managed within the construction footprint.	Contractor	Construction
B17	Invasion and spread of weeds, pests and diseases	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B18	Invasion and spread of weeds, pests and diseases	Water-based equipment and vessels to be sourced from local suppliers. Equipment and vessels must be cleaned and inspected prior to entering the construction footprint.	Contractor	Construction
B19	Invasion and spread of weeds, pests and diseases	Occurrence of any marine pests must be reported to DPI Fisheries.	Contractor	Construction
B20	Noise and light vibration	Shading and artificial light impacts will be minimised through detailed design.	Transport for NSW	Detailed design

### 6.3.5 Biodiversity offsets

The proposal is not expected to clear any remnant native vegetation (or PCTs) and would only clear up to 0.04 hectares of native/exotic gardens. Offsets are not required for the clearing of this vegetation, however, the area would be replanted at completion.

The proposal is expected to impact less than 0.01 hectares of marine vegetation on intertidal and subtidal rocky reefs as well as about 0.01 hectares of vertically colonised marine vegetation on the existing wharf structures to be removed. About 0.02 hectares of submerged surface area would be available for recolonisation of marine vegetation and other habitat-forming species as part of the new wharf to replace the areas removed during construction. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).

## 6.4 Noise and vibration

This section summarises the proposals noise and vibration impacts. Appendix E contains a supporting technical paper prepared by Cardno (Cardno 2020c).

### 6.4.1 Methodology

#### Construction assessment

The construction assessment reviewed how the proposed activities, methods and scheduling described in section 3.3 would affect noise and vibration sensitive receivers in the local area. The assessment was completed in accordance with the *Construction Noise and Vibration Guideline* (CNVG)(RMS, 2016b). Noise levels from construction works were predicted using 3D noise modelling software (SoundPLAN).

#### Operational assessment

The operational assessment included qualitative consideration of any amenity noise change from using the upgraded wharf in its new location.

### 6.4.2 Existing environment

#### Noise monitoring and ambient noise levels

Existing noise levels surrounding the proposal were determined through unattended noise monitoring between 30 April 2020 and 7 May 2020. Details of noise monitoring locations and results are identified in Table 6-7.

Monitoring for unattended survey was performed across three time spans: day, evening and night. Figure 6-3 displays the logger locations.

The existing acoustic environment is generally dominated by road traffic noise on local roads and noise from boats on the Mosman Bay.

**Table 6-7: Unattended noise monitoring locations and noise levels**

ID	Location	Noise Level (dBA RBL <sup>1</sup> )		
		Day <sup>2</sup>	Evening <sup>2</sup>	Night <sup>2</sup>
Logger 1	Musgrave Street/Wharf Site	45	41	38
Logger 2	Cremorne Road	38	33	28

1. RBL – rating background level. The overall single-figure background level representing each assessment period (daytime/evening/night-time) as defined in the NSW Noise Policy for Industry (EPA 2017)
2. Time periods defined as – Day: 7am to 6pm Monday to Saturday, 8am to 6pm Sunday; Evening: 6pm to 10pm; Night: 10pm to 7am Monday to Saturday, 10pm to 8am Sunday.

It should be noted that the background noise monitoring was conducted during COVID-19 and may represent non-typical background noise levels on this basis.



**Figure 6-3: Noise logger locations**

### Sensitive receivers

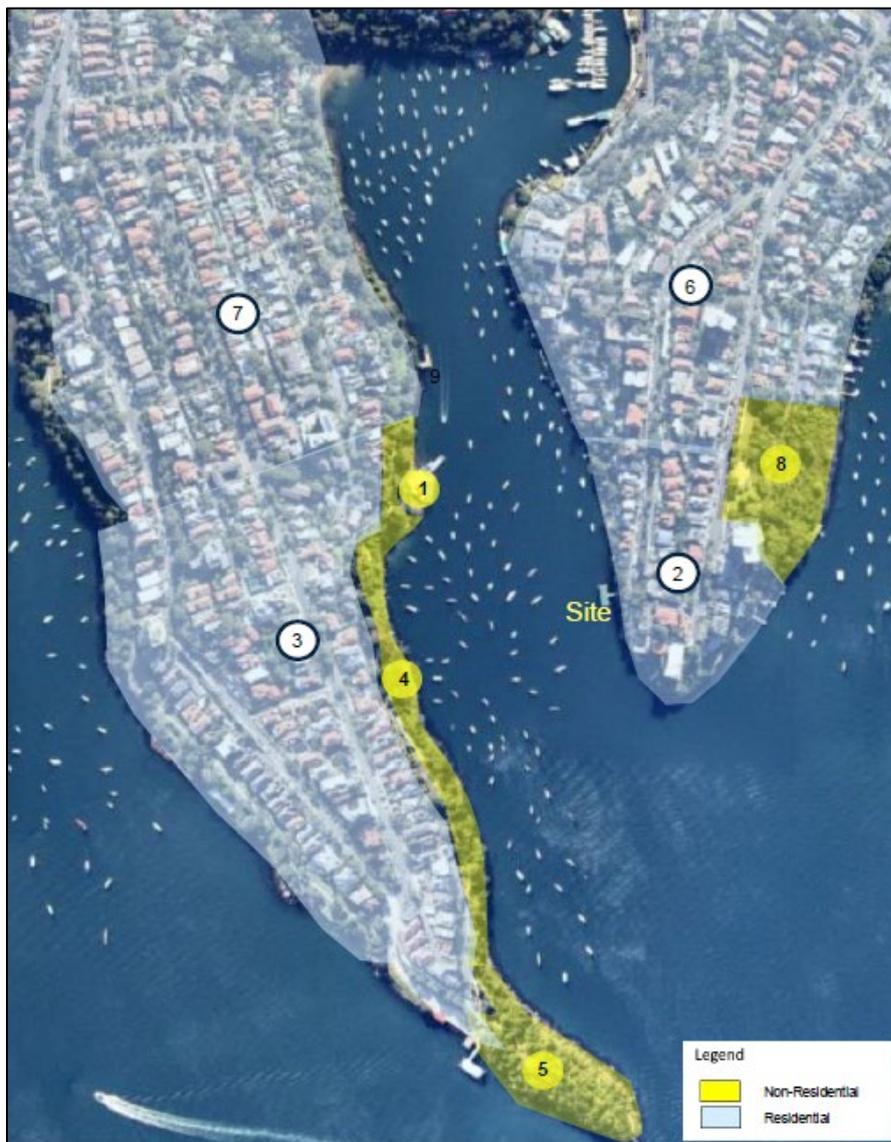
The existing wharf is surrounded by a range of noise sensitive receivers, mostly residential. Non-residential receivers include recreational areas such as the Sydney Amateur Sailing Club, Cremorne Point Garden and Walk and Cremorne Reserve Parkland.

Sensitive receivers around the proposal are listed in Table 6-8 and shown in Figure 6-4.

Sensitive receivers were assessed through the consideration of noise catchment areas (NCAs) and are shown in Figure 6-5.

**Table 6-8: Sensitive receivers and land uses around the proposal**

Label	Description	Land use
1	Sydney Amateur Sailing Club	Passive recreation
2	Residential (east)	Residential
3	Residential (west)	Residential
4	Cremorne Point Garden and Walk	Passive recreation
5	Cremorne Reserve Parkland	Passive recreation
6	Residential (north-east)	Residential
7	Residential (northwest)t	Residential
8	Curraghbeena Park	Passive recreation



**Figure 6-4: Sensitive receivers and surrounding land uses**



**Figure 6-5: Noise catchment areas**

### **6.4.3 Criteria**

The Roads and Maritime *Construction Noise and Vibration Guideline* (RMS, 2016b) (CNVG) provides a framework for the assessment of noise during the construction phase of the proposal. The CNVG references the following documents to provide the criteria for the assessment of construction noise and vibration impacts:

- EPA Interim Construction Noise Guideline (INCG)
- EPA Assessing Vibration – Technical Guideline
- EPA Road Noise Policy (RNP).

The CNVG provides recommended minimum separation distances between vibration intensive plant and sensitive receivers for minimising the risk of cosmetic damage. The CNVG further states that the minimum working distance for cosmetic damage must be complied with at all times, unless otherwise approved by Transport for NSW or under the environmental licence as relevant.

### Construction noise assessment criteria

Works may be carried out outside of standard hours due to the nature of the proposal. For this reason, noise management levels (NMLs) have been calculated for both standard and non-standard hours. The NMLs are detailed in Table 6-9 and are based on the measures RBLs and the noise criteria detailed in the INCG.

**Table 6-9: Noise management levels for each noise catchment area**

NCA	Noise Management Level, dB(A)			*Sleep Disturbance L <sub>A1</sub> , 1 min
	Standard Hours (RBL + 10 dB(A))	Outside Standard Hours (RBL + 5 dB(A))		
	Day	Evening	Night	
1	55	46	43	60
2	48	38	33	60

*\*Sleep disturbance criteria has been calculated based on an assumed typical internal LAeq noise level of 35 dB(A) referenced from Australian Standard AS:2107 and corrected with a typical inside to outside noise reduction of 10 dB(A).*

### Construction vibration assessment criteria

The minimum working distance for vibration intensive plant from sensitive receivers is listed in Table 2 of the CNVG. Table 6-10 presents these recommended minimum working distances for specific construction activities.

**Table 6-10: Recommended minimum working distances for vibration intensive plant from sensitive receivers**

Plant item	Rating / Description	Minimum working distance		
		Cosmetic Damage (BS 7385)	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human Response (OH&E Vibration Guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	14 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	16 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	33 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	41 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	54 m	100 m
	> 300 kN (> 18 tonnes)	25 m	68 m	100 m

Plant item	Rating / Description	Minimum working distance		
		Cosmetic Damage (BS 7385)	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human Response (OH&E Vibration Guideline)
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	19 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	60 m	73 m
Vibratory Pile Driver	Sheet Piles	2 m to 20 m	50 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	40 m	4 m
Jackhammer	Hand Held	1 m (nominal)	2 m	2 m

#### 6.4.4 Potential impacts

##### Construction

##### *Construction scenarios*

For assessment of construction and vibration impacts, six scenarios were determined to identify various construction stages. Table 6-11 identifies the construction scenarios.

**Table 6-11: Modelled construction scenarios**

Stage No.	Description
1a	Site establishment
2a	Demolition of gangway and pontoon
2b	Demolition of stairs and wharf
3	Construction of pathways, stairs and lift (outside of hours)
4a	Installation of piles within waterway – Drilling (outside of hours)
4b	Installation of piles within waterway – Hammering (outside of hours)

Stage No.	Description
4c	Installation of piles within waterway – Piling (outside of hours)
4d	Installation of piles within waterway – Cutting steel
5	Installation of gangway and pontoon
6	Site Clean Up

### **Activity based noise**

Each level of construction staging would include various types of equipment and be used during various times of the day. Table 6-12 lists the types of equipment and relevant sound power levels that would occur during construction and identify what scenario equipment would be used. The table also identifies the scenario total sound power level (SWP).

**Table 6-12: Plant and associated sound power levels**

Plant	SPL*	1a	2a	2b	3	4a	4b	4c	4d	5	6
Barge Crane	110		1	1						1	
Bobcat	105										1
Chainsaw	114										
Concrete Pump	109				1				1		
Concrete Truck	109				1				1		
Crane	113				1	1			1		
Day-maker	98					2	2	2	2		
EWP	98	1									
Excavator	108		1	1							1
Floating Boom (crane)	105	1	1	1							
Franna Crane	98	1			1						1
Generator	98		1	1	1	1	1	1	1		
Hand Tools	94				1					1	
Jack Hammer	115										

Plant	SPL*	1a	2a	2b	3	4a	4b	4c	4d	5	6
Landside Piling Rig	112				1						
Oxy Acetylene Cutting	96					1	1	1	1		
Pavement Profiler	117										
Piling Rig (Bored)	112							1			
Pneumatic Drill	115			1			1				
Pneumatic Hammer	115		1		1						
Road Truck	108	1									1
Rock Breaker (mounted)	118		1	1							
Rock Drill	118					1					
Truck	110					1	1	1	1		
Truck (medium rigid)	103	1			1					1	1
Tug Boat	108										1
Vibratory Roller	109										
Work Boat	108		1	2		1	1	1	1	1	
Total LAeq		111	121	121	119	118	116	116	113	113	113

\* SPL – Sound Power Level, LAeq, dB(A)

### **Predicted construction noise levels**

The predicted noise impact from construction activities in the form of noise contour maps and predicted levels at discrete receivers is presented in Appendix E. Predicted construction noise levels at each modelled NCA for each scenario are shown in Table 6-3.

The levels represent the worst case predicted noise impact at the most affected receivers in each NCA. Noise levels as a result of construction activities are predicted to be lower than these levels for the remaining receivers within each associated NCA.

**Table 6-13: Noise impact summary**

Criteria / Scenario	NCA1	NCA2
NML standard hours (dBA)	55	48
NML out of hours (evening) (dBA)	46	38
NML out of hours (night) (dBA)	43	33
Highly noise affected (dBA)	75	75
Scenario 1 (standard hours)	80	59
Scenario 2a (standard hours)	86	68
Scenario 2b (standard hours)	86	68
Scenario 3 (standard hours)	87	66
Scenario 4a (out of hours)	85	67
Scenario 4b (out of hours)	84	65
Scenario 4c (out of hours)	85	66
Scenario 4d (standard hours)	84	64
Scenario 5 (standard hours)	77	60
Scenario 6 (standard hours)	81	61
<b>Noticeable:</b> <ul style="list-style-type: none"> <li>Standard hours: NML to NML + 10dB(A)</li> <li>Out of hours: NML – 5 dB(A) to NML + 5 dB(A)</li> </ul>		
<b>Clearly audible:</b> <ul style="list-style-type: none"> <li>Standard hours: NML + 10 dB(A) to NML + 20 dB(A)</li> <li>Out of hours: NML + 5 dB(A) to NML + 15 dB(A)</li> </ul>		
<b>Moderately intrusive:</b> <ul style="list-style-type: none"> <li>Standard hours: NML + 20 dB(A) to NML + 25 dB(A)</li> <li>Out of hours: NML + 15 dB(A) to NML + 25 dB(A)</li> </ul>		
<b>Highly intrusive / Highly noise affected:</b> <ul style="list-style-type: none"> <li>Standard hours: &gt;75 dB(A)</li> <li>Out of hours: &gt; NML + 25 dB(A)</li> </ul>		

Some receivers are expected to be highly noise affected for all construction scenarios associated with the wharf proposal.

Construction noise levels are predicted to exceed management levels for “standard” and “non-standard” hours of operation for all construction stages at the nearby residential receivers, particularly for construction scenarios 4a, 4b and 4c (piling works outside of construction hours).

General noise and vibration impacts on the local community would be mitigated by restricting construction works to daytime hours wherever possible. However, due to the requirement for calm water conditions during pile installation and for intricate lifts, some activities would need to be carried out at night, with about 30 night shifts (from 11pm to 7am) proposed across the construction period of up to six months. Piling would be restricted to be carried out from 5am to 7am only. During piling, it is anticipated that each pile would be hammered for one minute (about 10 hits with a hammer within one minute). For each pile the activity is likely to occur about five times over a period of one hour.

It should be noted that this assessment has endeavoured to carry out “worst case” noise modelling, and noise levels are predicted based on all sources operating simultaneously within the worksite. This is therefore likely to represent the worst case scenario and construction noise levels would generally be less than those predicted.

### ***Sleep disturbance***

The most likely source of potential sleep disturbance from outside of construction hours works would be from construction of pathways and lift and hammering, pile screwing, and drilling proposed as early morning works.

Maximum noise levels have been predicted to the nearest affected residential receivers to allow a review of the potential for sleep disturbance from construction activities at night. The predicted  $L_{Amax}$  results are detailed in Table 6-15 of Appendix E and indicate that maximum construction noise levels at NCA 1 and 2 are likely to exceed the sleep disturbance criteria for all “outside of standard hours” construction scenarios, at all assessed receivers when construction works are located nearby.

### ***Vibration impacts***

For the purposes of this assessment, the following proposed plant with the potential to generate the most vibration have been considered:

- Bored piling rig
- Vibratory roller
- Rock hammers
- Rock drill
- Truck movements.

Construction vibration levels vary depending on the distance from the equipment in use, the energy level imparted to the ground by the construction process, and the bedrock type. The most vibration generating sources associated with the construction work would be vibratory rollers and piling rigs.

The closet heritage structures (Musgrave Street wharf (remains and seawall) and Divided road) are located 5 and 10 metres respectively from the proposed works. Works would involve piling, the use of a rock hammer and other vibration intensive plant and would be located within the minimum safe working distance for cosmetic damage identified in the CNVG (Table 6-10), identified as 50 metres. Similar results apply to other heritage items in proximity to the proposed works including Heron Walk Steps and Group of 2 Houses, divided into 3 dwellings, however to a lesser extent due to their greater separation distances of around 20 metres. Further information on vibration impacts to heritage structures is provided in section 6.6.

Construction works may also be undertaken within the safe working distances for cosmetic damage to residential buildings, identified in the CNVG (Table 6-10) up to 25 metres depending on the type of plant. The residential buildings within the minimum working distance are 2A, 5 and 7 Musgrave Street.

### **Operation**

The upgraded wharf would service a similar patronage as to the existing environment. As such, there is not expected to be any change in amenity noise under the proposal. No change in operational traffic is anticipated.

### 6.4.5 Safeguards and management measures

Table 6-14 lists the noise and vibration safeguards and management measures that would be implemented to account for the impacts identified in section 6.4.4.

**Table 6-14: Noise and vibration safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
NV1	Noise and vibration	<p>Preparation of a noise and vibration management plan based on recommendations provided within the NSW ICNG and Australian Standard AS 2436-1981: <i>Guide to Noise Control on Construction, Maintenance and Demolition Sites</i>. This is to include, but not be limited to:</p> <ul style="list-style-type: none"> <li>• Plant controls: <ul style="list-style-type: none"> <li>○ Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc.</li> <li>○ Plant and equipment will be in good working order to prevent excess noise generation.</li> <li>○ Locating static sources of noise such as the generators as remotely as possible from noise sensitive receivers</li> <li>○ Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations</li> <li>○ Use of temporary noise barriers where practical. The height and location of these barriers will be determined during preparation of the construction noise and vibration management plan when more information regarding the proposed plant to be used for each construction stage is available.</li> <li>○ Investigate whether “at plant” mitigation or muffled plant is available for plant with high source noise levels such as rock hammers and piling rigs, and plant emitting continuous noise such as generators.</li> <li>○ Acoustic curtains (generally loaded vinyl based products), attached to wire construction fencing or laid over steel scaffold can also provide practical</li> </ul> </li> </ul>	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>temporary noise barriers. Acoustic curtains will be investigated for stationery plant within the worksites once a detailed schedule of works and plant is available.</p> <ul style="list-style-type: none"> <li>• Management and behavioural controls: <ul style="list-style-type: none"> <li>○ Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings.</li> <li>○ Avoid the need for reversing in the construction area by creating a loop road or similar.</li> <li>○ Avoid dropping materials from height.</li> <li>○ Workers will avoid shouting, minimise talking loudly, and avoid slamming vehicle doors.</li> </ul> </li> <li>• Allowing construction to occur only during approved construction hours, unless otherwise required as a condition of TfNSW safety requirements</li> <li>• Conducting noise monitoring during all construction phases/scenarios considering the potential exceedances for the purposes of assisting in noise mitigation and to verify the findings of this noise assessment.</li> <li>• Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately.</li> <li>• Conducting additional monitoring if complaints are received or proposed activities and number of plant exceed those assumed in this assessment.</li> <li>• Modifying work activities where noise or vibration is found to cause unacceptable impact.</li> <li>• Implementation of additional mitigation measures in accordance with the CNVG including notification, respite periods and alternate accommodation as reasonable and feasible.</li> </ul>		
NV2	Noise and vibration	<ul style="list-style-type: none"> <li>• Carrying out works within standard daytime hours as follows: <ul style="list-style-type: none"> <li>– 7:00 am to 6:00 pm Monday to Friday</li> </ul> </li> </ul>	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>– 8:00 am to 1:00 pm Saturdays, no work on Sundays or public holidays.</li> <li>• Do not carry out operations during evening or night-time hours, unless required for safety reasons when the water is calmer during the night period (including early morning) or due to requirements to enable bus access.</li> <li>• Should operations be required outside standard hours, an Out of Hours Procedure detailing works schedule, approval process, communications requirements and management measures will be prepared.</li> <li>• All reasonable and feasible efforts should be undertaken to ensure noise levels will not exceed the ICNG noise management levels stated in section 6.4.3 of this assessment by carrying out night-works with reduced numbers of plant for example.</li> </ul>		
NV3	Noise and vibration	<ul style="list-style-type: none"> <li>• Notification of potentially affected receivers detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the work (where applicable) and contact telephone number.</li> <li>• Notification should be a minimum of 7 calendar days prior to the start of work.</li> <li>• A contact telephone number and email address will be available for community feedback.</li> </ul>	Transport for NSW / Contractor	Pre-construction
NV4	Noise	Conduct short term background noise monitoring prior to construction to confirm the ambient noise levels presented in this report, which were carried out during COVID 19 and may not be representative of typical levels.	Transport for / Contractor	Pre-construction
NV5	Vibration impact to heritage structures	Where works are proposed within the safe working limits for the heritage structures (the original seawall and retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183)), specialist advice will be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works will potentially result in impacts to heritage structures. Vibration	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		monitoring will be carried out to confirm vibration levels prior to construction commencement.		
NV6	Vibration impact to heritage structures	<p>Regular inspections of the construction activities and work areas will be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology and confirm the integrity of the seawall and retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183). Assessment and monitoring of vibration impacts will adhere to:</p> <ul style="list-style-type: none"> <li>• British Standard BS 7385: Part 2: Evaluation and Measurement for Vibrations in Buildings –Part 2 Guide to Damage Levels from Ground-Borne Vibration</li> <li>• German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.</li> </ul>	Contractor	Construction
NV7	Vibration	Where buildings are located within the safe working distance zone, dilapidation surveys will be carried out prior to construction.	Contractor	Pre-construction / Construction
NV8	Vibration	Where receivers are located within the safe work distance zones, vibration monitoring will be carried out to ensure compliance with the required criteria. If exceedances are recorded, works will be modified accordingly to reduce vibration levels.	Contractor	Pre-construction / Construction

## 6.5 Landscape character and visual impact

This section summarises the proposal's landscape character and visual impacts. Appendix F contains a supporting paper (landscape and visual impact assessment, LCVIA) prepared by Cardno (Cardno, 2020d).

### 6.5.1 Methodology

The LCVIA was prepared based on the Transport for NSW's *Environmental Impact Assessment Practice Note: Guideline for landscape character and visual impact assessment (EIA-N04)* (TfNSW, 2020b).

The assessment identifies the overall impact of the proposed works on each of the Landscape Character Zones (LCZ) through predicting the sensitivity of the LCZ to changes as a result of the proposed works followed by identifying the anticipated magnitude change that would result from implementation of the proposed works within each LCZ. The assessment also provides a visual impact assessment to identify the visual changes and impacts on the site and its surroundings when viewed from key vantage points. The assessment would combine the viewers' sensitivity to the proposed works/structures with the magnitude of the proposed works/structure within the existing views. Table 6-15 details the landscape character and visual impact grading matrix.

**Table 6-15: Landscape character and visual impact rating matrix (Source: TfNSW, 2020b)**

		Magnitude			
		High	Moderate	Low	Negligible
Sensitivity	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

### 6.5.2 Existing environment

The existing South Mosman wharf is located on the Eastern shoreline of Mosman Bay, close to the end of the Mosman Point peninsula. The wharf faces south west and is located at the foot of a small escarpment approximately six metres below street level at Musgrave Street. Existing pedestrian access to the wharf is via a set of stairs from a turning circle at the end of the Musgrave Street cul-de-sac.

#### Landscape and urban context

The existing South Mosman wharf is a concrete wharf incorporating a jetty with single berthing and a canopy cover. Access to the shore is via a covered gangway leading to the stair connection to Musgrave Street.

The wharf site is in the context of single dwelling residential houses and a relatively natural foreshore comprised of the sandstone escarpment and a shore edge terrace supported by a sandstone sea wall. The majority of the vegetation at the terrace level includes common garden, street or park plantings, and widespread priority weeds. North of the terrace, existing private residential properties extend almost to the foreshore of the bay.

Mosman Bay is approximately 250 meters wide and is flanked by a mix of residential properties and public open space. The Cremorne Reserve pedestrian walkway extends along the western shoreline of the Bay and provides views of the harbour which often include the South Mosman wharf.

The Sydney Amateur Sailing Club is on the opposite foreshore, north west of the South Mosman wharf site two other ferry wharves are within the Bay, one on the western foreshore and the other on the eastern foreshore close to the head of the Bay.

### Heritage context

According to the Mosman LEP, the following local heritage items are located within the vicinity of the proposal:

- Local Item 1411 – Musgrave Street Divided Road
- Local Item A491 - Musgrave Street Wharf (remains and sea wall).

### Landscape character zones

In assessing the landscape character of Mosman and how the proposed wharf would fit within the surrounding landscape, the study area has been divided into five LCZ as describer in Table 6-16 and shown in Figure 6-6.

**Table 6-16: Landscape character zones**

LCZ	Description
LCZ1 - Residential Slopes – Mosman	<p>The Mosman Peninsula residential precinct is a mix of single dwellings and apartment buildings in a high quality, well treed setting.</p> <p>The precinct consists of a variety of architectural styles and building forms from large federation dwellings to 'tower' form residential flat buildings. The precinct includes a number of heritage items.</p> <p>The narrow peninsula that supports the residential precincts is moderately sloping resulting in many opportunities for high quality views to the harbour.</p> <p>Mature trees and vegetation are visible along the street frontage, which forms a significant part of the precinct's appearance.</p> <p>Yachts moored close to the shoreline form part of the visual character of the Mosman residential slopes.</p>
LCZ2- Residential slopes – Cremorne Point Sydney Harbour	<p>The Cremorne Point peninsula supports a variety of residential forms, dominated by large single dwelling houses of Edwardian and Federation design interspersed with a small number of 4-8 storey residential apartment buildings.</p> <p>Large scale trees are also dominant in the landscape in streets and within private properties.</p>

LCZ	Description
LCZ 3 - Foreshore Reserves	The foreshore of Cremorne Point is a continuous public reserve including pathways, picnic areas, seating and conservation zones with views across the harbour to adjacent foreshores. The South Mosman wharf site is a part of the view from these recreational areas on the eastern foreshore of Cremorne Point
LCZ 4 - Taronga Zoo	The Taronga Zoo site reads as a generally natural element in the greater Sydney Harbour foreshore landscape.
LCZ 5 - Sydney Harbour	<p>Sydney Harbour is a large body of water.</p> <p>The landform around the harbour comprises peninsulas with steep slopes rising to ridgelines.</p> <p>Natural sandstone outcrops and manmade sandstone walls are visible from parts of the Harbour foreshore.</p> <p>The foreshore of Sydney Harbour mainly consists of vegetated public recreational areas and private dwellings. The harbour also includes moored yachts flanking the foreshores, and jetties and pontoons.</p> <p>The existing wharf is enclosed and protected by the escarpment to the east and Cremorne Point to the west.</p>

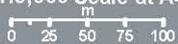


**Legend**

- Construction footprint
- Cadastre (NSW SS, 2019)
- Landscape character zones (Aurecon)**
- Zone 1 - Residential slopes - Mosman
- Zone 2 - Residential slopes - Cremorne Point
- Zone 3 - Recreation / foreshore reserves
- Zone 4 - Taronga Zoo
- Zone 5 - Sydney Harbour

**FIGURE 6-6**

1:5,000 Scale at A4



**Landscape character zones**

**SOUTH MOSMAN**



## Viewpoints

The following distance zones have been established to assist in the assessment on key views within the vicinity of the proposal. The zones are categorised as follow:

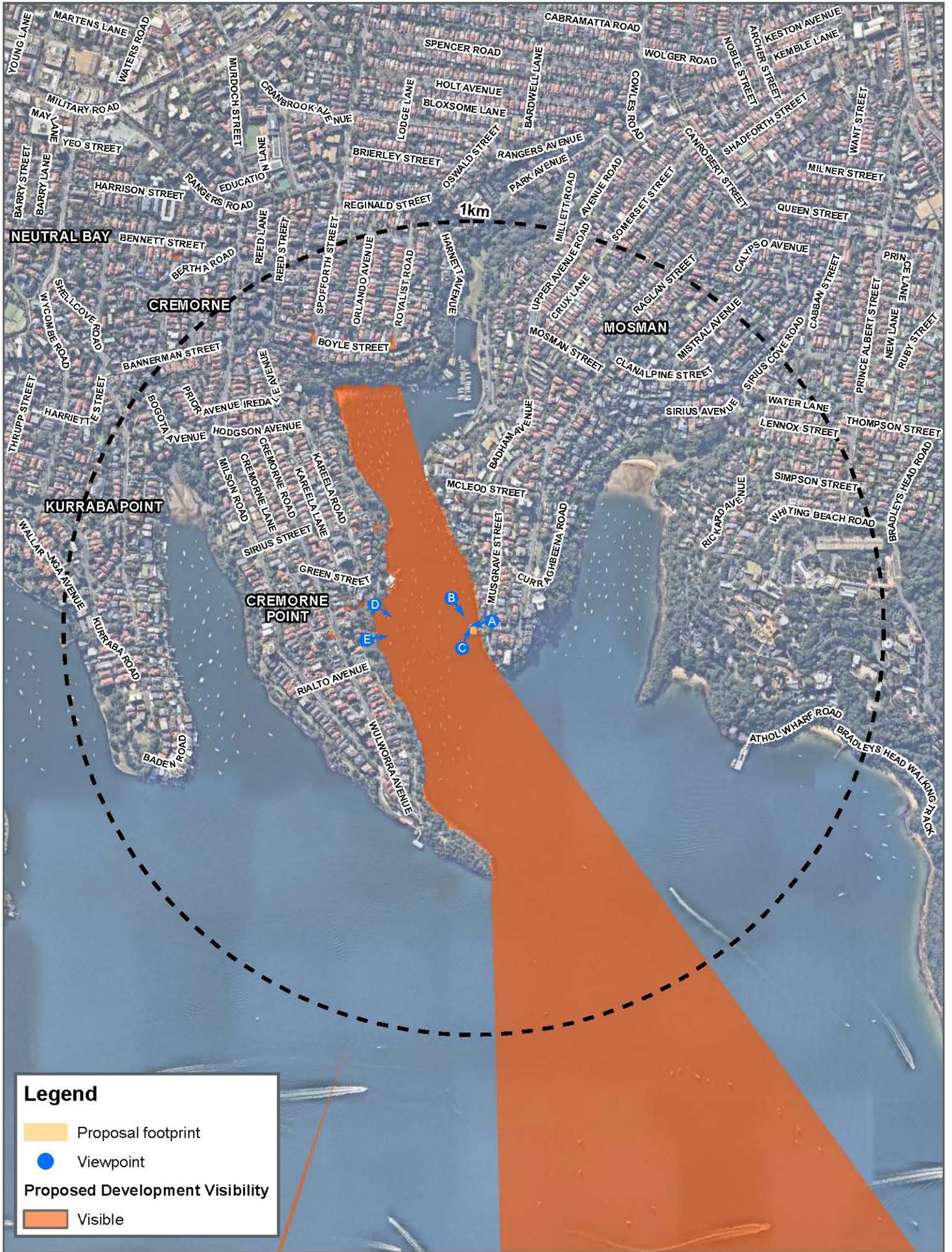
- Foreground zone (FZ): 0 – 250 metres from the viewer
- Middle ground zone (MZ): 250 – 500 metres from the viewer
- Background zone (BZ): 500 metres or greater from the viewer.

Five viewpoints were selected in consultation with Transport for NSW to assess the visual impact which are detailed in Table 6-17 and shown on Figure 6-7.

**Table 6-17: Viewpoint locations and descriptions**

Viewpoint	Description	Distance zone
Viewpoint A – Musgrave Street turning circle looking south-west (Source: TfNSW Figure 6-8)	Viewpoint A is located on a terrace above the southern end of Musgrave Street adjacent to the existing bus stop. The viewpoint is elevated above the site of the existing wharf. The existing view incorporates views of the harbour through canopies of existing indigenous trees that are growing from the foreshore terrace that provides access to the existing wharf. The existing residence in the view is No.2 Musgrave Street.	FZ
Viewpoint B – Foreshore adjacent to 2 Musgrave Street, Mosman looking south (Source: TfNSW Figure 6-9)	Viewpoint B is from the harbour waterway, approaching the wharf site from the north-west. The view includes the existing sea wall and vegetated foreshore against the backdrop of single dwelling houses and apartments on the southern end of the peninsula. The southern foreshore of Sydney Harbour forms the distant horizon.	FZ
Viewpoint C – Sydney Harbour looking north-east toward wharf (Source: TfNSW Figure 6-10)	The existing view includes the current wharf against the backdrop of housing and vegetation on the mid to northern portion of the Mosman Point peninsula. The historically significant Musgrave Street wharf seawall is a significant component of the view as is the well vegetated foreshore. The existing wharf is somewhat dilapidated and is a detractor from the quality of the view. The visual quality of residential development is high and vegetation forms a significant portion of the view.	FZ
Viewpoint D – Cremorne Point foreshore walkway looking south-east toward wharf (Source: TfNSW Figure 6-11)	The view is from the pedestrian path immediately south-west of the Sydney Amateur Sailing Club. The view includes the sweep of Mosman Bay and the foreshores of Mosman Point and Cremorne Point. Horizon views include the Taronga Zoo peninsula and the southern foreshore of Sydney Harbour. The existing South Mosman wharf forms a small component of this broad view. It is recessive against the backdrop of Mosman Point.	MZ

Viewpoint	Description	Distance zone
Viewpoint E – Cremorne Point foreshore walkway looking east towards wharf (Source: <i>TfNSW</i> Figure 6-12)	Viewpoint E is from open space on the Cremorne Point foreshore, directly south of the South Mosman wharf site. The view is dominated by the southern end of the Mosman Point peninsula. Other components include Mosman Bay with moored yachts and the residential precinct of Mosman Point which is the dominant backdrop. The wharf site is central in the middle ground of the view.	MZ



**Legend**

- Proposal footprint
- Viewpoint

**Proposed Development Visibility**

- Visible

**FIGURE 6-7**  
 1:12,000 Scale at A4  
 0 50 100 150 200  
 m

**Visibility analysis  
 and key viewpoints**  
 SOUTH MOSMAN



Source: TfNSW

**Figure 6-8 Viewpoint A**



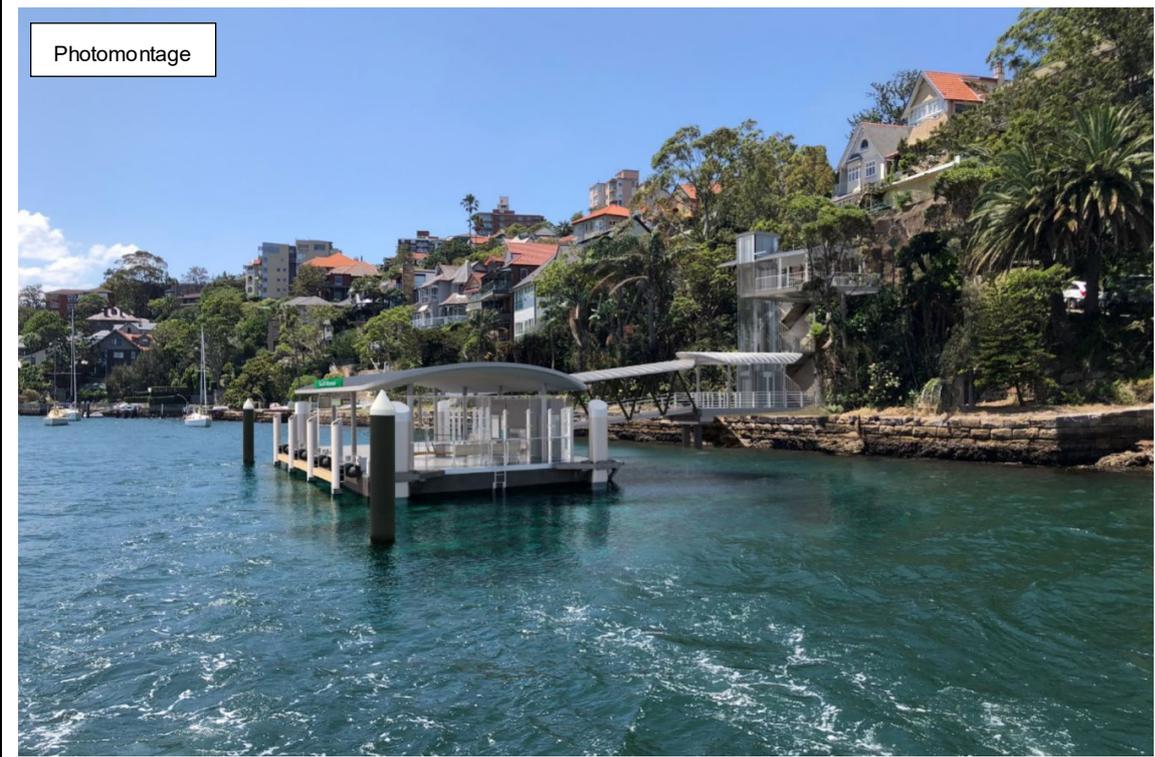
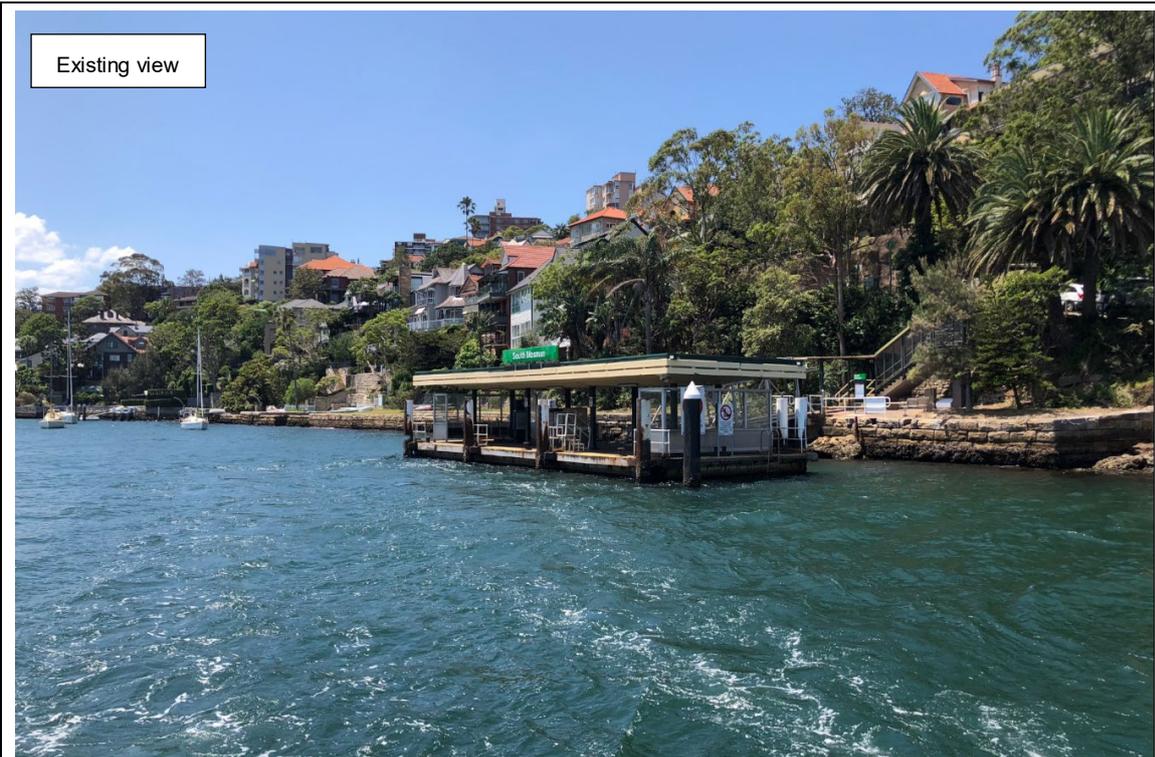
Existing view



Photomontage

Source: TfNSW

**Figure 6-9 Viewpoint B**



Source: TfNSW

**Figure 6-10 Viewpoint C**



Source: TfNSW

**Figure 6-11 Viewpoint D**



Source: TfNSW

**Figure 6-12 Viewpoint E**

### **6.5.3 Potential impacts**

#### **Construction**

Landscape character and visual impacts during construction are expected due to the following construction components:

- Presence of equipment, barges and piling equipment around the wharf
- Removal of the existing wharf structure and construction of a new wharf

- Removal of vegetation to accommodate new wharf structure, lift and compound area
- Established temporary compound area to include site sheds, amenities shed and storage containers for tools and materials
- Minor excavation during construction of the lift and stairs.

Construction work would have the greatest impact to values associated with the Residential slopes (Mosman) and Sydney Harbour landscape zones where the effects would be:

- Change in the composition and setting of the wharf by its removal
- Temporary introduction of construction equipment into the landscape, affecting overall amenity and setting.

This impact would be limited to the construction duration.

## Operation

### *Landscape character*

Table 6-18 summarises the landscape impact assessment on the landscape character zones identified in section 6.5.2. Appendix F provides additional detail on the landscape character zones.

**Table 6-18: Landscape character assessment summary**

Zone	Sensitivity	Magnitude	Description of impact
LCZ1 – Residential slopes - Mosman	High	Moderate	<p>Moderate - High</p> <p>The proposed wharf and lift would have visual connections with private dwellings on Musgrave Street, on the Mosman Peninsula to the north and south of the site and from the Cremorne Point peninsula to the west.</p> <p>The proposal would include some removal of existing trees to facilitate construction of a new pedestrian lift. These land based works would have the highest potential for impact on landscape character.</p> <p>This Mosman residential zone is, however, capable of absorbing moderate change without altering its character.</p>
LCZ2 – Residential slopes – Cremorne Point Sydney Harbour	High	Moderate	<p>Moderate</p> <p>Construction of the new wharf and lift / stair complex would introduce a new built element on the foreshore to the east of the Cremorne Peninsula. The removal of some trees from the foreshore would increase the impact of the new form. Distance from residences on the Cremorne peninsula would be a moderating factor and the wharf complex would form a small component of broad views of the bay and foreshore.</p>

Zone	Sensitivity	Magnitude	Description of impact
LCZ3 – Foreshore reserves	High	Moderate	<p>Moderate</p> <p>The new wharf complex would result in changes to these views from the loss of some foreshore trees and construction, principally, of the new lift and stairs. Again, these views would be over moderate distances and the changed component of the view would be relatively small. In this regard, it is considered that the impact of the development on the Cremorne Point foreshore landscape character unit would be moderate.</p>
LCZ4 – Taronga Zoo	High	Negligible	<p>Negligible</p> <p>The South Mosman wharf site is screened from view from Taronga Zoo by existing landforms. The proposed redevelopment of the Wharf would not be visible from the Zoo.</p>
LCZ5 – Sydney Harbour	High	Moderate	<p>Moderate</p> <p>The proposed South Mosman wharf forms part of a group of wharves servicing Sydney Harbour. The waterside design would be in character with other existing wharves in the broader locality (e.g. Rose Bay, Cremorne Point Wharf, Neutral Bay Wharf, and Balmain Wharf).</p> <p>Tree removal and the proposed lift would impact substantially on views from the harbour waterway.</p> <p>It is considered, however, is that with mitigating measures including new tree planting and the use of contemporary design forms and finishes the proposed redevelopment with pontoon and lift structure would introduce large new built elements to the South Mosman foreshore, which would be quite prominent within scenic context of Sydney Harbour within proximity to the vegetated north shore.</p>

It is considered that the proposed South Mosman wharf would have a moderate to high potential impact on the surrounding character zones.

The proposal would introduce a larger wharf structure and new associated access infrastructure into the local landscape and would also involve loss of some foreshore trees. In close views, these changes are considered to have the potential for high impact on the local landscape character. The impact would reduce to moderate and low to moderate with distance from the wharf site.

## Viewpoints

Visual impact from each key viewpoint is established through an assessment of the sensitivity of the view combined with the magnitude of the proposal within that view point. Table 6-19 summarises the visual impact assessment.

**Table 6-19: Visual impact assessment summary**

View - point	Visible element	Sensitivity	Magnitude	Description of impact
A (Source : <i>T#NSW</i> Figure 6-8)	Lift access platform and canopy, staircase to wharf level.  Removed trees are also a significant element of the changed view.	High	High	High  The magnitude of change to this view that would result from the proposal is considered high as it involves removal of existing indigenous trees and introduction of a substantial amount of new built form into available view towards the harbour.  The impact on the view would be mitigated by the contemporary design form of the proposed infrastructure and the use of lightweight and relatively non-intrusive construction materials and finishes.
B (Source : <i>T#NSW</i> Figure 6-9)	Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stairs.	High-Moderate	High-Moderate	High-Moderate  The magnitude of impact on the view of the new wharf complex is also considered moderate to high as it involves substantial new built form and removal of some foreshore trees, offset by an improved quality of built form and finishes.
C (Source : <i>T#NSW</i> Figure 6-10)	Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stairs.	High-Moderate	High-Moderate	High-Moderate  The magnitude of impact on the view of the new wharf complex is also considered moderate to high as it involves substantial new built form and removal of some foreshore trees, offset by

View-point	Visible element	Sensitivity	Magnitude	Description of impact
				an improved quality of built form and finishes.
D (Source : <i>T#NSW</i> Figure 6-11)	Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stairs.	Moderate-Low	Low	Moderate-Low  The magnitude of impact on the view of the new wharf complex is also considered low to moderate as it occupies a small component of the broad, expansive view of the harbour and foreshores.
E (Source : <i>T#NSW</i> Figure 6-12)	Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stairs.	Moderate	Moderate	Moderate-Low  The magnitude of impact on the view of the new wharf complex is also considered moderate. It would incorporate new built form including the passenger lift, platform and access stair and removal of some existing trees on the foreshore.

The new South Mosman wharf would be a significant new built element within its locality. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site.

The South Mosman wharf and access infrastructure are located within the Mosman Point Scenic Protection Area and the Musgrave Street wharf Item of local heritage significance. A determining authority is required to take into account impacts on the scenic quality of the locality and the integrity of the Heritage Item when undertaking an environmental assessment.

Visual impacts from houses on Musgrave Street adjacent to the new wharf complex are considered to be high due to close proximity to the development site and the significant level of change that would occur in these views as a result of the proposal.

Impacts on views from the water within Mosman Bay are considered to be moderate to high due largely to the loss of existing trees in the view and the construction of the new lift, access stair and street level platform. The impacts on these views would be moderated by the existence of the ferry wharf in the current view and the improvement in design quality and finishes that would result from the implementation of the proposal.

Impacts on views from the Cremorne Point foreshore are considered to be moderate from directly opposite the wharf site and decline with movement further to the north where the new wharf complex would be viewed over a greater distance and would be a relatively small component of very broad existing views.

Overall the impact is considered moderate within the context of the harbour and its foreshores.

#### 6.5.4 Safeguards and management measures

Table 6-20 lists the landscape character and visual amenity safeguards and management measures that would be implemented to account for the impacts identified in section 6.5.3 .

**Table 6-20: Landscape character and visual amenity safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
LV1	Landscape and visual	<p>Urban design principles will be integrated throughout the detailed design and construction of the proposal and include:</p> <ul style="list-style-type: none"> <li>• Similar visual structures (such as jetties, pontoons and wharfs) as those located within Neutral Bay, Neutral Harbour and Careening Cove</li> <li>• A coordinated palette of materials and colours to respond to the existing maritime and foreshore character</li> <li>• Low-scale landside and waterside works to improve accessibility, wayfinding and services</li> <li>• The approaches to and surrounds of the wharf designed to maximise amenity and keeping with the existing urban and landscape environment.</li> <li>• Landscape treatment of the wharf to be appropriate and complimentary to the existing landscape.</li> </ul>	Transport for NSW	Detailed design
LV2	Landscape and visual	Hoarding will be erected around the construction compound where possible, to reduce visibility.	Contractor	Construction
LV3	Landscape and visual	Where out of hours work is required, lighting will be directionally controlled to limit potential impacts of light spill on surround receivers, including residential properties.	Contractor	Construction
LV4	Landscape and visual	All impacted areas and ground surfaces, including grassed surfaces adjacent to the wharf and the road surface of Musgrave Street, must be reinstated as near as possible to their original state following the completion of works.	Contractor	Post-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B5	Landscape and visual	Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). Replacement planting (species and number) will be determined in consultation with Mosman Council to reinstate habitat and minimise visual impacts.	Contractor	Detailed design / Post construction

Safeguards and management measures that would address heritage interpretation in the area are identified in section 6.6 (non-Aboriginal heritage).

## 6.6 Non-Aboriginal heritage

This section summarises the proposal's non-Aboriginal heritage impacts. Appendix G contains a supporting technical paper (statement of heritage impact, SOHI) prepared by Artefact (Artefact, 2020).

### 6.6.1 Methodology

This SOHI has been prepared in accordance with the guidelines outlined by the Heritage Office, now Heritage NSW, Department of Premier and Cabinet (Heritage NSW, DPC), and Department of Urban Affairs and Planning in the document *Statements of Heritage Impact as part of the NSW Heritage Manual*. This SOHI has been prepared in accordance with the principles contained in the most recent edition of *The Burra Charter: The Australian ICOMOS Charter for Places of Cultural Significance*.

Heritage listed items within and in the vicinity of the construction footprint were identified through a search of the relevant state and federal statutory and non-statutory heritage registers, including:

- World Heritage List (WHL)
- Commonwealth Heritage List (CHL)
- National Heritage List (NHL)
- State Heritage Register (SHR)
- Section 170 Heritage and Conservation Registers
- Mosman LEP
- *North Sydney Local Environmental Plan 2013* (North Sydney LEP)
- NSW State Heritage Inventory (SHI) Database
- Register of the National Estate (RNE)
- Register of the National Trust of Australia (NSW) (RNTA).

A site inspection was conducted on 26 March 2020. The aim of the site inspection was to inspect the area of proposed impacts to inform a preliminary assessment of archaeological potential and to identify heritage items in the vicinity of the construction footprint that may be affected by the proposal. The inspection was undertaken on foot and a photographic record was made.

### 6.6.2 Existing environment

#### South Mosman wharf historical background

The original South Mosman wharf was constructed in 1873 at the southern end of Musgrave Street and built of piles with timber planking. A sandstone seawall was also constructed, and the wharf was accessed via Raglan Street. While there are no detailed plans of the original wharf, one subdivision plan illustrates the wharf coming out to the west from the very southern point of Musgrave Street. In 1880 a small timber waiting room was constructed on the wharf. The first wharf was used intermittently at first, however by 1893 it was a part of the regular ferry service between Mosman and Circular Quay. The first wharf was then closed and ceased operations entirely by 1905, however it was not demolished for some time after. Portions of the first wharf remain

visible today (particularly at low tide), including the surrounding sea wall and some timber piling fragments.

A second wharf was constructed about 100 metres north of the first Musgrave Street wharf, located on reclaimed land. The second wharf was opened in 1905 and comprised a wharf that was larger and more formalised than the first. This included a large retaining wall, a new pontoon and waiting room, and increased services through Mosman. The early stairs of Musgrave Wharf were constructed of timber and aligned directly west of the wharf.

A photograph from 1929 shows that the waiting room has windows and a new roof. The sandstone wall is present in this photo which does not appear to be modified over time and is still in its original form today. The stairs appear to have been modified over time; in the 1910s they are supported by a stone retaining wall however 1960s photographs show that the sandstone supports had been removed with timber posts replacing them to support the structure. The structure was demolished by the 1970s, as evidenced by aerial imagery, and the SHI states that new pontoon was constructed in 1967. The extant stairs from Musgrave Street were added in 1983. There appears to have been limited upgrades since the late-twentieth century, except for replacement of the enclosed walls and potentially the roof.

### Listed heritage items

Table 6-21 lists the heritage items located within or next to the construction footprint of the proposal. These heritage items are shown on Figure 6-13. The heritage items within a one kilometre visual buffer zone are also included in Table 6-21. The extent of the one kilometre visual buffer zone is based on the visibility analysis shown on Figure 6-7.

**Table 6-21: List of heritage items in the vicinity of the proposal**

Item	Address	Significance	Listing	Distance from construction footprint
Musgrave Street wharf Site	Musgrave Street	Local	Roads and Maritime s170 Heritage and Conservation Register (SHI no. 4920109) Mosman LEP 2012 no. A491	Within
Divided road	Musgrave Street	Local	Mosman LEP 2012 no. I411	Within
Group of 2 houses divided into 3 dwellings	9A-11 Musgrave Street	Local	Mosman LEP 2012 no. I183	Adjacent
Herron Walk Steps	Musgrave Street and Raglan Street	Local	Mosman LEP 2012 no. I412	Adjacent

Item	Address	Significance	Listing	Distance from construction footprint
Chinese boatshed	3 Musgrave Street	Local	Mosman LEP 2012 no. I182	Visual buffer zone (50 metres south-east)
Cremorne Reserve (including Robertsons Point)	N/A	Local	North Sydney LEP 2012 no. I0136	Visual buffer zone (200 metres west)
Sydney Amateur Sailing Club building	Green Street	Local	North Sydney LEP 2012 no. I0103	Visual buffer zone (200 metres north-west)
Cremorne Point Conservation Area	N/A	Local	North Sydney LEP 2012 no. CA06	Visual buffer zone (200 metres west)
Smite of Cremorne Smelter	East of 5 Green Street	Local	North Sydney LEP 2012 no. I0102	Visual buffer zone (220 metres south-west)
Old Cremorne Wharf	Kareela Road, foreshore of Mosman Bay	Local	North Sydney LEP 2012 no. I0110	Visual buffer zone (300 metres north-west)
Balangowan	5 Bromley Avenue	Local	North Sydney LEP 2012 no. I0086	Visual buffer zone (620 metres north-west)
Lower Boyle Street Conservation Area	Lower Boyle Street	Local	Mosman LEP 2012 no. C13	Visual buffer zone (620 metres north-west)

Items I231 (Flats), I229 ('The Castle' Flats), I435 (Raglan Street divided Road) and I437 (Pedestrian steps and walkway) (shown on Figure 6-13) are also listed on the Mosman LEP, however they are outside the visual buffer zone shown on Figure 6-7.



**Legend**

Construction footprint

**Heritage - Mosman LEP 2012 (DPE, Nov 2019)**

Item - General

Item - Archaeological

**FIGURE 6-13**  
 1:1,000 Scale at A4  
 0 5 10 15 20

**Heritage listings**  
 SOUTH MOSMAN

## Archaeology

A preliminary archaeological assessment identified that the construction footprint has potential to contain archaeological remains of local significance, largely associated with the development of the original Musgrave Street wharf and earlier road construction during Phase 2. However, only a small area of the construction footprint is associated with the original Musgrave Street wharf, and these remains are still extant and visible today. Areas of archaeological potential are shown on Figure 6-14. A summary of the findings of archaeological potential and significance is provided in Table 6-22. These archaeological remains are generally unlikely to be found in association with in situ artefact bearing deposits, such as intact occupation deposits. Artefactual material would primarily be associated with reclamation fills, which would not be considered in situ deposits. As a result, the potential archaeological remains within the construction footprint would be classified as 'works'. The preliminary archaeological assessment has found that there is generally nil to low potential for 'relics' as defined by the *Heritage Act 1977*.

**Table 6-22: Summary of archaeological potential and significance**

Phase	Land use	Potential remains	Potential	Significance
Phase 1 (1788-1873)	Informal land use and whaling allotments	Evidence of informal land use, land clearance and evidence of whaling allotments	Nil to low	Local
Phase 2 (1873-1905)	Richard Hayes Harnett development	Evidence of earlier road constructions, such as earlier (gravelled and stone) road surfaces, kerbing and drainage	Low	Local (works)
		Structural evidence of the original Musgrave Street Wharf and seawall, including extant remains at the south end of the construction footprint	High	Low (works)
		Evidence of land reclamation events	Moderate to high	Would not reach the threshold of local significance
Phase 3 (1905-1968)	Second Musgrave Street wharf	Maritime and terrestrial evidence of the second Musgrave Street Wharf and former stairs	Low	Would not reach the threshold of local significance
		Evidence of the Musgrave Street waiting room, including extant remains of the horizontal timber beams	High (low potential for other remains such as sandstone)	Would not reach the threshold of local significance

Phase	Land use	Potential remains	Potential	Significance
			bricks footings)	
		Evidence of early twentieth century road upgrades and formalisation of road surfaces, kerbing and drainage	Low	Would not reach the threshold of local significance
		Evidence of land reclamation events	Moderate to high	Reclamation fill would not reach the threshold of local significance
Phase 4 (1968-present)	Current South Mosman wharf	Not considered archaeological	Nil	N/A



**Legend**

Construction footprint

**Archaeological potential (Artefact, 2020)**

- Phase 2 Original Wharf (high potential)
- Phase 2 Seawall (high potential)
- Phase 2/3 Road Surfaces (low potential)
- Phase 3 Former Wharf (low-moderate potential)
- Phase 3 Reclamation (moderate-high potential)
- Phase 3 Stairs (low potential)
- Phase 3 Waiting Room (high potential)

**FIGURE 6-14**

1:600 Scale at A4

**Areas of archaeological potential**

SOUTH MOSMAN



Map Produced by Cardno NSM/ACT Pty Ltd (MOL)  
 Date: 2020-11-06 | Project: ANIE200198  
 Coordinate System: GDA 1994 MGA Zone 56  
 Map: ANIE200198\_G5044\_SMosman\_ArchHeritage.mxd 01  
 Aerial Imagery supplied by Neamap (August, 2020)

### 6.6.3 Potential impacts

#### Construction

##### ***Direct and potential direct (physical) impacts***

##### Musgrave Street wharf (SHI no. 4920109 and LEP no. A491)

The Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491) is a listed archaeological item and therefore impacts to potential archaeological remains associated with the item would equate to direct impacts to the heritage item. Potential impacts to archaeological remains of the heritage item are discussed in the Impacts to archaeological resources section. An assessment of potential direct impacts to archaeological remains resulting from vibrations are discussed below.

The proposed works would involve the removal of the existing stairs and path which are partially within the curtilage of the heritage item, however, these are not considered to be contributing elements to the significance of the item. The existing wharf and gangway also are not considered to be significant elements of the heritage item and therefore their removal would not result in heritage impacts. As a result, there are little to no built elements associated with the heritage item within the construction footprint except for a small portion of the sandstone retaining wall at the end of Musgrave Street. However, this was constructed as part of the second Musgrave Street wharf and therefore does not provide a strong contribution to the heritage significance of Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491). The portion of the retaining wall within the curtilage of Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491) would not be directly modified by the proposed works. As a result, the proposed works would not result in direct impacts to Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491).

The proposed works would involve piling and the use of a rock hammer and other vibration intensive plant. These works would be located within the minimum safe working distance for cosmetic damage, which is identified in the CNVG (RMS, 2016b) as being within 50 metres of vibration intensive plant. Therefore, due to the close proximity of the works the vibrations associated with the piling, hammering and additional plant have the potential to cause impacts to the archaeological remains in the area, including the extant remains of the original Musgrave Street wharf seawall and the later retaining wall at the south end of the construction footprint. However, only a small number of piles are required, the rock hammering would primarily be located on the opposite side of the construction footprint, the extant remains of the original seawall are already subject to some movement as a result of being within the water, and as stated above the later retaining wall contributes little to the significance of Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491). The potential impacts could also be largely mitigated through control measures (see mitigation measures and recommendations in section 6.6.4). As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, there would be a neutral direct and negligible potential direct impacts to Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491).

##### Divided road (LEP no. I411)

The proposed works would include impacts with the Musgrave Street Divided road (LEP no. I411), including sawing, cutting and excavating in the roadway, and impacts to pavements and kerbing, in addition to temporary construction impacts. The significance of the Musgrave Street Divided road however is largely associated with the structure and form of the road as a divided road, rather than the fabric of the road surface. Although the works would result in impacts within the roadway, they would only affect a small, localised area at the south end of the larger heritage item, and they

would not alter the overall layout or form of the road. Therefore, any impacts to the heritage listed roadway would be minimal.

The proposed works would be located within the curtilage of Divided road (LEP no. I411) and therefore the vibrations associated with the proposed works could result in potential direct impacts. In particular, the proposed works are located within 10 metres of the rock face which divides the two halves of the road and vibrations resulting from the proposed works could potentially cause cracking of the significant rock face. However, the rock face is a robust feature and it is therefore unlikely that the relatively minor works in the roadway would cause substantial structural issues. Furthermore, the portion of the divided road within the construction footprint is only a small part of the overall heritage item. As a result, any potential direct vibration impacts would cause minimal impacts to Divided road (LEP no. I411) overall.

Overall, there would be a negligible direct and potential direct impact to Divided road (LEP no. I411).

#### Chinese boatshed (LEP no. I182)

The proposed works are located outside of the curtilage of Chinese boatshed (LEP no. I182). As a result, there would be no direct impacts to Chinese boatshed (LEP no. I182), and the works would be far enough away (>50 metres) that there would be no risk of potential direct impacts resulting from vibrations.

Overall, the proposed works would result in neutral direct and potential direct impacts to Chinese boatshed (LEP no. I182).

#### Group of 2 houses, divided into 3 dwellings (LEP no. I183)

The proposed works are located outside of the curtilage of Group of 2 houses, divided into 3 dwellings (LEP no. I183). As a result, there would be no direct impacts to the heritage item. Group of 2 houses, divided into 3 dwellings (LEP no. I183) is located 20 metres east from the nearest proposed work (works on Musgrave Street). As a result, the heritage item would be located within the minimum safe working distance for cosmetic damage and the vibrations associated with the proposed works could result in potential direct impacts. However, as the structure is located further away from the main works it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposed works would result in neutral direct and negligible potential direct impact to Group of 2 houses, divided into 3 dwellings (LEP no. I183).

#### Herron Walk Steps (LEP no. I412)

The proposed works are located outside of the curtilage of Herron Walk Steps (LEP no. I412). As a result, there would be no direct impacts to Herron Walk Steps (LEP no. I412). The heritage item is located 20 metres east from the nearest proposed work (removal of the existing stairs). As a result, the heritage item would be located within the minimum safe working distance for cosmetic damage and the vibrations associated with the proposed works could result in potential direct impacts. However, as the structure is located further away from the main works and is on higher ground it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposed works would result in neutral direct and negligible potential direct impact to Herron Walk Steps (LEP no. I412).

### ***Impacts to archaeological resources***

The proposed works within the construction footprint would require excavations up to 5-10 metres deep for the elevator piles and up to 1 metre deep on Musgrave Street, with the remainder of the works typically being shallower than this. However, the preliminary archaeological assessment has identified that there is relatively low potential for significant archaeological remains to be within the impact footprint of the works.

The construction footprint contains extant archaeological remains of the Phase 1 sandstone seawall of the original Musgrave Street Wharf. However, the remains of the seawall are located to the south of the angled return of the later seawall, and the proposed excavations would be located to the north of the angled return of the seawall, therefore the extant archaeological remains of the original seawall would not be directly impacted. Furthermore, the main structure of the original wharf was located further south-east outside the construction footprint, and there are no known Phase 2 remains associated with the original wharf within the grass and pavement area of the construction footprint next to the existing wharf, where excavations for landscaping and construction of the elevator would be undertaken. As a result, the known and potential archaeological remains associated with the original wharf structure and seawall would not be impacted by excavations. The proposed excavations in Musgrave Street would also be located within a small portion of the northern end of the archaeological site and could impact potential Phase 2 archaeological remains of earlier road construction that may survive in that location. This would result in a direct impact to locally significant archaeological remains within the heritage item. However, this would only be within a very small area. Overall, the potential archaeological impacts to Musgrave Street Wharf site (SHI no. 4920109 and LEP no. A491) would be negligible.

On Musgrave Street there is also low potential for locally significant archaeological remains of Phase 2 road constructions to be present within the curtilage of Divided road (LEP no. I411). Evidence of the former road constructions, including earlier road surfaces and associated kerbing and drainage, would be directly associated with the establishment of Divided road (LEP no. I411). Therefore, impacts to the potential archaeological remains would result in an archaeological impact to the heritage item. The proposed works would only be undertaken within a relatively small portion of the heritage item, however. Overall, the potential archaeological impacts to Divided road (LEP no. I411) would be negligible.

The bulk of the proposed excavations would be undertaken around the base of the elevator for the piles and landscaping. However, the preliminary archaeological assessment has identified that there are unlikely to be significant archaeological remains present in that location. There is generally nil to low potential for locally significant archaeological remains from the Phase 1 whaling allotment. The construction footprint was primarily associated with the Phase 3 establishment of the second Musgrave Street wharf and waiting room, however, it has been assessed that archaeological remains associated with these would not reach the threshold of local significance as this site was associated with later development of transportation in Mosman and was not associated with Richard Harnett, local developer and organiser of the first ferry service to the original wharf site. A large amount of available imagery of the site is also available and would therefore provide no additional research potential.

This would include potential maritime remains associated with the former pontoon, such as timber piles, as well as non-significant Phase 2 reclamation fills including minor artefactual material contained within the fill layers. As a result, there is limited risk of impacts to significant archaeological remains within the main portion of the construction footprint.

Overall, the proposed works would potentially result in negligible impacts to archaeological remains of local significance. As a result, it is unlikely that detailed archaeological management and investigation would be required.

## Operation

### *Indirect (visual) impacts*

The visual impact of the proposal was assessed for all heritage items identified within the visual buffer of the proposal as shown in Table 6-23 (refer Appendix G for details).

It was determined that the proposal would result in neutral visual impact to the Chinese Boat Shed (LEP no. I182), Balangowan (LEP no. I0086) and Lower Boyle Street Conservation Area (LEP no.C13). The proposed works would result in negligible visual impact to the other heritage items within the visual buffer zone.

**Table 6-23: Summary of heritage impacts**

Item	Direct	Indirect (visual)	Potential direct	Archaeological
Musgrave Street wharf site	Neutral	Negligible	Negligible	Negligible
Divided road	Negligible	Negligible	Negligible	Negligible
Chinese boatshed	Neutral	Neutral	Neutral	Negligible
Group of 2 houses, divided into 3 dwellings	Neutral	Negligible	Negligible	Neutral
Herron Walk Steps	Neutral	Negligible	Negligible	Neutral
Cremorne Reserve (including Robertsons Point)	Neutral	Negligible	Neutral	Neutral
Sydney Amateur Sailing Club building	Neutral	Negligible	Neutral	Neutral
Cremorne Point Conservation Area	Neutral	Negligible	Neutral	Neutral
Site of Cremorne Smelter	Neutral	Negligible	Neutral	Neutral
Old Cremorne Wharf	Neutral	Negligible	Neutral	Neutral
Balangowan	Neutral	Neutral	Neutral	Neutral
Lower Boyle St Conservation Area	Neutral	Neutral	Neutral	Neutral

#### 6.6.4 Safeguards and management measures

Table 6-24 lists the non-Aboriginal safeguards and management measures that would be implemented to account for the impacts identified in section 6.6.3.

**Table 6-24: Non-Aboriginal safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
H1	Archaeological significance	If archaeological 'works' such as evidence of earlier road constructions are encountered during construction works and will be impacted, archaeological investigation and recording will be undertaken prior to impacts.	Contractor	Construction
H2	Archaeological significance	If unexpected 'relics' are encountered during excavation, a section 146 relics notification will be forwarded to Heritage NSW, DPC. 'Relics' cannot be impacted without appropriate approvals under the <i>Heritage Act 1977</i> .	Contractor	Construction
H3	Archaeological significance	If significant archaeological remains are encountered during excavation, design options for avoiding impacts to the significant archaeological remains should be considered where practicable and opportunities should be investigated for the implementation of heritage interpretation.	Contractor	Construction
H4	Non-Aboriginal heritage	A heritage induction will be provided to workers prior to construction, informing them of the location and significance of known heritage items and the implementation of the Roads and Maritime <i>Unexpected Heritage Item Procedure</i> (RMS, 2015) if unanticipated heritage items or depositions are located during construction. The heritage induction will include management of expected non-significant archaeological remains, such as minor artefactual material associated with Phase 2 reclamation fills.	Contractor	Pre-construction
H5	Non-Aboriginal heritage	The Roads and Maritime <i>Unexpected Heritage Item Procedure</i> (RMS, 2015) will be implemented if unanticipated heritage items or depositions are located during construction.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
NV5	Vibration impact to heritage structures	Where works are proposed within the safe working limits for the heritage structures (the original seawall and retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183)), specialist advice will be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works will potentially result in impacts to heritage structures. Vibration monitoring will be carried out to confirm vibration levels prior to construction commencement.	Contractor	Pre-construction
NV6	Vibration impact to heritage structures	Regular inspections of the construction activities and work areas will be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology and confirm the integrity of the seawall and retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183). Assessment and monitoring of vibration impacts will adhere to: <ul style="list-style-type: none"> <li>British Standard BS 7385: Part 2: Evaluation and Measurement for Vibrations in Buildings –Part 2 Guide to Damage Levels from Ground-Borne Vibration</li> <li>German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.</li> </ul>	Contractor	Construction
H6	Vibration impact to heritage structures	If vibration monitors are attached to the retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183), they must not be attached with permanent fixings. They should be removable without causing damage. Bees wax may be a suitable attachment method.	Contractor	Construction
H7	Vibration impact to	If it is identified that levels of vibration are causing damage to heritage fabric, works must cease, and the construction methodology reviewed by the project	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	heritage structures	engineers in consultation with a Heritage Consultant in order to mitigate further impacts. A temporary protection plan to outline protection measures required for significant fabric during activities causing potential vibration impacts will be prepared prior to commencement of works.		
LV4	Visual impact	All impacted areas and ground surfaces, including grassed surfaces adjacent to the wharf and the road surface of Musgrave Street, must be reinstated as near as possible to their original state following the completion of works.	Contractor	Post-construction
H8	Heritage Interpretation Strategy	<p>In accordance with the sustainability requirements for the project, opportunities for implementation of heritage interpretation will be investigated during detailed design. A Heritage Interpretation Strategy will be prepared for the proposal to discuss various media for heritage interpretation appropriate to the location and heritage significance of the South Mosman wharf. Interpretation may include heritage signs and/or artwork pieces.</p> <p>This report will be consistent with the recommended management for Musgrave Street wharf site (SHI no. 4920109) that is outlined in the SHI sheet for the Roads and Maritime s170 Heritage and Conservation listed item, which states that <i>'The wharf waiting shelter provides opportunities for interpretation of the history and significance of the wharf, the ferry system and other heritage elements within their visual catchment which should be explored and developed'</i>.</p>	Contractor	Detailed design
H9	Heritage Interpretation Strategy	As part of the preparation of the Heritage Interpretation Strategy the area around South Mosman wharf, Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491) and Divided road (LEP no. I411) should be photographed to help document the changes to the area and the development of the South Mosman wharf.	Contractor	Pre-construction
H10	Impact to heritage item (SHI no.	If feasible, the extant timber beams that are visible in the seawall and are associated with the second Musgrave Street wharf and waiting room should be retained and re-use can be incorporated into the Heritage Interpretation Strategy.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	4920109 and LEP no. A491)			
H11	Design	If design changes result in additional excavations and impacts to significant archaeological remains associated with Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), further archaeological assessment and management will be required.	Transport for NSW	Detailed design / Pre-construction
H12	Design	Any project redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to the South Mosman wharf SOHI.	Transport for NSW	Detailed design / Pre-construction

## 6.7 Aboriginal cultural heritage

This section summarises the proposal's Aboriginal heritage impacts. The Transport for NSW Aboriginal Cultural Heritage Officer has issued a Stage 1 clearance letter for the proposal in accordance with *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) on 30 October 2020, included as Appendix H.

### 6.7.1 Methodology

The assessment included a desktop review of published records, data and literature, including a records search of the Aboriginal Heritage Information Management System (AHIMS) to confirm the presence of values in the local area.

The PACHCI assessment was completed for Aboriginal heritage assessment in reference to the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011b) and the *Code of Practice for the Protection of Aboriginal Objects* (DECCW, 2010b).

### 6.7.2 Existing environment

The Stage 1 PACHCI assessed the proposed works as being unlikely to have an impact on Aboriginal cultural heritage.

The assessment is based on the following due diligence considerations:

- The project is unlikely to harm known Aboriginal objects or places
- The AHIMS search did not indicate any known Aboriginal objects or places in the immediate study area
- The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the *Code of Practice for the Protection of Aboriginal Objects* (DECCW, 2010b), and the Roads and Maritimes' procedure
- The Aboriginal cultural heritage potential of the study area appears to be severely reduced due to past disturbance.

### 6.7.3 Potential impacts

#### Construction

The proposed works are unlikely to result in harm to Aboriginal objects and sites, as the works are limited to the existing wharf structure and the proposed site to the north; all of which are within heavily disturbed land. Stage 1 of the Roads and Maritime PACHCI was completed for the proposal, which concluded the proposal was unlikely to have an impact on Aboriginal cultural heritage and did not require further investigations or assessment.

#### Operation

The South Mosman wharf would continue to operate as a wharf, serviced by the same vessels, so it is not expected that there would be any change in the nature or severity of impact to unknown Aboriginal objects or sites.

An Aboriginal Heritage Impact Permit (AHIP) under the *National Parks and Wildlife Act 1974* is not required for the proposal.

No impacts to Aboriginal heritage items are anticipated during operation of the proposal as no significant change to the existing operation is proposed.

#### 6.7.4 Safeguards and management measures

Table 6-25 lists the Aboriginal heritage safeguards and management measures that would be implemented to account for the impacts identified in section 6.7.3.

**Table 6-25: Aboriginal heritage safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
AH1	Aboriginal heritage	Should the scope of the proposed work change, further consultation with Transport for NSW's Aboriginal Cultural Heritage Officer and regional environmental staff must be undertaken to reassess any potential impacts on Aboriginal cultural heritage.	Transport for NSW	Pre-construction / Construction
AH2	Heritage Interpretation Strategy	In accordance with the sustainability requirements for the project, opportunities for implementation of Aboriginal heritage interpretation (such as interpretation signage) should be investigated during detailed design, and incorporated into the overall Heritage Interpretation Strategy for the project.	Contractor	Detailed design
AH3	Unexpected heritage finds	The Roads and Maritime <i>Unexpected Heritage Items</i> (RMS, 2015) will be followed in the event that (an) unknown or potential Aboriginal object(s), including skeletal remains, is/are found during construction. This applies where Transport for NSW does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the procedure) is not in place. Work will only restart once the requirements of that procedure have been satisfied.	Contractor	Construction

## 6.8 Transport, traffic and access

This section describes the land and maritime based traffic, transport and access impacts associated with the proposal.

### 6.8.1 Methodology

A qualitative assessment of transport, traffic and access was performed and considers the following:

- Desktop assessment of existing transport options near the proposal
- Evaluation of construction and operation impacts to maritime and landside transport.

### 6.8.2 Existing environment

#### Land transport

##### **Road network**

South Mosman wharf is located to the east of the Warringah Freeway and can be accessed via Musgrave Street, which runs through the peninsula and terminates at the Wharf. The road network in the vicinity of the wharf is characterised by residential streets with on-street and off-street parking. Speed limits in the vicinity to the proposal are generally 50 kilometres per hour.

##### **Bus network**

There are two bus routes that service the wharf: route 230 and route 236.

Route 236 services the wharf exclusively, traveling between Spit Junction and South Mosman wharf. The entire journey takes about 10 minutes. The bus stop is located 50 metres from the wharf entrance. The route caters to public transport users who live in residential areas away from the Military Road arterial corridor. On weekdays, the 236 bus operates from Spit Junction between 06:14 to 20:05 and the last bus leaves the wharf at 20:18 to Spit Junction. On Saturdays the 236 bus operates from Spit Junction between 07:14 to 20:09 and the last bus from the wharf leaves at 20:20. On Sundays and public holidays the 236 bus operates from Spit Junction between 09:09 and 20:09 and the last bus leaves the wharf at 20:20. There are services every 30 minutes from Monday to Friday, as well as on weekends. There are various bus routes between the Spit Junction and Military Road that travel to the Sydney CBD.

Route 230 travels between Milsons Point wharf and Mosman Bay wharf passing through the suburbs of Mosman, Cremorne, Neutral Bay and North Sydney. This route service the residents in Mosman connecting Milsons Point Wharf, Milsons Point Station, North Sydney Station and Mosman Bay wharf. On average, the entire journey takes about 35 minutes. The South Mosman wharf is within 10 minute walk from Mosman Bay wharf on Avenue Road. On weekdays, the 230 bus operates from Milsons Point wharf between 06:56 and 23:49 and the last bus leaves Mosman Bay wharf at 23:25 to Milsons Point. On Saturdays the 230 bus operates from Milsons Point wharf between 07:54 and 23:53 and the last bus from the Mosman Bay wharf leaves at 23:23 to Milsons Point. On Sundays and Public holidays, the 230 bus operates from Milsons Point wharf between 08:23 and 21:49 from Milsons Point wharf and the last bus leaves the Mosman Bay wharf at 22:23 to Milsons Point. The frequency of bus

services on Route 230 range between 15 minutes and 30 minutes during peak periods, and 30 minutes and 60 minutes off-peak and on weekends.

### ***Train network***

Milsons Point station and North Sydney station are located 4.1 kilometres and 4.3 kilometres (walking distance) away from the wharf, respectively. Both stations are on the T1 North Shore, Northern and Western Line, providing connectivity to Hornsby, Epping, Penrith and Richmond. The frequency of services along this line ranges from three minutes between trains during the peak period and 10 minutes during off-peak periods.

### ***Bicycle network***

Marked bicycle routes established by Mosman Council are present along Raglan Street, Avenue Road, and the Rangers Avenue. These bicycle routes provide connectivity to Military Road in the north and towards the Pacific Highway, Milsons Point Station and North Sydney Station. Access for cyclists travelling to and from the wharf requires connectivity to the local bicycle network via Musgrave Street. Musgrave Street is also identified as a suggested, unmarked cycling route in the Northern Sydney Cycling Map, with the identified route running along both Musgrave Street and Raglan Street providing connectivity to Mosman Town Centre. No bicycle parking hoops or secure lockers are currently provided at the wharf.

### ***Pedestrian access***

Pedestrian access to the wharf is mainly via Musgrave Street and alternatively via Raglan Street, the two-main north-south roadways through the peninsula.

Provision for pedestrians walking towards the wharf comprises a 1.2 metre wide concrete footpath along the western side of Musgrave Street, which has an average slope of 9.8 per cent along a 100 metre section starting from the wharf entrance. This may cause issues for passengers with limited mobility. Access from Raglan Street to the wharf requires pedestrians to traverse a steep stairway and elevated walkway accessible via Herron Walk. This route is not wheelchair accessible.

### ***Parking***

On-street parallel parking is available along the western side of Musgrave Street. Parking is restricted to two hours between 8:30 am and 6:00 pm Monday to Friday, with exceptions for permit holders. There is a 'no parking' restriction at the Musgrave Street cul-de-sac and the bus stop on the western side.

## **Water transport**

### ***Ferry network***

South Mosman wharf is part of the F6 Ferry Service that operates between Circular Quay and Mosman Bay. The Mosman Bay ferry service operates from Cremorne Point, South Mosman, Old Cremorne and Mosman Bay wharves to Circular Quay. It takes about 15 minutes for the ferry to travel from South Mosman wharf to Circular Quay.

During weekdays the F6 Mosman Bay to Circular Quay ferry service stops at South Mosman wharf from 6:29 to 00:27 with the exception of 17:00 to 19:00 when the ferry service runs express from Mosman Bay to Cremorne Point. On Saturdays, the ferry service stops at the Wharf from 7:30 to 00:27. During Sundays and public holidays the ferry service stops at the Wharf from 9:30 to 21:27.

During weekdays the F6 Circular Quay to Mosman Bay ferry service stops at South Mosman wharf from 9:15 to 00:15. On Saturdays, the ferry service stops at the wharf from 7:15 to 00:15. During Sundays and public holidays the ferry service stops at the Wharf from 9:15 to 21:15.

During weekdays the F6 ferry service usually operates every 30 minutes from the Wharf and during weekends and public holidays the ferry service operates every hour from the Wharf.

A review of 2017 opal card data completed during the concept design stage indicated that the highest average patronage in a one-hour period was 81 patrons (79 boarding, two alighting).

Ferry patronage in the case of a special event was also recorded, with the maximum number of boarding and alighting passengers in an hour as 109 patrons.

Transdev (formerly Harbour City Ferries) is the primary public transport network operator using the wharves within the Inner Harbour, Outer Harbour and Parramatta River areas. Transdev operates the services under an agreement with Transport for NSW.

### **6.8.3 Potential impacts**

#### **Construction**

##### ***Land transport***

Construction vehicles would access the proposal via Musgrave Street. There would be a large number of heavy vehicles accessing site via Musgrave Street during earthworks, installation of the lift and demolition of the existing shelter and stairs. It is anticipated that most materials and equipment required for land based elements of the proposal would be delivered by road.

Up to five heavy vehicles would be used for construction and a maximum of ten light and heavy vehicles would be used for deliveries to site. Temporary traffic lights or stop-go provisions on Musgrave Street may be required if major deliveries take place by road. The additional construction traffic expected within the area is considered minor and would be unlikely to affect the capacity of the road network.

Closure of South Mosman wharf would require commuters to use alternative transport. The proposal would be constructed over a duration of up to six months and the wharf would be closed throughout the construction period. Local bus services, North Sydney train station, Milsons Point train station and Mosman Bay wharf are possible alternatives for some public transport customers in the catchment area of South Mosman wharf.

Existing bus services would be used to support access to Sydney CBD as bus transport would remain operational with the exception of when construction activities are occurring near the bus stop at the wharf. Ferry users travelling to or from the city could catch the existing 236 bus service along Musgrave Street to Spit Junction and then use a connecting bus service to the Sydney CBD. Alternatively, customers can catch the route 230 from Mosman Bay Wharf along the Avenue Road to Milsons Point Station.

The existing bus service (route 236) has reduced operating hours compared with the ferry service. The bus services from the wharf to Spit Junction stops at 20:18 during the weekdays and 20:20 during weekends and public holidays. However, the Circular Quay to Mosman Bay ferry service to the wharf stops at 00:15 during weekdays and

Saturdays and 21:15 during Sundays and public holidays. As such consideration should be given to extending the bus operating hours to reduce travel impacts.

Some commuters may also use private vehicles during the construction which may result in additional commuter traffic. This traffic would be spaced over the day, and from different locations within the wharf catchment, and is not likely to result in congestion related impacts to the existing road network.

Pedestrian and cyclist access is not anticipated to be impacted from the construction.

The ancillary facilities identified in section 3.4 do not include provision for light vehicle parking. It is anticipated that any parking requirements during construction would utilise the existing parking arrangements available locally. There may be loss of some parking spaces on Musgrave Street during construction. Some workers may travel to and from the site by boat from the off-site facility minimising impacts to parking in the vicinity of the proposal. Where feasible, plant, equipment and materials would also be transported to the construction work site by barge or boat. Where parking is required for construction vehicles this would be managed through the TMP.

### ***Water transport***

South Mosman wharf would be closed for up to six months during construction. Based on the patronage data for the South Mosman wharf, there would be disruption of up to 81 passengers during peak hour due to closure of the wharf.

A maritime exclusion zone may be required around the construction footprint during construction to prevent commercial and recreational traffic entering the area. This would also include changes to the F6 Mosman Bay ferry route to avoid the construction site.

Where feasible, materials and equipment for water based elements of the proposal would be shipped (barged) into and out of the area to limit any impact on Musgrave Street and surrounds. This would provide the best method to build the marine components and may also be used to deliver materials for the land-based components of the proposal. The amount of materials shipped to site, over being delivered by road, would be confirmed during detailed design.

Construction of the proposal would result in up to four vessels travelling between an off-site facility and the wharf each day. The minor increase in vessel movements is not considered to be significant in the context of the harbour.

## **Operation**

### ***Land transport***

Ferry services would recommence once the new wharf is operational. The proposal would result in the improvement of efficiency and user experience of ferry services from the wharf. This may result in an increase to patronage of the wharf and ferry service and additional commuter traffic travelling to and from the wharf. However, this is not considered to be significant based on the existing patronage of the wharf.

The proposal would result in the construction of a lift in proximity to the bus stop in the cul-de-sac of Musgrave Street.

Three bicycle hoops would also be installed at street level.

### ***Water transport***

Ferry operations to South Mosman wharf would commence once the new wharf is operational. The proposal would result in the improvement of efficiency and user experience of ferry services from the wharf. This may result in an increase to patronage of the wharf and ferry service. However, this is not considered to be significant based on the existing patronage of the wharf.

The proposal would enable the continuation of a ferry service for the period of its 50-year operational life and would also improve the efficiency and user experience of the wharf.

Recreational fishing would continue to be allowed at the proposed wharf.

#### 6.8.4 Safeguards and management measures

Table 6-26 lists the transport, traffic and access safeguards and management measures that would be implemented to account for the impacts identified in section 6.8.3.

**Table 6-26: Transport, traffic and access safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
T1	Land transport, parking and access	<p>A Traffic Management Plan (TMP) will be prepared and will include the following.</p> <ul style="list-style-type: none"> <li>• Final access and parking arrangements</li> <li>• Alternate pedestrian and cyclist access around the construction area</li> <li>• Measures to ensure light vehicle parking is strictly in accordance with Mosman Council requirements and prevents parking on footpaths and grassed areas adjacent the site.</li> </ul>	Contractor	Pre-construction
T2	Land transport, parking and access	Where possible, the preferred means of transporting equipment and materials to the site will be via boat and barge over land transport so as to limit impacts to the local road network.	Contractor	Construction
T3	Land transport, parking and access	Public transport passengers will be notified of any impacts to transport services and the alternative transport arrangements prior to the commencement of construction. This will include updates to the timetable (online and Opal app) indicating the temporary closure of the South Mosman wharf.	Transport for NSW	Pre-construction / Construction
T4	Water transport	<ul style="list-style-type: none"> <li>• A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area.</li> <li>• This zone will be clearly defined to communicate access for other water users.</li> </ul>	Contractor	Pre-construction / Construction
T5	Water transport	A Maritime TMP will be prepared and implemented during the water based construction work. The Maritime TMP will be prepared in consultation with Transport for NSW and approved by the Harbourmaster. In addition, the project will:	Contractor	Pre-construction / Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>• Fit all buoys with lights</li> <li>• Prepare Response Plans for emergencies and spills for all construction vessels</li> <li>• Fit at least one vessel with an Automatic Identification System (AIS)</li> <li>• Retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements</li> <li>• Prepare a Communications Plan for implementation during the work which must include 24/7 contact details, protocols for enquiries, complaints and emergencies.</li> </ul> <p>Any variation to the above will be agreed in advance with the Harbourmaster.</p>		
T6	Water transport	Commercial, recreational operators and private services that use the existing wharf will be advised of the wharf closure at least two weeks prior to closure.	Transport for NSW	Pre-construction / Construction

## 6.9 Socio-economic

This section summarises the proposal's socio-economic impacts. Appendix I contains a Socio-Economic Impact Assessment (SEIA) prepared by Cardno (Cardno, 2020e).

### 6.9.1 Methodology

The SEIA assesses the socio-economic impact of the proposal in accordance with the *Environmental Impact Assessment Practice Note: Socio-economic assessment (EIA-N05)*(RMS, 2013).

For the purpose of defining a boundary for assessing social and economic characteristics, Australian Bureau of Statistics (ABS) geographic boundaries referred to as Statistical Areas Level 2 (SA2s) have been used, and the Mosman LGA was used as a comparison.

The following data sources were used to define the socio-economic baseline:

- Data on population and demography, income and employment, and business and industry were sourced from the ABS Census 2016, and Commonwealth, State and local government agencies
- Existing socio-economic policies and strategies in the North Sydney-Mosman area, including local government policies and strategies:
  - Mosman Disability Inclusion Action Plan 2017-2021 (Mosman Council, 2017a)
  - The MOSPLAN: Community Strategic Plan 2018-2028 (Mosman Council, 2018a)
  - Mapping Mosman's Community Services and Programs (Mosman Council, 2018b)
  - Greater Sydney Harbour Estuary Coastal Management Program Scoping Study (BMT, 2018)
  - 2018-2019 Annual Report (Mosman Council, 2019)
  - The MOSPLAN: Revised Delivery Program 2018-2021 and Operational Plan 2020-2021 (Mosman Council, 2020a)
- South Mosman Wharf Upgrade Concept Design Community Consultation Report – July 2020 (NSW Government, 2020) details the outcomes of community consultation on the concept design of the proposal
- DPIE population projections (DPIE, 2019b)
- Analysis of social infrastructure based on a review of publicly available information, including Council's webpage
- Available mapping and imagery from Google maps and from government agencies.

This assessment is informed by the specialist studies prepared as part of the concept design and REF.

The SEIA was also informed by stakeholder and community consultation undertaken during the concept design.

## **6.9.2 Existing environment**

The proposal is situated in the Mosman LGA (refer Figure 6-15). It is an area of 865 hectares within the North Sydney–Mosman SA3. The Mosman LGA (the study area) includes the suburbs of Mosman Bay, Middle Head - Georges Heights - Clifton Gardens, Mosman Junction, Mosman Central, Balmoral, Middle Harbour and Beauty Point – The Spit. The proposal is located in the suburb of Mosman Bay. The study area is bounded by the Middle Harbour in the north and north-east, Port Jackson in the east and south, and the North Sydney LGA in the west.

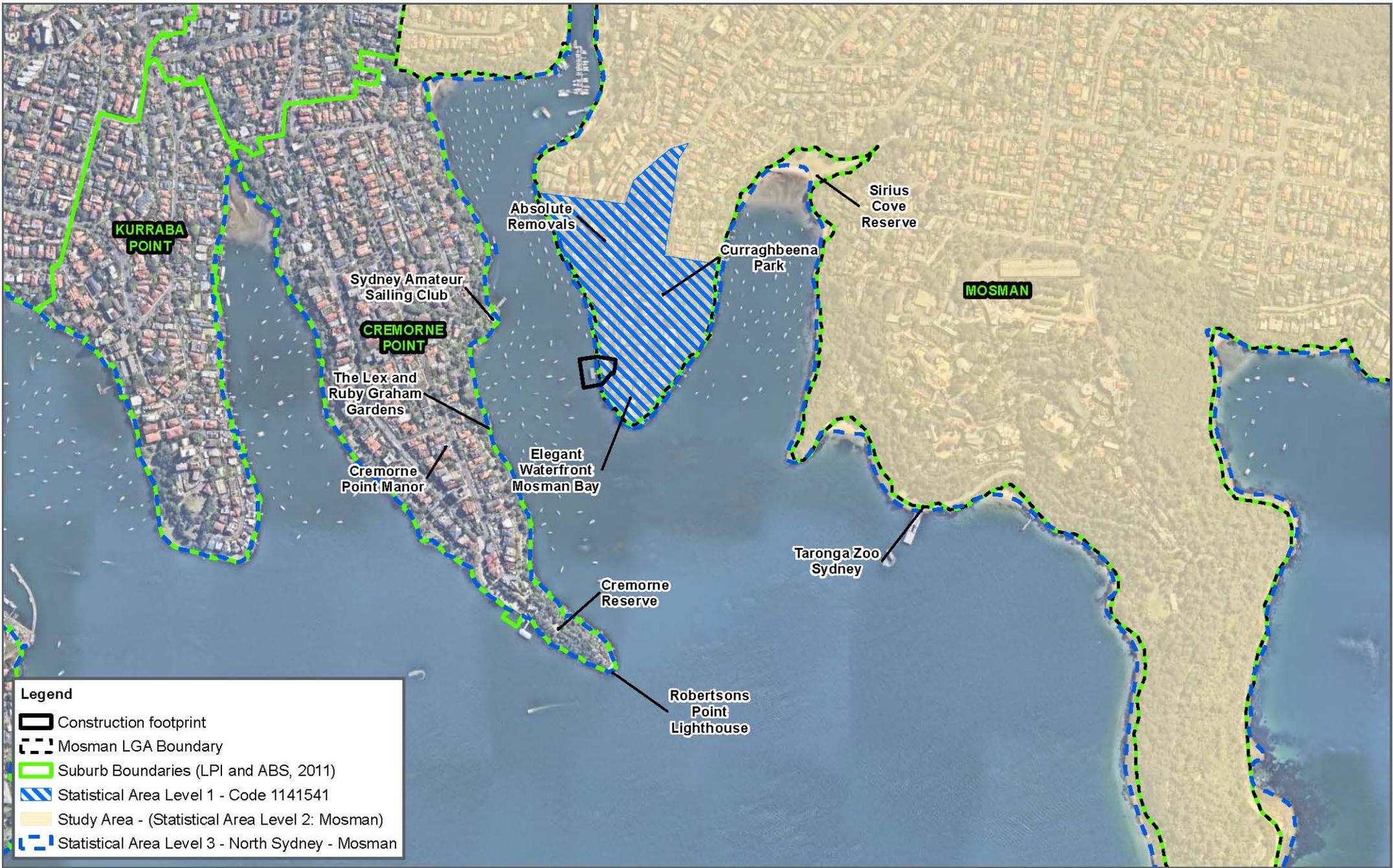
### **Population and demography**

At the time of the 2016 Census, the study area had an estimated residential population of about 28,475 people, of these 46 per cent were male and 54 per cent were female. Aboriginal and/or Torres Strait Islander people made up 0.2 per cent of the population.

About 587 people live in the neighbourhoods closest to South Mosman wharf in Statistical Area 1 – Code 1141541 (refer Figure 6-15).

The study area experienced a four per cent population growth between 2011 and 2016. This is lower than the rate of population growth in the North Sydney–Mosman SA3 (6.5 per cent) and Greater Sydney (10 per cent) for the same period.

In 2018, Mosman LGA recorded population was 30,877 (Mosman Council, 2019). By 2041, the population of Mosman LGA is forecast to grow by 2.44 per cent, which is 31,630 people (DPIE, 2019b).



**FIGURE 6-15**

1:10,000 Scale at A4



**Administrative boundaries of the study area**

**SOUTH MOSMAN**



## Transport and access

The majority of the employed residents (43 per cent) of the study area travelled to work by car (either as driver or as passenger) while 32 per cent used public transport (train, bus, ferry, tram/light rail) as at least one of their methods of travel to work. About 21 per cent travelled by bus and three per cent travelled by ferry as the primary method of travel to work. When compared to Greater Sydney (20 per cent), a high proportion of residents rely on public transport to reach work in the study area (32 per cent). This reflects the study area's high level of access to bus, rail and ferry services.

The transport network is described in further detail in section 6.8.

## Economic profile

In 2016 the median weekly household income in the study area was \$2,522. This was higher than that of the North Sydney-Mosman SA3 (\$2,393).

About 40 per cent of the study area's labour force was employed full time and about 18 per cent were employed part time. Labour force participation (62 per cent) in the Study Area is lower than the North Sydney-Mosman SA3, which is 68 per cent. This correlates with the low percent of the young workforce group in the study area. The most common occupations in the study area include professionals (40 per cent), managers (24 per cent) and clerical and administrative workers (12 per cent). People in the study area mainly worked for the professional, scientific and technical services, and financial and insurance industry sectors.

## Local business

The study area is comprised of large (4,273; ABS, 2016) number of local businesses due to the close proximity to the Sydney CBD. The largest employing industries are: professional, scientific and technical Services.

The only local business in close proximity to the wharf is Elegant Waterfront Mosman Bay guest house. The entrance to the Elegant Waterfront Apartment is via Raglan Street.

Local businesses and service providers within 500 metres of the proposal are (Figure 6-15):

- Elegant Waterfront Mosman Bay – guest house
- Absolute Removals – professional furniture removal business
- Rochelhill Consulting Pty Ltd – professional services company
- The Sydney Amateur Sailing Club
- Cremorne Point Manor – hotel
- Various cafés and restaurants.

## Social infrastructure

Social infrastructure refers to community facilities, services and networks which help individuals, families, groups and communities meet their social needs, maximise their potential for development and enhance community well-being.

Social infrastructure located within the study area, close to the proposal includes (refer Figure 6-15):

- Local parks including:
  - Curraghbeena Park

- The Lex and Ruby Graham Gardens
- Cremorne Reserve
- Cremorne Point Circuit walking track
- Hunts Lookout
- Sirius Cove Reserve
- Taronga Zoo Sydney
- Robertsons Point Lighthouse
- Public transport facilities such as bus stops operating in the Musgrave Street and Raglan Street.

### **Community values**

Community values are those socio-economic aspects considered to be important to quality of life and well-being. They include social factors such as a sense of safety, well-being, belonging and community diversity, as well as physical assets, such as parks and recreational areas.

A community satisfaction survey conducted in 2017 (Mosman Council, 2017b) reveals that the most cherished aspects of living in Mosman are:

- Opportunities for a healthy lifestyle
- Location/proximity to amenities
- Natural environment including provision and maintenance of parklands
- Lifestyle/ambience within Mosman
- Friendly neighbourhood
- Sense of community
- Beaches and harbour foreshore.

### **6.9.3 Potential impacts**

#### **Construction**

The proposal would be constructed over a duration of up to six months and the wharf would be closed throughout the construction period. Local bus services, North Sydney train station, Milsons Point train station and Mosman Bay Wharf are possible alternatives for some public transport customers in the catchment area of South Mosman wharf. The impacts on traffic, transport and access are discussed in section 6.8.

Noise, visual and air quality impacts from construction activities would disrupt the amenity of the area. This would directly impact residents surrounding the wharf. There would be temporary loss of amenity in the area surrounding the wharf due to the construction works and the presence and use of barge mounted cranes and other plant and equipment. Lift installation and associated construction activities would result in removal of trees and native vegetation and a loss of amenity near the wharf. The loss of amenity, along with restrictions on pedestrian access, may discourage the use of these areas in the vicinity of the wharf during construction.

Some construction activities may require work to be carried out during early mornings when the water is calm and the harbour is least busy, a time of day where residents may be more likely to be at home and therefore disrupted by the activities.

Construction activities conducted at night-time, and the high voltage lighting used

during construction, may also disrupt nearby residents. Further information on noise, visual and air quality impacts are described in sections 6.4, 6.5 and 6.10, respectively.

Indirect impact to local businesses in the broader area may occur due to noise, air quality and visual impacts, as well as the decline in patronage of the wharf and general, short term decline in local amenity.

The proposal would also generate some opportunities for employment of local people, and the construction Contractor/personnel may also buy resources, potentially from businesses in the region.

## **Operation**

The proposal would provide a range of long-term socio-economic benefits for the community of the study area, as well as communities and businesses in the wider region.

Currently, customers with mobility needs are unable to access Musgrave Street from the wharf. The proposed wharf design would improve the efficiency and safety for customers getting on and off ferries that stop at the wharf. The new lift would provide access to street-level from the wharf. This also would improve access to customers with prams. This may result in an increase to patronage of the ferry service and additional commuter traffic travelling to and from the wharf. However, this is not considered to be significant in the context of the existing patronage of the Wharf.

The proposal would potentially increase access to goods, services, and economic opportunities for locals by upgrading and improving accessibility to the wharf.

Recreational fishing would continue to be allowed at the new wharf.

The overall visual impact of the proposal once operational is considered moderate. The wharf design aims to unify and identify the harbour wharves and the ferry commuter transport system. The design would minimise the removal of vegetation and incorporate surrounding elements to tie-in to the area; for example the landside upgrades have been designed to fit in with the urban landscape of the surrounding area. It incorporates use of lightweight materials and maximises transparency while at the same time providing for safety, weather protection and equitable access for ferry users. Refer to section 6.5 for further details on landscape character and visual impacts.

During operation, the extra lighting and security cameras at the wharf would deter antisocial behaviour from occurring and provide a safer night-time environment for ferry users. Generally, the design of the ferry wharf creates a clear hierarchy of space, enables safe access/egress, and enables formal and passive surveillance. There would be an emergency button on the pontoon for the security of waiting passengers.

#### 6.9.4 Safeguards and management measures

Table 6-27 lists the socio-economic safeguards and management measures that would be implemented to account for the impacts identified in section 6.9.3. Other safeguards and management measures that would address socio-economic impacts are identified in section 6.8 (traffic, transport and access), section 6.4.5 (noise) 6.5.4 (visual) and 6.10.3 (air quality).

**Table 6-27: Socio-economic safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
SE1	Socio-economic	<p>A Communications and Stakeholder Engagement Plan will be developed prior to the commencement of construction and will be implemented during construction to provide timely and accurate information to stakeholders. It will include (as a minimum):</p> <ul style="list-style-type: none"> <li>• Mechanisms to provide details and timing of proposed activities to affected residents and local businesses, including changes to traffic, public transport services and access</li> <li>• A contact name and telephone number for complaints.</li> </ul>	Transport for NSW	Pre-construction / Construction
SE2	Socio-economic	<ul style="list-style-type: none"> <li>• A webpage and free-call number will be established for enquiries regarding the proposal, and will remain active for the duration of construction.</li> <li>• Contact details will be clearly displayed at the entrance to the site.</li> <li>• All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received.</li> </ul>	Contractor	Pre-construction / Construction
SE3	Socio-economic	Investigate opportunities to improve priorities group employment participation in line with Transport for NSW's Social Procurement Policy.	Contractor	Pre-construction / Construction
SE4	Sustainability	Investigate opportunities to encourage the construction Contractor to purchase goods and services locally.	Transport for NSW	Pre-construction / Construction
SE5	Sustainability	Investigate opportunities to incorporate community health and well-being initiatives in the design and construction of the proposal.	Transport for NSW	Detailed design / Construction

## 6.10 Air quality

### 6.10.1 Existing environment

The existing air quality near the location of the proposal is primarily influenced by emissions from motor vehicles and residential activities. Air quality is also influenced by the prevailing weather and climatic conditions, bushfires and other natural factors such as pollen.

The nearest DPIE air quality monitoring stations to the site is the Bradfield Highway roadside monitoring station in North Sydney. This site was commissioned in 2018. The nearest long term air quality monitoring site is located at Rozelle which is part of the Sydney east monitoring network.

A review of air quality data for the year to April 2020 for Bradfield Highway and Rozelle indicates that air quality is generally categorised as 'Good' based on the air quality index (AQI) (DPIE, 2020b).

The closest Bureau of Meteorology (BoM) monitoring station to the location of the proposal with rainfall data is located at Observatory Hill, Sydney (station number 066062). Data from the BoM (BoM, 2020b) reports that the average annual rainfall recorded at Observatory Hill is 1210 millimetres.

Sydney Harbour (Wedding Cake West) weather station (station number 066196) is located about three kilometres to the east of the proposal. Afternoon winds are generally stronger than morning winds tending towards 20-40 kilometres per hour with morning winds generally 10-30 kilometres per hour (BOM, 2020b). Wind direction and speed varies throughout the day, usually being calmer in the morning. Wind speed and direction also varies throughout the year.

### 6.10.2 Potential impacts

#### Construction

During the construction of the proposal temporary impacts on air quality may arise from:

- Minor generation of particles and dust from general construction work e.g. concrete cutting and breaking
- Minor emissions (primarily diesel exhaust) from plant and machinery
- Minor emissions from construction traffic and water vessels.

These impacts are expected to be short-term, low intensity and be able to be managed through identified safeguard and management measures.

#### Operation

The level of operation of the ferry services would increase, however there are no additional impacts to the air quality expected from the operation of the proposal.

### 6.10.3 Safeguards and management measures

Table 6-28 lists the air quality safeguards and management measures that would be implemented to account for the impacts identified in section 6.10.2.

**Table 6-28: Air quality safeguards and management measures**

No	Impact	Environmental safeguards	Responsibility	Timing
AQ1	Air quality	<p>Air quality during construction will be considered and addressed within the CEMP and will include methods to manage work during strong winds or other adverse weather conditions as required. As a minimum, the following measures will be included:</p> <ul style="list-style-type: none"> <li>• Covering all loaded trucks and vessels</li> <li>• Machinery to be turned off rather than left to idle when not in use</li> <li>• Maintenance of all vehicles, including trucks and vessels entering and leaving the site in accordance with the manufacturers specifications to comply with all relevant legislation</li> <li>• Maintenance of all plant and equipment to ensure good operating conditions and exhaust emissions comply with the <i>Protection of the Environment Operations Act 1997</i></li> <li>• Maintaining the work site in a condition that minimises fugitive emissions such as minor dust</li> <li>• Appropriate sediment and erosion controls for any exposed earth or stockpiled waste.</li> </ul>	Contractor	Pre-construction / construction
AQ2	Sustainability	<p>During construction, the construction contractor is to monitor performance of their non-road diesel plant and equipment against US EPA, EU or equivalent emissions standards using Transport for NSW <i>Air Emissions Workbook - DMS-FT-439</i>.</p>	Contractor	Construction

## 6.11 Waste management

### 6.11.1 Methodology

The assessment considered the impacts associated with:

- Resource use and materials management during construction
- Waste generation, management and disposal during construction
- The proposal's ability to respond to waste management and resource conservation plans, policies and guidelines.

The basis of assessment was to consider the hierarchy of avoiding waste generation and primary resource use in favour of reduction, reuse and recycling, consistent with the *NSW Waste Avoidance and Resource Recovery Act 2001*.

### 6.11.2 Existing environment

Public waste bins are provided at the existing wharf and are managed as part of the existing wharf operations. There is the potential for litter to enter Sydney Harbour from existing wharf activities.

Recreational fishing is undertaken from the existing wharf. Fishing waste was noted as an issue during the community consultation for the concept design development.

In terms of resource use, the wharf has required ongoing maintenance, repair and upgrade over time. This has required the use of small quantities of replacement materials such as timber and metal.

### 6.11.3 Potential impacts

#### Construction

##### ***Waste management***

Construction activities would generate various waste streams that would need to be managed and disposed of. Potential wastes include:

- Waste fuels, oils, liquids and chemicals
- Packaging wastes such as cardboard, timber, paper and plastic
- General garbage and sewage from the temporary compound
- Potential for acid sulfate soils in the marine environment (refer section 6.1.2)
- Potential for contaminated soils and sediment (refer section 6.1.2)
- Various building material wastes (including metals, timbers, plastics and concrete)
- Earthworks spoil
- Asphalt and concrete
- General waste, including food, litter and other wastes generated by the construction workers.

Landside ancillary facilities would be contained within the site compound area, and may include a portable toilet and small shipping container/shed. Minimal storage of materials is anticipated, but may include precast materials and some plant and equipment. Where feasible, materials would be barged, including fuels, oils and other required liquids which would be stored in bunded containers. All waste removed from the proposal footprint would be transferred by a licenced contractor to a licenced receiving facility.

Any excavated material would be reused where suitable or classified before being disposed to an appropriately licenced facility in accordance with *Waste Classification Guidelines: Part 1 Classifying Waste* (EPA, 2014). Where necessary, this would include sampling and analysis.

### **Resource use**

Transport for NSW adopts a resource reduction strategy based on using:

- Alternative low-energy, high recycled content materials where they are cost and performance competitive and comparable in environmental performance
- Locally sourced materials, noting that most of the materials needed to build the proposal are widely available and typically in abundant supply in the local market
- Alternative forms of material sourcing to reduce the distances or methods travelled to supply materials.

### **Operation**

One of the objectives of the Ferry Wharf Upgrade Program is to increase patronage of the Sydney Harbour ferry network. The proposal may lead to an increase in patronage as a result of improved access and generally improving the wharf facility. As a result, increased waste may be generated but incidences of littering are not expected to increase given that waste management is likely to improve with the installation of new garbage receptacles and improved facilities.

#### 6.11.4 Safeguards and management measures

Table 6-29 lists the waste management safeguards and management measures that would be implemented to account for the impacts identified in section 6.11.3. Other safeguards that address waste impacts are identified in sections 6.1.4 and 6.2.4 (e.g. spills, contamination).

**Table 6-29: Waste management safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
WM1	Waste	<p>A Waste Management Plan (WMP) will be prepared in accordance with the WARR Act. A WMP is to be prepared as part of the CEMP and will include measures to minimise waste, outline methods of disposal, reuse and recycling and monitoring, as appropriate. This is to include the following:</p> <ul style="list-style-type: none"> <li>• Appropriate measures to avoid and minimise waste associated with the proposal should be investigated and implemented where possible.</li> <li>• Waste management, littering and general tidiness will be monitored during routine site inspections.</li> </ul>	Contractor	Pre-construction / Construction
LS2	Waste	Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's <i>Waste Classification Guidelines: Part 1 Classifying Waste</i> (EPA, 2014) prior to being disposed of at a waste facility licensed to accept the relevant class of waste. Any materials classified as Hazardous Waste may require treatment or an immobilisation approach in accordance with Part 10 of the Protection of the Environment Operations (Waste) Regulation 2014 prior to off-site disposal.	Contractor	Construction
WM2	Resource use	Recycled, durable, and low embodied energy products will be considered to reduce primary resource demand in instances where the materials are cost and performance competitive and comparable in environmental performance (e.g. where quality control specifications allow).	Transport for NSW	Detailed design
WM3	Sustainability	During construction, the Construction Contractor is to monitor waste and recycling quantities using Transport for NSW <i>Waste Data Collection Workbook – DMS-FT-436</i> to support compulsory requirement 4 of the Transport for NSW <i>Sustainable Design Guidelines version 4.0</i> .	Contractor	Construction

## 6.12 Hazards and risk

### 6.12.1 Methodology

The assessment considered the impacts associated with potential hazards and risks, and utilities during construction and operation of the proposal.

### 6.12.2 Existing environment

The existing wharf may pose a safety risk to ferry users due to the use of stairs which are not accessible. The stairs make it difficult for prams and wheelchairs to get access South Mosman wharf. There is the potential for slips and falls from the steps.

There is an alarmed life buoy in a sheltered case at the bottom of the stairs on the pontoon.

There are no potentially hazardous and contaminated sites (as identified on the NSW EPA contaminated sites register) located within 1 kilometre of the site (refer section 6.1).

No flooding issues, or other hazards and risks are expected at the site.

Utilities in the vicinity of the proposal footprint include:

- Low voltage cables (Ausgrid)
- 210 KPa gas cable (Jemena)
- Communication cable (NBN)
- Underground communications cable (Telstra)
- Aqueduct and sewer (Sydney Water).

There is the potential for unknown utilities to exist within the proposal footprint.

### 6.12.3 Potential impacts

#### Construction

The following hazards and risks would be associated with the proposal during construction:

- Construction materials, wastes and/or other objects have the potential to fall from the land based construction area into the harbour causing water pollution and risk to human health
- Construction materials, waste and/or objects have the potential to fall from the construction barge or other construction vessels into the harbour causing water pollution and risk to human health
- Physical injury to construction workers due to various hazards and risks associated with the construction activities (e.g. piling or underwater construction activities, gangway installation, or confined space entry)
- Physical injury to public due to various hazards and risks associated with the construction activities

- Risk to human health or the environment from spillage of materials and/or wastes into the water
- Risk to human health or the environment from the dispersion of potentially contaminated sediments, discussed further in section 6.1.2
- Risk to human health or the environment from air quality related impacts from dust generated during construction activities.

Potential impacts to utilities include:

- Upgrade of the existing LV cables to accommodate the electricity requirements of the new wharf
- Connection to the existing water main
- Relocation or protection of the other utilities in proximity to the works identified above.
- The provisions for a water connection would be developed during detailed design.

### **Operation**

The new wharf has been designed to comply with relevant standards, minimising risk to passenger welfare during operation of the wharf, and improving accessibility.

The installation of two pivot piles would assist ferries berthing and disembarking at the wharf.

Vessel movements to the wharf would continue to be managed through standard maritime procedures.

#### 6.12.4 Safeguards and management measures

Table 6-30 lists the hazards safeguards and management measures that would be implemented to account for the impacts identified in section 6.12.3.

**Table 6-30: Hazards safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
HR1	Hazards and risk	Appropriate emergency equipment such as flotation devices and first aid kits will be kept within the construction area.	Contractor	Construction
HR2	Hazards and risk	Safe work method statements or similar will be implemented to manage health and safety risks for the works.	Contractor	Pre-construction / Construction
HR3	Hazards and risk	Weather forecasts will be monitored during construction. In the unlikely event of a major flood event or strong marine winds/waves, equipment and materials will be temporarily removed from the site, where possible.	Contractor	Construction
HR4	Hazards and risk	Further assessment of impacts to local utilities will be undertaken including on-site services locating.	Transport for NSW	Detailed design
HR5	Hazards and risk	Dial Before You Dig (DBYD) investigations will be carried out prior to undertaking any excavation or piling works to identify any additional cables not identified during design.	Contractor	Pre-construction
HR6	Hazards and risk	All utilities within and adjacent to the proposal footprint will be located prior to the start of the works.	Contractor	Pre-construction

## 6.13 Climate change and greenhouse gas

### 6.13.1 Climate change strategic framework

The Intergovernmental Panel on Climate Change has produced climate change projections. In Australia, both the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM) have produced regional downscaled projections for Australia from these projections.

In 2014 the NSW Government published climate change 'snapshots' for each region in NSW, including the Sydney region. The climate change predictions for Sydney can be summarised as (OEH, 2014b):

- Higher than average temperatures (maximum and minimum temperatures)
- The number of hot days will increase and the number of cold nights will decrease
- Rainfall is projected to decrease in spring and winter, and increase in summer and autumn
- Average fire weather is projected to increase in spring, and severe fire weather days are projected to increase in spring and summer.

The NSW Coastal Planning Guideline: *Adapting to Sea Level Rise* (DoP, 2010) applies to the proposal. This guideline requires that the following eight criteria be considered when designing development proposals:

- Development avoids or minimises exposure to immediate coastal risks (seaward of the immediate hazard line)
- Development provides for the safety of residents, workers or other occupants on-site from risks associated with coastal processes
- Development does not adversely affect the safety of the public off-site from a change in coastal risks as a result of the development
- Development does not increase coastal risks to properties adjoining or within the locality of the site
- Infrastructure, services and utilities on-site maintain their function and achieve their intended design performance
- Development accommodates natural coastal processes
- Coastal ecosystems are protected from development impacts
- Existing public beach, foreshore or waterfront access and amenity is maintained.

In October 2009 the NSW government released its *NSW Sea Level Rise Policy* (DECCW, 2009a). The policy provided sea level rise planning benchmarks as follows:

- 40 centimetres by 2050
- 90 centimetres by 2100.

On 8 September 2012, the State government withdrew these benchmarks in order to provide more flexibility in considering local conditions when determining future hazards. Responsibility for adopting sea level rise projections for use in planning was transferred back to local government.

## Climate change risk assessment

A Climate Change Risk Assessment was completed at Concept Design Phase (Aurecon, 2019c). The assessment identifies climate variables that are a risk to the proposal including:

- Sea level rise – sea level rise would increase the potential for inundation of fixed marine structures such as jetties, saltwater intrusion onto marine structures and coastal erosion. Inundation could result in the failure of floating pontoons and gangways. Increased coastal erosion could affect the foundations of landside structures and compromise their integrity. Sea level rise could also inundate landside stormwater and drainage infrastructure, resulting in increased localised flooding at and near the landside approaches to the wharves
- Increased mean annual temperature – higher temperatures have the potential to compromise the integrity of external facades and road surfaces leading to quicker deterioration and cracking, which would increase maintenance costs
- Increased number of hot days and heatwave events – extreme heat has the potential to cause heat stress in customers, especially at wharves that do not provide shelter from sunlight
- More frequent and intense fire weather – more frequent or intense fire events could result in direct loss of wharf property or assets and lives of passengers and staff
- Mean rainfall – extreme rainfall events could create water flows that exceed the drainage and stormwater systems resulting in localised flooding. It could also result in damage to aboveground structures
- Drought – extended periods of drought conditions can cause decrease in soil moisture resulting in ground shrinkage and soil movements. This has the potential to damage underground infrastructure which could compromise serviceability.

### 6.13.2 Potential impacts

#### Construction

Climatic factors would not constrain construction of the proposal except during adverse weather conditions such as prolonged heavy rain or high winds which may occur during the construction period. These may delay the completion of construction.

Construction would contribute to climate change through the generation of greenhouse gases from construction activities. A temporary increase in greenhouse gas emissions, primarily carbon dioxide, would be expected during construction of the proposal due to exhaust emissions from construction machinery and vehicles transporting materials and personnel to and from the site.

The detailed design process would undertake a compliant carbon footprinting exercise in accordance with Transport for NSW's *Carbon Estimate and Reporting Tool Manual* (TfNSW, 2019) or other approval modelling tools. The carbon footprint would be used to inform decision making in design and construction.

Due to the small scale of the proposal and the short-term temporary nature of the individual construction works, it is considered that greenhouse gas emissions resulting

from the construction would be kept to a minimum through the implementation of the standard mitigation measures.

## Operation

Projections for various climate variables which have the potential to impact the wharf were considered in the Climate Risk Assessment completed during the concept design phase in line with Transport for NSW *Climate Risk Assessment Guidelines*.

The proposal has minimised its exposure to climate change risks by including a fixed gangway and hydraulic platform which have been designed to provide appropriate clearances of existing tides, storm surge, sea and wave action whilst also considering projected sea level rise over the next 50 years. The design of the pontoon, waiting area and gangway was designed to account for 2070 projections of sea level rise. The proposal includes the construction of a new fixed structure within the water. The hydraulic platform has been designed to consider the changes in sea level rise.

More extreme and more frequent heat events as a result of climate change may lead to more rapid degradation of the wharf structures. This may result in additional maintenance requirements.

Shading is provided on the pontoon to protect passengers during extreme weather events.

Any climate change impacts of constructing, operating and maintaining the proposal are considered minor.

There would be some greenhouse gas emissions during maintenance of the wharf, although maintenance requirements have been considered in the materials used for the proposal and are considered minor.

It is anticipated that, once operational, the proposal may result in an increase in use of South Mosman wharf and a relative decrease in use of private motor vehicles by commuters to travel to and from South Mosman. A modal shift in transport usage may reduce the amount of fuel consumed by private motor vehicles with a corresponding relative reduction in associated greenhouse gas emissions in the local area.

### 6.13.3 Safeguards and management measures

Table 6-31 lists the climate change and greenhouse gas safeguards and management measures that would be implemented to account for the impacts identified in section 6.13.2.

**Table 6-31: Climate change and greenhouse gas safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
CC1	Climate change	During detailed design undertake a compliant carbon footprinting exercise in accordance with the Transport for NSW <i>Carbon Estimate and Reporting Tool Manual</i> (TfNSW, 2019). The carbon footprint will be used to inform decision making in design and construction.	Contractor	Detailed design / Construction
CC2	Climate change	During detailed design undertake a compliant climate risk assessment in accordance with the Transport for NSW <i>Climate Risk Assessment Guidelines – DMS-SD-081</i> .	Contractor	Detailed design
CC3	Climate change	The detailed design process will consider adaptation measures for climate change, including the following: <ul style="list-style-type: none"> <li>• Design of pontoons, waiting areas and gangways</li> <li>• Integrate coastal erosion control techniques around landside infrastructure</li> <li>• Drainage and storm water infrastructure</li> <li>• Specifications of materials in design</li> <li>• Weather protection features.</li> </ul>	Contractor	Detailed design

## 6.14 Sustainability

### 6.14.1 Sustainability in design

Transport for NSW is committed to minimising the impact on the natural environment using the Transport for NSW *Sustainable Design Guidelines (SDG) v4.0 rating tool* to measure and drive sustainability performance. The SDG rating tool was developed to support Transport for NSW's ongoing commitment to sustainability to deliver environmental and social benefits as outlined in the Transport for NSW *Environment and Sustainability Policy* (TfNSW, 2020a) and Transport for NSW's *Future Transport Strategy 2056* (TfNSW, 2018).

The SDG rating tool sets targets across the following key areas:

- Climate change adaptation and resilience
- Energy management
- Waste and recycling
- Materials
- Water conservation
- Supply chain management
- Community benefit.

Key design elements and strategies developed during concept design will be used to further develop the design and construction.

### 6.14.2 Potential impacts

The design of the proposal has been based on the principles of sustainability, including aiming for a 'Silver' rating under the Transport for NSW *Sustainability Design Guidelines v4.0* and the Transport for NSW *Environmental Management System (EMS)*. These guidelines require a number of mandatory and discretionary initiatives to be applied.

Further positive impacts in relation to climate change and sustainability associated with the proposal include encouraging a reduction in private vehicle use and increase the accessibility of public transport services.

### 6.14.3 Safeguards and management measures

Table 6-32 lists the sustainability safeguards and management measures that would be implemented to account for the impacts identified in section 6.14.2.

**Table 6-32: Sustainability safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
S1	Sustainability	The Contractor shall propose a suitably qualified and experienced sustainability officer at a minimum 14 days prior to site establishment to be endorsed by Transport for NSW. The sustainability officer will be responsible for implementing the sustainability objectives for the Project. Details of the sustainability officer, including defined responsibilities, duration and resource allocation throughout the appointment are to be submitted to Transport for NSW prior to the preparation of the Sustainability Management Plan.	Contractor	Detailed design
S2	Sustainability	Prior to commencement of construction, a Sustainability Management Plan shall be endorsed by Transport for NSW. The Plan shall be provided at least 14 days prior to site establishment and include the following minimum components: <ul style="list-style-type: none"> <li>• A completed electronic checklist demonstrating compliance with Transport for NSW's <i>Sustainable Design Guidelines version 4.0</i> (7TP-ST-114)</li> <li>• The Contractors sustainability goals and targets, internal procedures, and implementation strategy.</li> </ul>	Contractor	Detailed design
S3	Sustainability	The Contractor must comply with the Transport for NSW <i>Sustainable Design Guidelines version 4.0</i> .	Transport for NSW / Contractor	Detailed design / Construction

Other safeguards and management measures that address hazards impacts are identified in sections 6.3.4 (biodiversity), 6.6.4 (non-Aboriginal heritage), 6.9.4 (socio-economic), 6.10.3 (air quality), 6.11.4 (waste) and 6.13.3 (climate change).

## **6.15 Cumulative impacts**

### **6.15.1 Study area**

South Mosman wharf is within the Mosman LGA. Projects within the Mosman LGA and the Sydney Ferries Network (refer Figure 6-16) have been considered for the purposes of this cumulative impact assessment.

A search of the following databases was completed to identify any projects which might result in cumulative impact with the proposal:

- DPIE – major project
- Sydney North Planning Panel Development and Planning Register
- Mosman Council Development Application Register.

Projects identified on the above registers that would impact the Proposal have been identified in Table 6-33.

### **6.15.2 Broader program of work**

The proposal is part of a broader program of work to upgrade the commuter ferry wharves in Sydney. The Proposal is located at Mosman, which is part of the F6 Ferry Service that operates between Circular Quay and Mosman Bay.

The Ferry Wharf Upgrade Program includes planned upgrades to multiple wharves in the Sydney Ferries Network including Taronga Zoo (F2).

South Mosman wharf upgrade is expected to start in late 2021 and to be closed for a period of up to six months.

Potential impacts from the construction and operation of identified past, present and future projects are summarised in Table 6-33.

In addition, other minor residential alterations and development applications have been identified. No significant construction related traffic would be generated for these projects outside of light vehicles travelling to the site and minor deliveries of equipment and materials.

# Sydney Ferries Network

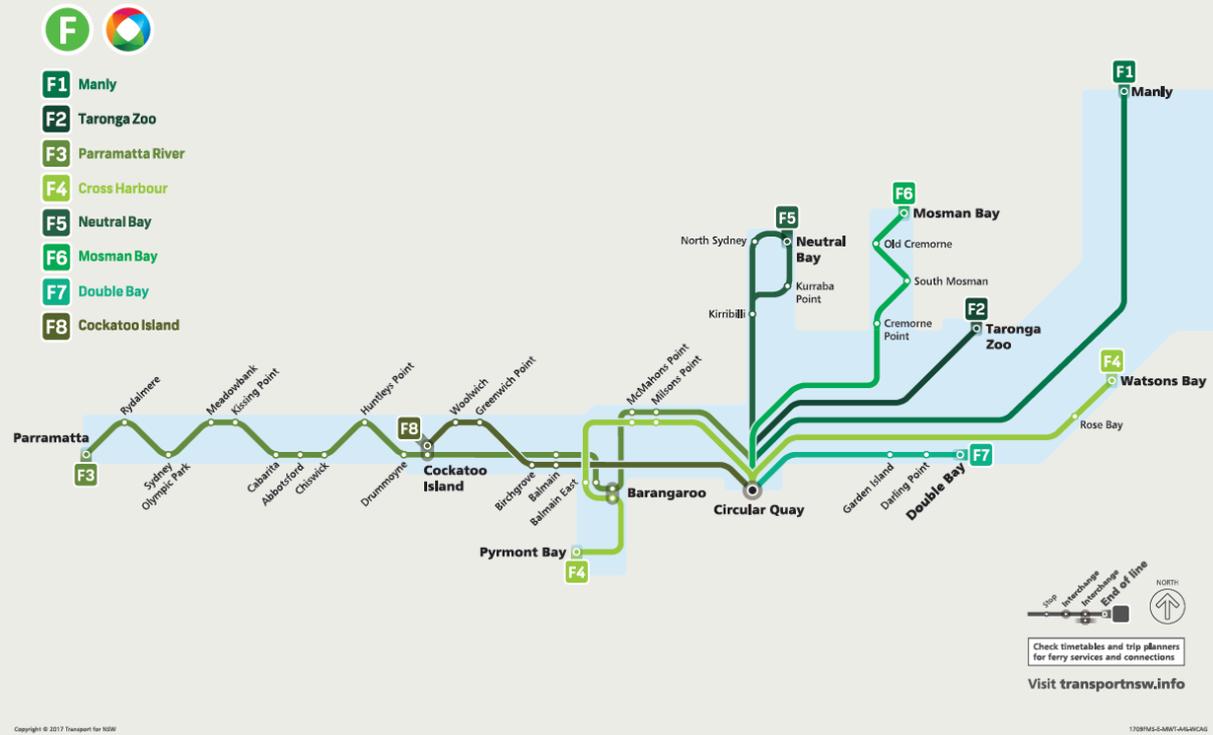


Figure 6-16 Sydney ferries network

## 6.15.3 Other projects and developments

Table 6-33: Present and future projects

Project	Construction impacts	Operational impacts
Ferry Wharf Upgrade Program	<p>Upgrade of South Mosman wharf would require additional movements within Sydney Harbour and may conflict with other wharf upgrades.</p> <p>There would be a potential minor short-term cumulative increase in exhaust emissions from construction projects within the region.</p> <p>Developments within the region would contribute to climate change through the generation of greenhouse gases from construction activities. Greenhouse gases would be generated through the use of fossil fuels by construction plant and</p>	<p>The Ferry Wharf Upgrade Program would have a beneficial cumulative impact through improved passenger amenity and consistent ferry wharf design across the network. It would result in improvements to:</p> <ul style="list-style-type: none"> <li>• Safety for commuters</li> <li>• Recreational facilities</li> <li>• Improved travel times</li> <li>• Improved customer experience due to upgraded facilities</li> <li>• The public domain and quality of customer experience.</li> </ul>

Project	Construction impacts	Operational impacts
	equipment, transportation of personnel and materials and the embodied carbon in the materials used such as concrete and steel. These impacts are considered to be minor.	
<p>African Savannah and Congo Exhibits, Taronga Zoo (State Significant Development).</p> <p>Partial demolition of the African Safari and Orangutan Rainforest exhibits and redevelopment to form the new exhibit including minor earthworks and regrading of the site.</p> <p>The project would be staged as follows:</p> <ul style="list-style-type: none"> <li>▪ Stage 1 – the African Savannah exhibit</li> <li>▪ Stage 2 – the Congo Forest exhibit intended to commence construction in May 2021 and open in October 2022.</li> </ul>	<p>Potential impacts to traffic, noise and air quality. Reduced visual amenity during construction.</p>	<p>The built form, visual impacts and heritage view.</p>

#### 6.15.4 Potential impacts

The potential cumulative impacts are listed in Table 6-34.

**Table 6-34: Potential cumulative impacts**

Environmental factor	Construction	Operation
Socioeconomic	Cumulative impacts to patrons of the ferry network due to the closure of South Mosman wharf.	No operational impacts anticipated.
Traffic and transport	Minor increases in marine traffic.	No operational impacts anticipated.

### 6.15.5 Safeguards and management measures

Table 6-35 lists the cumulative impacts safeguards and management measures that would be implemented to account for the impacts identified in section 6.15.4.

**Table 6-35: Cumulative impacts safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
C1	Cumulative construction impacts	<ul style="list-style-type: none"><li>• Consultation will include notification prior to the start of the works</li><li>• Updates on any delays or changes to the construction period will also be communicated.</li></ul>	Transport for NSW	Pre-construction / construction

## **7 Environmental management**

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This chapter describes how the proposal would be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided. A summary of site-specific environmental safeguards is provided and the licence and/or approval requirements required prior to construction are also listed.

### **7.1 Environmental management plans (or system)**

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) would be prepared to describe the safeguards and management measures identified. The CEMP would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The CEMP would be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment Officer prior to the commencement of any on-site work. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

## 7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed work on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

**Table 7-1: Summary of safeguards and management measures**

No.	Impact	Environmental safeguards	Responsibility	Timing
GEN1	General - minimise environmental impacts during construction	<p>A CEMP will be prepared and submitted for review and endorsement of the Transport for NSW Environment Manager prior to commencement of the activity.</p> <p>As a minimum, the CEMP will address the following:</p> <ul style="list-style-type: none"> <li>• Any requirements associated with statutory approvals</li> <li>• Details of how the project will implement the identified safeguards outlined in the REF</li> <li>• Issue-specific environmental management plans</li> <li>• Roles and responsibilities</li> <li>• Communication requirements</li> <li>• Induction and training requirements</li> <li>• Procedures for monitoring and evaluating environmental performance, and for corrective action</li> <li>• Reporting requirements and record-keeping</li> <li>• Procedures for emergency and incident management</li> <li>• Procedures for audit and review.</li> </ul> <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p>	Contractor / Transport for NSW	Pre-construction / Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
GEN2	General - notification	All businesses, residential properties and other key stakeholders (e.g. schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor / Transport for NSW	Pre-construction
GEN3	General – environmental and sustainability awareness	<p>All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular ‘toolbox’ style briefings. Sustainability initiatives and targets will also be addressed.</p> <p>Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include:</p> <ul style="list-style-type: none"> <li>• Areas of non-Aboriginal heritage sensitivity</li> <li>• Adjoining residential areas requiring particular noise management measures</li> <li>• Waterside impacts.</li> </ul>	Contractor / Transport for NSW	Pre-construction / Detailed design
LS1	Land surface and hydrology	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion, contamination and water pollution and describe how these risks will be addressed during construction.	Contractor	Pre-construction
LS2	Land surface and hydrology	Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA’s <i>Waste Classification Guidelines: Part 1 Classifying Waste</i> (EPA, 2014) prior to being disposed of at a waste facility licensed to accept the relevant class of waste. Any materials classified as Hazardous Waste may require treatment or an immobilisation approach in accordance with Part 10 of the Protection of the Environment Operations (Waste) Regulation 2014 prior to off-site disposal.	Contractor	Construction
LS3	Land surface and hydrology	Clean and suitable topsoil will be stockpiled and reused on site where appropriate.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
LS4	Land surface and hydrology	An intrusive soil investigation to the depth of excavation will be undertaken to ensure the safety of construction workers and provide waste classification of the materials to be removed.	Contractor	Construction
LS5	Land surface and hydrology	If unexpected contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.	Contractor	Construction
LS6	Land surface and hydrology	The piling methodology shall seek to mitigate the risk of sediment dispersal.	Contractor	Construction
LS7	Land surface and hydrology	Site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the SWMP. Control measures are to be implemented and maintained (in accordance with the Landcom/Department of <i>Housing Managing Urban Stormwater, Soils and Construction Guidelines</i> , the Blue Book) to: <ul style="list-style-type: none"> <li>• Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets</li> <li>• Reduce water velocity and capture sediment on site</li> <li>• Minimise the amount of material transported from site to surrounding pavement surfaces</li> <li>• Divert clean water around the site.</li> </ul>	Contractor	Pre-construction
LS8	Land surface and hydrology	Prior to commencement of construction activities, sediment control device (such as sediment boom and curtain) will be installed around the construction footprint to contain disturbed sediment from the water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will extend from a	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>minimum of 100 millimetres above the water line to a minimum of 2.5 metres below the water line before starting work.</p> <p>Installation should be undertaken during high tide periods from a boat. The device should be designed to rise and fall with the tide to prevent disturbance. Inspection of the device should be undertaken on a daily basis after ebbing tides, with additional inspection be carried following storm events. Monitoring of turbidity inside and outside of the device should also be performed, using a portable turbidity meter/logger. Prior to removing the sediment control device, conditions within the curtain will be assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.</p>		
LS9	Land surface and hydrology	<p>Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be undertaken on a regular basis to identify any potential spills or deficient silt curtains or erosion and sediment controls.</p> <p>Results of the observations are required to be recorded. Records are required to be kept on the site and to be made available for inspection by persons authorised by Transport for NSW.</p>	Contractor	Construction
LS10	Land surface and hydrology	<p>The number of jack-ups/anchor points will be minimised where possible. The locations will be selected to avoid areas of sensitive habitat.</p>	Contractor	Construction
LS11	Land surface and hydrology	<p>Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts.</p>	Contractor	Construction
WQ1	Water quality	<ul style="list-style-type: none"> <li>• A spill management plan will be developed and communicated to all staff working on site.</li> <li>• Appropriate land and aquatic spill kits are to be maintained on site and on barges. Aquatic spill kits must be specific for working within the marine environment. The spill kit must be appropriately sized for the volume of substances at the work site.</li> </ul>	Contractor	Pre-construction / Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>All workers will be advised of the location of the spill kit and trained in its use.</li> </ul>		
WQ2	Water quality	If an incident (e.g. spill) occurs, the Transport for NSW <i>Environmental Incident Classification and Reporting Procedure</i> is to be followed and the Transport for NSW Contract Manager notified as soon as practicable.	Contractor	Construction
WQ3	Water quality	In the event of a maritime spill, the incident emergency plan will be implemented in accordance with Port Authority of NSW's response to shipping incidents and emergencies outlined in the <i>NSW State Waters Marine Oil and Chemical Spill Contingency Plan</i> (RMS, 2016c).	Contractor	Construction
WQ4	Water quality	Emergency contacts will be kept in an easily accessible location on vehicles, vessels, plant and site office. All workers will be advised of these contact details and procedures.	Contractor	Pre-construction / Construction
WQ5	Water quality	Vehicles, vessels and plant must be properly maintained and regularly inspected for fluid leaks.	Contractor	Construction
WQ6	Water quality	No vehicle or vessel wash-down or re-fuelling will occur on-site.	Contractor	Construction
WQ7	Water quality	Any chemicals or fuels stored at the site or equipment barges will be stored in a bunded area.	Contractor	Construction
WQ8	Water quality	An environmental work method statement (EWMS) will be developed for the removal of the existing wharf structure to minimise the risk of pollutants and debris entering the waterway. The EWMS must be approved by Transport for NSW prior to the demolition of the existing wharf structure.	Contractor	Pre-construction
WQ9	Water quality	Consideration of water sensitive urban design (WSUD) principles in line with the <i>Water sensitive urban design guideline</i> (RMS, 2017).	Transport for NSW	Detailed design
B1	Biodiversity	Integrate the management of flora and fauna into the construction environmental management plan (either as a standalone flora and fauna management plan or a subplan). This is to include all terrestrial and	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>marine flora and fauna and include but not be limited to such measures as:</p> <ul style="list-style-type: none"> <li>• Documenting and establishing site clearing limits</li> <li>• Establishment of no go zones</li> <li>• Implementation of tree protection measures</li> <li>• Pre-clearing surveys, vegetation removal, unexpected finds measures in line with the <i>Biodiversity Guidelines</i> (RTA, 2011).</li> </ul>		
B2	Biodiversity	Native vegetation and habitat removal will be minimised through detailed design with focus to retain vegetation along the boundary of the compound site and 2 Musgrave Street	Transport for NSW	Detailed design
B3	Biodiversity	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). Any roosting microbats in the vegetation and wharf structures to be removed and the escarpment area to be impacted will be captured and relocated to similar or higher condition habitat. Release will only be done at dusk and roosting individuals should be kept in a secure, dark and warm location until then. Injured individuals or unfurred juveniles are to be transported to a veterinarian.	Contractor	Pre-construction
B4	Biodiversity	Vegetation and habitat removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction
B5	Biodiversity	Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). Replacement plantings (species and number) will be determined in consultation with Mosman Council to reinstate habitat and minimise visual impacts.	Contractor	Detailed design / Post construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B6	Biodiversity	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the construction footprint.	Contractor	Construction
B7	Biodiversity	Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).	Contractor	Detailed design
B8	Biodiversity	Minimise anchoring were possible and avoid anchoring on subtidal rocky reef habitat.	Contractor	Construction
B9	Biodiversity	Complete a targeted survey for Black Rockcod and White's Seahorse within 24 hours prior to the commencement of water-based construction activities. Black Rockcod individuals will be encouraged to move away from the study area and White's Seahorse will be captured and relocated to nearby similar habitat. A White's Seahorse relocation plan will be developed in consultation with NSW DPI (Fisheries) to dictate this activity.	Transport for NSW	Pre-construction
B10	Biodiversity	A Section 37 permit under the FM Act to relocate Syngnathids collected during the targeted pre-clearance survey will be required as part of the White's Seahorse relocation.	Transport for NSW	Construction
B11	Biodiversity	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and guidelines for fish habitat conservation and management Update 2013</i> (NSW DPI, 2013).	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B12	Biodiversity	Piling to stop if marine mammals are observed within 100 metres of the project area and only to recommence once they have moved beyond 100 metres of the project or are not seen for at least 20 minutes.	Contractor	Construction
B13	Biodiversity	The detailed design will aim to avoid/minimise any impact to coastal processes and hydrology.	Transport for NSW	Detailed design
B14	Biodiversity	Fauna will be managed in accordance with Guide 9: Fauna handling of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction
B15	Biodiversity	Weed species will be managed in accordance with Guide 6: Weed management of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction
B16	Biodiversity	Marine pest species will be managed within the construction footprint.	Contractor	Construction
B17	Biodiversity	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction
B18	Biodiversity	Water-based equipment and vessels to be sourced from local suppliers. Equipment and vessels must be cleaned and inspected prior to entering the construction footprint.	Contractor	Construction
B19	Biodiversity	Occurrence of any marine pests must be reported to DPI Fisheries.	Contractor	Construction
B20	Biodiversity	Shading and artificial light impacts will be minimised through detailed design.	Transport for NSW	Detailed design
NV1	Noise and vibration	Preparation of a noise and vibration management plan based on recommendations provided within the NSW ICNG and Australian Standard AS 2436-1981: <i>Guide to Noise Control on Construction, Maintenance and Demolition Sites</i> . This is to include, but not be limited to:	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>• Plant controls:               <ul style="list-style-type: none"> <li>○ Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc.</li> <li>○ Plant and equipment will be in good working order to prevent excess noise generation.</li> <li>○ Locating static sources of noise such as the generators as remotely as possible from noise sensitive receivers</li> <li>○ Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations</li> <li>○ Use of temporary noise barriers where practical. The height and location of these barriers will be determined during preparation of the construction noise and vibration management plan when more information regarding the proposed plant to be used for each construction stage is available.</li> <li>○ Investigate whether “at plant” mitigation or muffled plant is available for plant with high source noise levels such as rock hammers and piling rigs, and plant emitting continuous noise such as generators.</li> <li>○ Acoustic curtains (generally loaded vinyl based products), attached to wire construction fencing or laid over steel scaffold can also provide practical temporary noise barriers. Acoustic curtains will investigated for stationery plant within the worksites once a detailed schedule of works and plant is available.</li> </ul> </li> <li>• Management and behavioural controls:               <ul style="list-style-type: none"> <li>○ Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings.</li> <li>○ Avoid the need for reversing in the construction area by creating a loop road or similar.</li> <li>○ Avoid dropping materials from height.</li> </ul> </li> </ul>		

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>○ Workers will avoid shouting, minimise talking loudly, and avoid slamming vehicle doors.</li> <li>• Allowing construction to occur only during approved construction hours, unless otherwise required as a condition of TfNSW safety requirements</li> <li>• Conducting noise monitoring during all construction phases/scenarios considering the potential exceedances for the purposes of assisting in noise mitigation and to verify the findings of this noise assessment.</li> <li>• Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately.</li> <li>• Conducting additional monitoring if complaints are received or proposed activities and number of plant exceed those assumed in this assessment.</li> <li>• Modifying work activities where noise or vibration is found to cause unacceptable impact.</li> </ul> <p>Implementation of additional mitigation measures in accordance with the CNVG including notification, respite periods and alternate accommodation as reasonable and feasible.</p>		
NV2	Noise and vibration	<ul style="list-style-type: none"> <li>• Carrying out works within standard daytime hours as follows: <ul style="list-style-type: none"> <li>– 7:00 am to 6:00 pm Monday to Friday</li> <li>– 8:00 am to 1:00 pm Saturdays, no work on Sundays or public holidays.</li> </ul> </li> <li>• Do not carry out operations during evening or night-time hours, unless required for safety reasons when the water is calmer during the night period (including early morning) or due to requirements to enable bus access.</li> <li>• Should operations be required outside standard hours, an Out of Hours Procedure detailing works schedule, approval process, communications requirements and management measures will be prepared.</li> </ul>	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>All reasonable and feasible efforts should be undertaken to ensure noise levels will not exceed the ICNG noise management levels stated in section 6.4.3 of this assessment by carrying out night-works with reduced numbers of plant for example.</li> </ul>		
NV3	Noise and vibration	<ul style="list-style-type: none"> <li>Notification of potentially affected receivers detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the work (where applicable) and contact telephone number.</li> <li>Notification should be a minimum of 7 calendar days prior to the start of work.</li> <li>A contact telephone number and email address will be available for community feedback.</li> </ul>	Transport for NSW / Contractor	Pre-construction
NV4	Noise and vibration	Conduct short term background noise monitoring prior to construction to confirm the ambient noise levels presented in this report, which were carried out during COVID 19 and may not be representative of typical levels.	Transport for / Contractor	Pre-construction
NV5	Noise and vibration	Where works are proposed within the safe working limits for the heritage structures (the original seawall and retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183)), specialist advice will be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works will potentially result in impacts to heritage structures. Vibration monitoring will be carried out to confirm vibration levels prior to construction commencement.	Contractor	Pre-construction
NV6	Noise and vibration	Regular inspections of the construction activities and work areas will be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology and confirm the integrity of the seawall and retaining wall in Musgrave Street wharf site	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>(SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183). Assessment and monitoring of vibration impacts will adhere to:</p> <ul style="list-style-type: none"> <li>British Standard BS 7385: Part 2: Evaluation and Measurement for Vibrations in Buildings –Part 2 Guide to Damage Levels from Ground-Borne Vibration</li> <li>German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.</li> </ul>		
NV7	Noise and vibration	Where buildings are located within the safe working distance zone, dilapidation surveys will be carried out prior to construction.	Contractor	Pre-construction / Construction
NV8	Noise and vibration	Where receivers are located within the safe work distance zones, vibration monitoring will be carried out to ensure compliance with the required criteria. If exceedances are recorded, works will be modified accordingly to reduce vibration levels.	Contractor	Pre-construction / Construction
LV1	Landscape and visual	<p>Urban design principles will be integrated throughout the detailed design and construction of the proposal and include:</p> <ul style="list-style-type: none"> <li>Similar visual structures (such as jetties, pontoons and wharfs) as those located within Neutral Bay, Neutral Harbour and Careening Cove</li> <li>A coordinated palette of materials and colours to respond to the existing maritime and foreshore character</li> <li>Low-scale landside and waterside works to improve accessibility, wayfinding and services</li> <li>The approaches to and surrounds of the wharf designed to maximise amenity and keeping with the existing urban and landscape environment.</li> </ul>	Transport for NSW	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>Landscape treatment of the wharf to be appropriate and complimentary to the existing landscape.</li> </ul>		
LV2	Landscape and visual	Hoarding will be erected around the construction compound where possible, to reduce visibility.	Contractor	Construction
LV3	Landscape and visual	Where out of hours work is required, lighting will be directionally controlled to limit potential impacts of light spill on surround receivers, including residential properties.	Contractor	Construction
LV4	Landscape and visual	All impacted areas and ground surfaces, including grassed surfaces adjacent to the wharf and the road surface of Musgrave Street, must be reinstated as near as possible to their original state following the completion of works.	Contractor	Post-construction
H1	Non-Aboriginal heritage	If archaeological 'works' such as evidence of earlier road constructions are encountered during construction works and will be impacted, archaeological investigation and recording will be undertaken prior to impacts.	Contractor	Construction
H2	Non-Aboriginal heritage	If unexpected 'relics' are encountered during excavation, a section 146 relics notification will be forwarded to Heritage NSW, DPC. 'Relics' cannot be impacted without appropriate approvals under the <i>Heritage Act 1977</i> .	Contractor	Construction
H3	Non-Aboriginal heritage	If significant archaeological remains are encountered during excavation, design options for avoiding impacts to the significant archaeological remains should be considered where practicable and opportunities should be investigated for the implementation of heritage interpretation.	Contractor	Construction
H4	Non-Aboriginal heritage	A heritage induction will be provided to workers prior to construction, informing them of the location and significance of known heritage items and the implementation of the Roads and Maritime <i>Unexpected Heritage Item Procedure</i> (RMS, 2015) if unanticipated heritage items or depositions are located during construction. The heritage induction will	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		include management of expected non-significant archaeological remains, such as minor artefactual material associated with Phase 2 reclamation fills.		
H5	Non-Aboriginal heritage	The Roads and Maritime <i>Unexpected Heritage Item Procedure</i> (RMS, 2015) will be implemented if unanticipated heritage items or depositions are located during construction.	Contractor	Construction
H6	Non-Aboriginal heritage	If vibration monitors are attached to the retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183), they must not be attached with permanent fixings. They should be removable without causing damage. Bees wax may be a suitable attachment method.	Contractor	Construction
H7	Non-Aboriginal heritage	If it is identified that levels of vibration are causing damage to heritage fabric, works must cease, and the construction methodology reviewed by the project engineers in consultation with a Heritage Consultant in order to mitigate further impacts. A temporary protection plan to outline protection measures required for significant fabric during activities causing potential vibration impacts will be prepared prior to commencement of works.	Contractor	Construction
LV4	Non-Aboriginal heritage	All impacted areas and ground surfaces, including grassed surfaces adjacent to the wharf and the road surface of Musgrave Street, must be reinstated as near as possible to their original state following the completion of works.	Contractor	Post-construction
H8	Non-Aboriginal heritage	In accordance with the sustainability requirements for the project, opportunities for implementation of heritage interpretation will be investigated during detailed design. A Heritage Interpretation Strategy will be prepared for the proposal to discuss various media for heritage interpretation appropriate to the location and heritage significance of the	Contractor	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>South Mosman wharf. Interpretation may include heritage signs and/or artwork pieces.</p> <p>This report will be consistent with the recommended management for Musgrave Street wharf site (SHI no. 4920109) that is outlined in the SHI sheet for the Roads and Maritime s170 Heritage and Conservation listed item, which states that ‘The wharf waiting shelter provides opportunities for interpretation of the history and significance of the wharf, the ferry system and other heritage elements within their visual catchment which should be explored and developed’.</p>		
H9	Non-Aboriginal heritage	As part of the preparation of the Heritage Interpretation Strategy the area around South Mosman wharf, Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491) and Divided road (LEP no. I411) should be photographed to help document the changes to the area and the development of the South Mosman wharf.	Contractor	Pre-construction
H10	Non-Aboriginal heritage	If feasible, the extant timber beams that are visible in the seawall and are associated with the second Musgrave Street wharf and waiting room should be retained and re-use can be incorporated into the Heritage Interpretation Strategy.	Contractor	Construction
H11	Non-Aboriginal heritage	If design changes result in additional excavations and impacts to significant archaeological remains associated with Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), further archaeological assessment and management will be required.	Transport for NSW	Detailed design / Pre-construction
H12	Non-Aboriginal heritage	Any project redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to the South Mosman wharf SOHI.	Transport for NSW	Detailed design / Pre-construction
AH1	Aboriginal heritage	Should the scope of the proposed work change, further consultation with Transport for NSW’s Aboriginal Cultural Heritage Officer and regional environmental staff must be undertaken to reassess any potential impacts on Aboriginal cultural heritage.	Transport for NSW	Pre-construction / Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
AH2	Aboriginal heritage	In accordance with the sustainability requirements for the project, opportunities for implementation of Aboriginal heritage interpretation (such as interpretation signage) should be investigated during detailed design, and incorporated into the overall Heritage Interpretation Strategy for the project.	Contractor	Detailed design
AH3	Aboriginal heritage	The Roads and Maritime <i>Unexpected Heritage Items</i> (RMS, 2015) will be followed in the event that (an) unknown or potential Aboriginal object(s), including skeletal remains, is/are found during construction. This applies where Transport for NSW does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the procedure) is not in place. Work will only restart once the requirements of that procedure have been satisfied.	Contractor	Construction
T1	Transport, traffic, access	A Traffic Management Plan (TMP) will be prepared and will include the following. <ul style="list-style-type: none"> <li>• Final access and parking arrangements</li> <li>• Alternate pedestrian and cyclist access around the construction area</li> <li>• Measures to ensure light vehicle parking is strictly in accordance with Mosman Council requirements and prevents parking on footpaths and grassed areas adjacent the site.</li> </ul>	Contractor	Pre-construction
T2	Transport, traffic, access	Where possible, the preferred means of transporting equipment and materials to the site will be via boat and barge over land transport so as to limit impacts to the local road network.	Contractor	Construction
T3	Transport, traffic, access	Public transport passengers will be notified of any impacts to transport services and the alternative transport arrangements prior to the commencement of construction. This will include updates to the timetable (online and Opal app) indicating the temporary closure of the South Mosman wharf.	Transport for NSW	Pre-construction / Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
T4	Transport, traffic, access	<ul style="list-style-type: none"> <li>• A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area.</li> <li>• This zone will be clearly defined to communicate access for other water users.</li> </ul>	Contractor	Pre-construction / Construction
T5	Transport, traffic, access	<p>A Maritime TMP will be prepared and implemented during the water based construction work. The Maritime TMP will be prepared in consultation with Transport for NSW and approved by the Harbourmaster. In addition, the project will:</p> <ul style="list-style-type: none"> <li>• Fit all buoys with lights</li> <li>• Prepare Response Plans for emergencies and spills for all construction vessels</li> <li>• Fit at least one vessel with an Automatic Identification System (AIS)</li> <li>• Retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements</li> <li>• Prepare a Communications Plan for implementation during the work which must include 24/7 contact details, protocols for enquiries, complaints and emergencies.</li> </ul> <p>Any variation to the above will be agreed in advance with the Harbourmaster.</p>	Contractor	Pre-construction / Construction
T6	Transport, traffic, access	Commercial, recreational operators and private services that use the existing wharf will be advised of the wharf closure at least two weeks prior to closure.	Transport for NSW	Pre-construction / Construction
SE1	Socio-economic	A Communications and Stakeholder Engagement Plan will be developed prior to the commencement of construction and will be implemented during construction to provide timely and accurate information to stakeholders. It will include (as a minimum):	Transport for NSW	Pre-construction / Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>Mechanisms to provide details and timing of proposed activities to affected residents and local businesses, including changes to traffic, public transport services and access</li> <li>A contact name and telephone number for complaints.</li> </ul>		
SE2	Socio-economic	<ul style="list-style-type: none"> <li>A webpage and free-call number will be established for enquiries regarding the proposal, and will remain active for the duration of construction.</li> <li>Contact details will be clearly displayed at the entrance to the site.</li> <li>All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received.</li> </ul>	Contractor	Pre-construction / Construction
SE3	Socio-economic	Investigate opportunities to improve priorities group employment participation in line with Transport for NSW's Social Procurement Policy.	Contractor	Pre-construction / Construction
SE4	Socio-economic	Investigate opportunities to encourage the construction Contractor to purchase goods and services locally.	Transport for NSW	Pre-construction / Construction
SE5	Socio-economic	Investigate opportunities to incorporate community health and well-being initiatives in the design and construction of the proposal.	Transport for NSW	Detailed design / Construction
AQ1	Air quality	<p>Air quality during construction will be considered and addressed within the CEMP and will include methods to manage work during strong winds or other adverse weather conditions as required. As a minimum, the following measures will be included:</p> <ul style="list-style-type: none"> <li>Covering all loaded trucks and vessels</li> <li>Machinery to be turned off rather than left to idle when not in use</li> <li>Maintenance of all vehicles, including trucks and vessels entering and leaving the site in accordance with the manufacturers specifications to comply with all relevant legislation</li> </ul>	Contractor	Pre-construction / construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>Maintenance of all plant and equipment to ensure good operating conditions and exhaust emissions comply with the <i>Protection of the Environment Operations Act 1997</i></li> <li>Maintaining the work site in a condition that minimises fugitive emissions such as minor dust</li> </ul> <p>Appropriate sediment and erosion controls for any exposed earth or stockpiled waste.</p>		
AQ2	Air quality	During construction, the construction contractor is to monitor performance of their non-road diesel plant and equipment against US EPA, EU or equivalent emissions standards using Transport for NSW <i>Air Emissions Workbook - DMS-FT-439</i> .	Contractor	Construction
WM1	Waste management	<p>A Waste Management Plan (WMP) will be prepared in accordance with the WARR Act. A WMP is to be prepared as part of the CEMP and will include measures to minimise waste, outline methods of disposal, reuse and recycling and monitoring, as appropriate. This is to include the following:</p> <ul style="list-style-type: none"> <li>Appropriate measures to avoid and minimise waste associated with the proposal should be investigated and implemented where possible.</li> <li>Waste management, littering and general tidiness will be monitored during routine site inspections.</li> </ul>	Contractor	Pre-construction / Construction
WM2	Waste management	Recycled, durable, and low embodied energy products will be considered to reduce primary resource demand in instances where the materials are cost and performance competitive and comparable in environmental performance (e.g. where quality control specifications allow).	Transport for NSW	Detailed design
WM3	Waste management	During construction, the Construction Contractor is to monitor waste and recycling quantities using Transport for NSW Waste Data Collection Workbook – DMS-FT-436 to support compulsory requirement 4 of the Transport for NSW <i>Sustainable Design Guidelines version 4.0</i> .	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
HR1	Hazards and risk	Appropriate emergency equipment such as flotation devices and first aid kits will be kept within the construction area.	Contractor	Construction
HR2	Hazards and risk	Safe work method statements or similar will be implemented to manage health and safety risks for the works.	Contractor	Pre-construction / Construction
HR3	Hazards and risk	Weather forecasts will be monitored during construction. In the unlikely event of a major flood event or strong marine winds/waves, equipment and materials will be temporarily removed from the site, where possible.	Contractor	Construction
HR4	Hazards and risk	Further assessment of impacts to local utilities will be undertaken including on-site services locating.	Transport for NSW	Detailed design
HR5	Hazards and risk	Dial Before You Dig (DBYD) investigations will be carried out prior to undertaking any excavation or piling works to identify any additional cables not identified during design.	Contractor	Pre-construction
HR6	Hazards and risk	All utilities within and adjacent to the proposal footprint will be located prior to the start of the works.	Contractor	Pre-construction
CC1	Climate change	During detailed design undertake a compliant carbon footprinting exercise in accordance with the Transport for NSW <i>Carbon Estimate and Reporting Tool Manual</i> (TfNSW, 2019). The carbon footprint will be used to inform decision making in design and construction.	Contractor	Detailed design / Construction
CC2	Climate change	During detailed design undertake a compliant climate risk assessment in accordance with the Transport for NSW <i>Climate Risk Assessment Guidelines – DMS-SD-081</i> .	Contractor	Detailed design
CC3	Climate change	The detailed design process will consider adaptation measures for climate change, including the following: <ul style="list-style-type: none"> <li>• Design of pontoons, waiting areas and gangways</li> </ul>	Contractor	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>Integrate coastal erosion control techniques around landside infrastructure</li> <li>Drainage and storm water infrastructure</li> <li>Specifications of materials in design</li> <li>Weather protection features.</li> </ul>		
S1	Sustainability	The Contractor shall propose a suitably qualified and experienced sustainability officer at a minimum 14 days prior to site establishment to be endorsed by Transport for NSW. The sustainability officer will be responsible for implementing the sustainability objectives for the Project. Details of the sustainability officer, including defined responsibilities, duration and resource allocation throughout the appointment are to be submitted to Transport for NSW prior to the preparation of the Sustainability Management Plan.	Contractor	Detailed design
S2	Sustainability	<p>Prior to commencement of construction, a Sustainability Management Plan shall be endorsed by Transport for NSW. The Plan shall be provided at least 14 days prior to site establishment and include the following minimum components:</p> <ul style="list-style-type: none"> <li>A completed electronic checklist demonstrating compliance with Transport for NSW's <i>Sustainable Design Guidelines version 4.0</i> (TTP-ST-114)</li> <li>The Contractors sustainability goals and targets, internal procedures, and implementation strategy.</li> </ul>	Contractor	Detailed design
S3	Sustainability	The Contractor must comply with the Transport for NSW <i>Sustainable Design Guidelines version 4.0</i> .	Transport for NSW / Contractor	Detailed design / Construction
C1	Cumulative impacts	<ul style="list-style-type: none"> <li>Consultation will include notification prior to the start of the works</li> <li>Updates on any delays or changes to the construction period will also be communicated.</li> </ul>	Transport for NSW	Pre-construction / construction

### 7.3 Licensing and approvals

A summary of the licences and approval required for the proposal are provided in Table 7-2.

**Table 7-2: Summary of licensing and approvals required**

<b>Instrument</b>	<b>Requirement</b>	<b>Timing</b>
<i>Fisheries Management Act 1994</i>	Permit is required to relocate seahorses, if applicable	Prior to start of the activity.
<i>Roads Act 1993</i>	Notification to, and consent from, Mosman Council is required for works on Musgrave Street.	Prior to start of the activity.
Ports and Maritime Administration Regulations 2012	Written permission from the Harbour Master is required to disturb sediment in Sydney Harbour.	Prior to start of the activity.
<i>Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005</i>	An application is required to Ausgrid to upgrade the existing switchboard to accommodate the new wharf.	Prior to start of the activity.

## 8 Justification and conclusion

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This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

### 8.1 Justification

The proposal forms part of the TAP, which is an ongoing “initiative to deliver modern, safe and accessible transport infrastructure” in NSW (TfNSW, 2015). As part of the TAP, Transport for NSW assessed the condition of all ferry wharves across the transport network in 2009 in terms of:

- Safety and structural integrity
- Access for less mobile and disabled passengers
- Existing and predicted future patronage and use.

Initial justification for the proposal was provided through an assessment of the existing wharf, which was identified as needing upgrading due to its lack of accessible pathway throughout the interchange and non-DDA compliant wharf.

Consideration of alternatives and options was then carried out. The preferred design of the proposal selected to best achieve the objectives outlined in section 2.3, which included meeting the project objectives by providing improvements in access, user experience including passenger comfort and amenity, and safety. The design efficacy was determined by comparison to the option of doing nothing and other options outlined in section 2.4.

Potential environmental and social impacts resulting from construction and operation of the proposal have been minimised through the safeguards and management measures outlined in Chapter 7.

The following sub-headings provide justification through considering the impacts and benefits of the proposal.

#### 8.1.1 Social factors

The proposal would result in temporary social impacts whilst being built such as noise and visual impacts. However, all construction related impacts would be appropriately managed prior to and during construction.

Operation of the proposal provides justification over the above temporary impacts, as it would benefit the community through improving passenger amenity, safety and overall user experience. It is anticipated that the proposal would also have indirect wider community benefits, through ensuring continuation of the wharf for its expected lifespan (50 years). This extends to the cultural and amenity benefit of continuing to operate a wharf in this location.

### 8.1.2 Biophysical factors

As discussed in Chapter 6, no significant aquatic or terrestrial ecology impacts have been identified. Adverse impacts are expected as a result of tree removal to accommodate the proposed lift structure and compound area. Identified impacts would be managed through the safeguards and management measures outlined in this REF.

The design of the proposal includes tolerances to allow for sea level rise and extreme weather events, which would ensure the wharf continues to be operational throughout its 50-year design life.

### 8.1.3 Economic factors

Upgrade of the wharf would generate economic benefits over the next 50 years, with the wharf being an attractor for people to live in the area due to the recreational value of the ferry service and ability to access the CBD.

Design of the wharf has also incorporated measures to decrease the maintenance required for operation which are standardised across all newly constructed wharves. The implementation of these measures would result in cost savings for the ongoing operation of the ferry network.

## 8.2 Objects of the EP&A Act

Objects of the EP&A Act are considered in Table 8-1

**Table 8-1: Objects of the EP&A Act**

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	<p>Through the assessment in Chapter 6, it has been identified that the proposal would not significantly impact on any natural or artificial resources.</p> <p>The proposal would result in community benefits through facilitation of a safe and reliable ferry service to South Mosman for the next 50 years.</p>
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	<p>The proposal's urban design includes high quality, durable and low impact materials to minimise ongoing maintenance requirements. The design also provides thematic consistency across the entire network (refer to Chapter 3). Both factors provide for a sustainable urban environment over its 50-year design life. The Transport for NSW <i>Sustainable Design Guideline</i> would be implemented on the proposal.</p>
1.3(c) To promote the orderly and economic use and development of land.	<p>The proposal includes continuation of the use of the proposal location as a ferry wharf.</p>

Object	Comment
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	An aquatic ecology assessment has been prepared for the proposal, which is summarised in section 6.3. The assessment concluded that no significant impacts to biodiversity would be caused by the proposal.  Vegetation removal is expected to result from the proposal.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The identified mitigation measures would mitigate any potential impacts of the proposal on Aboriginal and non-Aboriginal heritage items.
1.3(g) To promote good design and amenity of the built environment.	The proposal has been designed to be consistent with the urban design objectives identified in section 2.3.3.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	The proposal would benefit the community through improving passenger amenity, safety and overall user experience. The proposal aligns with this objective as it involves the maintenance of, and continued safe access to, the wharf.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Stakeholder consultation would continue during the public display of this document to capture feedback. Should the proposal proceed to construction, consultation with the community and stakeholders would continue throughout the work.

### 8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

## **The precautionary principle**

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

Through the assessment of the potential impacts of the proposal in Chapter 6, it has been demonstrated that threats of serious or irreversible environmental damage do not exist for the proposal.

Notwithstanding, to account for the subjectivity of professional judgement applied in environmental assessment and modelling uncertainty, worst-case assumptions have been incorporated into the assessment, including the following:

- Conservative 'worst case' scenarios were considered while assessing environmental impact.
- Specialist studies were incorporated to gain a detailed understanding of the existing environment including terrestrial and aquatic ecology, landscape character and visual assessment, noise and vibration, socio-economic, non-Aboriginal heritage.
- Undertaking verification monitoring to validate results and allow modification of safeguards and mitigation controls accordingly.

## **Intergenerational equity**

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The proposal would result in benefit to the community through improvements to passenger amenity, safety and overall user experience of the ferry wharf for the next 50 years.

No potential impacts to future generations would be generated by the proposal.

## **Conservation of biological diversity and ecological integrity**

Conservation of biological diversity and ecological integrity has been considered through the assessment of ecology provided in section 6.3, and Appendix D.

Providing the safeguard measures are implemented, the proposal would not have a material or significant impact on biological diversity and ecological integrity within the proposal footprint or surrounds.

## **Improved valuation, pricing and incentive mechanisms**

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

Environmental, economic and social issues were considered in the rationale for the proposal and design options. Construction planning for the proposal would also be progressed in the most cost-effective way.

Safeguards and management measures detailed in Chapter 6, including avoiding, reusing, recycling, managing waste during construction and operation, would be implemented.

## **8.3 Conclusion**

The proposed South Mosman wharf upgrade is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (as relevant) of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on water quality, ecology, traffic and transport, landscape character and visual assessment, non-Aboriginal heritage, socio-economic values and noise and vibration. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would provide better commuter experience through improvements to passenger amenity, safety, access for people with a disability and overall user experience of the ferry wharf for the next 50 years, as well as contributing to unifying and standardising wharves in Sydney Harbour and Parramatta River. On balance the proposal is considered justified and the following conclusions are made.

### **8.3.1 Significance of impact under NSW legislation**

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from council is not required.

### **8.3.2 Significance of impact under Australian legislation**

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

## 9 Certification

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This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Belinda Crichton  
Principal, Environment  
Cardno (NSW/ACT) Pty Ltd  
Date: 26 November 2020

I have examined this review of environmental factors and accept it on behalf of Transport for NSW.

James Paddock  
Project Manager  
Infrastructure and Place  
Date: 26 November 2020

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## Terms and acronyms used in this REF

Term/ Acronym	Description
ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
AQI	air quality index
ARI	average recurrence interval
ASMA	Australian Maritime Safety Authority
ASS	acid sulfate soils
ASRIS	Australian Atlas of Acid Sulfate Soils
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCA	Building Code of Australia
BoM	Bureau of Meteorology
BZ	background zone
Cardno	Cardno (NSW/ACT) Pty Ltd
CBD	Central Business District
CCTV	closed circuit television
CD	Chart datum
CEMP	Construction Environmental Management Plan
CHL	Commonwealth Heritage List
CNVG	<i>Roads and Maritime Construction Noise and Vibration Guideline</i>
Coastal Management SEPP	<i>State Environmental Planning Policy (Coastal Management) 2018</i>
Construction footprint	Area around the proposal footprint required for construction including the compound area. Construction footprint is shown on Figure 3-2.
Compound area	Temporary facility required for construction, including for example an office and amenities compound, construction compound and materials storage compound. Compound area is shown on Figure 3-2.
COVID-19	COVID-19 is the infectious disease caused by the most recently discovered coronavirus. COVID-19 is now a pandemic affecting many countries globally. COVID-19 was first confirmed in Australia in late January 2020.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Australian Government Department of Agriculture, Water and Environment
DBYD	Dial Before You Dig
DDA	<i>Disability Discrimination Act 1992 (Commonwealth)</i>
DECCW	Former Department of Environment, Climate Change and Water

Term/ Acronym	Description
Disability Standards 2010	Disability (Access to Premises – Buildings) Standards (2010)
DPE	former Department of Planning and Environment
DPC	Department of Premier and Cabinet
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
DPIE-EES	DPIE – Environment, Energy and Science
DSAPT	<i>Disability Standards for Accessible Public Transport 2002</i>
DUAP	Former Department of Urban Affairs and Planning
EIA	Environmental impact assessment
EIS	Environmental Impact Statement
EPA	Environment Protection Agency
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i> . Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i> . Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
EWMS	environmental work method statement
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
FZ	foreground zone
HAT	Highest Astronomical Tide
Heritage Act	<i>Heritage Act 1977</i>
ICNG	EPA's <i>Interim Construction Noise Guideline</i>
ISEPP	<i>State Environmental Planning Policy (Infrastructure) 2007</i>
KFH	key fish habitat
LALC	Local Aboriginal Land Council
LAT	Lowest Astronomical Tide
LCVIA	landscape and visual impact assessment
LCZ	Landscape Character Zones
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
LV	low voltage
MNES	Matters of national environmental significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> .
Mosman LEP	<i>Mosman Local Environmental Plan 2013</i>

Term/ Acronym	Description
MZ	middle ground zone
NCA	Noise Catchment Area
NCC	National Construction Code 2016 Volumes 1, 2 and 3 (Formerly Building Code of Australia)
NHL	National Heritage List
NML	Noise Management Level
North Sydney LEP	<i>North Sydney Local Environmental Plan 2013</i>
NPW Act	National Parks and Wildlife Act 1974 (NSW)
OEH	Office of Environment and Heritage
OOHW	Out of hours work
PACHCI	<i>Procedure for Aboriginal Cultural Heritage Consultation and Investigation</i>
PAH	polycyclic aromatic hydrocarbons
PCTs	Plant Community Types
PMST	Protected Matters Search Tool
Proposal, the	The new wharf proposed to be constructed at Mosman, and as described in section 3.1.
Proposal footprint	The area directly impacted by proposed works, including the installation and removal of structures. Proposal footprint is shown on Figure 3-2.
PSI	Preliminary Site Investigation
RBL	rating background level
REF	Review of Environmental Factors
RMS	NSW Roads and Maritime Services, now known as Transport for NSW
RNE	Register of the National Estate
RNP	EPA Road Noise Policy
RNTA	Register of the National Trust of Australia (NSW)
Roads and Maritime	NSW Roads and Maritime Services, now known as Transport for NSW
RTA	Former Roads and Traffic Authority
SDG	<i>Sustainability Design Guidelines</i>
SEIA	Socio-economic impact assessment
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SHI	NSW State Heritage Inventory
SHR	State Heritage Register
SIS	species impact statement
SOHI	Statement of Heritage Impact
SRD SEPP	<i>State Environmental Planning Policy (State and Regional Development) 2011</i>
SWMP	Soil and Water Management Plan
Sydney Harbour SREP	<i>Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005</i>

<b>Term/ Acronym</b>	<b>Description</b>
TAP	Transport Access Program
TfNSW	Transport for NSW
TMP	Traffic Management Plan
TRH	total recoverable hydrocarbons
VIS	vegetation information system
WHL	World Heritage List
WMP	Waste Management Plan

## Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance and Commonwealth land

## Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline (DUAP 1995/1996) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
<p>a) Any environmental impact on a community?</p> <p>During construction of the proposal, there would be impact from construction related noise to surrounding receivers and impacts to traffic and transport due to temporary closure of the wharf.</p>	High, short-term negative
<p>Operation of the wharf would have improved public transport facilities at South Mosman.</p> <p>Impacts would be minimised through implementing the safeguards and management measures identified in section 7.1 of the REF.</p>	Long term positive
<p>b) Any transformation of a locality?</p> <p>The proposal would have a moderate impact to visual and landscape character. Impacts have been reduced through design of the wharf.</p>	Moderate, long term negative impact
<p>c) Any environmental impact on the ecosystems of the locality?</p> <p>The assessment of aquatic ecology indicates there would be a minor impact to marine biodiversity during construction.</p>	Minor, short term negative
<p>This would be offset by the creation of hard surfaces and newly exposed subtidal substrate.</p>	Minor, long term positive
<p>Further impact to aquatic and terrestrial ecology would be mitigated through implementing the safeguards and management measures identified in section 7.1 of the REF.</p>	Minor, long term negative
<p>d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</p> <p>There would be temporary aesthetic impacts during construction of the proposal.</p>	Moderate, short term negative
<p>Landscape character and visual impacts have been assessed as moderate. Impacts have been reduced through design of the wharf, including retention of the wharf in its location.</p> <p>Impacts to environmental quality and value have been assessed as low to moderate, and would be limited to short-term impacts during construction of the proposal.</p> <p>No long-term impacts to environmental quality and value are anticipated.</p>	Moderate, long term negative
<p>e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?</p> <p>There would be negligible or neutral impacts to other non-Aboriginal heritage items in the visual range of the proposal.</p>	Minor/ negligible long term
<p>No known Aboriginal sites would be impacted.</p>	Negligible.

Factor	Impact
<p>f) Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)?</p> <p>Water-based activities have potential to impact habitat for the Black Rockcod and White's Seahorse. The foraging resource that the study area represents would be made available for these species following the completion of construction thus, proposal impacts to potential foraging habitat for these species are only temporary. The loss of potential habitat from the installation of piles on subtidal rocky reef and the removal impact of part of the existing structure is considered minimal for Black Rockcod and White's Seahorse. This is a very small proportion of available habitat in their distribution and the installation of new piles would provide similar, if not the same habitat for these species during operation. Additional controls would be implemented to survey for Black Rockcod and White's Seahorse at the start of construction so that individuals in the area at the start of construction are not harmed.</p>	<p>Minor, short term, negative</p>
<p>The removal of vegetation as a result of the proposal would remove potential habitat for native fauna. However, the overstorey and groundcover species to be removed forms only a small portion of similar habitat along the fragmented and highly urbanised foreshores of Neutral Bay. The removal of habitat resources is unlikely to have a substantial impact on native fauna as there is an abundance of similar habitat across the study locality.</p>	<p>Negligible, long term</p>
<p>g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</p> <p>The proposal would not endanger any species of animal, plant or other form of life, whether living on land, in water or in the air.</p>	<p>No impact</p>
<p>h) Any long-term effects on the environment?</p> <p>The proposal would result in long term visual impacts. No other long-term negative effects on the environment are anticipated.</p>	<p>Long term negative</p>
<p>The proposal would result in improvements in user amenity for the wharf.</p>	<p>Long term positive</p>
<p>i) Any degradation of the quality of the environment?</p> <p>The proposal would result in localised sediment disturbance during piling activities, which would result in temporary impacts to water quality.</p> <p>There is potential for accidental spills/leaks of fuel, oil or other chemicals to impact water quality during construction.</p> <p>Impacts would be minor with implementation of the safeguards and management measures identified in section 7.1 of the REF.</p>	<p>Minor, short term negative</p>
<p>j) Any risk to the safety of the environment?</p> <p>Construction related activities pose potential risks to the safety of the environment through spills/leaks of fuel, oil or other chemicals.</p> <p>Impacts would be minor with implementation of the safeguards and management measures identified in section 7.1 of the REF.</p>	<p>Minor, short term negative</p>
<p>k) Any reduction in the range of beneficial uses of the environment?</p>	<p>No impact</p>

Factor	Impact
<p>The proposal would not reduce the range of beneficial uses of the environment.</p>	
<p>l) Any pollution of the environment? Construction related activities may result in pollution of the environment through spills/leaks of fuel, oil or other chemicals. Impacts would be minor with implementation of the safeguards and management measures identified in section 7.1 of the REF.</p>	<p>Minor, short term negative</p>
<p>m) Any environmental problems associated with the disposal of waste? All wastes generated by the proposal would be disposed of at an off-site facility which is licenced to receive such waste. There would be no significant environmental problems associated with waste disposal.</p>	<p>Minor, short term negative</p>
<p>n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? All resources required by the proposal are readily available and are not likely to become in short supply.</p>	<p>No impact</p>
<p>o) Any cumulative environmental effect with other existing or likely future activities? Assessment of cumulative impacts for the proposal is provided in section 6.12. Other projects in the same timing of this proposal include upgrade of other wharfs in the ferry network, and building developments in the local Council area. There may be a minor increase in marine traffic, and noise impacts. No other significant cumulative impacts have been identified for the proposal. The proposal design includes an allowance for sea level rise.</p>	<p>Minor, short term negative</p>
<p>p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? Consideration of coastal processes and coastal hazards is detailed in section 6.1. No impacts to these issues are anticipated for the proposal.</p>	<p>No impact</p>

## Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on the Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of Agriculture, Water and Environment.

A referral is not required for proposed actions that may affect nationally listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
a) Any impact on a World Heritage property?	No impact
b) Any impact on a National Heritage place?	No impact
c) Any impact on a wetland of international importance?	No impact
d) Any impact on a listed threatened species or communities? Black Rockcod ( <i>Epinephelus daemeli</i> ) listed as vulnerable under the EPBC Act. Water-based activities have potential to impact habitat for the Black Rockcod. The foraging resource that the study area represents would be made available for these species following the completion of construction thus, proposal impacts to potential foraging habitat for this species are only temporary. The loss of potential habitat from the installation of three piles on subtidal rocky reef and the removal impact of part of the existing structure is considered minimal for Black Rockcod. This is a very small proportion of available habitat in their distribution and the installation of new piles would provide similar, if not the same habitat for these species during operation. Additional controls would be implemented to survey for Black Rockcod at the start of construction so that individuals in the area at the start of construction are not harmed.	Minor, short term
e) Any impacts on listed migratory species?	No impact
f) Any impact on a Commonwealth marine area?	No impact
g) Does the proposal involve a nuclear action (including uranium mining)?	No impact
h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	No impact

# Appendix B

## Statutory consultation checklists

# Infrastructure SEPP

## Certain development types

Development type	Description	Yes/No	If 'yes' consult with	ISEPP clause
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No	-	ISEPP cl. 95A
Bus Depots	Does the project propose a bus depot?	No	-	ISEPP cl. 95A
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	-	ISEPP cl. 95A

## Development within the Coastal Zone

Issue	Description	Yes/No/NA	If 'yes' consult with	ISEPP clause
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	N/A	-	ISEPP cl. 15A

Note: See interactive map here: <https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management>. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

## Council related infrastructure or services

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Stormwater	Is the work likely to have a <i>substantial</i> impact on the stormwater management services which are provided by council?	No	-	ISEPP cl.13(1)(a)

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Traffic	Is the work likely to generate traffic to an extent that will <i>strain</i> the capacity of the existing road system in a local government area?	No	-	ISEPP cl.13(1)(b)
Sewerage system	Will the work involve connection to a council owned sewerage system? If so, will this connection have a <i>substantial</i> impact on the capacity of any part of the system?	No	-	ISEPP cl.13(1)(c)
Water usage	Would the work involve connection to a council owned water supply system? If so, would this require the use of a <i>substantial</i> volume of water?	No	-	ISEPP cl.13(1)(d)
Temporary structures	Would the work involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a <i>minor</i> or <i>inconsequential</i> disruption to pedestrian or vehicular flow?	Yes	Mosman Council	ISEPP cl.13(1)(e)
Road and footpath excavation	Would the work involve more than <i>minor</i> or <i>inconsequential</i> excavation of a road or adjacent footpath for which council is the roads authority and	Yes	Mosman Council	ISEPP cl.13(1)(f)

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
	responsible for maintenance?			

### Local heritage items

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the work? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than <i>minor</i> or <i>inconsequential</i> ?	No	-	ISEPP cl.14

### Flood liable land

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Flood liable land	Is the work located on flood liable land? If so, would the work change flood patterns to more than a <i>minor</i> extent?	No	-	ISEPP cl.15
Flood liable land	Is the work located on flood liable land? (to any extent). If so, does the work comprise more than minor alterations or additions to, or the demolition of, a building, emergency work or routine maintenance	No	-	ISEPP cl.15AA

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable land* published by the New South Wales Government.

## Public authorities other than councils

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
National parks and reserves	Is the work adjacent to a national park or nature reserve, or other area reserved under the <i>National Parks and Wildlife Act 1974</i> , or on land acquired under that Act?	No	-	ISEPP cl.16(2)(a)
National parks and reserves	Is the work on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	-	ISEPP cl. 16(2)(b)
Aquatic reserves	Is the work adjacent to an aquatic reserve or a marine park declared under the <i>Marine Estate Management Act 2014</i> ?	No	-	ISEPP cl.16(2)(c)
Sydney Harbour foreshore	Is the work in the Sydney Harbour Foreshore Area as defined by the <i>Place Management NSW Act 1998</i> ?	No		ISEPP cl.16(2)(d)
Bush fire prone land	Is the work for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	-	ISEPP cl.16(2)(f)
Artificial light	Would the work increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	-	ISEPP cl.16(2)(g)
Defence communication	Is the work on buffer land around the	No	-	ISEPP cl. 16(2)(h)

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
ons buffer land	defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.			
Mine subsidence land	Is the work on land in a mine subsidence district within the meaning of the <i>Mine Subsidence Compensation Act 1961</i> ?	No	-	ISEPP cl. 16(2)(i)

## Sydney Harbour SREP Consultation

Issue	Potential impact	Yes/No	If 'yes' consult with	SREP clause
Provision of services	Do the works require the provision of services (including water, sewerage or stormwater systems)?	Yes	Ausgrid	SREP cl.31(2)(a)(ii)
Advertising	Do the works include advertisements or advertising structures?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Aviation	Do the works include aviation facilities?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Boat launching	Do the works include boat launching facilities?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Boat lifts	Do the works include boat lifts?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Boat repair	Do the works include boat repair facilities?	No	-	SREP cl.31(2)(a)(i) & Schedule 2

<b>Issue</b>	<b>Potential impact</b>	<b>Yes/ No</b>	<b>If 'yes' consult with</b>	<b>SREP clause</b>
Boat sheds	Do the works include a boat shed or sheds?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Charter and tourism boating facilities	Do the works include charter and tourism boating facilities?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Marinas	Do the works include a commercial or private marina?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Commercial port facilities	Do the works include commercial port facilities?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Commercial or retail use of land	Do the works include the commercial or retail use of land below or partly below mean high water mark?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Dredging	Do the works involve any dredging?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Flora and fauna enclosures	Do the works include any flora and/or fauna enclosures?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Houseboats	Do the works include a houseboat or houseboats?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Inclinators	Do the works include an inclinators?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Private landing facilities	Do the works include private landing facilities (including jetties, wharves and pontoons)?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Public boardwalks	Do the works include a public boardwalk?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Public water recreational facilities	Do the works include any public water recreational facilities?	No	-	SREP cl.31(2)(a)(i) & Schedule 2

<b>Issue</b>	<b>Potential impact</b>	<b>Yes/ No</b>	<b>If 'yes' consult with</b>	<b>SREP clause</b>
Public water transport facilities	Do the works include public water transport facilities?	Yes	Foreshores and Waterways Development Advisory Committee	SREP cl.31(2)(a)(i) & Schedule 2
Reclamation works	Do the works require any reclamation?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Recreational or club facilities	Do the works include any recreational or club facilities?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Residential	Do the works include any residential use of land below or partly below mean high water mark?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Retaining walls	Do the works include retaining walls?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Sea walls	Do the works include sea walls?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Skids	Do the works include skids (i.e. an inclined ramp used for the manual launching of small craft but not including a slipway)?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Swimming enclosures	Do the works include a swimming enclosure?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Water based restaurants and entertainment facilities	Do the works include water-based restaurants and/or entertainment facilities? (i.e. a vessel or structure that floats on, or is fixed in, the waterway, that is used as a club or restaurant or for entertainment (on a commercial basis) and that has a direct structural connection between the	No	-	SREP cl.31(2)(a)(i) & Schedule 2

Issue	Potential impact	Yes/ No	If 'yes' consult with	SREP clause
	foreshore and the waterway).			
Stairs	Do the works include waterfront access stairs?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Demolition	Do the works include demolition – including demolition in relation to heritage items?	No	-	SREP cl.31(2)(a)(i) & Schedule 2

# Appendix C

## Preliminary site investigation

# Preliminary Site Investigation

## South Mosman Wharf Upgrade

AWE200198



Prepared for  
Transport for NSW

19 November 2020

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Our report is based on information made available by the client. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Cardno is both complete and accurate. Whilst, to the best of our knowledge, the information contained in this report is accurate at the date of issue, changes may occur to the site conditions, the site context or the applicable planning framework. This report should not be used after any such changes without consulting the provider of the report or a suitably qualified person.

## Executive Summary

Cardno (NSW/ACT) Pty Ltd (Cardno) was engaged by Transport for NSW (TfNSW) to undertake a Preliminary Site Investigation (PSI) to determine the risk of contamination at the South Mosman wharf. TfNSW proposes to remove the existing wharf structure at South Mosman and construct a new wharf in its place which would be accessible for all passengers.

Construction of the land-based elements would involve earthworks including lift construction, regrading of existing footpaths and piling. Removal of vegetation on the foreshore for construction of the lift and stairs would also be required. Construction of the new wharf structure would require piling within the waterway. It is expected that harbour sediment would be disturbed during piling and demolition of the existing wharf.

Cardno conducted a site inspection and reviewed previous environmental investigations, background information and historical aerial imagery. The investigation was undertaken to:

- > Identify historical sources of potential contamination or potentially contaminating activities that may have taken place on or adjacent to the Site
- > To identify potential sources and indicators of contamination including potential sensitive receptors.

### Site contaminants of concern

Following the review of background information and a site inspection, Cardno identified the following contaminating activities at the Site:

- > Fill during construction of the South Mosman wharf and ancillary features
- > Contaminant transport from Sydney Harbour.

The following contaminants were identified as having potential of occurring at the Site:

- > Polycyclic aromatic hydrocarbons (PAH)
- > Heavy metals
- > Organochlorine Pesticides/Organophosphorus Pesticides (OCP/OPP).

### Risk assessment

The information sourced during the preparation of this investigation has been utilised to determine the likelihood for historical and current land use activities to have affected the suitability of the Site. Taking into consideration the available background data and the site inspection, the main sources of possible contamination are:

- > The current impacts and origin of soils at the Site are unknown. The Site history indicates that there is medium risk that impacted soils are present at the Site
- > Previous assessment by Coffey (2016) indicates that sediment within the construction footprint is contaminated with concentrations of various analytes above the adopted criteria and are Acid Sulfate Soils
- > The location of the ferry wharf is in the lower reaches of Mosman Bay, which experiences a greater amount of flushing and on average has less contamination than the upper reaches of Mosman Bay and the areas further upstream of Sydney Harbour (Birch & Taylor, 2004). It is considered unlikely that water entering the Site from tidal influences would be enriched with contaminants.

### Recommendations

Given the results of the assessment, the following is recommended:

- > An intrusive soil investigation to the depth of excavation to ensure the safety of construction workers and provide waste classification of the materials to be removed
- > The piling methodology shall seek to mitigate the risk of sediment dispersal
- > The above works be undertaken by a suitably qualified contaminated land specialist.

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# 1 Introduction

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## 1.1 Background

Transport for NSW (TfNSW) proposes to upgrade the wharf at South Mosman (the proposal) as part of the NSW Government's Transport Access Program (TAP). TAP is an ongoing 'initiative to deliver modern, safe and accessible transport infrastructure' in NSW (TfNSW, 2015). The focus of the program is improving access to the transport network for less mobile passengers. As a result, Roads and Maritime Services (now TfNSW) assessed the condition of all ferry wharves across the transport network in 2009 in terms of:

- > Safety and structural integrity
- > Access for less mobile and disabled passengers
- > Existing and predicted future patronage and use.

The aims behind the above objective of the TAP are to:

- > Improve the accessibility for passengers who use wheelchairs and prams by removing stairs and providing ramps
- > Build facilities for all transport modes to meet the needs of a growing population
- > Provide an effective and seamless interchange that supports an integrated transport network.

## 1.2 Proposal description

The proposal is to upgrade the South Mosman wharf (the proposal) as part of TAP. The water based features of the proposal would include:

- > Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- > Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- > Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- > Removal of the existing gangway and pontoon including existing piles
- > Remediation of the seawall following removal of the existing wharf, if required.

The land based features of the proposal would include:

- > Installation of a new 16-metre high lift and new covered stairs
- > Installation of a new covered street level waiting area
- > Installation of a covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- > Installation of three bicycle parking hoops
- > Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- > Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

The proposal would be constructed over a duration of up to six months starting in late 2021.

**Figure 1** in **Appendix A** shows the key features of the proposal including the water-based and land-based features.

Construction of the land-based elements would involve earthworks including lift construction, regrading of existing footpaths and piling. Removal of vegetation on the foreshore for construction of the lift and stairs would also be required. Construction of the new wharf structure would require piling within the waterway. It is expected that harbour sediment would be disturbed during piling and demolition of the existing wharf.

### 1.3 Purpose and objectives

Cardno (NSW/ACT) Pty Ltd (Cardno) was engaged by TfNSW to undertake a Preliminary Site Investigation (PSI) to determine the risk of contamination at the South Mosman wharf. The study area for the PSI is defined by the construction footprint presented in **Figure 2** in **Appendix A** (the Site).

The purpose of the PSI is to provide TfNSW with preliminary advice on the potential constraints at the Site from a contamination perspective. The objectives of the investigation are to:

- > Identify historical sources of potential contamination or potentially contaminating activities that may have taken place on or adjacent to the project Site
- > To identify potential sources and indicators of contamination including potential sensitive receptors.

### 1.4 Scope

Cardno carried out the following tasks to satisfy the purpose and objectives of the PSI:

- > Defined the Site features and immediate surrounds based on site observations during the assessment activities
- > Reviewed available background information for the Site, including searches of public databases, previous reports, historical aerial imagery and NSW EPA maintained registers
- > Identified nearby sensitive receptors
- > Reviewed regional and local geology and hydrogeology, including details on registered bores
- > Developed a conceptual site model (CSM) to evaluate potential risks to identified sensitive receptors
- > Prepared this PSI report.

### 1.5 Guidelines and legislation

The scope of work was completed in general accordance the following guidelines and legislation:

- > *Guidelines for the Assessment of On-Site Containment of Contaminated Soil*, Australian and New Zealand Environment and Conservation Council (ANZECC, 1999)
- > *National Environment Protection (Assessment of Site Contamination) Measure (NEPM)*. National Environment Protection Council (NEPC, 1999)
- > *Managing Land Contamination: Planning Guidelines: SEPP 55 Remediation of Land*. NSW Department of Urban Affairs and Planning (DUAP, 1998)
- > *Waste Classification Guidelines*. NSW Environment Protection Authority (EPA, 2014)
- > *Consultants reporting on contaminated land Contaminated land guidelines*. NSW Environment Protection Authority (EPA, 2020)
- > *Mosman Local Environment Plan 2012* (Mosman LEP 2012).

## 2 Site condition and surrounding environment

The Site is located off Musgrave Street, Mosman NSW. The Site is bounded by residential properties to the north, Mosman peninsula to the south, Musgrave Street to the east and Mosman Bay to the west.

The Site location is shown in **Figure 1** in **Appendix A** with Site details provided in **Table 2-1**.

Table 2-1 Site identification

Item	Details
Site Address	Musgrave Street, Mosman
Approximate Site Area	<0.5 hectares
Title Details	Lot 1 DP725239 and Lot 1100 DP752067 Works below mean high water mark
Local Government Area	Mosman Council
Suburb	Mosman
Site Owners at the time of this engagement	Mosman Council (landside) and Crown land (waterside)

### 2.2 Site description

The Site is irregular in shape and located on the Mosman peninsula. It is understood that the Site has remained the same since at least 1930, although the footprint of the ferry wharf has changed.

An inspection of the Site was undertaken on 26 March 2020 with details and observations made during the site inspection provided in **Table 2-2**. Photographs from the site inspection are presented in **Appendix B**.

Table 2-2 Site inspection observations

Item	Observations
Site use	The Site is currently used as the berthing point for the F5 Neutral Bay ferry network.
Weather condition	Clear and sunny.
Site Slope and Drainage Features	The Site is located on the western side of the Mosman peninsula which is characterised by a sandstone cliff between Musgrave Street and the ferry wharf. The low side of the cliff is the location of the ferry wharf and is relatively flat. It is a mixture of vegetated and hardstand, with a concrete footpath and stairs which are surrounded by established trees and shrubs. The high side of the cliff is Musgrave Street and is predominantly hardstand.  During rainfall events it is expected that some overland flow from Musgrave Street will be directed toward to Site due to the sloping topography, however the majority will continue along Musgrave Street toward the southern tip of the peninsula. Water is then expected to infiltrate into the grass-covered areas, where it will likely interact with Sydney Harbour due to tidal influences.
Nearby water bodies	A portion of the Site lies within Sydney Harbour, which adjoins the Site to the east and south.
Site surface coverings	The Site is covered by approximately 70 per cent grass-covered areas and 30 per cent hardstand.
Site cut and fill	Cut and filling is likely to have occurred during the construction of the stairs and levelling of the land on the low side of the cliff.
Surface soils	Brown sandy silt.
Buildings	A covered staircase is on-site.
Potential asbestos in building materials	Asbestos containing material (ACM) materials were not identified during the walkover.
Manufacturing, industrial or chemical processes and infrastructure	Ferry wharf which acts as a berthing point for ferries on the F6 Mosman Bay Network.

Item	Observations
Fuel storage tanks (USTs/ASTs)	Not observed.
Dangerous goods	Not observed.
Solid waste deposition	General waste and recycling receptacles were observed on the ferry wharf.
Liquid waste disposal features	Not observed.
Evidence of previous site contamination investigations	Preliminary Site Investigation, Coffey 2016.
Evidence of land contamination (staining or odours)	Not observed.
Evidence of groundwater contamination	Not observed.
Groundwater use	Not observed.
Vegetation	There are a number of established trees located at the base of the cliff within the Site. Small shrubs and undergrowth occupy the majority of the surface area below.

## 2.3 Surrounding land use

Land uses surrounding the Site are detailed in **Table 2-3** and illustrated in **Figure 2** in **Appendix A**.

Table 2-3 Surrounding land use

Direction	Land Use or Activity
North	Rocky shoreline and residential properties along Musgrave Street
West	Mosman Bay
East	Musgrave Street beyond which are residential properties
South	Rocky shoreline

## 2.4 Topography and drainage

The Site is located on the western side of the South Mosman peninsula which is characterised as hilly and steep. The high side of the Site adjoining Musgrave Street has an elevation of approximately 16 mAHD, while the low side of the Site has an elevation of approximately 3 mAHD. The high side and low side are separated by a sandstone outcrop. Currently the Site is a mixture of a hardstand footpath and stairs and vegetated areas, with no stormwater drainage systems observed. It is understood that surface water drainage discharges into Mosman Bay during rainfall events.

## 2.5 Flood potential

During the review of the Mosman Council LEP 2012 flood risk maps were not identified. As there are no flood risk maps available it is considered unlikely that the Site is subject to flooding.

## 2.6 Regional geology and hydrology

The Sydney 1:100,000 Geological Map Sheet 9130 (1983) accessed from NSW Resources and Energy indicates that the Site is underlain by Hawkesbury Sandstone from the Mesozoic Era, which is characterised by medium to coarse grained quartz sandstone, very minor shale and laminite lenses.

### 2.6.1 Acid sulfate soils

Review of the Mosman Council LEP 2012 ASS (ASS\_003) risk maps indicated that the Site was not within an area of known ASS for the landside elements.

Review of the Australian Atlas of Acid Sulfate Soils (ASRIS) on the 5 April 2020 indicated that there is a high probability of occurrence for ASS in the subtidal marine environments.

## 2.6.2 Salinity

During the background information review, salinity risk maps were not identified for the Site. It is considered that there is low risk for salinity hazards to be present at the Site.

## 2.7 Groundwater database

A search of the Australian Groundwater Explorer database did not identify any groundwater bores within the Site. The search did not identify groundwater wells within 500 metres of the Site.

## 2.8 Previous environmental reports

The following report was used as a reference for sediment contamination in Sydney Harbour:

- > *The Contaminant Status of Sydney Harbour Sediments, A handbook for the Public and Professionals.* (Birch and Taylor, 2004)

Cardno was provided and reviewed the following report:

- > *Stage 2 Contamination Assessment – South Mosman Ferry Wharf.* (Coffey, 2016).

### ***The Contaminant status of Sydney Harbour sediments, a handbook for the public and professionals (Birch and Taylor, 2004)***

The study into the contaminant status of Sydney Harbour primarily assessed four groups of contaminants:

- > Heavy metals
- > Organochlorine Pesticides (OCP) residues
- > Polycyclic aromatic hydrocarbons (PAH)
- > Polychlorinated Biphenyls (PCB).

Assessment of organic compounds such as Total Recoverable Hydrocarbons (TRH) was not undertaken for economic reasons. Following sampling and laboratory analysis of sediment from Neutral Bay, the following analytes were identified as the most enriched in Sydney Harbour:

- > Aldrin
- > Heptachlor
- > PCBs
- > Dieldrin
- > Dichlorodiphenyltrichloroethane (DDT)
- > Lead
- > HCB (hexachlorobenzene)
- > PAHs.

The mean concentrations of analytes are provided in **Table 2-4**.

Table 2-4 Mean analyte concentrations in Neutral Bay

Analyte	Mean Concentration (mg/kg)
PAHs	45
Lead	425
Copper	250
Zinc	650
PCBs	65
Chlordane	50
DDD	13
DDT	8

Analyte	Mean Concentration (mg/kg)
Aldrin	1.5
Dieldrin	2
Heptachlor	3

The results indicated that the sediment within Mosman Bay contained high levels of copper, lead and PAHs when compared to sediment in other areas of Sydney Harbour that were subject to industrial activity. Stormwater discharge and surface water runoff are considered to be the primary sources of contamination at Mosman Bay.

### 2.8.2 Stage 2 contamination assessment – South Mosman ferry wharf (Coffey, 2016)

Coffey Geotechnics Pty Ltd (Coffey) was commissioned by Hansen Yuncken (HY) to provide a contamination assessment for the proposed South Mosman wharf upgrade. The project area for this assessment was within Mosman Bay and included taking two sediment samples to assess for the contamination and ASS potential of soils as well as to provide an indicative waste classification.

During fieldwork, the sediment encountered was described as fine to dark grey sandy silt to approximately 2.7 to 3.5 metres below the sea floor which was underlain by sandstone bedrock. Analytical laboratory results indicated that samples were below the ANZECC (2000) *Australia and New Zealand Guidelines for Fresh and Marine Water Quality*, Table 3.5.1 – Interim Sediment Quality Guidelines (ISQG) Low criteria with the exception of the following analytes:

- > Copper
- > Lead
- > Endrin
- > Dieldrin
- > Benzo(a)anthracene
- > Benzo(a)pyrene
- > PAH (total).

Mercury was the only analyte with concentrations that were reported higher than ISQG High criteria.

The material was considered to be General Solid Waste when compared to the *Waste Classification Guidelines* (EPA, 2014). However, the classification was preliminary and further sampling would be required if any material was excavated during works. Sediments were also recorded chromium reducible sulfur concentrations of 0.33 percent and 0.06 percent sulfur, which is greater than the action criteria of 0.03 per cent in the ASS Manual 1998 (Stone et al., 1998).

The results were compared to previous studies of sediment contamination within Sydney Harbour (Irvine and Birch, 1998) and were considered to be similar. The study determined that the contamination risk arising from ferry wharf construction are considered medium to high.

## 2.9 EPA records search

### 2.9.1 Contaminated Land Record of Notices

The Contaminated Land Record of Notices is maintained by the Environment Protection Authority (EPA) in accordance with Part 5 of the *Contaminated Land Management (CLM) Act 1997* and contains regulatory notices issued by the EPA in relation to contaminated sites.

A search of the Contaminated Land Record of Notices on 2 April 2020 did not identify sites within a 500 metres radius of the Site.

### 2.9.2 PoEO public register

The Public register under Section 308 of the *Protection of the Environment Operations Act 1997* (PoEO Act) contains Environment Protection Licences (EPLs), applications and notices issued by the EPA. The Public Register was searched on 2 April 2020 within 500 metres of the Site and identified one site with a current license. Results are summarised in **Table 2-5**.

Table 2-5 PoEO public register

Site Name	Address	Activity	Status	Distance (m) / Direction
Taronga Zoo	Bradleys Head Road, Mosman	Sewage treatment processing by small plants	Active	406 / east

### 2.9.3 List of contaminated sites notified to the EPA

A search of the list of Contaminated Sites Notified to the EPA on 2 April 2020 did not identify any notified sites within 500 metres of the Site.

## 2.10 Planning information

Review of the Mosman LEP 2012 (map LZN 003) indicates that the majority of the Site is within an area zoned as SP2 - Infrastructure. The SP2 – Infrastructure zone has the following objectives:

- > To provide for infrastructure and related uses
- > To prevent development that is not compatible with or that may detract from the provision of infrastructure.

## 3 Site History

### 3.1 Historical aerial photograph review

Fifteen historical aerial photographs were obtained dating back to 1930 (refer Appendix C, LI Resources). An interpretation of aerial photographs from 1930 until 2020 are presented in **Table 3-1**.

Table 3-1 Historical aerial photograph review

Year	Description of Site	Off-Site Direction	Description
1930 (low image quality)	Details of the ferry wharf and supporting infrastructure is unknown due to low resolution. The landside portion of the Site is vegetated. An unsealed path traverses the western portion of the Site.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street which appears to be unsealed and residential properties.
		West	Mosman Bay.
1943	A structure/concrete landing on the foreshore is identified that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street which is sealed and residential properties.
		West	Mosman Bay.
1955	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
1961	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Construction or alterations have occurred at the existing South Mosman wharf.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
1965	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures are present to the south of the existing South Mosman wharf in the water.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
1971 (low quality)	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures are present to the south of the existing South Mosman wharf in the water.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.

Year	Description of Site	Off-Site Direction	Description
		West	Mosman Bay.
1975 (low quality)	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures are present to the south of the existing South Mosman wharf in the water.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
1986	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation has increased in the northern landside portion. Structures to the south of the existing South Mosman wharf in the water are no longer present.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
1991	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures to the south of the existing South Mosman wharf in the water are no longer present.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
1994	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures to the south of the existing South Mosman wharf in the water are no longer present.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
2004	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures to the south of the existing South Mosman wharf in the water are no longer present.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
2009	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures to the south of the existing South Mosman wharf in the water are no longer present.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
2011	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.

Year	Description of Site	Off-Site Direction	Description
	Structures to the south of the existing South Mosman wharf in the water are no longer present.	East	Musgrave Street and residential properties.
		West	Mosman Bay.
2014	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures to the south of the existing South Mosman wharf in the water are no longer present.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.
2017	A structure/concrete landing on the foreshore that connects to the gangway and existing South Mosman wharf pontoon. Vegetation in the northern landside portion. Structures to the south of the existing South Mosman wharf in the water are no longer present.	North	Residential properties.
		South	Residential structures on Curraghbeena Point beyond which is Sydney Harbour.
		East	Musgrave Street and residential properties.
		West	Mosman Bay.

### 3.2 Heritage

A search of the NSW Department of Planning, Industry and Environment (DPIE) State Heritage Inventory, indicated there are fifteen heritage items listed within 200 metres of the Site. A summary of the heritage items is presented in **Table 3-2**.

Table 3-2 Heritage items

Site Name	Significance	Distance (m)
Musgrave Street Divided Road	Local	On-site
Site of original 1870s Musgrave Street wharf	Local	On-site
Herron Walk Steps	Local	10 south-east
Group of 2 houses (3 dwellings)	Local	20 north-east
Chinese boatshed	Local	54 south-east
Flats	Local	55 north-east
Raglan Street Divided Road	Local	66 east
'The Castle', Flats	Local	72 south east
Group of four houses	Local	84 east
'Ythanbank', House (formerly known as 'Boxmoor Flats')	Local	96 east
Pedestrian steps and walkway	Local	112 north-east
'Rutledge Lodge', House	Local	129 north
'Bareena', House	Local	139 north-east
'Abington', House	Local	150 north-east
Cremorne Point	Local	193 north-west

### 3.3 Summary of relevant historical activities

Historical land uses and potential activities occurring at the Site are summarised in **Table 3-3**. Activities with the potential to cause contamination are noted.

Table 3-3 Summary of site historical activities and potential causes of contamination

Year	Information Source	Interpretation	Site Activities
Pre 1930	Historical Aerial Photograph	Use of fill material of unknown origin and impact	Levelling the Site for construction of the ferry wharf
1930 – ongoing	Historical Aerial photograph	Surface water runoff containing pesticides, heavy metals and PAHs from the road	Ferry wharf

### 3.4 Contaminants of potential concern

Based on the available site history the contaminants of potential concern (COPC) identified by Cardno are listed in **Table 3-4**.

Table 3-4 Identified contaminants of potential concern

Area of Concern	Potential Source	Potential Contaminant
Landside	<ul style="list-style-type: none"> <li>▪ Fill material of unknown origin and impact; and</li> <li>▪ Tidal flows of contaminated water into subsurface profile.</li> </ul>	<ul style="list-style-type: none"> <li>▪ PAH;</li> <li>▪ Heavy metals; and</li> <li>▪ OCP/OPP.</li> </ul>
Waterside	<ul style="list-style-type: none"> <li>▪ Contaminant transport from the greater Sydney Harbour; and</li> <li>▪ Fuel leaks from vessels.</li> </ul>	<ul style="list-style-type: none"> <li>▪ PAH;</li> <li>▪ TRH;</li> <li>▪ Heavy metals; and</li> <li>▪ OCP/OPP.</li> </ul>

## 4 Preliminary site conceptual model

A conceptual site model (CSM) provides an assessment of the potential fate and transport of COPCs relative to site-specific subsurface conditions with regard to their potential risk to human health and the environment. The CSM considers site-specific factors including:

- > Source(s) of contamination
- > Identification of COPCs associated with past (and present) source(s)
- > Vertical, lateral and temporal distribution of COPCs
- > Actual or potential receptors considering both current and future land use both for the Site and adjacent properties, and any sensitive ecological receptors.

Based on the information sourced in this report, a preliminary CSM has been developed and is outlined in **Table 4-1**. Additional details are included in the sections that follow as necessary.

Table 4-1 Preliminary conceptual site model

Conceptual Site Model Element	Description
Site History/Contaminant Sources	The Site has been the location of the ferry wharf pre-1930. Since 1930, the surrounding land use of the local area has been residential. Sources of contamination at the Site are considered to be off-site sources from the surface water runoff from Musgrave Street and potentially impacted fill materials at the Site.
Site Current and Future Use	The current use of the Site is a ferry wharf adjoining Musgrave Street. The future use of the Site would remain the same.
Site Geology	The Site is underlain by Hawkesbury Sandstone from the Mesozoic Era, which is characterised by medium to coarse grained quartz sandstone, very minor shale and laminite lenses. A sandstone outcrop was visible to the north of the Site.
Site Hydrogeology	The depth of groundwater on the landside portion of the Site is unknown. The waterside portion of the Site includes Mosman Bay which is contained within Sydney Harbour. It is expected that there would be tidal influence to groundwater in the landside section of the Site. Sydney Harbour has been identified as having high levels of contamination which vary from tides and storm flows (Birch and Taylor, 2004).
Potential Contaminants – Soil & Sediment	<ul style="list-style-type: none"> <li>▪ PAH</li> <li>▪ Heavy metals</li> <li>▪ OCP/OPP.</li> </ul>
Potential Human Receptors	<ul style="list-style-type: none"> <li>▪ Current and future users of the Mosman Bay ferry service</li> <li>▪ Maintenance workers</li> <li>▪ Future construction workers</li> <li>▪ Users of Mosman Bay and the greater Sydney Harbour.</li> </ul>
Potential Environmental Receptors	<ul style="list-style-type: none"> <li>▪ Sydney Harbour</li> <li>▪ Aquatic biota and vegetation</li> <li>▪ Soil biota and vegetation.</li> </ul>
Potential Human Exposure Pathways	<ul style="list-style-type: none"> <li>▪ Inhalation of particles</li> <li>▪ Dermal contact and ingestion of contaminated soils.</li> </ul>
Potential Environmental Exposure Pathways	<ul style="list-style-type: none"> <li>▪ Tidal influences transporting contaminants to and from the Site</li> <li>▪ Uptake of contaminants from surrounding soil biota and vegetation.</li> </ul>

## 5 Conceptual risk assessment

A preliminary risk ranking for potential contaminants has been developed for the site based on the background review, aerial photographs, previous site investigations and Site inspections/observations. For a contaminant to represent a risk to human health or the environment, the following must be present:

- > Evidence of a contaminant exceeding a generic threshold of toxicological concern (TTC) being present on-Site
- > A potential exposure pathway is present
- > A human or environmental receptor is present.

The relative risk of the COPC identified in **Table 3-4** have been estimated by assessing the potential risk of the contaminant as well as the probability that the contaminant is present at the Site using the risk matrix **Table 5-1**.

Table 5-1 Risk matrix table

		Consequence (Potential Impact)				
		Minor	Moderate	High	Major	Critical
Likelihood (Possibility of Presence)	Highly Likely	Medium	High	High	Extreme	Extreme
	Likely	Low	Medium	High	Extreme	Extreme
	Possible	Low	Medium	Medium	High	High
	Unlikely	Low	Low	Medium	Medium	High
	Rare	Low	Low	Low	Low	Medium

Based on the review of the provided reports, historical aeriels and observations from the Site inspection, the Site represents a high risk.

The preliminary risk assessment is limited to the data obtained from provided reports by others, historical aeriels and our Site observations. Due to heterogeneity of fill materials subsurface conditions may vary considerably from the surficial conditions encountered and have COPCs present that were not apparent during the previous investigations.

The conceptual risk assessment presented in **Table 5-1** was developed to identify and rank potential risks to the project and future cost predictions to make the Site suitable for future land use. The relative risk of the COPC identified in **Table 5-2** have been estimated by assessing the potential impact of the risk as well as the probability that the contaminant is present at the Site.

Table 5-2 Residual risk assessment

Identified COPCs (potential source)	Project Location	Hazard	Consequence	Probability	Residual Risk Rating
Subsurface materials	Landside	Unknown if impacted from previous industrial activity or tidal influences	Moderate	Possible	Medium
Groundwater	Waterside	Potential migration of contaminants out of the Site from tidal influences.	Moderate	Unlikely	Low
Sediment	Waterside	Impacted sediment material	Low	Likely	Medium

## 5.2 Risk evaluation

The information sourced during the preparation of this investigation has been utilised to determine the likelihood for historical and current land use activities to have affected the suitability of the Site. Taking into consideration the available background data and the site inspection that occurred on the 26 March 2020, the main sources of possible contamination are:

- > The current impacts and origin of soils at the Site are unknown. The Site history indicates that there is medium risk that impacted soils are present at the Site
- > Previous assessment by Coffey (2016) indicates that sediment within the project footprint is contaminated with concentrations of various analytes above the adopted criteria and are Acid Sulfate Soils
- > The location of the ferry wharf is in the lower reaches of Mosman Bay, which experiences a greater amount of flushing and on average has less contamination than the upper reaches of Mosman Bay and the areas further upstream of Sydney Harbour (Birch and Taylor, 2004). It is considered unlikely that water entering the Site from tidal influences would be enriched with contaminants.

## 6 Conclusions

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Cardno has completed a PSI at South Mosman wharf for the ferry wharf upgrade on behalf of TfNSW.

It is understood that the Site has remained largely unchanged as a location of public use since pre-1930, consisting of the ferry wharf. The surrounding area has remained primarily residential for at least the last 90 years. Based on the previous investigation, historical aerials a summary of the contamination is provided below.

### 6.1.1 Soil

Soil impacts at the Site are currently unknown. Due to the age of the Site, there is potential that fill of unknown quality is present at the Site from the landside-levelling, construction and maintenance of the ferry wharf.

### 6.1.2 Sediment

Previous investigations by Coffey (2016) indicate that sediment at the Site is impacted with the following analytes in the top 0.2 m:

- > Copper
- > Lead
- > Endrin
- > Dieldrin
- > Benzo(a)anthracene
- > Benzo(a)pyrene
- > Polycyclic Aromatic Hydrocarbons (total).

The sediment has been identified as Acid Sulfate Soils, however it is unlikely that construction would cause the material to oxidise.

### 6.1.3 Groundwater

Impacts to groundwater are currently unknown, there are no groundwater bores on-site. It is considered possible that groundwater would be impacted at the Site due to tidal interaction with Sydney Harbour.

## 6.2 Recommendations

Given the results of the assessment, the following is recommended:

- > An intrusive soil investigation to the depth of excavation to ensure the safety of construction workers and provide waste classification of the materials to be removed
- > The piling methodology shall seek to mitigate the risk of sediment dispersal
- > The above works be undertaken by a suitably qualified contaminated land specialist.

## 7 References

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- ANZECC (1999) *Guidelines for the Assessment of On-Site Containment of Contaminated Soil*, Australian and New Zealand Environment and Conservation Council (ANZECC), September 1999.
- ANZECC (2000) *Australia and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council (ANZECC).
- Birch and Taylor (2004) *The Contaminant Status of Sydney Harbour Sediments, A handbook for the Public and Professionals*. January 2004.
- CCME (2010), *Canadian soil quality guidelines: carcinogenic and other polycyclic aromatic hydrocarbons (PAHs) (environmental and human health effects)*, Scientific criteria document (revised), Canadian Council of Ministers for the Environment, 2010.
- Coffey (2016) *Stage 2 Contamination Assessment – South Mosman Ferry Wharf*. Prepared by Coffey Geosciences Pty Ltd on behalf of Hansen Yuncken, 8 April 2016.
- CRC Care (2011) *Technical Report No. 10 Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater Part 1: Technical Development Document*, September 2011
- CRC Care (2011) *Technical Report No. 39 Risk-Based Management and Remediation Advice for Benzo(a)pyrene*, January 2017.
- DUAP (1998) *Managing Land Contamination: Planning Guidelines: SEPP 55 Remediation of Land*. NSW Department of Urban Affairs and Planning, August 1998.
- EPA (2014) *Waste Classification Guidelines*. NSW Environment Protection Authority, November 2014.
- EPA (2020) *Consultants reporting on contaminated land Contaminated land guidelines*. NSW Environment Protection Authority, May 2020.
- Irvine and Birch (1998) *Distribution of Heavy Metals in Surficial Sediments of Port Jackson, Sydney, New South Wales*. April 1998.
- NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure (NEPM)*. National Environment Protection Council (NEPC), December 1999, as varied May 2013.
- EPA (2014) *Waste Classification Guidelines*. New South Wales Environment Protection Authority (EPA), November 2014
- OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. New South Wales Office of Environment a& Heritage (OEH), November 1997, Reprinted September 2000, Reprinted August 2011.
- Stone, Ahern and Blunden (1998) *Acid Sulfate Soils Manual*. Acid Sulfate Soil Management Advisory Committee, 1998.

## 8 Limitations

This assessment has been undertaken in general accordance with the current “industry standards” for a PSI for the purpose and objectives and scope identified in this report. These standards are set out in:

- > *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM). National Environment Protection Council (NEPC, 1999) as varied May 2013 (the ‘NEPM 2013’)
- > *AS4482.1- 2005: Guide to the sampling and investigation of potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (Standards Australia, 2005).

The agreed scope of this assessment has been limited for the current purposes of the Client. The assessment may not identify contamination occurring in all areas of the Site, or occurring after sampling was conducted. Subsurface conditions may vary considerably away from the sample locations where information has been obtained.

This Document has been provided by Cardno subject to the following limitations:

- > This Document has been prepared for the particular purpose outlined in Cardno’s proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose
- > The scope and the period of Cardno’s services are as described in Cardno’s proposal, and are subject to restrictions and limitations. Cardno did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Cardno in regards to it
- > Conditions may exist which were undetectable given the limited nature of the enquiry Cardno was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required
- > In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Cardno’s opinions are based upon information that existed at the time of the production of the Document. It is understood that the services provided allowed Cardno to form no more than an opinion of the actual conditions of the site at the time this Document was prepared and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations
- > Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document
- > Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Cardno for incomplete or inaccurate data supplied by others
- > Cardno may have retained sub consultants affiliated with Cardno to provide services for the benefit of Cardno. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, Cardno’s affiliated companies, and their employees, officers and directors.

This assessment report is not any of the following:

- > A Site Audit Report or Site Audit Statement as defined under the *Contaminated Land Management Act, 1997*
- > A Detailed ESA or Environmental Site Investigation sufficient for an Environmental Auditor to be able to conclude a Site Audit Report and Site Audit Statement

- > A geotechnical report and the bore logs or test pit logs may not be sufficient as the basis for geotechnical advice
- > A detailed hydrogeological assessment in conformance with NSW DEC (2007) Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination
- > An assessment of groundwater contaminants potentially arising from other sites or sources nearby.

A total assessment of the site to determine suitability of the entire parcel of land at the site for one or more beneficial uses of land.

APPENDIX

A

FIGURES

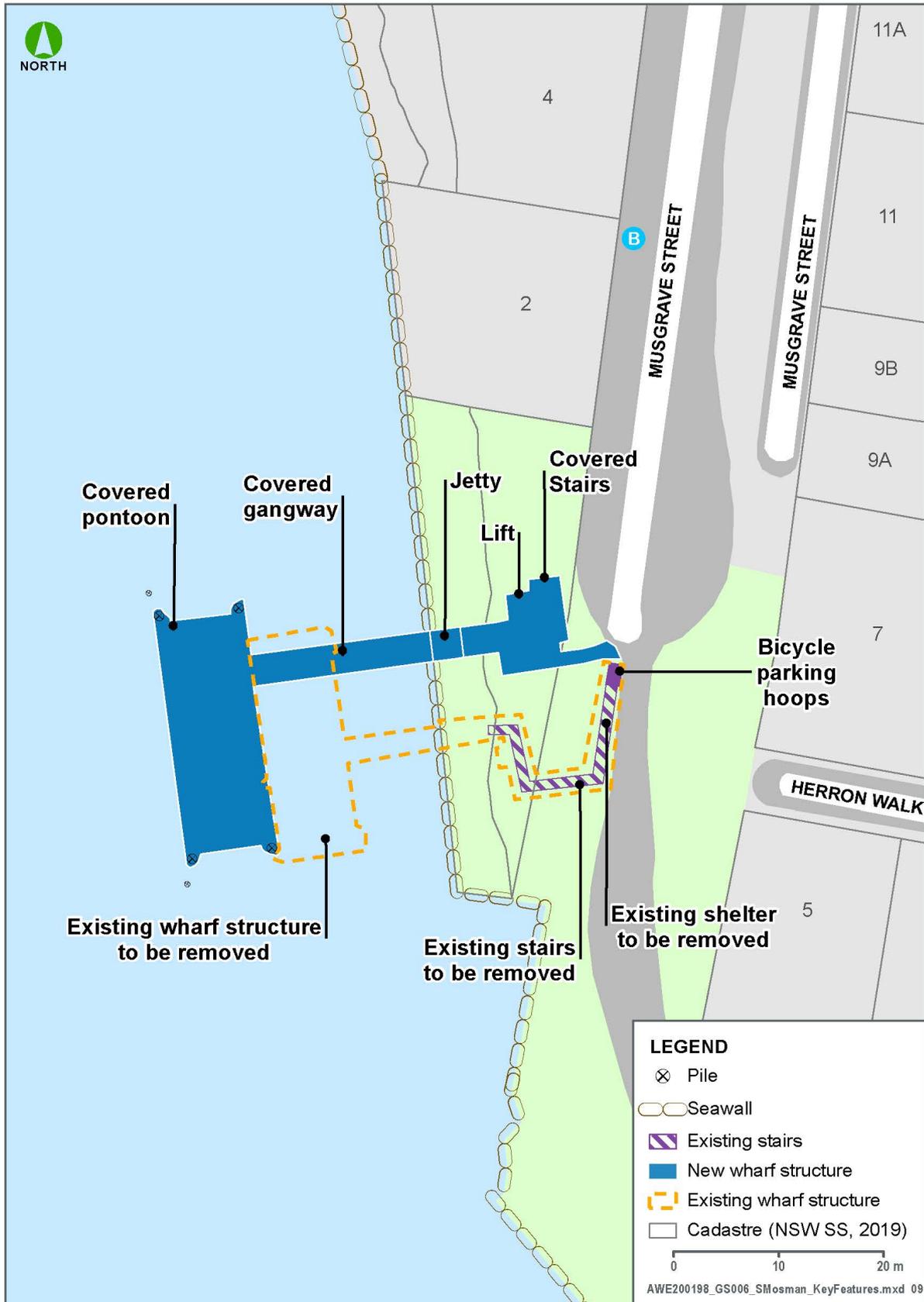


Figure 1: Key Features of the proposal



Figure 2: Construction footprint and proposal footprint

APPENDIX

# B

SITE PHOTOGRAPHS



Photograph 1: Landside of the wharf, vegetation in the foreground, sandstone outcrop in the background, facing east.



Photograph 2: Musgrave Street entrance to wharf, facing south.



Photograph 3: Existing ferry wharf, facing south-west.

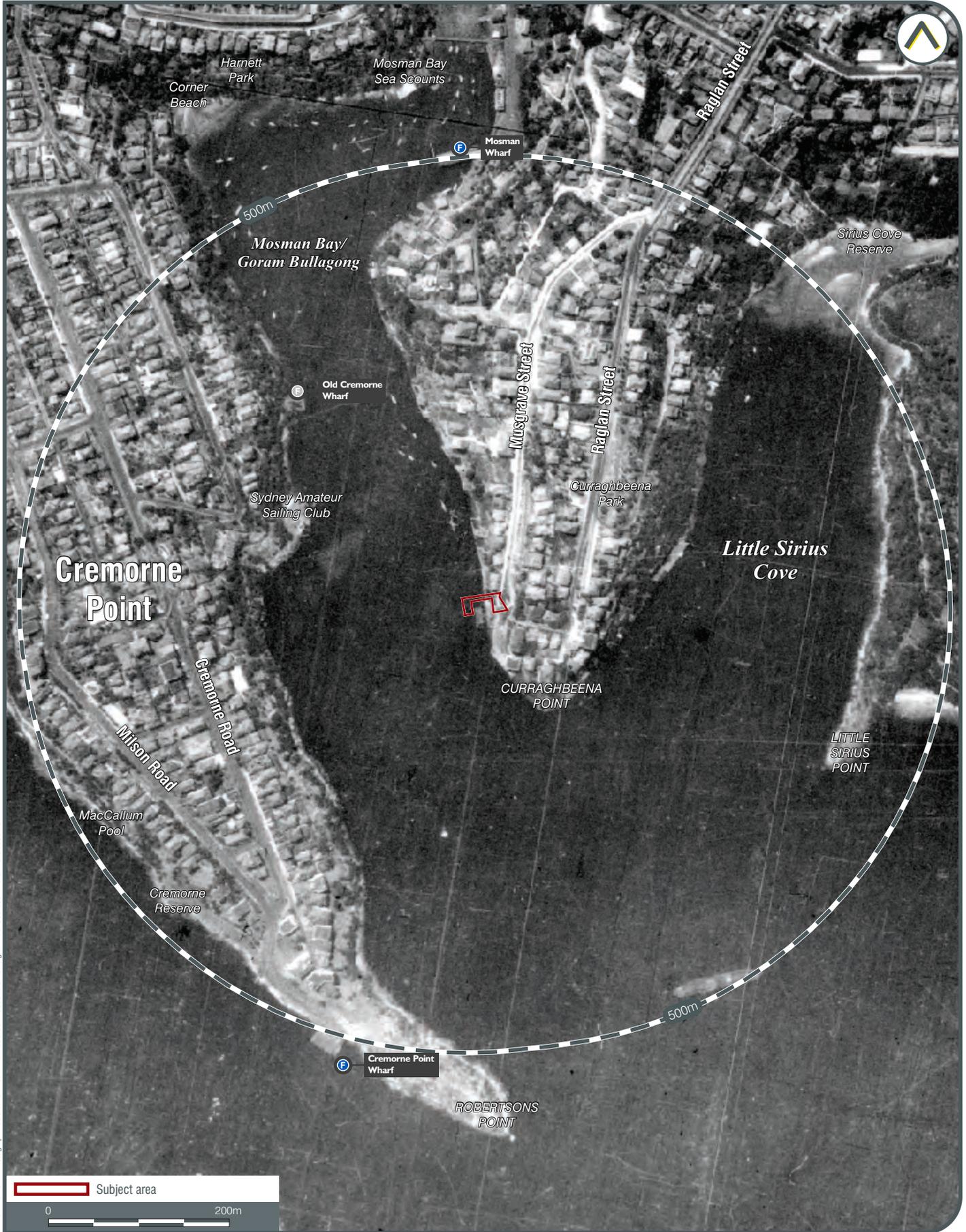


Photograph 4: Existing gangway, retaining wall and stairs connecting Musgrave Street to the ferry wharf, facing east.

APPENDIX

C

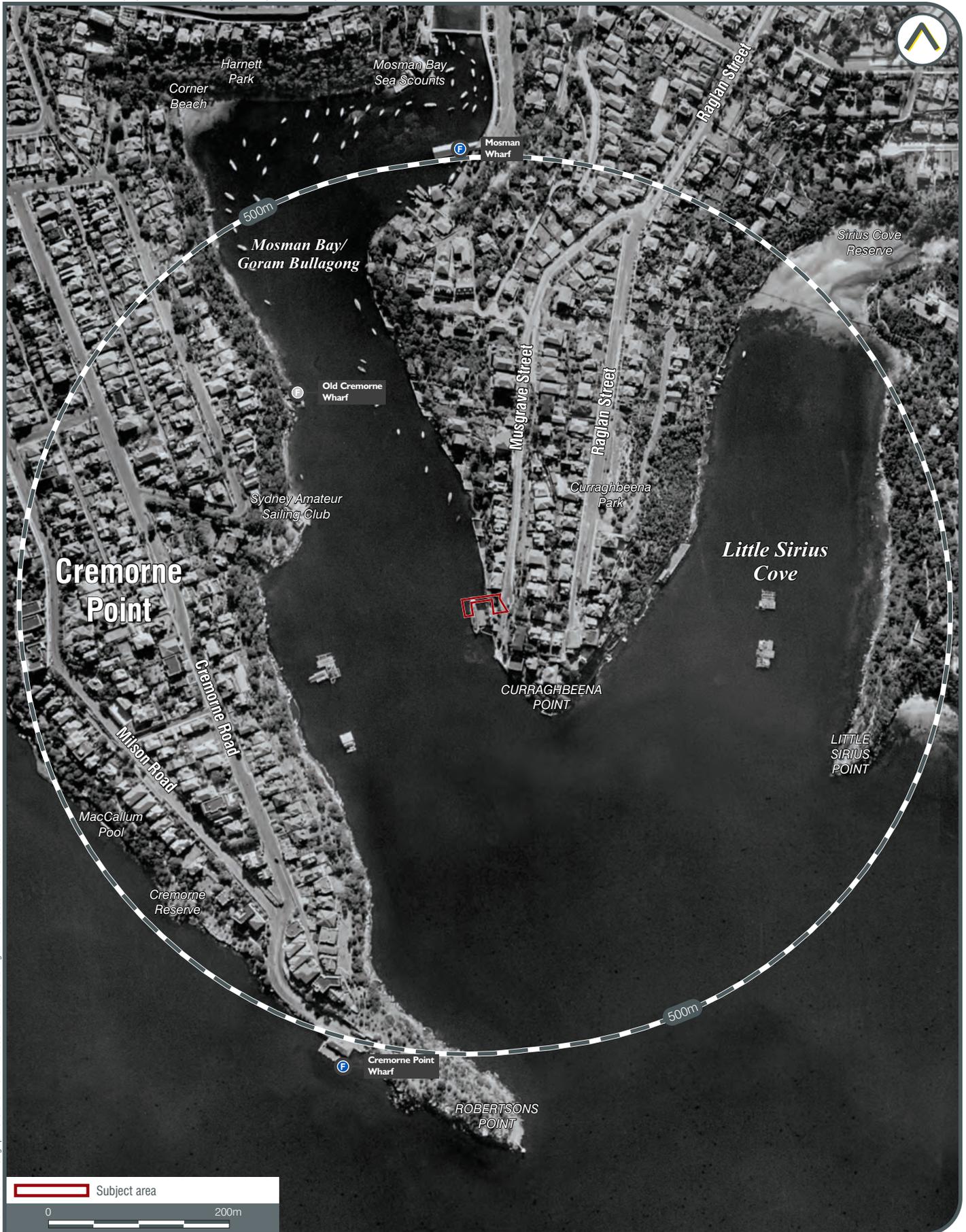
HISTORICAL IMAGERY



LUR-01216 Aerial Photograph 1930.02.04.2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide

## HISTORIC AERIAL PHOTOGRAPH - 1930

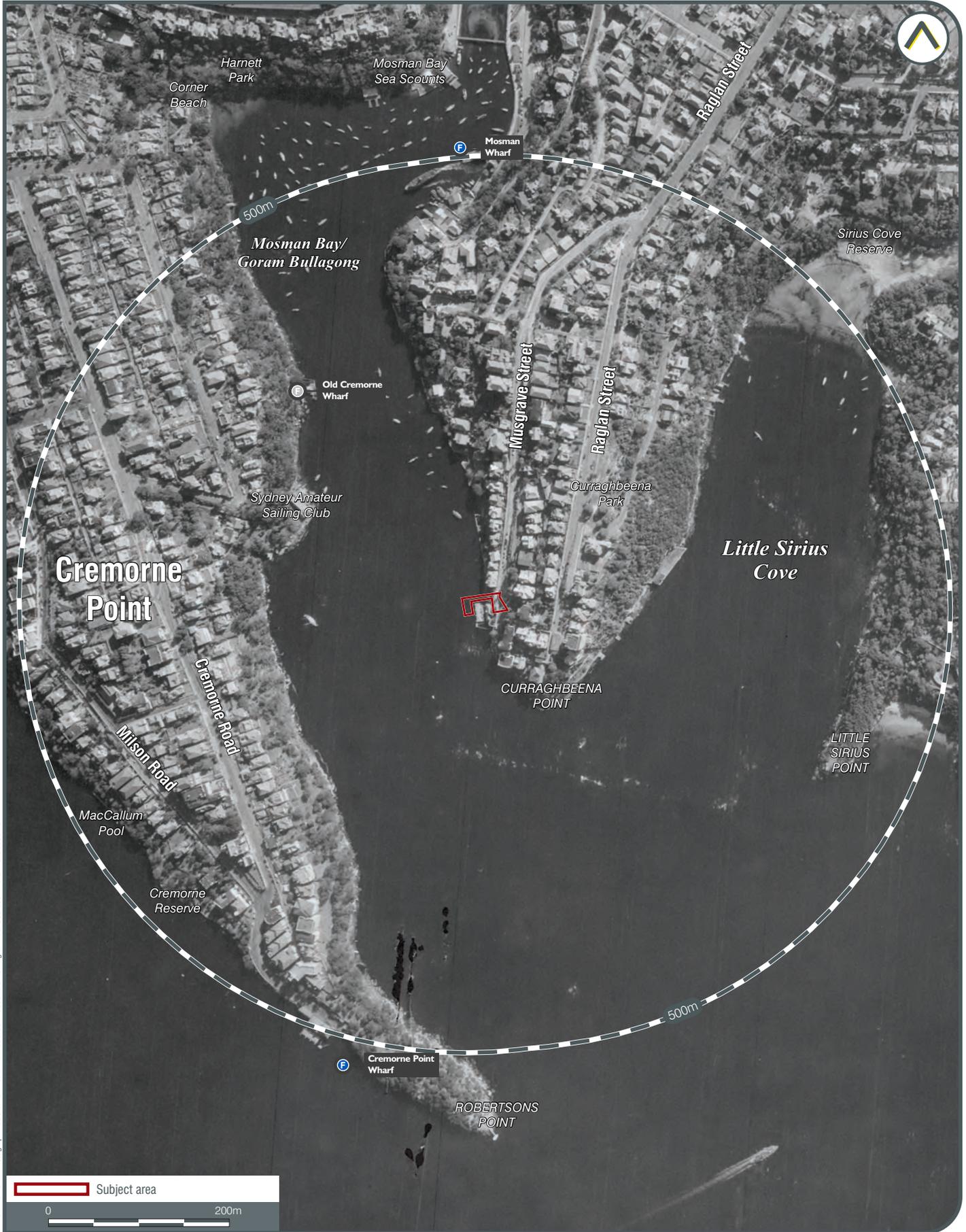
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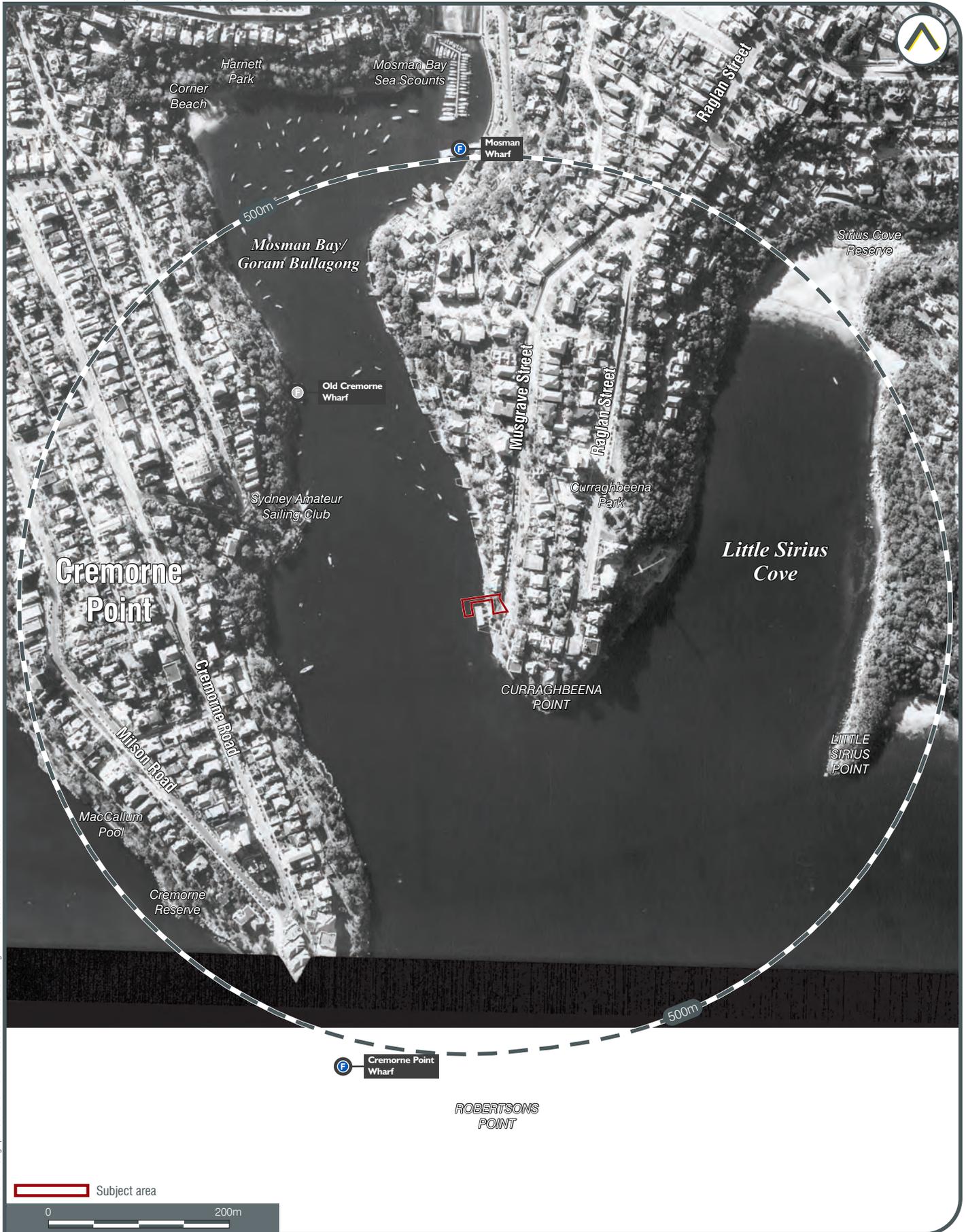
LIR-01216 Aerial Photograph 1943 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide.

## HISTORIC AERIAL PHOTOGRAPH - 1943





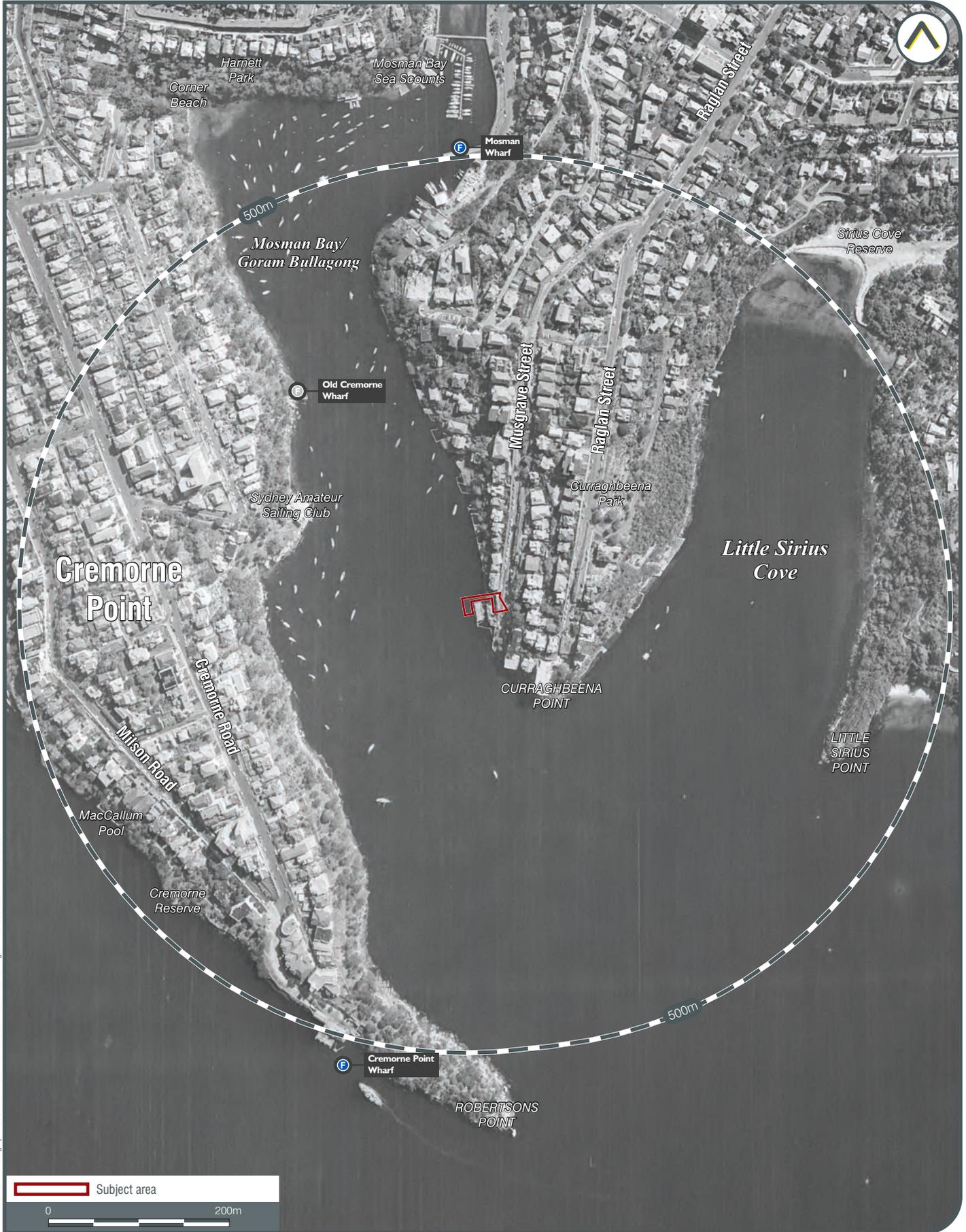
LUR-01216 Aerial Photograph, 1955 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide



LUR-01216 Aerial Photograph 1961 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide

## HISTORIC AERIAL PHOTOGRAPH - 1961

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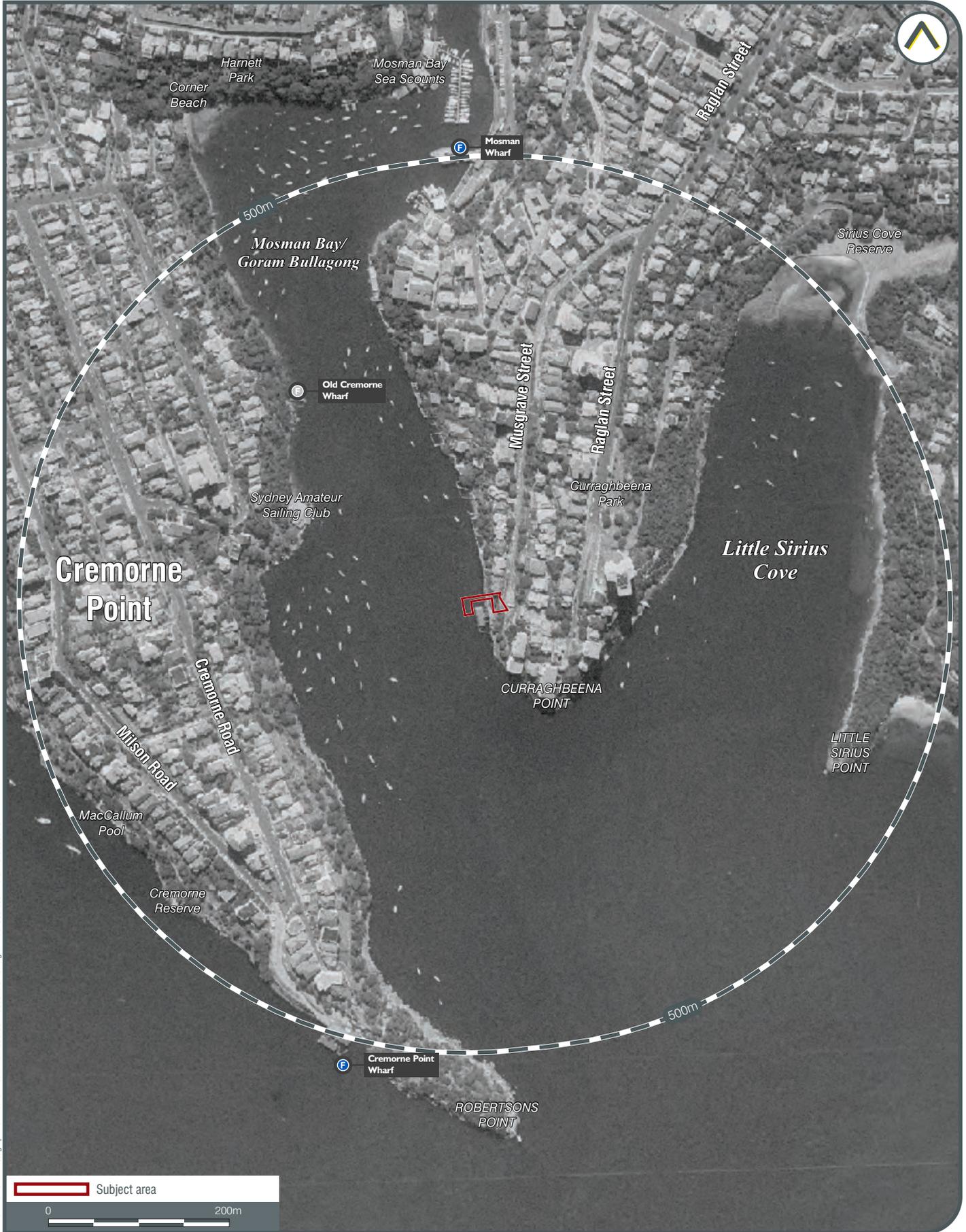


LUR-01216 Aerial Photograph, 1965 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide

## HISTORIC AERIAL PHOTOGRAPH - 1965



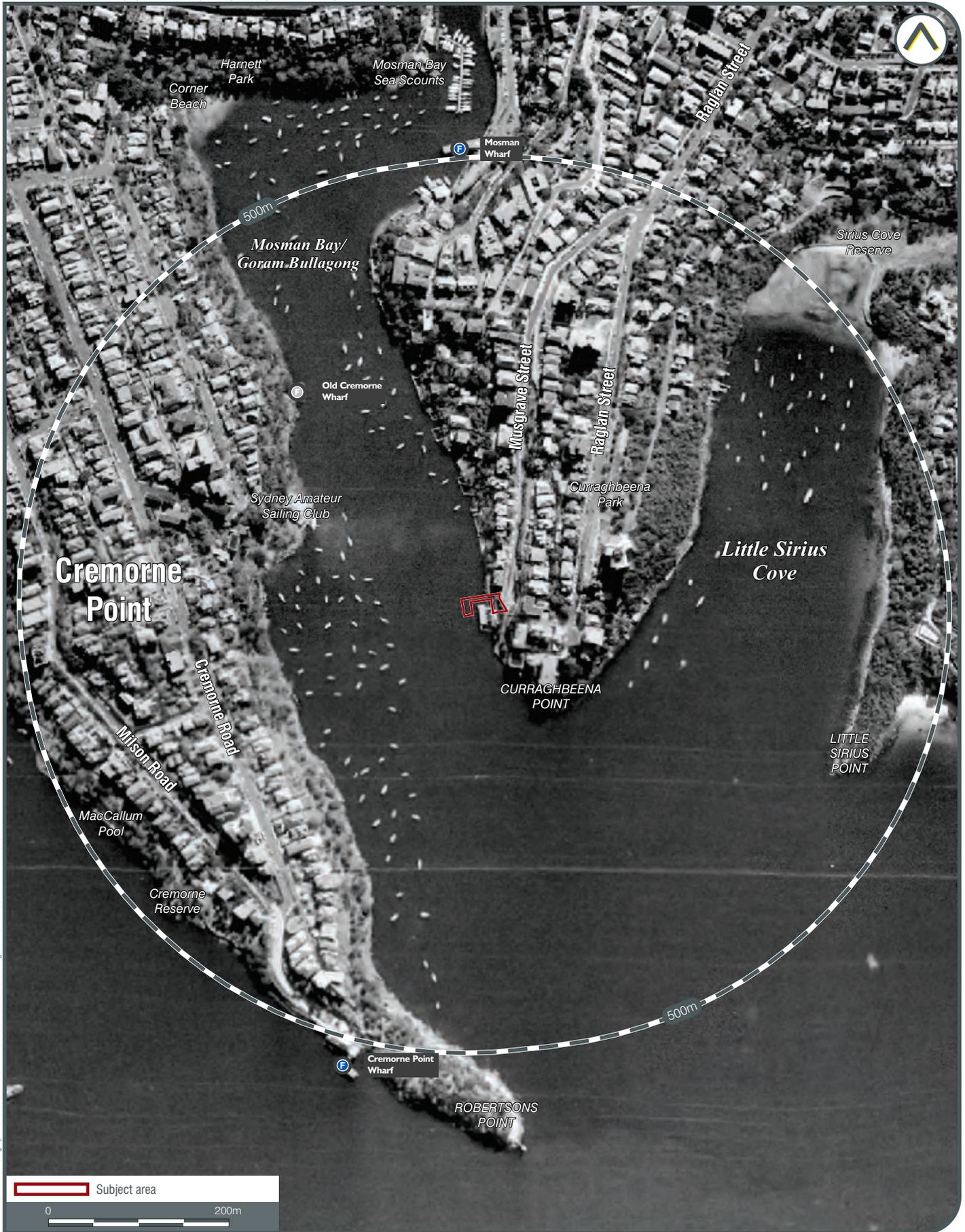
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LUR-01216 Aerial Photograph 1971 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide

## HISTORIC AERIAL PHOTOGRAPH - 1971





LUR-01216 Aerial Photograph, 1975 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide

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LUR-01216 Aerial Photograph, 1986 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide

## HISTORIC AERIAL PHOTOGRAPH - 1986

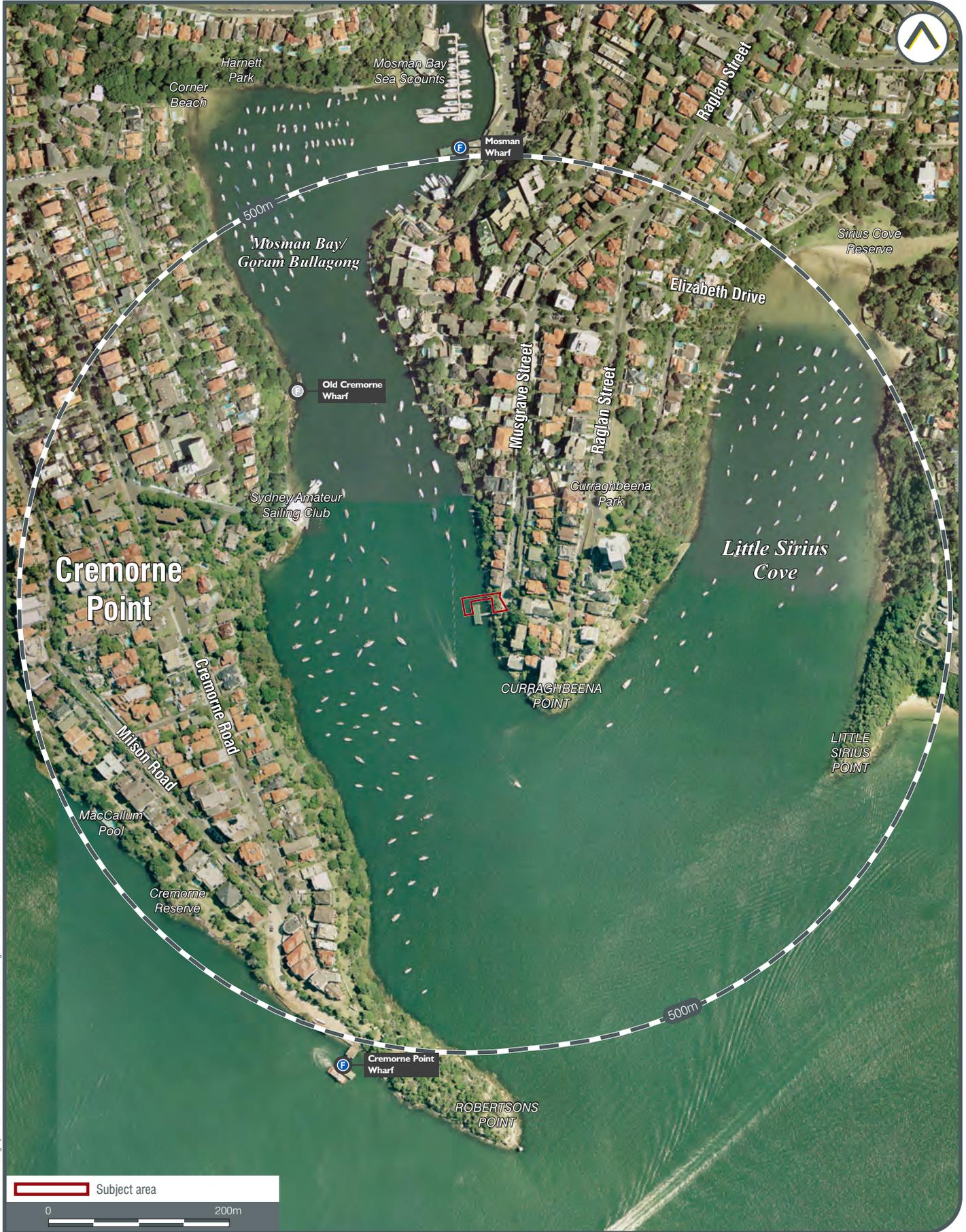


LUR-01216 Aerial Photograph 1991 02 04 2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide



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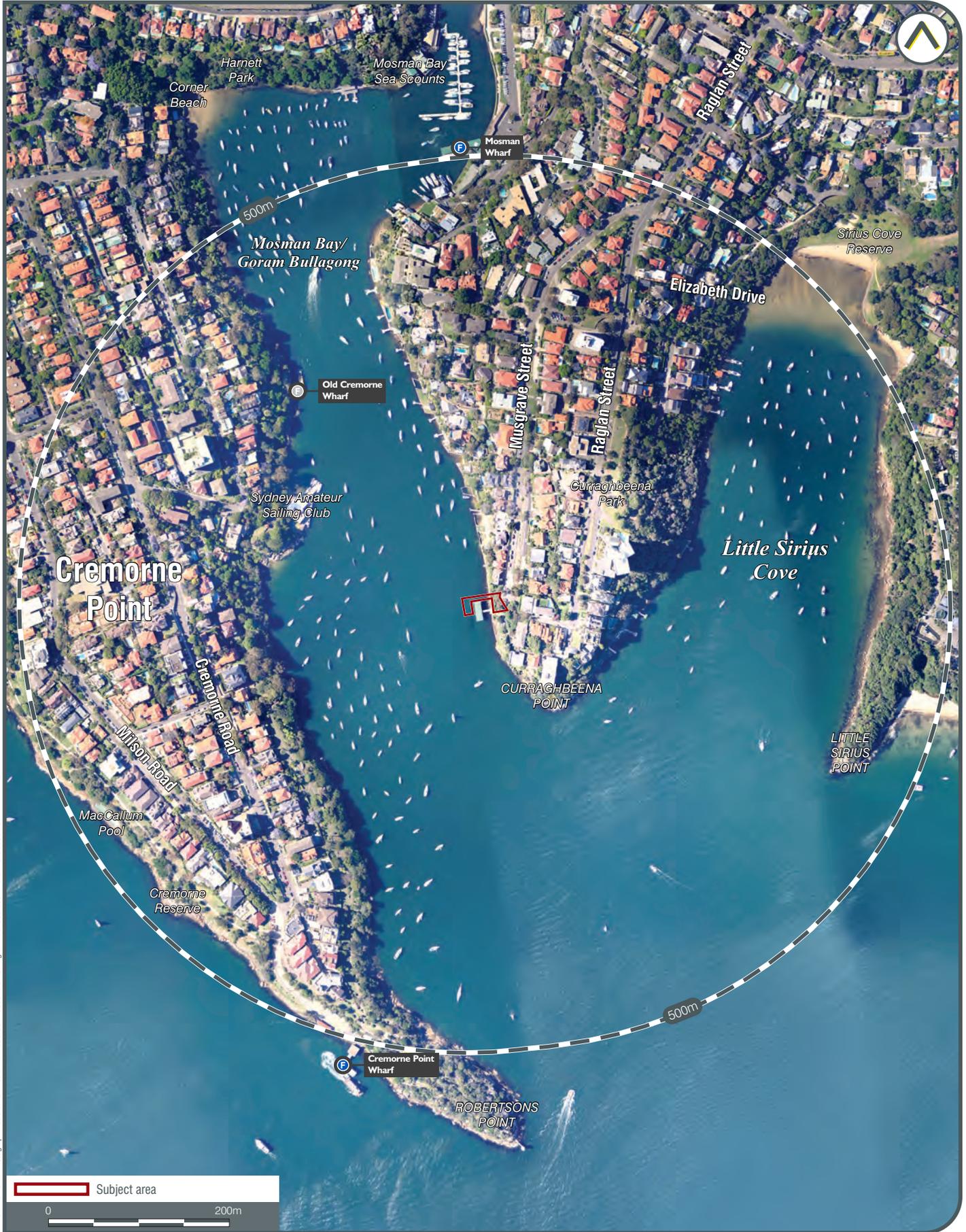


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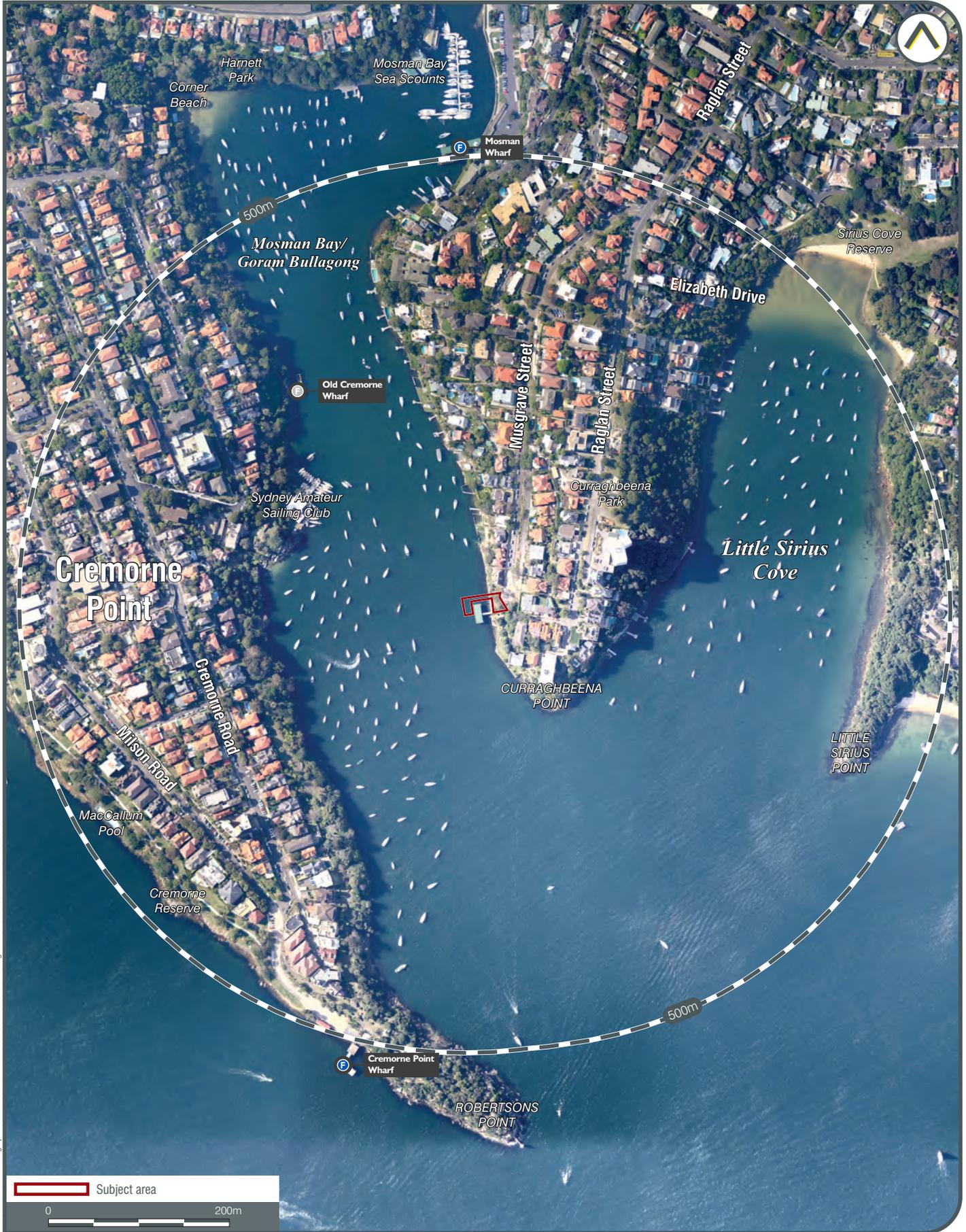
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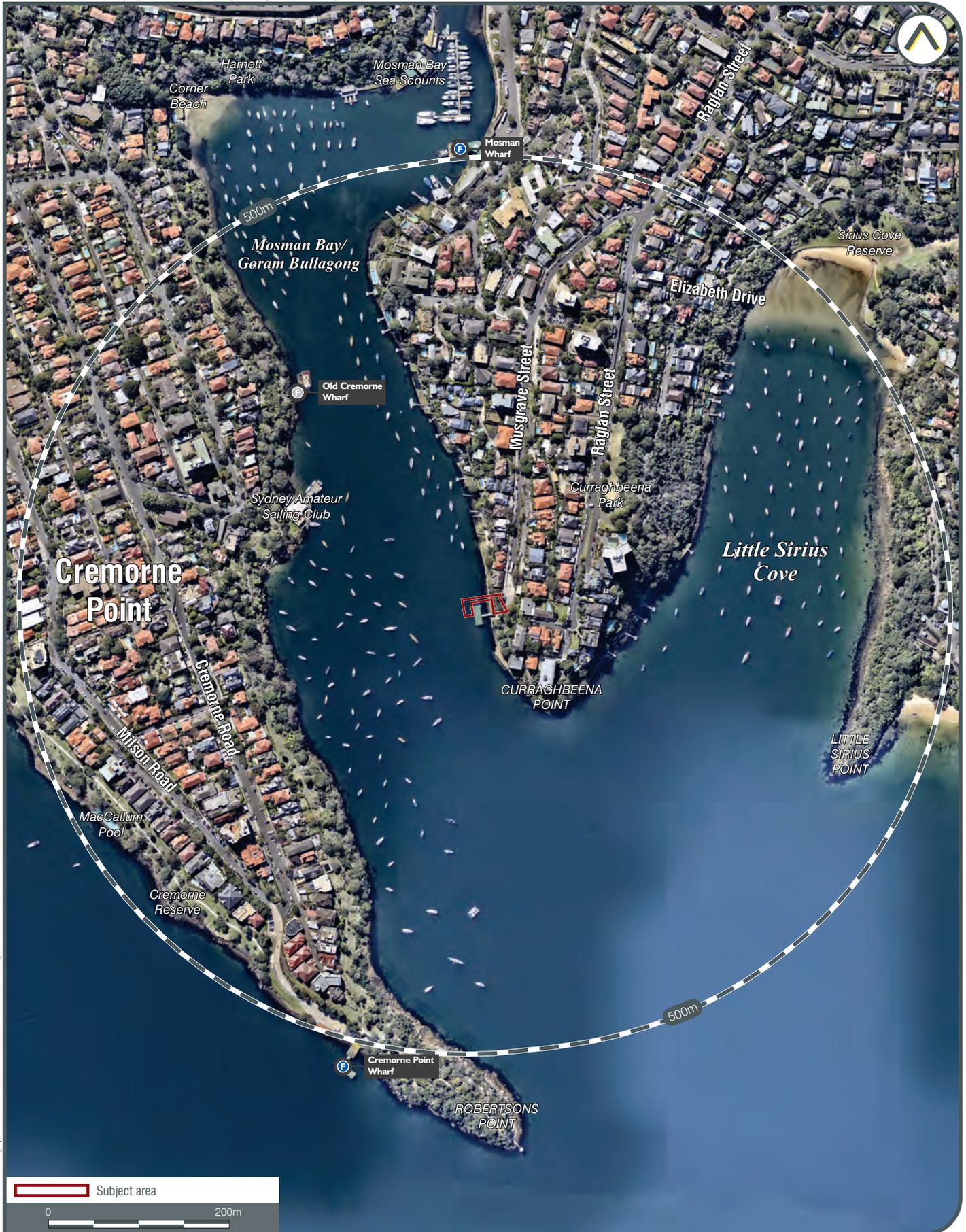




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## HISTORIC AERIAL PHOTOGRAPH - 2017

# Appendix D

## Biodiversity assessment report



# South Mosman Wharf Upgrade

## Biodiversity Assessment Report

Transport for NSW

# South Mosman Wharf Upgrade

## Biodiversity Assessment Report

Transport for NSW | November 2020

Prepared by Cardno (NSW/ACT) Pty Ltd

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## Document controls

### Approval and authorisation

<b>Title</b>	South Mosman Wharf Upgrade Biodiversity Assessment Report
<b>Accepted on behalf of Transport for NSW by:</b>	Bob Rimac Senior Project Manager
<b>Signed:</b>	
<b>Dated:</b>	

### Document status

<b>Document status</b>		<b>Date</b>	<b>Prepared by</b>	<b>Reviewed by</b>
V1	Draft for internal review	16/07/2020	Dilys Zhang	Brendan Alderson Kevin Roberts
Rev A	Draft for client review	16/08/2020	Dilys Zhang	James Paddock (TfNSW) Rebecca Murray (TfNSW)
Rev B	Second draft for client review	28/10/2020	Dilys Zhang	Belinda Crichton
Rev 0	Final	19/11/2020	Dilys Zhang	Belinda Crichton

## Executive summary

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The South Mosman wharf upgrade project (the proposal) forms part of the Ferry Wharf Upgrade Program and the NSW Government's Transport Access Program (TAP). The proposal includes a number of land- and water-based features which complement the new wharf and removal of the existing wharf.

A biodiversity assessment has been completed to define the existing coastal and marine environment within the study area and assess impacts to coastal and marine biodiversity as a result of the proposed construction and operation. The biodiversity assessment was informed by a review of existing information and a field survey.

The study area is located in Great Sirius Cove, an embayment on the northern foreshores of Sydney Harbour. The terrestrial portion of the study area is on reclaimed land while the marine portion was comprised of a vertical sandstone seawall bound by a corridor of intertidal and subtidal rocky reef and soft sediment habitat in the deeper areas. There was no remnant native vegetation in the study area but rather a landscape park and a garden area with native and exotic plantings thus, no native plant community types (PCTs) or threatened ecological communities (TECs) occur within or next to the study area. There were no mangroves, saltmarsh or seagrass in or next to the study area however, a mosaic of macroalgae and habitat-forming species, including *Ecklonia radiata* and Sydney Rock Oysters (*Saccostrea glomerata*), colonised the intertidal and subtidal rocky reef (Type 2 KFH) and debris in the soft sediment habitats (Type 3 KFH).

The vegetation and habitat in the study area provides potential habitat for a number of urban, disturbance tolerant native species. Vegetation and habitat in the study area forms potential habitat for eight terrestrial and two marine threatened fauna species:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act
- Black Rockcod (*Epinephelus daemeli*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Seven microchiropteran bats (microbats):
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
  - Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
  - Little Bent-winged Bat (*Miniopterus australis*)
  - Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
  - Southern Myotis (*Myotis macropus*)
  - Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

The proposal would include the removal of up to 0.04 hectares of native/exotic garden vegetation. The removal of habitat resources is unlikely to have a substantial impact on native fauna as there is an abundance of similar habitat across the study locality. The majority of vegetation to be cleared is associated with the establishment of the compound site. Thus, following the decommissioning of the compound site (i.e. completion of construction), up to 0.03 hectares of the compound site would be restored and landscaped. The risks of the spread/introduction of weeds and diseases and the potential for erosion and sediment mobilisation associated with vegetation clearing and construction activities would be managed during construction in accordance with the relevant TfNSW guidelines. In doing so, these risks would be removed or minimised substantially.

Six piles (two at 467 millimetres in diameter and four at 760 millimetres in diameter) would be driven into subtidal soft sediment habitat. The area of soft sediment habitat (Type 3 KFH) under the footprint of the piles would be permanently lost while the anchor areas for the barge during construction would be temporarily impacted. This would include the direct removal of epifauna and infauna from soft sediment habitats. However, soft sediment habitats in the study area are

characteristic of the majority of subtidal habitat in the harbour and community assemblages are generally ubiquitous and quick to recolonise following disturbance.

Removal of the existing wharf structure and piles would result in the removal of about 0.01 hectares of marine vegetation, habitat and sessile/less mobile fauna on the piles and pontoon. These existing structures are densely colonised and the majority of these species are common in subtidal rocky reefs and would quickly colonise the piles of the new wharf and pontoon (0.02 hectares of available space). There is potential that the materials proposed for the new piles are not suitable for colonisation, in which case, the marine assemblage on the removed structures would be permanently lost. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).

There is potential for fragments of the existing seawall to dislodge during the installation of the land-based jetty piles. An area of <0.01 hectares of the rocky reef platform and the vertical rocky reef has potential to be crushed or dislodged. If this were to happen, the seawall would be remediated to a similar or better condition and habitat-forming species are likely to recolonise these areas following construction completion.

The new wharf structures would also shade less than 0.01 hectares of intertidal and subtidal rocky reef habitat and about 0.04 hectares of soft sediment habitat and some vertical intertidal rocky reef habitat. This impact area is a very small proportion of subtidal rocky reef habitat in the study area and the wider harbour and areas where existing structures would be removed would no longer be shaded thus, is not considered ecologically significant. Shading of intertidal and soft sediment habitat is not expected to substantially change community assemblages as these areas generally lack marine vegetation.

Under Section 199 of the FM Act, consultation with NSW DPI (Fisheries) is required for any dredging and reclamation works. 'Dredging' under the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013) is classified as disturbance of the seabed/streambed. In this case, this refers to removal of structures and piling. Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required. However, through consultation with NSW DPI (Fisheries) (dated 16 November 2020), this is not required for the piling and pile removal works associated with this proposal.

Sediment mobilisation and vessel wash and scour were also identified as likely proposal impacts. However, the study area is likely to be frequently exposed to elevated levels of sediment, associated with rainfall and sea conditions, and vessel traffic in Great Sirius Cove. Thus, with the appropriate controls, a slight, temporary increase in these impacts is not expected to substantially impact marine biodiversity.

Impacts from the introduction/spread of marine pests would also be managed during construction. There is currently no evidence of marine pests or disease in the study area. Impacts from the potential introduction/spread of marine pests would also be managed during construction.

The proposal is unlikely to significantly impact threatened species and disturbances to potential habitat would largely be temporary and constitute a very small proportion of available habitat. The proposal would not fragment or isolate threatened species populations or substantially impact any species' lifecycle. Additional controls could be implemented to survey for the Black Rockcod and White's Seahorse prior to the start of any water-based activities so that individuals in the area are not harmed. Species impact statements (SIS) or referrals were not considered to be required.

Considering the above and assuming project controls (i.e. mitigation measures) are implemented, the proposal is unlikely to significantly impact biodiversity.

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**Annexure A Species recorded**

**Annexure B Habitat assessment table**

**Annexure C Aquatic habitat complexity examples**

**Annexure D Assessments of Significance**

# Terms

Biodiversity Assessment Method	The Biodiversity Assessment Method is established under section 6.7 of the BC Act for the purpose of assessing certain impacts on threatened species and threatened ecological communities, and their habitats, and the impact on biodiversity values.
Commonwealth Minister	Australian Minister for the Environment
Compound area	Temporary facility for construction, including for example an office and amenities compound, construction compound and materials storage compound. Compound area is shown on Figure 1.3.
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (ref <a href="http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf">http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf</a> ).
The estuary	Parramatta River estuary
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).
The harbour	Sydney Harbour
Indirect impact	Where an event or circumstance is a direct consequence of the action (ref <a href="http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf">http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf</a> ). Indirect impacts include but not limited to:  (a) indirect impacts on adjacent vegetation and habitat during construction  (b) indirect impacts on adjacent vegetation and habitat during operation  (c) impacts on adjacent vegetation and habitat arising from a change in land-use patterns (NSW OEH, 2017)
Microbats	Microchiropteran bats
Matters of National Environmental Significance	A Matter of National Environmental Significance (MNES) protected by a provision of Part 3 of the EPBC Act.
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (Mitchell, 2002).
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.

Population	A group of organisms, all of the same species, occupying a particular area (NSW OEH, 2017).
The proposal	The new wharf interchange proposed to be constructed at South Mosman and as described in Section 3.1 of the Review of Environmental Factors.
Proposal footprint	The area directly impacted by the proposed works including installation and removal of structures. Proposal footprint is shown in Figure 1.3.
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly.
Study locality	Refers to an area within 5 kilometres of the proposal footprint (for the purpose of the background search).

## Abbreviations

AASS	Actual acid sulfate soils/sediments
AOBV	Area of Outstanding Biodiversity Value
AoS	Assessment of Significance
ASS	Acid sulfate soils/sediments
BAR	Biodiversity Assessment Report
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BDAR	Biodiversity Development Assessment Report
BoM	Bureau of Meteorology
CCTV	Closed circuit television
Coastal Management SEPP	NSW <i>State Environmental Planning Policy (Coastal Management) 2018</i>
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DDD	Dichlorodiphenyldichloroethane
DoE	Commonwealth Department of the Environment (former)
DPIE	NSW Department of Planning, Industry and Environment
DPI	NSW Department of Primary Industries
DSAPT	Disability Standards for Accessible Public Transport 2002
EAC	East Australian Current
EES	Environment, Energy and Science group (in DPIE)
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i> (Federal).
EPI	Environmental planning instruments
FM Act	NSW <i>Fisheries Management Act 1994</i>
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
KFH	Key Fish Habitat
LGA	Local government area
MNES	Matters of National Environmental Significance
NP&W Act	NSW <i>National Parks and Wildlife Act 1974</i>
OCP	Organochlorine pesticides
OEH	NSW Office of Environment and Heritage (former)
PAH	Polycyclic aromatic hydrocarbons
PASS	Potential acid sulfate soils/sediments
PCT	Plant community type
PMST	Protected Matters Search Tool
POMS	Pacific Oyster Mortality Syndrome
RBG	Royal Botanic Garden Sydney
REF	Review of Environmental Factors

ROV	Remotely operated vehicle
SIS	Species impact statement
TAP	NSW Government's Transport Access Program
TAPs	Threat Abatement Plans
TEC	Threatened ecological community
TfNSW	Transport of New South Wales

# 1 Introduction

---

## 1.1 Proposal background

Transport for NSW (TfNSW) proposes to construct a new wharf interchange at South Mosman (the proposal) as part of the NSW Government's Transport Access Program (TAP, <https://www.transport.nsw.gov.au/projects/tap>). This is detailed in Section 3 of the Review of Environmental Factors (REF).

The proposal is located within the local government area (LGA) of Mosman Municipal Council. South Mosman wharf interchange is located in Great Sirius Cove, at the tip of a small peninsula to the east of the Warringah Freeway on Sydney's Lower North Shore. South Mosman wharf interchange sits on the eastern foreshore of Great Sirius Cove and towards the tip of Curraghbeena Point. The wharf is accessed from Musgrave Street, which runs along the ridge of the peninsula terminating at the wharf interchange.

## 1.2 The proposal

The proposal is to upgrade the South Mosman wharf as part of the TAP.

The water based features of the proposal would include:

- Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- Removal of the existing gangway and pontoon including existing piles
- Remediation of the seawall following removal of the existing wharf, if required.

The land based features of the proposal would include:

- Installation of a new 16-metre high lift and new covered stairs
- Installation of a new covered street level waiting level
- Installation of a new covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- Installation of three bicycle parking hoops
- Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

Figure 1-1 shows the key features of the proposal including the water-based and land-based features.



**Figure 1-1:** Key features of the proposal

### 1.3 Legislative context

A REF is prepared to satisfy TfNSW's duties under section 5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to "examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity" and in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the South Mosman Ferry Wharf Upgrade, and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

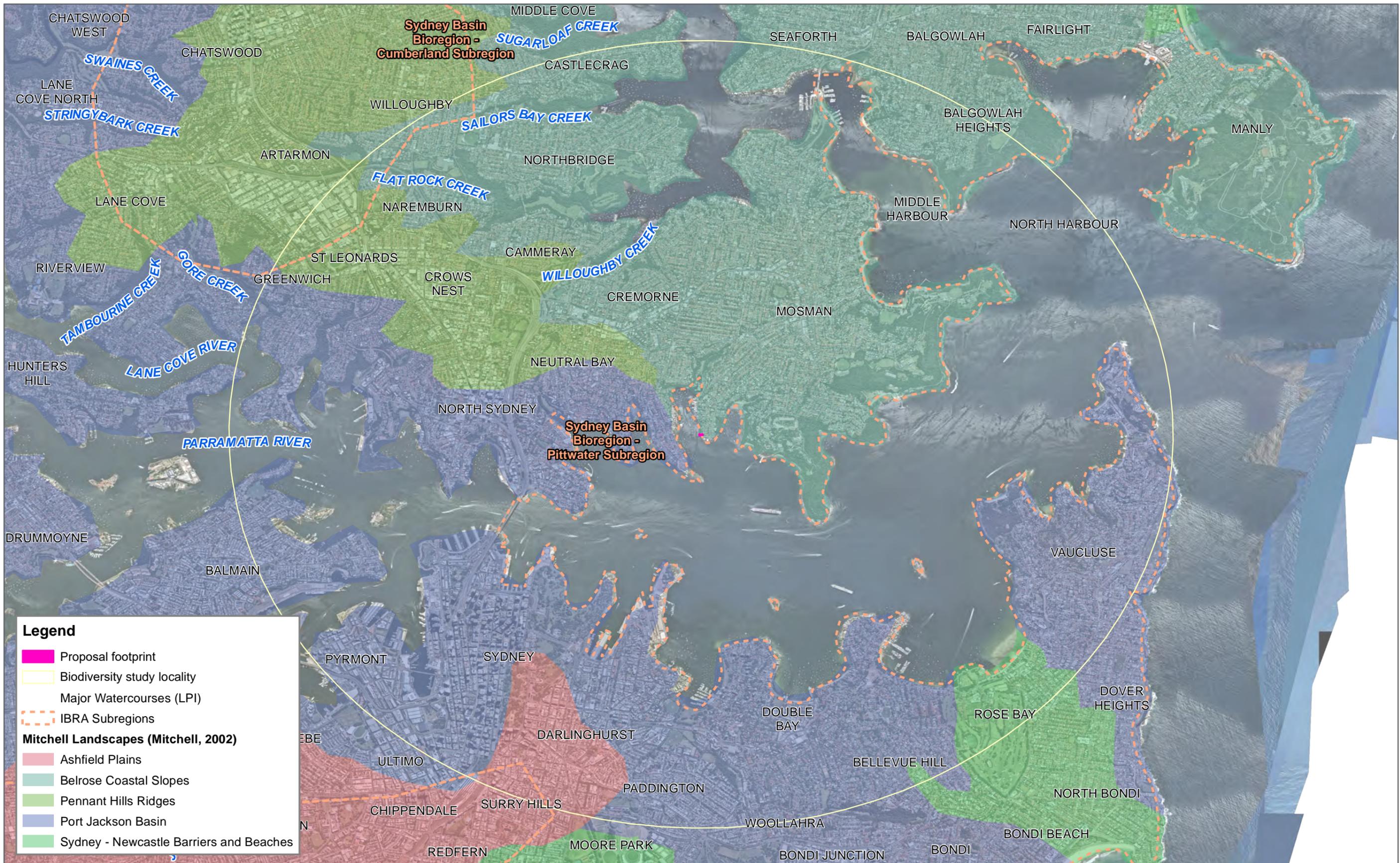
Sections 7.2A of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FM Act) require that the significance of the impact on threatened species, and threatened ecological communities (TECs) is assessed using a five-part test (BC Act) or the 7-part test (FM Act). Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Environment Agency Head's requirements or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The approval applies to TfNSW road works being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. Since this proposal is not considered under "road works", the strategic assessment approval does not apply. Significance of impacts on nationally listed threatened species, ecological communities and migratory species are to be assessed in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment (DoE), 2013). If significant impacts are considered likely, then the action is deemed a controlled action and a referral is required.

### 1.4 Definitions

The following definitions are used in this report:

- Biodiversity Assessment Report (BAR) - this report
- The proposal - refers to upgrade the South Mosman wharf as described in Section 1.2
- Proposal footprint - refers to the area directly impacted by the proposed works including the installation and removal of structures (Figure 1-3)
- Compound area – refers to the temporary facility required for construction (Figure 1-3)
- Study area - refers to the proposal and surrounding areas covered by this BAR (about 0.77 hectares and excludes private properties) (Figure 1-3)
- Study locality - refers to an area within five kilometres of the proposal footprint (for the purpose of the background research) (Figure 1-2).



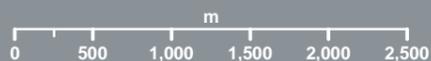
**Legend**

- Proposal footprint
- Biodiversity study locality
- Major Watercourses (LPI)
- IBRA Subregions

**Mitchell Landscapes (Mitchell, 2002)**

- Ashfield Plains
- Belrose Coastal Slopes
- Pennant Hills Ridges
- Port Jackson Basin
- Sydney - Newcastle Barriers and Beaches

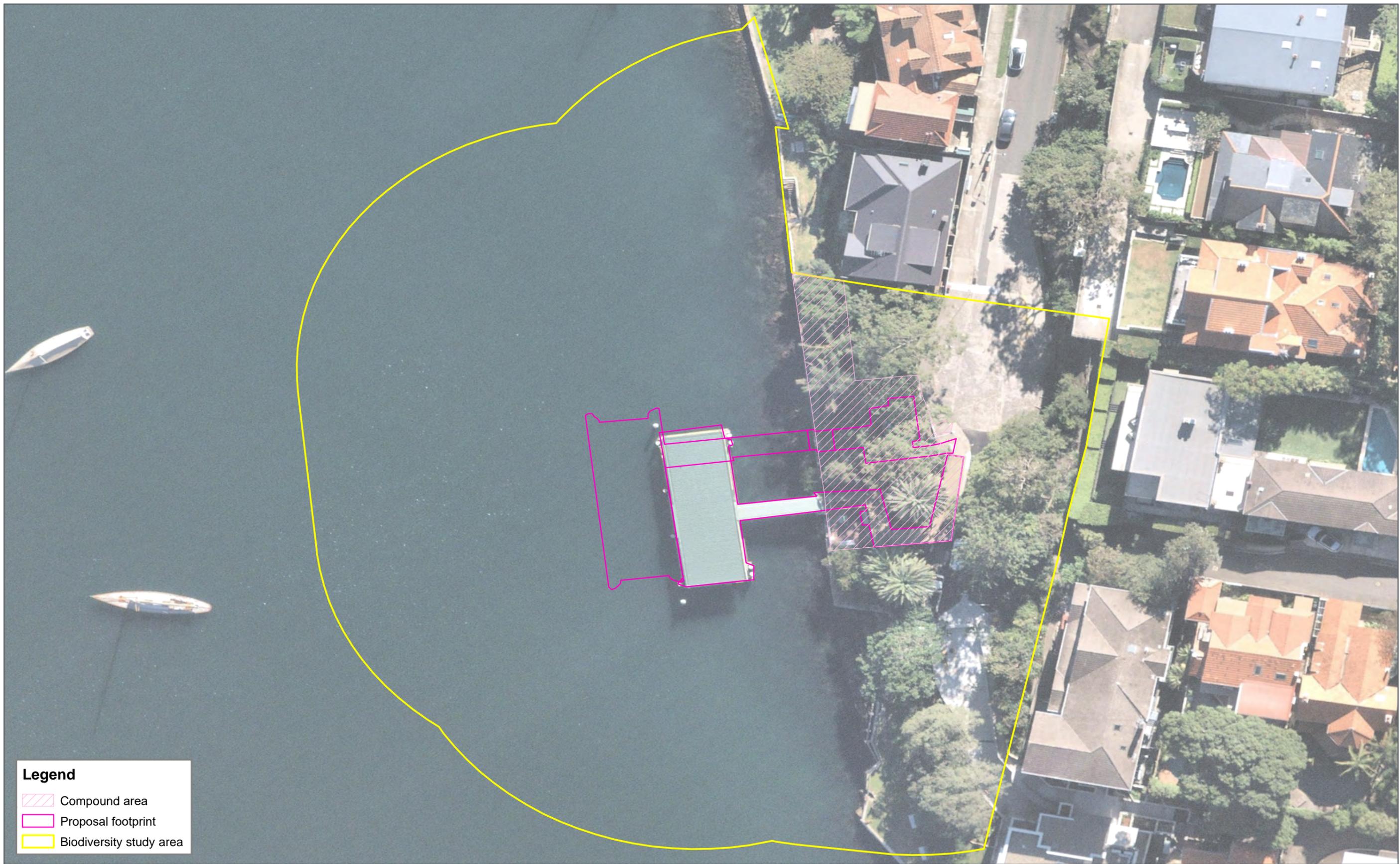
1:45,000 Scale at A3



**Study Locality**  
 FIGURE 1-2  
 SOUTH MOSMAN

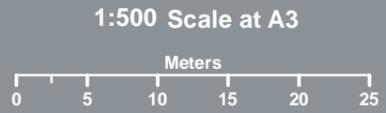


Map Produced by National Water & Environment  
 Date: 2020-10-09 | Project: AWE200198  
 Coordinate System: GCS\_GDA\_1994  
 Map: AWE200198\_GS015\_SMosman\_StudyLocality.mxd 02  
 Aerial Imagery supplied by Nearmaps (2020)



**Legend**

- Compound area
- Proposal footprint
- Biodiversity study area



**Project, Compound and Study Areas**  
 FIGURE 1-3  
 SOUTH MOSMAN



**Cardno**  
 Map Produced by National Water & Environment  
 Date: 2020-10-09 | Project: AWE200198  
 Coordinate System: GCS GDA 1994  
 Map: AWE200198\_GS016\_SMosman\_ProjectStudyArea.mxd 02  
 Aerial Imagery supplied by Nearmaps (2020)

## 2 Methods

### 2.1 Personnel

The Biodiversity Assessment Report (BAR) was prepared by the following personnel:

- Dilys Zhang (BSc (Hons)) – Senior Ecologist
- Dr Brendan Alderson (BSc (Hons), PhD) – Senior Ecologist
- Jake Ludlow (BSc) - Ecologist
- Kevin Roberts (BSc (Hons), MEnvSt, EMPA) – Senior Principal Environmental Scientist.

### 2.2 Background research

A review of information and data was completed in April 2020 to gain an understanding of biodiversity values within the study area and the broader study locality. Reviewed sources included:

- Soil Landscapes of the Sydney 1:100, 000 Sheet (Chapman & Murphy, 1989)
- the Native Vegetation of the Sydney Metropolitan Area – Version 3.1 VIS\_ID 4489 (NSW Office of Environment and Heritage (OEH), 2016)
- NSW Department of Planning, Industry and Environment – Environment, Energy and Science (DPIE-EES) vegetation information system (VIS) Classification: <https://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx?ReturnUrl=%2fNSWVCA20PRapp%2fdefault.aspx>
- NSW BioNet: <http://www.bionet.nsw.gov.au>
- NSW DPIE-EES Threatened Biodiversity Data Collection: <http://www.environment.nsw.gov.au/threatenedspecies>
- NSW Department of Primary Industries (DPI) Fish Communities and Threatened Species Distribution of NSW (NSW DPI, 2016a)
- NSW DPI Threatened species lists: <https://www.dpi.nsw.gov.au/fishing/species-protection/what-current>
- NSW DPI Listed Protected Fish Species: <https://www.dpi.nsw.gov.au/fishing/closures/identifying>
- NSW DPI Mapping the Habitats of NSW Estuaries (Creese, et al., 2009)
- Commonwealth Department of Agriculture, Water and the Environment (DAWE) (formerly DoE) Protected Matters Search Tool (PMST): <http://www.environment.gov.au/epbc/protected-matters-search-tool>
- Atlas of Living Australia: <http://www.ala.org.au/>
- National System for the Prevention and Management of Marine Pest Incursions: <http://www.marinepests.gov.au/Pages/default.aspx>

Aerial imagery from Nearmap (available from: <http://apps.nearmap.com/>) was used to identify potential vegetation and habitat to assist in the creation of presumptive maps.

Any sensitive ecological sites and areas protected by State and local environmental planning instruments (EPIs) due to their ecological significance (e.g. marine protected areas, aquatic reserves, National Parks/Reserves, wetlands and other conservation areas and reserves) were also identified using:

- Regional Conservation Plans prepared by the former NSW OEH: <http://www.environment.nsw.gov.au/biodiversity/regconsplans.htm>

- Areas of Outstanding Biodiversity Value register: <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register>
- NSW DPI Critical Habitat register: <http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what/register>
- NSW DPI key fish habitat maps: <http://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps>
- Commonwealth DAWE Register of Critical Habitat: <http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl>
- the Bureau of Meteorology's (BoM's) Groundwater Dependent Ecosystems (GDEs) Atlas: <http://www.bom.gov.au/water/groundwater/gde/>
- Commonwealth DAWE Directory of Important Wetlands Australia: <https://www.environment.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands>
- NSW State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) maps: [http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=SEPP\\_CoastalManagement](http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=SEPP_CoastalManagement)
- locations of NSW marine parks and reserves available from NSW DPI Marine Parks website: <https://www.dpi.nsw.gov.au/fishing/marine-protected-areas/marine-parks>.

The South Mosman wharf interchange: Concept design report (Aurecon Australasia Pty Ltd, 2019) included a concept design assessment which contains a summary of the biodiversity values to be considered in the REF as well as other environmental considerations. The relevant sections of the document were reviewed and incorporated into this report.

This report considers all coastal marine/estuarine and terrestrial species and ecological communities. Freshwater and oceanic species and ecological communities have been excluded from this report as no habitat occurs in or near the study area. Diadromous species have been included.

As the study area is located within Coastal Waters (within three nautical mile limit seaward of the state/territorial sea baseline), matters in Commonwealth waters have not been considered in this report.

## 2.3 Habitat assessment

A habitat assessment was completed to assess the likelihood of occurrence of each threatened or migratory species, threatened population or ecological community identified to occur within the study locality. The likelihood of occurrence criteria is detailed in Table 2-1.

Species are considered 'likely to occur' (i.e. moderate to high likelihood of occurrence) where:

- The geographic distribution of the species is known or predicted to include the Interim Biogeographic Regionalisation for Australia (IBRA) subregion in which the project is located, and
- The proposal footprint contains habitat features or components associated with the species, or
- Past or current surveys undertaken in the proposal footprint indicate the species is present.

A test of significance (under the BC Act or FM Act) and/or an assessment of significance (under the EPBC Act) for species considered 'likely to occur' by the habitat assessment has been completed.

**Table 2-1: Likelihood of occurrence criteria**

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently (within 20 years) in the locality (5 kilometre) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (5 kilometre). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

## 2.4 Field survey

Field surveys of the foreshore and marine areas within the study area were completed on 20 April 2020. The aims of the surveys were to ground-truth the results of the background research and habitat assessment with particular consideration given to species of conservation concern likely to occur. Presumptive vegetation and habitat maps based on the results of the background research were developed to facilitate the field survey. Presumptive vegetation and habitat maps were created for the study area using ArcGIS 10.7 from an orthorectified aerial Nearmap imagery captured on 1 July 2019. Potential vegetation and habitat were outlined on a preliminary map layer via on-screen digitising at a scale of no more than 1:800 to demarcate boundaries as polygons determined from imagery and from existing vegetation and habitat mapping (Creese, et al., 2009; NSW OEH, 2016).

Presumptive map data were loaded onto a tablet connected to a GPS receiver (for added accuracy) and field survey data collected on the tablet.

### 2.4.1 Weather and sea conditions

The weather and sea conditions during the field survey are summarised in Table 2-2 (BoM, 2020a; WillyWeather, 2020). Conditions during the survey were mostly overcast with light variable winds. There was no recorded rainfall in Sydney within seven days prior to the field

survey and water visibility ranged between 0.5 to 1.5 metres. The marine field survey was completed on an ebbing tide.

**Table 2-2:** Weather and sea conditions during the field survey (source: BoM, 2020; WillyWeather, 2020)

Date	Temperature range (°C)	Rainfall (mm)	Wind direction	Max wind speed (km/h)	High tide	Low tide
20/04/2020	15.5-21.3	0	WNW	39	6:37am (1.58 m)	12:30am (0.64 m)
					7:09pm (1.55 m)	12:57pm (0.5 m)

### 2.4.2 Vegetation surveys

The terrestrial portion of the study area includes the section south of 2 Musgrave Street to 1 Musgrave Street and the limit of the seawall and the existing wharf structure and comprised of only native/exotic gardens and landscaped gardens and parks. Thus, the categorisation of PCTs and TEC commensuration checks were not required. The vegetation survey was carried out in all vegetated areas within the terrestrial portion of the study area. A walkover of the study area was completed to describe and map the type, extent and condition of vegetation. The floristics of the site was also recorded albeit a plot-based full floristic survey was not considered for planted vegetation in the study area.

Priority weeds listed for the Greater Sydney region were recorded and the extent of infestation described, if detected.

### 2.4.3 Targeted flora surveys

As the background research and habitat assessment did not identify any threatened flora with a moderate or high likelihood of occurrence, no targeted flora surveys were completed.

### 2.4.4 Targeted fauna surveys

No targeted fauna surveys were completed and threatened fauna presence was determined/assumed from an assessment of habitat features.

### 2.4.5 Aquatic surveys

Fieldwork was carried out from a five metre Cardno survey vessel using a combination of an underwater remotely operated vehicle (ROV) and/or bathyscope. The intertidal areas were inundated at the time of survey and the landward extent limited by the seawall. Thus, all areas below high tide were surveyed from the vessel.

Weather conditions at the time of sampling were good with reasonable underwater visibility (about 0.5 to 1.5 metres). The vessel navigated to areas of potential marine vegetation and habitat areas to verify, describe and classify the presumptive map into categories below.

Seagrasses, where detected, were classified as follows:

- Species:
  - *Zostera* (*Zostera muelleri* subsp. *capricorni* (previously *Zostera capricorni*))
  - *Posidonia* (*Posidonia australis*)
  - *Halophila* (*Halophila* spp.)

- Density:
  - high (greater than 50 per cent cover)
  - medium (between 15 and 50 per cent cover, inclusive)
  - low (less than 15 per cent cover).

Reef habitat, where detected, was classified into two major groups:

- Reef with monospecific macroalgal communities
- Reef with mixed macroalgal communities.

The complexity of reef habitat was also classified, given complexity was considered to be a reasonable indicator of the potential for an area of reef to be habitat for threatened species such as Black Rockcod (*Epinephelus daemeli*). Habitat complexity was categorised as:

- High (greater than one-metre-high relief complex habitat associated with natural, unmodified shoreline, includes consolidated or boulder reef with/without macroalgae) (example illustrated in Plate E1 in Annexure C)
- Medium (0.5 to one metre medium relief complex habitat associated with natural or modified shoreline, includes consolidated or boulder reef with/without macroalgae) (example illustrated in Plate E2 in Annexure C)
- Low (less than 0.5 metres low relief reef with/without macroalgae) (example illustrated in Plate E3 in Annexure C).

## 2.5 Data analyses and mapping

Following completion of the field survey, polygons drawn on the presumptive maps were refined and reclassified as per the field data collected. Where areas comprised more than one species (e.g. *Zostera* with an understorey of *Halophila*), these were differentiated by the most abundant species albeit other species present are described.

## 2.6 Limitations

Survey efficacy is influenced by a range of factors. Fieldwork for this study was completed during autumn. For this type of survey, limitations are generally due to a single, short duration survey that does not account for seasonal or other temporal variation. The detection of certain species may be affected by:

- Seasonal migration (particularly migratory and transient species)
- Seasonal availability of food for fauna
- Weather conditions during the survey period (some species may go through cycles of activity related to specific weather conditions)
- Species lifecycle (cycles of activity related to breeding).

These potential limitations have been addressed by applying the precautionary principle in cases where the survey methodology may have given a false negative result (e.g. a species that could reasonably be expected to occur, based on previous records and available habitat, was not observed). All species (including threatened species) have been assessed on the basis of the presence of their habitat and the likely significance of that habitat to a viable local population.

## 3 Existing environment

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The proposal is located along the foreshores of Sydney Harbour (the harbour), in the Parramatta River estuary (the estuary). Sydney Harbour is a drowned valley, tidal estuary (Roy, et al., 2001; Sydney Institute of Marine Science, 2014) about 30 kilometres long and occupies about 5000 hectares (Birch, 2006). The Parramatta River is deeply incised in Hawkesbury sandstone between 15 and 29 million years ago. Subsequent sea level rise, about 17,000 years ago, resulted in the flooding of the river valley, deposition of sediments and the formation of the tidal estuary.

Sydney Harbour is of high aesthetic, ecological and socio-economic importance to Sydney. The foreshores of the estuary are highly urbanised and the harbour itself has a large volume of commercial and private boating activities. The estuary is the final destination for runoff from about 50,000 hectares of catchment, of which at least 86 per cent is urbanised and/or industrialised through a long history since the 1800s (Birch, 2006). Reclamation and vegetation clearing have resulted in major alterations to ecological function, hydrology and physio-chemical attributes of the estuary (Birch, 2006). Despite these alterations the estuary has shown signs of recovery in more recent times (Johnston, et al., 2015).

The study area lies within the waters and foreshores of Sydney Harbour in the Pittwater Subregion of the Sydney Basin Bioregion (NSW National Parks and Wildlife Service, 2003) and the Port Jackson Basin landscape (Mitchell, 2002). The Pittwater Subregion and the Port Jackson Basin are characterised by small beach, dune and lagoon barrier systems and steep coastal cliffs and rock platforms. The coastal cliffed margins are on Triassic quartz while Quaternary muddy sands and pocket beaches are at the head of most tributary streams. The bathymetry of the study area is a composite of the natural geology and anthropogenic alterations. A wide depth range is a result of dredged shipping channels and deep holes (28 to 45 metres) separated by shoals of three to five metre depths (Sydney Institute of Marine Science, 2018). A number of shallow bays fringe the main channel on the northern and southern sides. The study area is located on the eastern foreshores of Great Sirius Cove, which is one of these bays on the northern side of the main harbour channel (Figure 1-1).

### 3.1 Coastal processes and hydrology

The poleward flowing East Australian Current (EAC) brings nutrient depleted waters to the entrance of the harbour. Hence, the water at the entrance of the harbour is continually being renewed (Sydney Institute of Marine Science, 2014). Water circulation in drowned valley estuaries is dominated by tidal currents as opposed to wind stress (Roy, et al., 2001; Sydney Institute of Marine Science, 2014). Tides are predominately semi-diurnal, reverse every six hours but can vary considerably spatially and temporally. Tidal velocities can reach up to 0.25 metres per second with the most distal branches of the estuary usually experiencing slower velocities, sometimes up to an order of magnitude less (Sydney Institute of Marine Science, 2014). In some areas of the estuary, tide-induced residual circulation forms a number of gyres at regions of complex geometry which may force the retention of biota or pollutants (Das, et al., 2000).

Three common wind patterns are known on Sydney Harbour. The strongest of the three originate from the south (southerlies) and occur about 17 per cent of the time. The most frequent of the three (about 22 per cent of the time) are north-easterlies while the least common of the three patterns are westerlies which usually occur during the winter months (Sydney Institute of Marine Science, 2014).

The Hawkesbury Sandstone is a recognised aquifer and elsewhere across Sydney provides a source of potable groundwater, though it often has elevated levels of iron (up to 300 ppm) and manganese (up to 15 ppm).

## 3.2 Soil and sediment properties

The estuary lies on the southern edge of the Hornsby Plateau, an upland area of massive, vertically jointed Hawkesbury sandstone capped with Wianamatta Group shales (McLoughlin, 2000). Outcrops of Hawkesbury sandstone are visible on the slopes next to the South Mosman wharf interchange (Aurecon Australasia Pty Ltd, 2019).

Northern tributaries have deep, steep-side valleys with little capacity for shoreline sediment accumulation without substantial filling of the valley. The Wianamatta Group shales weather rapidly to fine-grained and easily transported clays. Sediment deposits over bedrock range between 25 and 50 metres vertical depth downstream of the Harbour Bridge and 20 to 35 metres in channels and bays upstream of the Harbour Bridge. The acceleration of sedimentation within the estuary was triggered by the advent of vegetation clearing and soil disturbance from 1788 across the catchment (McLoughlin, 2000). This was followed by the process of removing accumulating silt, reshaping foreshores and seabeds for shipping and amenities virtually continuously for 140 years from 1842. Reclamation aimed to eliminate and replace mudflats and marshes with flat waterside land for industry and recreation. The foreshore reclamation areas also became the final destination for dredged material which otherwise would be taken out to sea.

The present-day estuary comprises five environmental/sedimentological units including:

- Harbour entrance (marine flood-tide delta sands)
- Lower estuary (sands)
- Central estuary (muddy sands)
- Upper estuary (muds)
- Off-channel bays (muds) (Birch, 2006).

Generally, sediments west of Sow and Pigs Reef (west of units 1 and 2 and where the study area is located) are dominated by terrestrial mud (OzCoasts, 2015).

### 3.2.1 Acid sulfate soils/sediments

Acid sulfate soils/sediments (ASS) is the common name given to naturally occurring soils and sediments that contain iron sulfate (pyrite). Acid sulfate soils/sediments are defined as either:

- Actual ASS (AASS) - highly acidic soils or sediments with pH <4, or
- Potential ASS (PASS) - soils or sediments containing sulphuric material that have not been oxidised but have potential for oxidation to generate high acidity.

The marine/estuarine portion of the study area is considered high-risk ASS (mostly sediments that have been eroded from the land and deposited in the deeply cut bays) (NSW DPIE, 1997; Aurecon Australasia Pty Ltd, 2019). The landside component of the South Mosman wharf interchange and surrounding land areas are not identified as having PASS (Aurecon Australasia Pty Ltd, 2019).

### 3.2.2 Soil and sediment quality

Soils and sediments of the estuary contain heavy metals, asbestos, hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) and organochlorine pesticides (OCPs) (Birch, 2006). Although sediments have been remediated and industrial activities on the foreshores of the estuary have greatly reduced, leachates have been documented to enter the estuary from rainwater filtration and tidal action at various locations in the estuary. Thus, high sediment contaminant concentrations in bays in the estuary are likely to be the result of historical reclamation. Stormwater discharge locations also coincide with these bays rendering the identification of sources of sediment contamination complex. Stormwater has been identified

as the main contemporary source of heavy metal contamination in the estuary (Montoya, 2015).

Some concentrations of heavy metals in sediments in Sydney Harbour have been documented to be the highest in Australia and internationally (Montoya, 2015). About 20 per cent of all copper, lead and zinc were found in four bays in the estuary in the early 2000s: (1) Iron Cove; (2) Rozelle and Blackwattle Bays; (3) Homebush Bay; and (4) Hen and Chicken Bay. These bays are at least two kilometres upstream of the study area. Other areas where heavy metals have been detected in sediments are located in small, highly concentrated areas of upper parts of tributaries and bays but are usually low in concentrations.

Burning of waste, chemical manufacturing and certain industrial processes have introduced dioxins into estuary sediments (Montoya, 2015). Once in an aquatic environment, dioxins can absorb quickly to particulate organic matter before settling in bottom sediments. This group of chemicals is mostly resistant to biological and chemical breakdown in the aquatic or terrestrial environment hence, its persistence in estuarine sediments. Following detection of this substance in the late 1980s, total fin-fish bans were implemented in Homebush Bay in 1989 extending to a commercial fishing ban upstream of the Gladesville Bridge in 1990.

Microplastics are tiny plastic fragments, fibres and granules (generally smaller than 5 millimetres in diameter) (Montoya, 2015). These can either be manufactured as microplastics or a result of breakdown of larger plastic debris. Microplastics in the water column can settle in the sediment following accumulation of microbial films, algae and invertebrates and/or the adherence to other particles. A large number of compounds in plastics can interfere with biologically important processes resulting in endocrine disruption and carcinogenesis. Furthermore, marine plastic debris has been found to accumulate waterborne pollutants up to 100 times greater than sediments (Browne, et al., 2013). The highest concentrations of microplastics in sediments have been recorded in Sydney Harbour and Middle Harbour with some areas containing an order of magnitude greater than other estuaries internationally (Montoya, 2015). Berrys Bay and Balls Head Bay are two bays with the highest concentration (21 to 40 fragments per 100 millilitres of sediment) of microplastics in Sydney Harbour albeit both are about two kilometres west of the study area. Although many manufacturers are phasing out or have phased out the use of microplastics and microbeads into their products, the persistence of larger plastic debris and existing microplastics in the marine environment still presents a problem to biota.

Previous investigations during a Stage 1 desktop study identified a number of contaminants of potential concern (Aurecon Australasia Pty Ltd, 2019):

- PAHs
- Heavy metals lead, copper and zinc
- OCPs
- Polychlorinated Biphenyls (PCBs).

The foreshore surrounding the proposal footprint is reclaimed and contained with a vertical stone seawall (Aurecon Australasia Pty Ltd, 2019). Soil impacts at the study area are currently unknown. However, two registered contaminated sites are within one kilometre of the proposal footprint operating licences relating to hazardous, industrial or Group A waste generation or storage and sewage treatment plants (Aurecon Australasia Pty Ltd, 2019).

### **3.3 Water quality**

The quality of the waters within the estuary reflect the balance between the upstream catchment loads of varying quality (depending on the land use and practices within the catchment), the downstream ocean inputs and the tidal flushing that mixes the different water masses (Cardno, 2018). Tidal flushing intensity diminishes from the ocean entrance at the heads to the upstream extremities near the river and creek inputs. During the frequent rainfall events, creek and river flows carry suspended particles and dissolved substances into the

estuary causing the estuarine waters to become turbid. Following runoff events, these particles are dispersed into the estuary by tidal and wind-induced currents and settle to the bed where they can be resuspended by subsequent events. The dispersion process effectively dilutes the introduced constituents and over time their concentrations diminish toward the pre-event concentration. The concentration of total suspended solids (TSS) and nutrients are predicted to have increased between two- and four-fold in Mosman Bay, immediately east of Great Sirius Cove, since pre-European settlement (Local Land Services Greater Sydney, 2015). In general, the turbidity varies along the estuary from clearer, low turbidity oceanic waters near the mouth to higher values near the river/creek inputs. In addition, the temporal variability is characterised by higher turbidity following significant inflow events and relatively low values during dry periods.

Suspended sediments attenuate light penetration through the water column and thereby limit pelagic and benthic primary production (the process of converting light energy into biomass). As the suspended matter settles to the seabed it may also smother benthic organisms and affect the type of organisms and plants that can exist in this environment. Fluctuations in light and rates of sedimentation occur naturally in Sydney Harbour due to regular resuspension of particulate matter by the tidal currents, wind-driven mixing and runoff events. Any activities which involve seabed disturbance have the potential to increase sedimentation and turbidity beyond the natural range.

### 3.4 Terrestrial vegetation

The study area is located on reclaimed land. The vegetation in this area is not remnant or able to be classified as PCTs. The eastern foreshore of Great Sirius Cove is highly urbanised with little to no areas of natural shoreline or remnant foreshore vegetation. Residential buildings and recreational space closely fringe the eastern foreshore and are mostly surrounded by hardstands, landscaped gardens, street plantings or open parks. The western foreshore, from the Mosman Bay Marina southward, is mostly a natural shoreline bound by a thin corridor of vegetation and a track which leads to Cremorne Reserve at the southern tip of Cremorne Point.

The extent of vegetation within the study area was limited by the cul-de-sac hardstand at the end of Musgrave Street, the shoreline, private property boundaries, footpaths and the existing South Mosman wharf interchange structures. The steep escarpment along the foreshore was densely colonised by native/exotic planted vegetation and ornamental escapees (Figure 3-1) and occupied about 0.06 hectares (Figure 3-5). Trees, in varying life stages, included native Sydney Blue Gum (*Eucalyptus saligna*), Bangalay (*Eucalyptus botryoides*), Smooth-barked Apple (*Angophora costata*), Norfolk Island Pine (*Araucaria heterophylla*), Swamp Oak (*Casuarina glauca*), Flame Tree (*Brachychiton acerifolius*) and Cedar Wattle (*Acacia elata*); and exotic/ornamental Canary Island Date Palm (*Phoenix canariensis*), Jacaranda (*Jacaranda mimosifolia*), Silky Oak (*Grevillea robusta*), Travellers Palm (*Ravenala madagascariensis*) and Japanese Hackberry (*Celtis sinensis*). The midstorey and shrub species included native Sydney Green Wattle (*Acacia decurrens*), Coastal Wattle (*Acacia longifolia* subsp. *sophorae*), Weeping Bottlebrush (*Callistemon viminalis*), Brush Cherry (*Syzygium australe*), Sweet Pittosporum (*Pittosporum undulatum*); and exotic/ornamental Frangipani (*Plumeria alba*), Olive (*Olea* sp.), Cotoneaster (*Cotoneaster glaucophyllus*), Murraya (*Murraya paniculata*) and Lantana (*Lantana camara*). The majority of these species are commonly used as garden, street or park plantings or are widespread priority weeds (see Section 3.6). The exotic Creeping Fig (*Ficus pumila*) was the most abundant on the escarpment slope while the remaining understorey vegetation on the slope and on foreshore flats was mostly exotic with the exception of a few native species, namely *Carex* sp., Climbing Guinea Flower (*Hibbertia scandens*), Spiny-headed Mat-rush (*Lomandra longifolia*) and Couch (*Cynodon dactylon*) (Figure 3-2).



**Figure 3-1:** Vegetation along the foreshore, view from the top of escarpment



**Figure 3-2:** Vegetation along the foreshore, view from the bottom of escarpment

Mature Moreton Bay Fig (*Ficus macrophylla*) and White Fig (*Ficus virens*) plantings bound the landscaped garden area along the foreshore at the southern end of the study area. This area occupied about 0.03 hectares and contained manicured garden beds, mown lawns of Sir Walter Buffalo (*Stenotaphrum secundatum*) mix, hardstands and park benches (Figure 3-3 and Figure 3-5).



**Figure 3-3:** Landscaped gardens at the southern end of the study area

Silky Oak, Coast Banksias (*Banksia integrifolia*), Prickly-leaved Tea Trees (*Melaleuca styphelioides*), Japanese Hackberry, Sweet Pittosporum stood over a mostly exotic understorey in the terraced gardens (about 0.04 hectares) along the eastern boundary of the study area. The composition of the understorey in these gardens were similar to that along the foreshore (Figure 3-4 and Figure 3-5).

The list of flora species recorded during the field survey is provided in Annexure A.

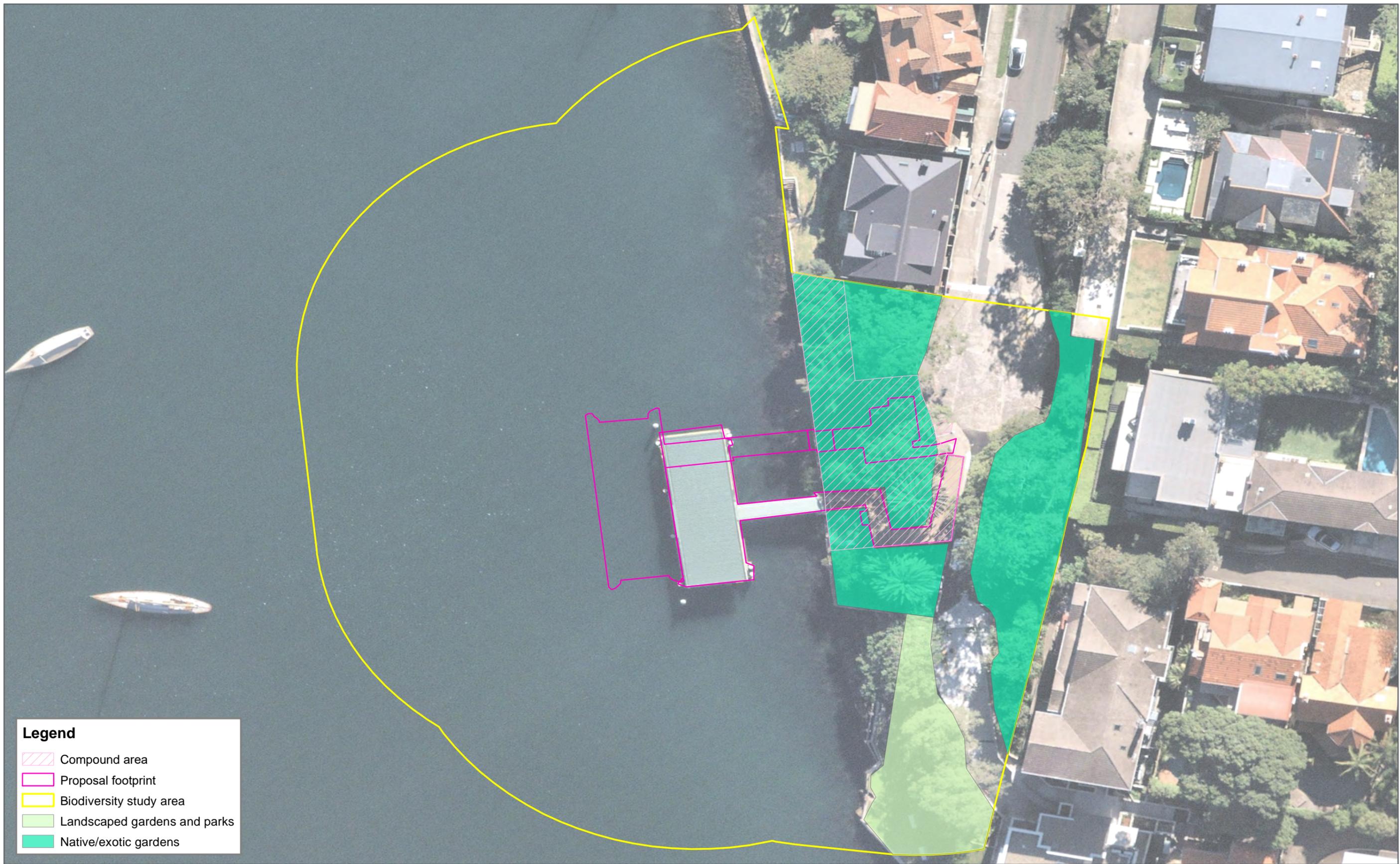


**Figure 3-4:** Native/exotic terraced gardens along the eastern boundary of the study area

The areas of terrestrial vegetation in the study area are provided in Table 3-1.

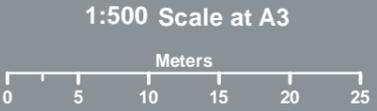
**Table 3-1:** Areas of terrestrial vegetation within the study area

Terrestrial vegetation	Area in study area (ha)
Native/exotic gardens	Foreshore – 0.06
	Terrace – 0.04
Landscaped gardens and parks	0.03
<b>Total</b>	<b>0.13</b>



**Legend**

- Compound area
- Proposal footprint
- Biodiversity study area
- Landscaped gardens and parks
- Native/exotic gardens



### Terrestrial Vegetation in the Study Area

FIGURE 3-5  
SOUTH MOSMAN



Map Produced by National Water & Environment  
 Date: 2020-10-09 | Project: AWE200198  
 Coordinate System: GCS GDA 1994  
 Map: AWE200198\_GS017\_SMosman\_TerrestrialVeg.mxd 02  
 Aerial Imagery supplied by Nearmaps (2020)

### 3.5 Terrestrial fauna habitat

The gardens and park areas form potential habitat for a number of species. Trees and shrubs provide potential foraging habitat for birds and arboreal and aerial mammals, particularly when in bloom/fruited. Birds and arboreal mammals may also roost in mature trees and shrubs. The trees and shrubs can also provide breeding habitat for birds common to urban areas. No tree hollows were observed during the field survey. Disturbance-tolerant birds may forage in the open park areas and the majority of the study area is likely foraging habitat for microchiropteran bats (microbats). Microbats may also roost in the crevices of existing wharf and terminal structures and in fissures in the sandstone escarpment during the day.

Local and vagrant seabirds may use the foreshores and existing wharf and terminal structures as perching areas while foraging in the area. The volume of pedestrian and vessel traffic in the study area is likely to be a deterrent for species that are not adapted to disturbance.

The list of fauna species recorded during the field survey is provided in Annexure A.

### 3.6 Priority weeds

Four priority weeds listed under the *Biosecurity Act 2015* for the Greater Sydney region were recorded in the vegetated areas within the study area (Table 3-2).

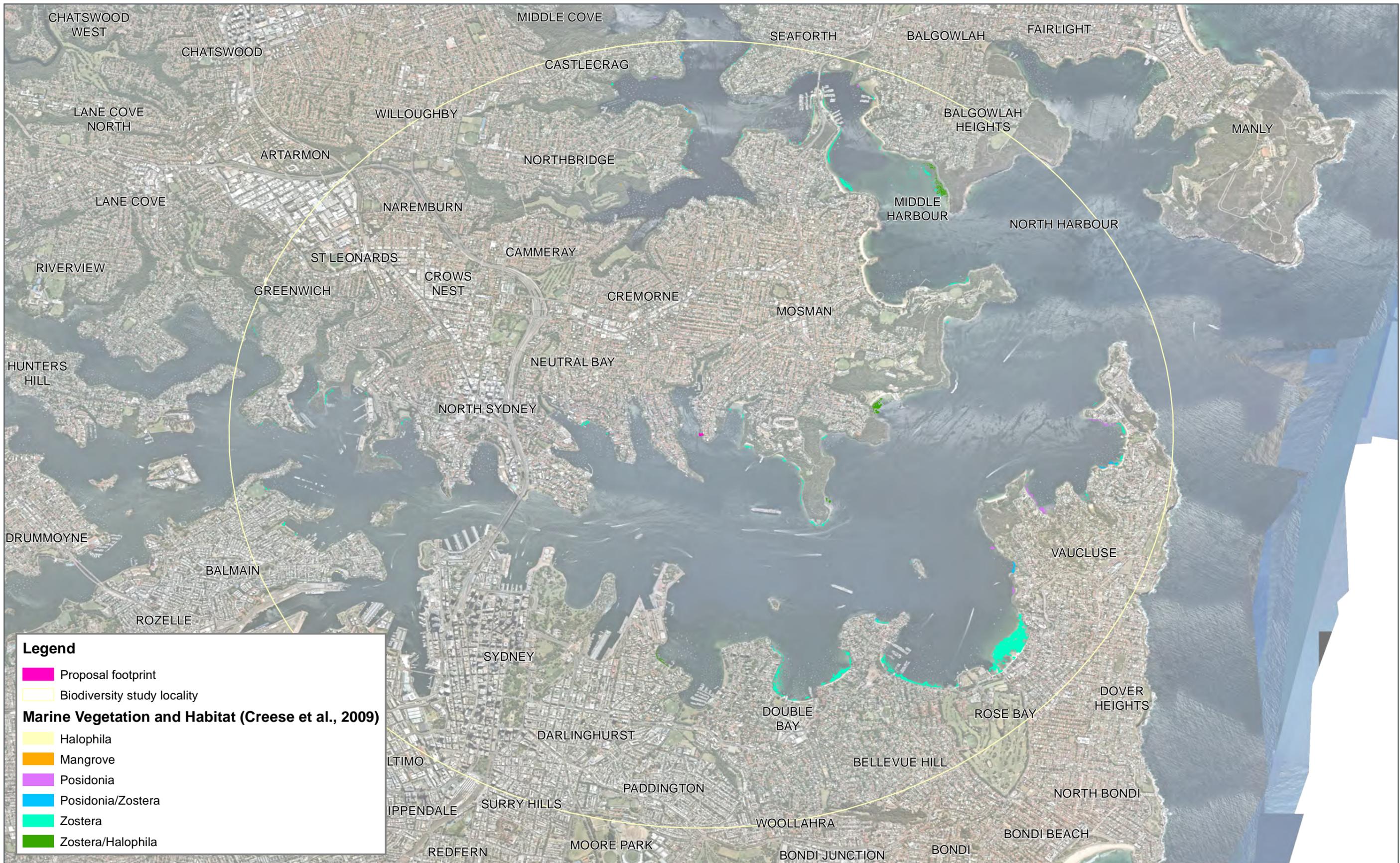
**Table 3-2:** Priority weeds recorded in the study area and their associated duty

Scientific name	Common name	Extent of infestation	Duty
<i>Asparagus aethiopicus</i>	Ground Asparagus	Some individuals in the understorey	Prohibition on dealings (must not be imported into the State or sold)
<i>Senecio madagascariensis</i>	Fireweed	Some individuals in the understorey	Prohibition on dealings (must not be imported into the State or sold)
<i>Anredera cordifolia</i>	Madeira Vine	Many occurrences wrapped around trunks and climbing up the escarpment/terrace	Prohibition on dealings (must not be imported into the State or sold)
<i>Lantana camara</i>	Lantana	Some individuals in the understorey	Prohibition on dealings (must not be imported into the State or sold)

### 3.7 Marine vegetation and habitat

The marine study area was comprised of the artificial seawall and the intertidal and subtidal areas surrounding the existing South Mosman wharf. The harbour is mapped as Key Fish Habitat (KFH) and is estuarine thus, considered a Class 1 waterway – Major KFH (NSW DPI, 2013; NSW DPI, 2020a).

No seagrass, mangroves or saltmarsh were recorded within the study area. The closest occurrences of these types of marine vegetation were a mapped patch of *Zostera* south of the Sydney Amateur Sailing Club on the western side of Great Sirius Cove and another patch about 330 m north of the study area along the eastern side of Great Sirius Cove (Creese, et al., 2009; NSW OEH, 2016) (Figure 3-6).



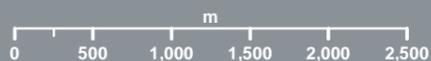
**Legend**

- Proposal footprint
- Biodiversity study locality

**Marine Vegetation and Habitat (Creese et al., 2009)**

- Halophila
- Mangrove
- Posidonia
- Posidonia/Zostera
- Zostera
- Zostera/Halophila

1:45,000 Scale at A3



## Marine Vegetation and Habitat in the Study Locality

FIGURE 3-6  
SOUTH MOSMAN



Map Produced by National Water & Environment  
 Date: 2020-07-12 | Project: AWE200198  
 Coordinate System: GCS GDA 1994  
 Map: AWE200198\_GS018\_SMosman\_MarineVegHabLocality.mxd 01  
 Aerial Imagery supplied by Nearmaps (2020)

Soft sediment habitats were associated with rock rubble, shell grit and solid waste materials. These consolidated materials were sparse in some areas (Figure 3-7) and dense in others (Figure 3-8) and formed a colonisation platform for some habitat-forming species including *Ecklonia radiata*, *Sargassum* spp. and sponges (Phylum Porifera; Figure 3-7). This habitat occupied the majority of the subtidal environment (about 0.46 hectares) in the study area (Table 3-3 and Figure 3-14). Soft sediment habitats generally lack the habitat complexity of consolidated rocky reef habitat. Only visible epifauna were recorded in this survey, however, soft sediment infauna occur in these habitats and have been linked to pelagic processes and play a central role in ecosystem functions by forming basal elements of many food chains (Gadd & Griffiths, 1977; Eyre & Ferguson, 2005; Connell & Gillanders, 2007).



**Figure 3-7:** Soft sediment habitat with sparse consolidated materials and colonising habitat-forming species



**Figure 3-8:** Soft sediment habitat with dense consolidated materials

The intertidal area was limited to the vertical sandstone seawall, the upper portions of the existing piles and two small rock platforms abutting the seawall, although the adjoining rocky reef may be exposed during low spring tides (Table 3-3, Figure 3-9, Figure 3-10 and Figure 3-14). Sydney Rock Oyster (*Saccostrea glomerata*) clusters colonised these areas and extended about 40 centimetres up the seawall from the base of the reef (Figure 3-9).

Stormwater or wastewater infrastructure was also observed along the seawall in the study area (Figure 3-11).



**Figure 3-9:** Intertidal habitat along the vertical seawall



**Figure 3-10:** The submerged intertidal platform colonised by Sydney Rock Oysters and the adjoining subtidal rocky reef



**Figure 3-11:** Stormwater/wastewater infrastructure along the shoreline in the study area

Subtidal rocky reefs abutted the sandstone seawall, where there was no intertidal platform, and extended from the intertidal platforms in other areas. This habitat extended about 10 metres from the shoreline along the extent of the study area (Figure 3-14). These areas comprised of low to medium relief reefs and occupied about 0.10 hectares of the study area (Table 3-3). The construct of subtidal rocky reefs appeared to be of natural bedrock, dislodged natural rock, seawall fragments and trapped soft sediment (localised or transported from other areas of the harbour).

Macroalgae and other habitat-forming species recorded in subtidal rocky reefs commonly occur in similar habitat in the harbour. Vertical and high gradient faces of subtidal reefs or areas of high wave energy were mostly colonised by lower profile habitat-forming species including turfing algae (i.e. *Halimtilon* sp., *Corallina* sp.), *Padina* sp., *Colpomenia* sp., *Zonaria* sp., *Dichtyota dichotoma*, *Sargassum* sp., *Ulva* sp. and mussels (Class Bivalvia) (Figure 3-10). *Ecklonia radiata* forest mosaics were generally found on horizontal or low gradient faces of subtidal reefs (Figure 3-12). These subtidal rocky reef communities also colonised the vertical submerged areas on existing piles and the pontoon although the communities on these structures were more characteristic of high gradient faces and high wave energy areas (Figure 3-13).



**Figure 3-12:** Characteristic subtidal rocky reef in the study area



**Figure 3-13:** Habitat-forming species on existing piles and the pontoon

Soft sediment areas are considered Type 3 – Minimally sensitive KFH as these areas are generally characterised by unstable or unvegetated sand or mud substrate (NSW DPI, 2013). The intertidal areas and subtidal rocky reefs of the study area are considered Type 2 – Moderately sensitive KFH as they meet the descriptions of estuarine rocky reefs and subtidal rocky reefs are colonised by macroalgae.

**Table 3-3:** Areas of marine vegetation and habitat within the study area

Marine vegetation and habitat	Area in study area (ha)
Intertidal rocky reef (Type 2 KFH)	0.01 (horizontal area) <0.01 (vertical area along seawall)
Low - medium relief subtidal rocky reef (Type 2 KFH)	0.10 (horizontal area) 0.01 (vertical area)
Soft sediment (Type 3 KFH)	0.46
Total	0.58

The marine vegetation and habitat within the study area is characteristic of many nearshore areas in the harbour. Subtidal rocky reefs in the harbour provide habitat for a number of local and vagrant fish and other mobile species and intertidal rocky reef areas can provide habitat for foraging shorebirds. These include threatened and migratory species known to occur in the harbour (see sections 3.11 and 3.17.1). No threatened or migratory species were observed during the field survey, however, fish species frequently observed in the harbour were recorded. These included Yellowfin Bream (*Acanthopagrus australis*), Luderick (*Girella tricuspidata*), Common Hardyhead (*Atherinomorus vaigiensis*), Blue-spotted Goatfish (*Upeneichthys vlamingii*), Gunther's Wrasse (*Pseudolabrus guentheri*), Silver Sweep (*Scorpiis lineolata*), Striped Cardinalfish (*Ostorhinchus fasciatus*), Red Morwong (*Morwong fuscus*), Rough Leatherjacket (*Scobinichthys granulatus*) and Eastern Hulafish (*Trachinops taeniatus*).

The list of marine fauna species recorded during the field survey is provided in Annexure A.

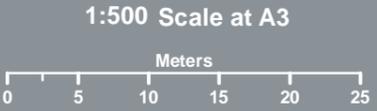


**Legend**

- Compound area
- Proposal footprint
- Biodiversity study area

**KFH Type**

- Type 2 - Moderately sensitive KFH
- Type 3 - Minimally sensitive KFH
- Intertidal rocky reef
- Low - medium relief rocky reef
- Soft sediment



**Marine Vegetation and Habitat in Study Area**  
 FIGURE 3-14  
 SOUTH MOSMAN



### 3.8 Marine pests and diseases

*Labyrinthula* spp. is a Stramenopile protist that causes seagrass wasting disease (Trevathan-Tackett, et al., 2018). This genus of protists is ubiquitous to coastal and marine ecosystems and are important to nutrient cycling as they excrete enzymes to breakdown plant or algal detritus (Raghukumar, 2002). However, *Labyrinthula* spp. has been known to infect living seagrass leaf cells leading to the necrosis of chloroplast, leaving distinct black lesions. The potential infection of seagrass wasting disease is linked to the virulence of species in this genus and the immunity of the host (Martin, et al., 2016). *Labyrinthula* spp. are also less tolerant to low salinities. Hence, seagrass meadows occurring in areas such as estuaries have the opportunity to clear their load of *Labyrinthula* spp. during freshwater influx events (McKone & Tanner, 2009). Seagrass wasting disease has not been described in NSW but has been known to occur in Queensland, Victoria and Western Australia, and little is understood of its ecology. Thus, Trevathan-Tackett et al. (2018) highlights the importance of monitoring the disease in Australian seagrass populations.

Like a great number of other estuaries and waterways, Sydney Harbour is at risk of infestation from the marine pest *Caulerpa taxifolia* (NSW DPI, 2016b). *Caulerpa taxifolia* is a fast-growing marine alga native to tropical Australia and the South Pacific (NSW DPI, 2016b). This species is known to alter the physical and chemical environment, which can affect biodiversity. Populations have been recorded in Port Jackson at Neutral Bay, Mosman, Clifton Gardens, Rushcutters Bay, Double Bay, Rose Bay and many locations in North Harbour and Middle Harbour. This species has not been mapped in Great Sirius Cove and was not detected in the study area during the field survey. *Caulerpa taxifolia* is known to spread via fishing and boating activities as well as natural hydrology and has potential to occur in the study area.

A large number of viral, bacterial and parasitic diseases affecting finfish, molluscs, crustacean and amphibians are known to occur within NSW waterways. The most renowned include Red Spot Disease, QX oyster disease and Pacific Oyster Mortality Syndrome (POMS) (NSW DPI, 2018). Red Spot Disease (or Epizootic ulcerative syndrome) is a fungal disease endemic in a number of waterways in NSW. This disease can affect many species of finfish and shows as red lesions or deep ulcers which can then be susceptible to secondary bacterial infections. Although the freshwater and estuarine waterways of the Sydney region have not recorded Red Spot Disease outbreaks, it is known to occur in all NSW waterways. QX oyster disease and POMS are high risk to oyster aquacultures, of which none currently reside within the study area or the harbour.

### 3.9 Threatened ecological communities (TEC)

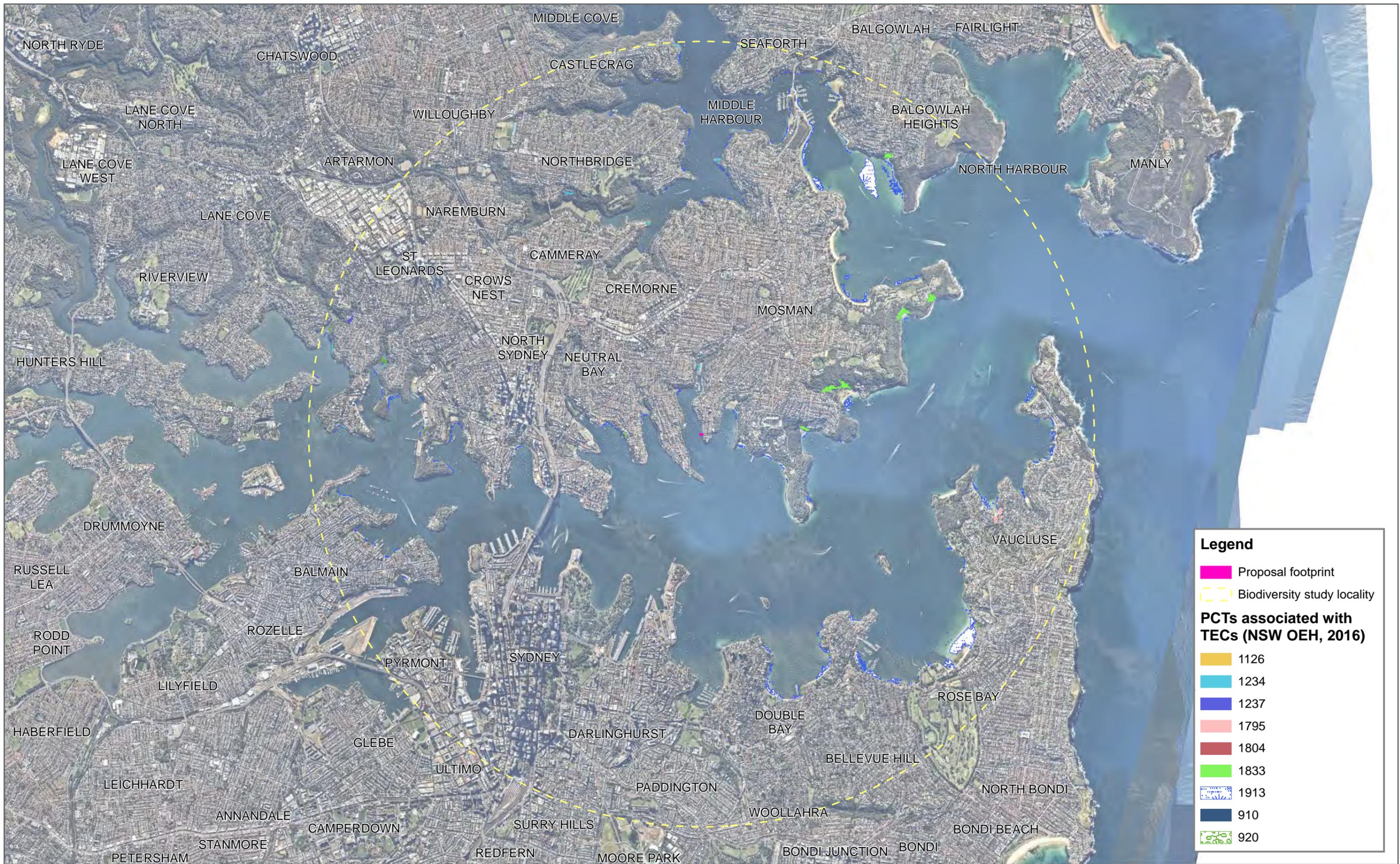
No remnant vegetation or PCTs occur within the study area and therefore no TECs occur within the study area. However, seven TECs have been mapped within the locality (Figure 3-15) (NSW OEH, 2016). These, and their proximity to the study area, are detailed in Table 3-4.

**Table 3-4:** Threatened ecological communities (TECs) mapped within the study locality and their proximity to the study area

Plant community type (PCT)	Associated TECs		Area in locality (ha)	Bearing and proximity of the closest occurrence to the study area
	BC Act	EPBC Act		
Coastal headland littoral	Littoral Rainforest in the New South Wales North	Littoral Rainforest and Coastal Vine	4.81	~1.2 km east

thicket (PCT 910) Coastal escarpment littoral rainforest (PCT 1833)	Coast, Sydney Basin and South East Corner Bioregions (endangered)	Thickets of Eastern Australia (critically endangered)		
Estuarine mangrove forest (PCT 920)* Estuarine saltmarsh (PCT 1126)*	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (endangered)	Subtropical and Temperate Coastal Saltmarsh (vulnerable)	0.70	~0.8 km north-west
Estuarine Swamp Oak forest (PCT 1234)	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (endangered)	Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of New South Wales and South East Queensland Ecological Community (endangered)	1.78	~0.5 km north-east
Blue Gum high forest (PCT 1237)	Blue Gum High Forest in the Sydney Basin Bioregion (critically endangered)	Blue Gum High Forest of the Sydney Basin Bioregion (critically endangered)	0.29	~4.7 km north-west
Swamp sclerophyll forest on coastal floodplains (PCT 1795)	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (endangered)	-	0.82	~3.9 km south-east
Coastal upland wet heath swamp (PCT 1804)	Coastal Upland Swamp in the Sydney Basin Bioregion (endangered)	Coastal Upland Swamps in the Sydney Basin Bioregion (endangered)	0.04	~2.5 km east
Seagrass meadows (PCT 1913)*	<i>Posidonia australis</i> seagrass endangered populations in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (endangered population under the FM Act)	<i>Posidonia australis</i> Seagrass Meadows of the Manning-Hawkesbury Ecoregion (endangered)	28.56	~0.4 km north-east

\*Marine vegetation discussed in Section 3.7.



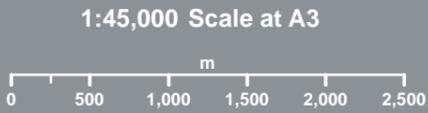
**Legend**

- Proposal footprint
- Biodiversity study locality

**PCTs associated with TECs (NSW OEH, 2016)**

- 1126
- 1234
- 1237
- 1795
- 1804
- 1833
- 1913
- 910
- 920

**TECs in Study Locality**  
**FIGURE 3-15**  
**SOUTH MOSMAN**



### 3.10 Groundwater dependent ecosystems

There are no aquatic or terrestrial GDEs in the study area (BoM, 2020b). The closest mapped GDE is in the reserve at Curraghbeena Park, about 150 metres north-east of the study area in Mosman.

### 3.11 Threatened species and populations

A review of the DPIE-EES BioNet database, NSW DPI Threatened species list and the DAWE PMST revealed 109 threatened species with potential to occur in the study locality. Those with records in the study locality are illustrated in Figure 3-16. Of the 109 threatened species, four were amphibians, 25 were flora, one was an invertebrate, 46 were birds, three were fish/Syngnathids, 21 were mammals, six were reptiles and three were elasmobranchs. Migratory species listed under the EPBC Act are discussed in Section 3.17.1.

No threatened species were observed during the field survey, however, potential habitat for some threatened species occurs in the study area. An assessment of the likelihood of occurrence of all threatened species based on the study area habitat was carried out to determine the potential for these species to occur within the study area. Table 2-1 provides the likelihood of occurrence criteria used in the assessment and Table 3-5 provides a summary of the assessment. The rationale behind the assessment is attached in Annexure B.

The likelihood of occurrence assessment found the majority of threatened species were either unlikely to occur or have a low likelihood of occurrence in the study area. However, due to the presence of suitable habitat in the study area and/or known populations in the harbour, ten species were considered to have a moderate to high likelihood of occurrence. These include:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act
- Black Rockcod (*Epinephelus daemeli*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Seven microbats listed as vulnerable under the BC Act:
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
  - Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
  - Little Bent-winged Bat (*Miniopterus australis*)
  - Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
  - Southern Myotis (*Myotis macropus*)
  - Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

White's Seahorse is listed as endangered under the FM Act and was considered to have a high likelihood of occurrence in the study area due to the presence of suitable habitat and known populations in the harbour. Resident populations of White's Seahorse have been reported in the harbour, some of which attract recreational divers. Recent conservation efforts by Sea Life Sydney Aquarium in collaboration with NSW DPI and University of Technology, Sydney released individuals from a breeding program into Clifton Gardens at Mosman. White's Seahorse are endemic to the estuaries and coastal embayments between Hervey Bay in Queensland and Sussex Inlet in NSW (NSW DPI, 2020b). They are usually found in sponge gardens, seagrass meadows and soft corals, as well as artificial habitats such as swimming nets and jetty/wharf pylons like those within the study area. The proposal has potential to present a risk to this species due to the presence of preferred habitat and known populations in the harbour and their limited mobility. Thus, an Assessment of

Significance (AoS) under the FM Act has been prepared to inform the impact assessment (Annexure D). White's Seahorse has also been nominated for listing as an endangered species under the EPBC Act. Invitation to comment on the proposed listing came to a close 15 April 2020 and DAWE are currently reviewing the proposition.

The Black Rockcod is listed as vulnerable under the FM Act and the EPBC Act and was considered to have a high likelihood of occurrence in the study area due to the presence of suitable habitat and anecdotal evidence of sightings of individuals in the harbour. This species is known to occur in warm temperate to subtropical waters of the south-western Pacific Ocean (Aquaculture, Conservation and Marine Parks Unit, Port Stephens Fisheries Institute, 2012). It has been recorded along the east coast of Australia from southern Queensland to Kangaroo Island off South Australia and around Lord Howe and Norfolk Islands. The Black Rockcod distribution is centred around the NSW coast and adults are usually found in caves, gutters and beneath bommies on rocky reefs up to 50 metres in depth. Juveniles of this species prefer coastal rock pools while larger juveniles prefer rocky reefs in estuaries. This species has high site fidelity and is territorial. Significant habitat for the species has been identified, of which the intertidal rocky shore within the coastal depth zone between 0 and 20 meters of the Hawkesbury Shelf is considered as significant. Although the study area does not extend to the coastal areas of the Hawkesbury Shelf, the subtidal rocky reefs of the harbour have potential to provide habitat for larger juvenile Black Rockcod. Suitable habitat within the study area for the Black Rockcod included subtidal, medium relief rocky reef areas (up to 0.10 hectares) which abut the stretch of seawall in the study area. Due to the presence of suitable habitat within the study area and the species' characteristic high site fidelity, AoSs under the FM Act and the EPBC Act have been completed for the species (Annexure D).

Seven microbats, listed under the BC Act, were considered to have a moderate likelihood of occurrence in the study area. There is no breeding habitat in the study area however, some of the existing wharf structures have potential to provide roosting habitat and the entire study area forms potential foraging habitat for these seven species, albeit suboptimal for these species. All of these species prefer to roost in caves or tree hollows however, they are known to roost in man-made structures including in/under bridges/wharves and buildings. The Eastern Coastal Free-tailed Bat is often recorded in coastal areas and has a number of records dated from 2006 on Goat Island, west of the Sydney Harbour Bridge and about 2.4 kilometres south-west of the study area. The Southern Myotis is known to forage over water and can be found roosting in small groups near water (NSW DPIE, 2017a). Although, the study area forms potential roosting habitat for the Little Bent-winged Bat, it is not optimal foraging habitat for the species as this species prefers densely vegetated forests (NSW DPIE, 2020). As these species are sedentary during the day when construction is likely to occur and difficult to detect, an AoS under the BC Act has been completed for this group of species (Annexure D).

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. There are no roosting camps in or near the study area. The closest roosting camp is in the Royal Botanic Garden Sydney (RBG) about 2 kilometres south-west of the study area, across the harbour channel. Individuals are likely to disperse from this camp and others and forage on flowering and fruiting shrubs and trees in the study area. The impacts of the proposal on foraging resources for the Grey-headed Flying-fox is assessed in the AoSs completed under the BC Act and the EPBC Act (Annexure D).

**Table 3-5:** Likelihood of occurrence summary of threatened species

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<b>Amphibians</b>					
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	(PMST)	None
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	(PMST)	None
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	(PMST)	None
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-	45 (BioNet)	None
<b>Flora</b>					
<i>Acacia bynoeana</i>	Bynoe's Tiny Wattle	E	V	(PMST)	None
<i>Acacia pubescens</i>	Downy Wattle	V	V	(PMST)	None
<i>Acacia terminalis subsp. terminalis</i>	Sunshine Wattle	E	E	106 (BioNet) (PMST)	None
<i>Allocasuarina glareicola</i>	-	E	E	(PMST)	None
<i>Allocasuarina portuensis</i>	Nielson Park She-oak	E	E	49 (BioNet) (PMST)	None
<i>Asterolasia elegans</i>	-	E	E	(PMST)	None
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	E	V	(PMST)	None
<i>Callistemon linearifolius</i>	Netted Bottlebrush	V	-	2 (BioNet)	None
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	(PMST)	None
<i>Doryanthes palmeri</i>	Giant Spear Lily	V	-	1 (BioNet)	None
<i>Darwinia biflora</i>	-	V	V	(PMST)	None

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	-	V	-	5 (BioNet)	None
<i>Eucalyptus camfieldii</i>	Camfields Stringybark	V	V	(PMST)	None
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	1 (Bionet)	None
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	E	E	(PMST)	None
<i>Hygrocybe reesia</i>	-	V		1 (Bionet)	None
<i>Melaleuca biconvexa</i>	Biconvexa Paperbark	V	V	(PMST)	None
<i>Persicaria elatior</i>	Tall Knotweed	V	V	(PMST)	None
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	(PMST)	None
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	V	V	(PMST)	None
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	(PMST)	None
<i>Prostanthera junonis</i>	Somersby Mintbush	E	E	(PMST)	None
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	-	1 (Bionet)	None
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	V	70 (Bionet) (PMST)	None
<i>Thesium australe</i>	Austral Toadflax	V	V	(PMST)	None
<b>Invertebrates</b>					
<i>Synemon plana</i>	Golden Sun Moth	E	CE	(PMST)	None
<b>Birds</b>					
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	(PMST)	Low

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	V	M, Ma	(PMST)	Low
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	1 (BioNet) (PMST)	Low
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	1 (BioNet)	Low
<i>Calidris canutus</i>	Red Knot	-	E, Mi, Ma	(PMST)	Low
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	CE, Mi, Ma	(PMST)	Low
<i>Calidris tenuirostris</i>	Great Knot	V	CE, Mi, Ma	(PMST)	Low
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	1 (BioNet)	None
<i>Calyptorhynchus lathamii</i>	Glossy Black Cockatoo	V	-	2 (BioNet)	None
<i>Charadrius leschenaultii</i>	Greater Sand Plover	V	V, Mi, Ma	(PMST)	Low
<i>Charadrius mongolus</i>	Lesser Sand Plover	V	E, Mi, Ma	(PMST)	Low
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	1 (BioNet)	None
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	(PMST)	None
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	6 (BioNet)	Low
<i>Grantiella picta</i>	Painted Honeyeater	V	V	(PMST)	None
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V	-	2 (BioNet)	Low
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	Ma	34 (BioNet) (PMST)	Low
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	2 (BioNet)	None

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Hirundapus caudacutus</i>	White-throated Needletail		V, Mi, Ma	(PMST)	Low
<i>Ixobrychus flavicollis</i>	Black Bittern	V	-	2 (BioNet)	Low
<i>Lathamus discolor</i>	Swift Parrot	E	CE, Ma	4 (BioNet) (PMST)	Low
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	1 (BioNet)	Low
<i>Limosa lapponica baueri</i>	Bar-tailed Godwit	-	V	(PMST)	Low
<i>Limosa lapponica menzbieri</i>	Northern Siberian Bar-tailed Godwit	-	CE	(PMST)	Low
<i>Limosa</i>	Black-tailed Godwit	V	Mi, Ma	(PMST)	Low
<i>Macronectes halli</i>	Northern Giant Petrel	V	V, Mi, Ma	(PMST)	Low
<i>Ninox connivens</i>	Barking Owl	V	-	3 (BioNet)	None
<i>Ninox strenua</i>	Powerful Owl	V	-	196 (BioNet)	Low
<i>Numenius madagascariensis</i>	Eastern Curlew	-	CE, Mi, Ma	(PMST)	Low
<i>Onychoprion fuscata</i>	Sooty Tern	V	Ma	1 (BioNet)	Low
<i>Pachyptila turtur subantarctica</i>	Fairy Prion (Southern)	-	V	(PMST)	Low
<i>Pandion cristatus</i>	Eastern Osprey	V	Mi, Ma	1 (BioNet) (PMST)	Low
<i>Pterodroma leucoptera</i>	Gould's Petrel	V	E, Ma	(PMST)	Low
<i>Pterodroma neglecta</i>	Kermadec Petrel	V	V, Ma	(PMST)	Low

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Ptilinopus superbus</i>	Superb Fruit-dove	V	Ma	5 (BioNet)	None
<i>Rostratula australis</i>	Australian Painted Snipe	E	E, Ma	(PMST)	Low
<i>Sternula albifrons</i>	Little Tern	E	Mi, Ma	1 (BioNet) (PMST)	Low
<i>Sternula nereis</i>	Australian Fairy Tern	-	V	(PMST)	Low
<i>Thalassarche bulleri</i>	Buller's Albatross	-	V, Ma, Mi	(PMST)	Low
<i>Thalassarche bulleri platei</i>	Northern Buller's Albatross	-	V, M, Ma	(PMST)	Low
<i>Thalassarche cauta</i>	Shy Albatross	V	V, Ma, Mi	(PMST)	Low
<i>Thalassarche melanophris</i>	Black-browed Albatross	V	V, Ma, Mi	(PMST)	Low
<i>Thalassarche salvini</i>	Salvin's Albatross	-	V, Ma, Mi	(PMST)	Low
<i>Thinornis rubricollis rubricollis</i>	Hooded Plover	CE	V, Ma	(PMST)	Low
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	1 (BioNet)	None
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	1 (BioNet)	None
<b>Fish and Syngnathids</b>					
<b><i>Hippocampus whitei</i></b>	<b>White's Seahorse</b>	<b>E (FM Act)</b>	<b>Ma (nominated for endangered listing)</b>	<b>(DPI) (PMST)</b>	<b>High</b>
<b><i>Epinephelus daemeli</i></b>	<b>Black Rockcod</b>	<b>E (FM Act)</b>	<b>V</b>	<b>(DPI) (PMST)</b>	<b>High</b>
<i>Prototroctes maraena</i>	Eastern Grayling	E (FM Act)	V	(DPI) (PMST)	Low

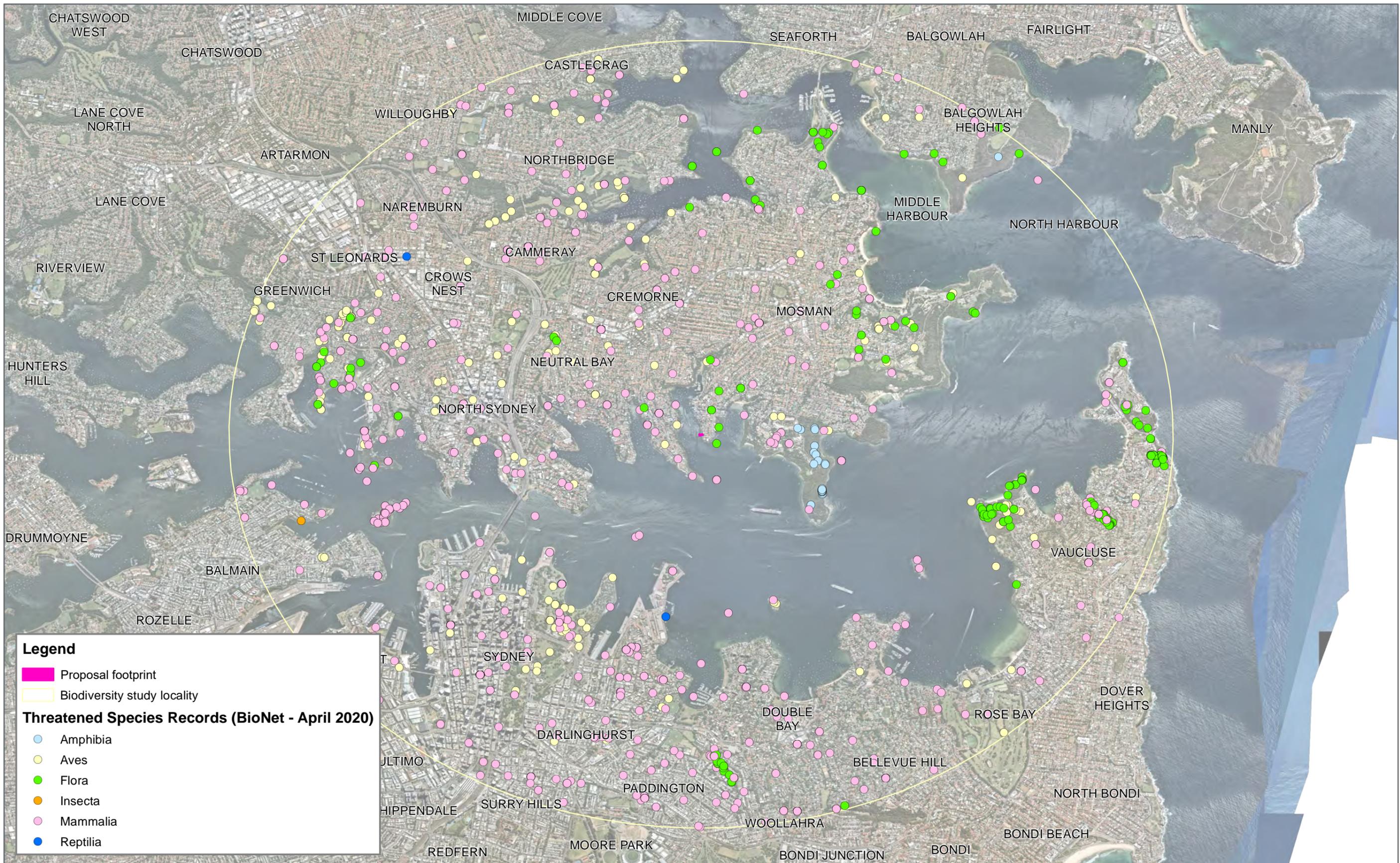
Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Mammals					
<i>Arctocephalus forsteri</i>	New Zealand Fur Seal	V	Ma	4 (BioNet)	Low
<i>Arctocephalus pusillus</i>	Australian Fur Seal	V	Ma	3 (BioNet)	Low
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	V	-	1 (BioNet)	None
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	1 (BioNet) (PMST)	Low
<i>Dasyurus maculatus</i>	Spotted-tail Quoll	V	E	1 (BioNet) (PMST)	None
<i>Eubalaena australis</i>	Southern Right Whale	E	E, Mi	2 (BioNet) (PMST)	Low
<b><i>Falsistrellus tasmaniensis</i></b>	<b>Eastern False Pipistrelle</b>	<b>V</b>	<b>-</b>	<b>1 (BioNet)</b> (PMST)	<b>Moderate</b>
<i>Isoodon obesulus</i>	Southern Brown Bandicoot (eastern/south eastern)	E	E	(PMST)	None
<i>Megaptera novaeangliae</i>	Humpback Whale	V	V, Mi	7 (BioNet) (PMST)	Low
<b><i>Micronomus norfolkensis</i></b>	<b>Eastern Coastal Free-tailed Bat</b>	<b>V</b>	<b>-</b>	<b>10 (BioNet)</b>	<b>Moderate</b>
<b><i>Miniopterus australis</i></b>	<b>Little Bent-winged Bat</b>	<b>V</b>	<b>-</b>	<b>5 (BioNet)</b>	<b>Moderate</b>
<b><i>Miniopterus orianae oceanensis</i></b>	<b>Large Bent-winged Bat</b>	<b>V</b>	<b>-</b>	<b>70 (BioNet)</b>	<b>Moderate</b>
<b><i>Myotis macropus</i></b>	<b>Southern Myotis</b>	<b>V</b>	<b>-</b>	<b>45 (BioNet)</b>	<b>Moderate</b>
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	1 (BioNet)	None

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Petauroides volans</i>	Greater Glider	-	V	(PMST)	None
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	(PMST)	None
<i>Phascolarctos cinereus</i>	Koala (combined populations Qld, NSW and the ACT)	V	V	3 (BioNet) (PMST)	Low
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	(PMST)	None
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	V	V	1,060 (BioNet) (PMST)	High
<b><i>Saccolaimus flaviventris</i></b>	<b>Yellow-bellied Sheathtail-bat</b>	<b>V</b>	<b>-</b>	<b>1 (BioNet)</b>	<b>Moderate</b>
<b><i>Scoteanax rueppellii</i></b>	<b>Greater Broad-nosed Bat</b>	<b>V</b>	<b>-</b>	<b>1 (BioNet)</b>	<b>Moderate</b>
Reptiles					
<i>Caretta</i>	Loggerhead Turtle	E	E, Mi, Ma	1 (BioNet) (PMST)	Low
<i>Chelonia mydas</i>	Green Turtle	V	V, Mi, Ma	(PMST)	Low
<i>Dermochelys coriacea</i>	Leatherback Turtle	E	E, Mi, Ma	1 (BioNet) (PMST)	Low
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	-	V, Mi, Ma	(PMST)	Low
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	(PMST)	None
<i>Natator depressus</i>	Flatback Turtle	-	V, Mi, Ma	(PMST)	Low
Elasmobranchs					
<i>Carcharias taurus</i>	Grey Nurse Shark (east coast population)	CE (FM Act)	CE	(DPI) (PMST)	Low

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Carcharodon carcharias</i>	Great White Shark	V (FM Act)	V, Mi	(PMST)	Low
<i>Rhincodon typus</i>	Whale Shark	-	V, Mi	(PMST)	Low

\*V = vulnerable; E = endangered; CE = critically endangered; Mi = migratory (EPBC Act); Ma = marine (EPBC Act)

Moderate or high likelihood of occurrence species are in **bold**.



**Legend**

- Proposal footprint
- Biodiversity study locality

**Threatened Species Records (BioNet - April 2020)**

- Amphibia
- Aves
- Flora
- Insecta
- Mammalia
- Reptilia

1:45,000 Scale at A3

m

0 500 1,000 1,500 2,000 2,500

**Threatened Species Records in Study Locality**  
 FIGURE 3-16  
 SOUTH MOSMAN

N

**Cardno**

Map Produced by National Water & Environment  
 Date: 2020-10-09 | Project: AWE200198  
 Coordinate System: GCS GDA 1994  
 Map: AWE200198\_GS021\_SMosman\_TSLocality.mxd 02  
 Aerial Imagery supplied by Nearmaps (2020)

### 3.12 Protected species

Some species of fish have been formally protected because they are naturally scarce or their numbers have been substantially reduced over recent decades. These species are protected to help prevent them becoming threatened in the future. Twenty-five marine fauna protected under the FM Act have potential to occur within the study locality. Fishing and collecting of these species without a permit will incur a penalty in accordance with Section 19 of the FM Act. An assessment of the likelihood of occurrence of all FM Act protected species, in accordance with the criteria set out in Table 2-1, was carried out to determine the potential for these species to occur within the study area (Annexure B). A summary of the likelihood of occurrence assessment is provided in Table 3-6.

The EPBC Act also provides for the protection of species. These are referred to as 'Marine' listed species. Their listing under the EPBC Act highlights the need for their conservation and management as protecting them from being killed, injured, taken, traded, kept or moved. Similar to the FM Act, all Syngnathids (Family: Syngnathidae) are also listed as Marine under the EPBC Act. The Protected Matters Search Tool also identified/predicted the occurrence of six bird species listed as Marine under the EPBC Act with potential to occur in the study locality albeit all five species were considered to have a low likelihood of occurrence due to the absence of preferred habitat.

With the exception of the Ornate Ghost Pipefish (*Solenostomus paradoxus*), which prefers coastal habitats, all Syngnathids were considered to have a high likelihood of occurrence in the study area. The majority of the remaining 20 species have an affinity to marine vegetation and habitat in estuaries (i.e. seagrass, macroalgae, mangroves and rocky reef). These 20 species have a wide distribution and are not unique to the harbour or the habitat within the study area (endemic).

A further three fish species were also considered to have a high likelihood of occurrence within the study area, including:

- Elegant Wrasse (*Anampses elegans*)
- Estuary cod (*Epinephelus coioides*)
- Eastern blue devil fish (*Paraplesiops bleekeri*).

The subtidal areas of the study area form potential habitat for all three species however, these subtidal habitat features are not unique to the study area and are widespread throughout the harbour, similar to the distribution of these species.

All marine vegetation, including seagrass, saltmarsh, mangroves and macroalgae, are protected under the FM Act. The study area does not encompass seagrass, saltmarsh or mangroves however, macroalgae colonised intertidal and subtidal rocky reefs (see Section 3.7). Macroalgae are considered as marine vegetation and Division 4 of the FM Act protects marine vegetation from 'harm' in the form of gathering, cutting, pulling up, destroying, poisoning, digging up, removing, injuring or preventing light from reaching or otherwise harm marine vegetation or any part of it.

**Table 3-6:** Likelihood of occurrence summary of protected species

Scientific Name	Common Name	FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Birds					
<i>Ardea alba</i>	Great Egret	-	Ma	(PMST)	Low
<i>Ardea ibis</i>	Cattle Egret	-	Ma	(PMST)	Low

Scientific Name	Common Name	FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	Ma	(PMST)	Low
<i>Himantopus</i>	Pied Stilt	-	Ma	(PMST)	Low
<i>Merops ornatus</i>	Rainbow Bee-eater	-	Ma	(PMST)	Low
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	-	Ma	(PMST)	Low
Fish, Syngnathids and reptiles					
<i>Acentronura tentaculata</i>	Shortpouch Pygmy Pipehorse	P	Ma	(DPI) (PMST)	High
<i>Anampses elegans</i>	Elegant Wrasse	P	-	(DPI)	High
<i>Epinephelus coioides</i>	Estuary Cod	P	-	(DPI)	High
<i>Epinephelus lanceolatus</i>	Queensland Groper	P	Ma	(DPI)	Moderate
<i>Festucalex cinctus</i>	Girdled Pipefish	P	Ma	(DPI) (PMST)	High
<i>Filicampus tigris</i>	Tiger Pipefish	P	Ma	(DPI) (PMST)	High
<i>Heraldia nocturna</i>	Upside-down Pipefish	P	Ma	(DPI) (PMST)	High
<i>Hippichthys penicillus</i>	Beady Pipefish	P	Ma	(DPI) (PMST)	High
<i>Hippocampus abdominalis</i>	Big-belly Seahorse	P	Ma	(DPI) (PMST)	High
<i>Histiogamphelus briggsii</i>	Crested Pipefish	P	Ma	(DPI) (PMST)	High
<i>Lissocampus runa</i>	Javelin Pipefish	P	Ma	(DPI) (PMST)	High
<i>Maroubra perserrata</i>	Sawtooth Pipefish	P	Ma	(DPI) (PMST)	High

Scientific Name	Common Name	FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Notiocampus ruber</i>	Red Pipefish	P	Ma	(DPI) (PMST)	High
<i>Paraplesiops bleekeri</i>	Eastern Blue Devil	P	-	(DPI)	High
<i>Pelamis platurus</i>	Yellow-bellied Seasnake	-	Ma	(PMST)	Low
<i>Phyllopteryx taeniolatus</i>	Weedy Seadragon	P	Ma	(DPI) (PMST)	High
<i>Solegnathus spinosissimus</i>	Spiny Pipefish	P	Ma	(DPI) (PMST)	High
<i>Solenostomus cyanopterus</i>	Robust Ghost Pipefish	P	Ma	(DPI) (PMST)	High
<i>Solenostomus paradoxus</i>	Ornate Ghost Pipefish	P	Ma	(DPI) (PMST)	Low
<i>Stigmatopora argus</i>	Spotted Pipefish	P	Ma	(DPI) (PMST)	High
<i>Stigmatopora nigra</i>	Widebody Pipefish	P	Ma	(DPI) (PMST)	High
<i>Syngnathoides biaculeatus</i>	Double-end Pipefish	P	Ma	(DPI) (PMST)	High
<i>Trachyrhamphus bicoarctatus</i>	Bentstick Pipefish	P	Ma	(DPI) (PMST)	High
<i>Urocampus carinirostris</i>	Hairy Pipefish	P	Ma	(DPI) (PMST)	High
<i>Vanacampus margaritifer</i>	Mother-of-Pearl Pipefish	P	Ma	(DPI) (PMST)	High

\*P=protected; Ma = marine (EPBC Act)

### 3.13 Commercial and recreational fishing

Drowned valley estuaries are the most productive of all estuary types in terms of commercial and recreational fishing (Roy, et al., 2001). In 1980-81, commercial fish catch was about 108 tonne, while the corresponding recreational fish catch was estimated as 165 tonne. Since then, prawn trawling has been phased out and because of elevated levels of dioxins in fish and crustaceans across Sydney Harbour, including Parramatta River and other connected tidal waterways, a ban was placed on commercial fishing in 2006. Recreational fishing in the

harbour has not been banned, but fishers are urged to follow dietary advice on the levels of consumption of seafood from the Sydney Harbour, Parramatta River and other connected tidal waterways. Fishers can also continue to practise catch and release.

Henry (1984) found recreational fishing effort in Sydney Harbour to be generally greater in summer and autumn and on weekends, and estimated over one million fish were caught in 1981. Recreational fishermen took 46 fish species from the estuary during the one-year survey period, with species occurring in a range of benthic, demersal and pelagic habitat. At that time, the top ten species by abundance were Yellowtail (*Trachurus novaezelandiae*), Tailor (*Pomatomus saltatrix*), Yellowfin Bream, Snapper, (*Pagrus auratus*), Silver Trevally (*Caranx georgianus*), Dusky Flathead (*Platycephalus fuscus*), Sweep (*Scorpius lineolatus*), Fanbelly Leatherjacket (*Monacanthus chinensis*), Yellowfin Leatherjacket (*Meuschenia trachylepis*) and Sand whiting (*Sillago ciliata*). More recent anecdotal information indicates Yellowtail Kingfish (*Seriola lalandi*) are now among the top ten common fish caught. Rod fishing and hand lining were the main recreational fishing methods observed during Henry's 1984 survey. Few fishers used traps (crab, lobster, fish), nets (prawn, scissors, dip) or spearfished in the harbour. Fishing from the shoreline was more popular than from boats. Fishing techniques may be attributed to the geography of the estuary. An extensive, convoluted shoreline provides many protected access points to the water's edge. Deep water can be reached by an easy cast of a lightly weighted line, and given Sydney Harbour is a major shipping waterway, the heavy water traffic is a hazard to small boats.

### **3.14 Critical habitat and Areas of Outstanding Biodiversity Value**

No critical habitats listed under the FM Act or EPBC Act or AOBVs listed under the BC Act occurs within the study area or in Great Sirius Cove. The only critical habitat or AOBV in the Sydney metropolitan area is the Little Penguin (*Eudyptula minor*) population in Sydney's North Harbour which protects Little Penguin nesting areas and access to nesting areas. This AOBV is over five kilometres north-east of the study area and outside of the study locality.

### **3.15 Wildlife connectivity corridors**

The study area is located on a highly modified, urban foreshore. There is minimal natural foreshore habitat and no natural riparian corridors along the eastern shoreline of Great Sirius Cove.

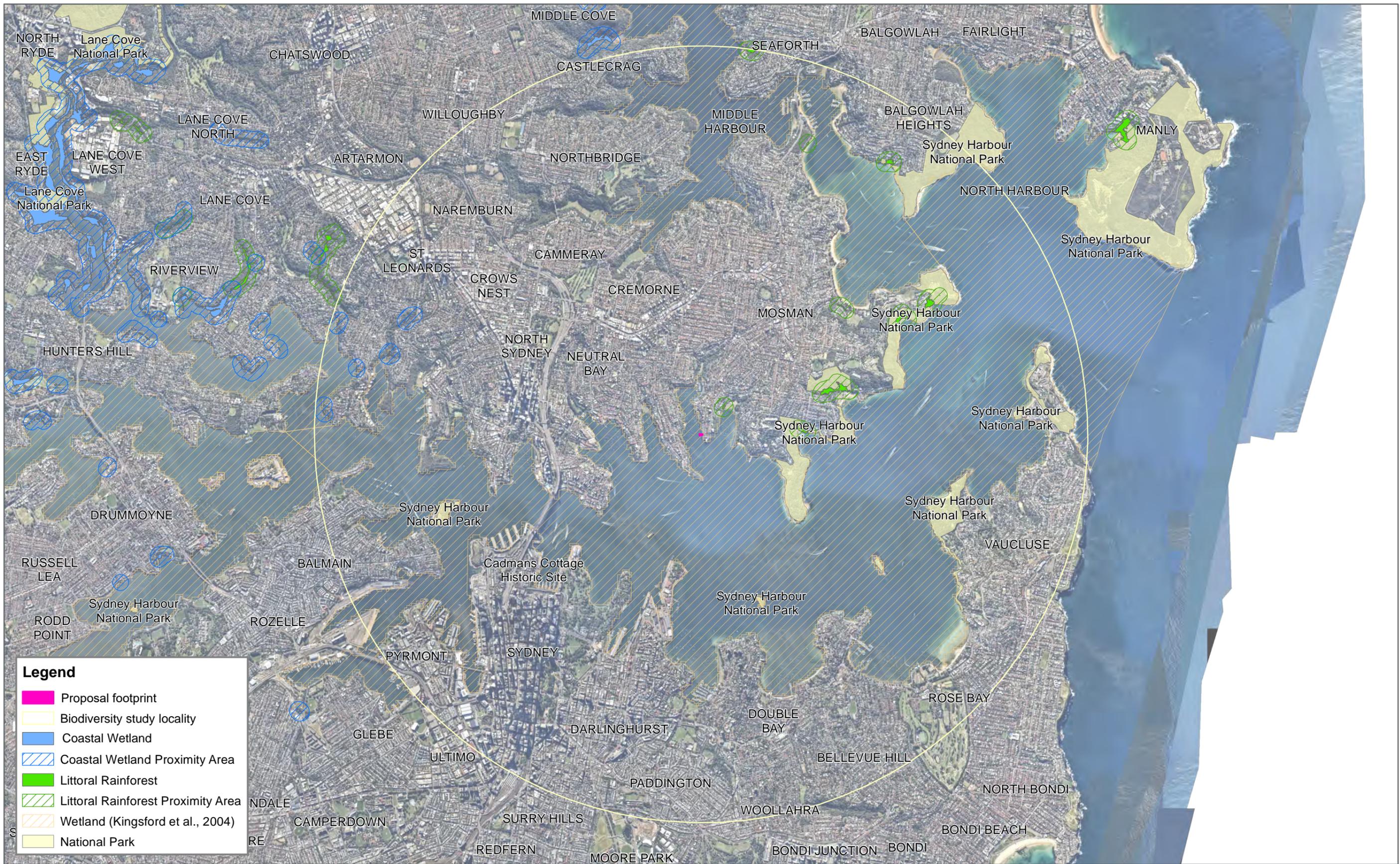
Great Sirius Cove forms part of the marine corridor that is the Parramatta Estuary and is easily accessible for marine and estuarine species.

### **3.16 Wetlands and other areas of conservation significance**

There are no Coastal Wetland or Littoral Rainforests, as defined in the Coastal Management SEPP, in the study area. The closest Coastal Wetland is over four kilometres west of the study area at Gore Cove Reserve. The closest Littoral Rainforest is about 400 metres north-east of the study area at Little Sirius Cove (Figure 3-17).

There are no nationally important wetlands or Ramsar Wetlands in the study area or the wider study locality. The Parramatta Estuary is considered an estuarine wetland (Kingsford, et al., 2004) (Figure 3-17).

The study area does not fall in or is next to any National Parks, Conservation Reserves, Nature Reserves or Regional Parks. The closest National Parks estate is the Fort Denison, which forms part of Sydney Harbour National Park, about 1.3 kilometres south-west of the study area (Figure 3-17). No Aquatic Reserves or Marine Parks occur within the study area or the study locality.



**Legend**

- Proposal footprint
- Biodiversity study locality
- Coastal Wetland
- Coastal Wetland Proximity Area
- Littoral Rainforest
- Littoral Rainforest Proximity Area
- Wetland (Kingsford et al., 2004)
- National Park

1:55,000 Scale at A3



## Conservation Areas and Wetlands in Study Locality

FIGURE 3-17  
SOUTH MOSMAN



Map Produced by APAC Water and Environment  
 Date: 2020-10-09 | Project: AWE200198  
 Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere  
 Map: AWE200198\_GS022\_SMosman\_ConservationAreas.mxd\_02  
 Aerial imagery supplied by Nearmaps (2020)

### 3.17 Matters of National Environmental Significance

There are nine types of Matters of National Environmental Significance (MNES) listed under the EPBC Act of which actions that have, or are likely to have, a significant impact on would require approval from the Australian Government Minister for the Environment (Commonwealth Minister). Of the nine types of MNES, four are potentially relevant to the proposal:

- Listed threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- Wetlands of international importance.

Threatened species and ecological communities listed under the EPBC Act are considered as MNES and are discussed in sections 3.9 and 3.11. The location and/or relevance of migratory species, Commonwealth marine areas and wetland of international importance are discussed in the following sections.

#### 3.17.1 Migratory species

Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. Listed migratory species may include any native species identified in an international agreement approved by the Minister. All listed migratory species are MNES under the EPBC Act. An action will require approval if the action has, will have, or is likely to have, a significant impact on a listed migratory species.

The PMST indicated 26 bird species and seven marine mammals/elasmobranchs have either been previously recorded or are predicted to occur within the study locality. An assessment of the likelihood of occurrence of all FM Act protected species, in accordance with the criteria set out in Table 2-1, was carried out to determine the potential for these species to occur within the study area (Annexure B). A summary of the likelihood of occurrence assessment is provided in Table 3-7.

No listed migratory species were considered to have a moderate or high likelihood of occurrence in the study area and will not be addressed further.

**Table 3-7:** Likelihood of occurrence summary of migratory species

Scientific Name	Common Name	EPBC Act*	Number of records (source)	Likelihood of occurrence
Birds				
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, Ma	(PMST)	Low
<i>Anous stolidus</i>	Common Noddy	Mi, Ma	(PMST)	Low
<i>Apus pacificus</i>	Fork-tailed Swift	Mi, Ma	(PMST)	Low
<i>Ardenna grisea</i>	Sooty Shearwater	Mi, Ma	(PMST)	Low
<i>Arenaria interpres</i>	Ruddy Turnstone	Mi, Ma	(PMST)	Low
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, Ma	(PMST)	Low

Scientific Name	Common Name	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi, Ma	(PMST)	Low
<i>Calidris ruficollis</i>	Red-necked Stint	Mi, Ma	(PMST)	Low
<i>Calonectris leucomelas</i>	Streaked Shearwater	Mi, Ma	(PMST)	Low
<i>Charadrius bicinctus</i>	Double-banded Plover	Mi, Ma	(PMST)	Low
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi	(PMST)	None
<i>Fregata ariel</i>	Lesser Frigate Bird	M, Ma	(PMST)	Low
<i>Fregata minor</i>	Great Frigate Bird	Mi, Ma	(PMST)	Low
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi, Ma	(PMST)	Low
<i>Limosa lapponica</i>	Bar-tailed Godwit	Mi, Ma	(PMST)	Low
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi, Ma	(PMST)	None
<i>Monarcha trivirgatus</i>	Spectacled Monarch	Mi, Ma	(PMST)	None
<i>Motacilla flava</i>	Yellow Wagtail	Mi, Ma	(PMST)	Low
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi, Ma	(PMST)	None
<i>Numenius phaeopus</i>	Whimbrel	Mi, Ma	(PMST)	Low
<i>Philomachus pugnax</i>	Ruff	Mi, Ma	(PMST)	Low
<i>Pluvialis fulva</i>	Pacific Golden Plover	Mi, Ma	(PMST)	Low
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi, Ma	(PMST)	Low
<i>Tringa brevipes</i>	Grey-tailed Tattler	Mi, Ma	(PMST)	Low
<i>Tringa nebularia</i>	Common Greenshank	Mi, Ma	(PMST)	Low
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Mi, Ma	(PMST)	Low
<b>Mammals and Elasmobranchs</b>				
<i>Balaenoptera edeni</i>	Bryde's Whale	Mi	(PMST)	Low
<i>Caperea marginata</i>	Pygmy Right Whale	Mi	(PMST)	Low

Scientific Name	Common Name	EPBC Act*	Number of records (source)	Likelihood of occurrence
<i>Lagenorhynchus obscurus</i>	Dusky Dolphin	Mi	(PMST)	Low
<i>Lamna nasus</i>	Porbeagle	Mi	(PMST)	Low
<i>Manta alfredi</i>	Reef Manta Ray	Mi	(PMST)	None
<i>Manta birostris</i>	Giant Manta Ray	Mi	(PMST)	None
<i>Sousa chinensis</i>	Indo-Pacific Humpback Dolphin	Mi	(PMST)	Low

\*Mi = migratory; Ma = marine (EPBC Act)

### 3.17.2 Commonwealth marine areas

Commonwealth marine areas extends from three to 200 nautical miles from the coast of Australia. Thus, the study locality and the study area lies outside of any Commonwealth marine areas. However, the coastal waters to the east of the study area resides within the Temperate East Marine Region which covers 383,352 square kilometres and includes eight marine reserves. The study area does not reside within any Commonwealth marine reserves. The closest marine reserves are the Hunter Commonwealth Marine Reserve, about 170 kilometres north of the study area, and the Jervis Commonwealth Marine Reserve, about 127 kilometres south of the study area.

### 3.17.3 Wetlands of International Importance

Wetlands of international importance are defined by the Ramsar Convention which recognises these areas as being of significant value for their respective countries as well as for humanity as a whole. There are no nationally important wetlands or Ramsar Wetlands in the study area or the wider study locality.

## 4 Impact assessment

This section assesses potential impacts to coastal and marine biodiversity in the study area as a result of the construction and operation of the proposal. The main components of the proposal with potential to impact biodiversity are summarised below and detailed in Section 3 of the REF:

- Construction:
  - Vegetation clearing and grubbing during site establishment
  - Movement and use of equipment, plant and vessels
  - Disturbance of the escarpment for installation of stairs and lift
  - Disturbance of the seabed from vessel traffic, anchoring and piling
  - Installation and removal of structures in the harbour
  - Landscaping
- Operation:
  - Persistence of the new wharf structures/features
  - Vessel and pedestrian traffic.

This section details the extent and significance of impacts as a result of the proposal including:

- Removal and disturbance of vegetation and habitat (terrestrial and marine)
- Mobilisation of soils, sediments and contaminants
- Alterations to hydrology
- Introduction/spread of weeds and/or marine pests and diseases
- Surface and underwater noise and vibration
- Vessel and pedestrian disturbance.

### 4.1 Construction impacts

#### 4.1.1 Native vegetation and habitat (terrestrial)

The proposal would remove up to 0.04 hectares of native/exotic gardens. This includes some native planted trees and a mostly exotic understorey along the foreshore of the study area (Table 4-1 and Figure 4-1).

Vegetation to be removed does not form part of any remnant PCT but does form potential habitat for some highly mobile, disturbance tolerant native fauna. This would result in the removal of potential habitat for native fauna. The removal of habitat resources is unlikely to have a significant impact on native fauna as there is an abundance of similar habitat across the study locality of which the study area only forms a small proportion. The majority of vegetation to be cleared is associated with the establishment of the compound site. Thus, following the decommissioning of the compound site (i.e. completion of construction), up to 0.03 hectares would be restored and landscaped.

Disturbance of vegetation can result in the introduction or spread of exotic flora (i.e. weeds). This can occur by the spread of opportunistic exotic vegetation from adjacent private properties or new species can be introduced via equipment, plant and footwear. Any foreign equipment or materials brought onto the construction site also has potential to introduce diseases such as *Phytophthora* (*Phytophthora cinnamomi*) and Myrtle Rust (*Puccinia psidii*). The vegetation and habitat in the study area and the surrounding areas are susceptible to weeds and diseases if not managed during construction.

Vegetation clearing and grubbing would expose soils and components of landfill which can then be easily mobilised. Contaminants in the soil and landfill can also be subsequently released into the surrounding environment. Erosion and sedimentation is most likely to impact harbour waters, particular during inclement weather (e.g. rainfall, high winds) if controls are not implemented. This could result in unfavourable, turbid conditions, the smothering of sessile marine vegetation, habitat and fauna and water, sediment and biota contamination in Great Sirius Cove and even the wider harbour.

#### 4.1.2 Marine vegetation and habitat

The proposal would not require large-scale disturbance of the seabed. To install the jetty and pontoon components of the new wharf, six piles would be installed in the subtidal habitat in the harbour. All of these piles (two at 467 millimetres in diameter and four at 760 millimetres in diameter) would be driven into subtidal soft sediment habitat. The area of soft sediment habitat (Type 3 KFH) under the footprint of the piles would be permanently lost while the anchor areas for the barge during construction would be temporarily impacted. This would include the direct removal of epifauna and infauna from soft sediment habitats. However, soft sediment habitats in the study area are characteristic of the majority of subtidal habitat in the harbour and community assemblages are generally ubiquitous and quick to recolonise following disturbance. Thus, the loss of these small areas would not be a substantial loss and anchor areas in soft sediment would quickly recolonise following the removal of anchors.

The removal of the existing structure would also result in the removal of marine vegetation, habitat and sessile/less mobile fauna on the piles and pontoon. This constitutes a total vertical marine vegetation/habitat area of about 0.01 hectares (Table 4-1). These existing structures are currently densely colonised and the majority of these species are common in other intertidal areas and subtidal rocky reefs and would quickly colonise the piles and pontoon of the new wharf. The total vertical submerged area of the new wharf available for colonisation is about double the vertical area to be removed (about 0.02 hectares). There is potential that the materials proposed for the new piles may not be suitable for colonisation in which case, the marine assemblage on the removed structures could be permanently lost. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project)

There is potential for fragments of the existing seawall to dislodge during the installation of the land-based jetty piles and removal of the existing wharf structure. An area of <0.01 hectares of the rocky reef platform and the vertical rocky reef has potential to be crushed (injury/mortality) or dislodged. If this were to happen, the seawall would be remediated to a similar or better condition and habitat-forming species are likely to recolonise these areas following construction completion.

Under Section 199 of the FM Act, consultation with NSW DPI (Fisheries) is required for any dredging and reclamation works. 'Dredging' under the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013) is classified as disturbance of the seabed/streambed. In this case, this refers to removal and installation of piles. Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required as per the definition detailed in Section 3.12. However, through consultation with NSW DPI (Fisheries) (dated 16 November 2020), this is not required for the piling and pile removal works associated with this proposal.

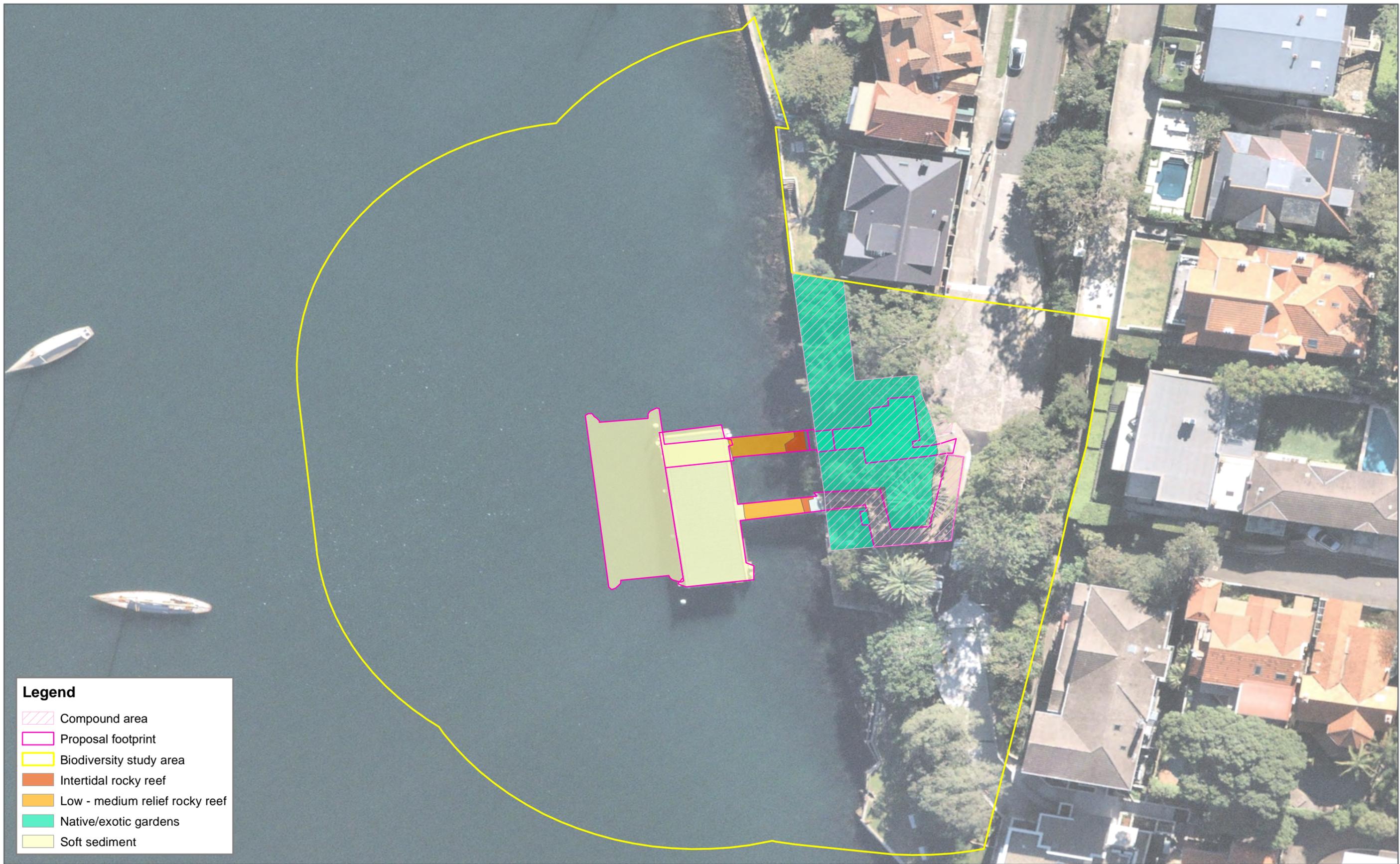
There is potential for coarse and fine debris to be mobilised during piling, removal of existing structures and vessel movement. This can crush, damage and/or smother marine vegetation and habitat depending on the size of debris. Larger debris would be disposed offsite and should not cause any impacts to marine biodiversity. Mobilisation of finer debris (ie sediments) can also result in the mobilisation of contamination known to persist in study area sediments. Depending on the volume and the size of fine debris, wave, tide and current actions, finer particles may not reside in the area for long and this may only be a temporary

nuisance to marine assemblages. Furthermore, Great Sirius Cove and the wider harbour periodically experiences impacts from elevated turbidity, usually as a result of rainfall, tides and swell. Thus, marine assemblages in the study area are likely to be frequently exposed to these conditions and the proposal is unlikely to introduce vastly different conditions.

Water-based construction activities would result in vessel and barge movements in and around the study area. This has potential to temporarily increase the frequency of vessel wash impact on intertidal and subtidal rocky reefs and the scour of soft sediment areas. Marine vegetation and sessile fauna can be scoured from the rocky reefs and epifauna, including scattered colonies of macroalgae on hard substratum, and infauna in soft sediment habitats can be removed/relocated. As large and small vessels currently frequent the study area, the community assemblages are likely to be well-adapted to vessel wash and scour. Thus, impacts as a result of vessel and barge movements are unlikely to substantially impact marine biodiversity in the study area.

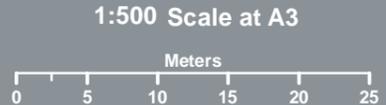
**Table 4-1:** Areas of terrestrial and marine vegetation and habitat to be directly impacted by the proposal

<b>Vegetation and habitat</b>	<b>Area to be directly and indirectly impacted/removed (ha)</b>
Native/exotic gardens	0.04
Intertidal rocky reef	<0.01
Vertical submerged marine vegetation/habitat (intertidal and subtidal)	0.01 (vertical area on existing structures)
Low - medium relief subtidal rocky reef (Type 2 – Moderately sensitive KFH)	<0.01
Soft sediment (Type 3 – Minimally sensitive KFH)	0.04
<b>Total</b>	<b>0.11</b>



**Legend**

- Compound area
- Proposal footprint
- Biodiversity study area
- Intertidal rocky reef
- Low - medium relief rocky reef
- Native/exotic gardens
- Soft sediment



**Vegetation and Habitat to be Impacted**  
 FIGURE 4-1  
 SOUTH MOSMAN

**Cardno**

Map Produced by APAC Water and Environment  
 Date: 2020-10-09 | Project: AWE200198  
 Coordinate System: GCS GDA 1994  
 Map: AWE200198\_GS023\_SMosman\_ImpactVegHab.mxd 02  
 Aerial Imagery supplied by Nearmaps (2020)

### 4.1.3 Coastal fauna and mobile marine fauna

Proposed construction activities are unlikely to substantially impact on mobile marine fauna occurring within the study area. Fish are highly mobile and temporary disturbance from the movement of vessels, piling and removal of structures would be minor, as similar and higher condition habitat are abundant and wide-ranging in the harbour. Other disturbances associated with these works may include noise and vibration and alterations to water quality. Tolerance to changes in noise, vibration and water quality may vary among species, but the response is generally similar to these types of activities in a busy harbour (i.e. movement away from unfavourable conditions). Marine fauna in the harbour are likely to be exposed to an ambient level of noise from existing marine activities. These species are also likely to recolonise the study area once conditions return to pre-construction levels.

Impacts on sessile and less mobile marine fauna (excluding threatened species) associated with rocky reef and soft sediments have been addressed in Section 4.1.2.

A temporary increase in vessel and barge activity during construction is associated with an increased risk of vessel strikes with marine turtles and mammals. The proposal footprint is considered suboptimal habitat for most marine mammals and very few individuals, if any, would occur during construction. The increased risk, however, is proportional to the increase in vessel traffic for the proposal relative to overall vessel traffic. This proportional increase is considered to be very small. Given marine turtles and marine mammals regularly breach the surface to breathe, the risk of vessel strike to these species could be managed by having observers monitoring potential encroachment of individuals. Vessel strike can also be mitigated by slow boat speeds that minimise collisions or result in minor harm from which fauna may recover.

Vegetation clearing in the study area would temporarily remove foraging habitat for highly mobile, disturbance tolerant fauna. This is addressed in Section 4.1.1. Land-based construction activities would also create noise and vibration in the study area and the responses of terrestrial fauna are likely to be similar to that of mobile marine fauna (i.e. move away from unfavourable conditions and return once disturbance is removed).

With the correct controls, proposal construction is unlikely to cause mortality to coastal or mobile marine fauna in the study area.

### 4.1.4 Threatened, migratory and protected species

The proposal is unlikely to significantly impact threatened species and disturbances to potential habitat would largely be temporary. The details of the AoSs which assess impacts on threatened species considered potentially occurring in the study area are in Annexure D.

Clearing of landscaped vegetation of up to 0.04 hectares and drilling into the escarpment to anchor the stairs and lift has potential to remove roosting and foraging habitat for the Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Little Bent-winged Bat, Large Bent-winged Bat, Southern Myotis, Yellow-bellied Sheath-tail-bat, Greater Broad-nosed Bay and the Grey-headed Flying-fox. However, the area of removal is considered suboptimal and a very small proportion of the available habitat for these species and is not expected to reduce species' range, disrupt breeding or reduce population sizes. Much of the disturbed area would be landscaped and reinstated following construction completion and the new wharf structures are likely to provide new roosting habitat for these species.

Water-based activities have potential to impact habitat for the Southern Myotis, Black Rockcod and White's Seahorse. The foraging resource that the study area represents would be made available for these species following the completion of construction thus, proposal impacts to potential foraging habitat for these species are only temporary. The impact from the removal of the existing structure is considered minimal for Black Rockcod and White's Seahorse. This is a very small proportion of available habitat in their distribution and the installation of new piles and structures would provide similar, if not the same habitat for these

species during operation. Additional controls would be implemented to survey for Black Rockcod and White's Seahorse at the start of construction so that individuals in the area are not harmed (see Section 5).

#### **4.1.5 Pests and diseases**

Aside from the potential for the introduction and/or spread and introduction of exotic vegetation and diseases addressed in Section 4.1.1, the study area is unlikely to be susceptible to any other land-based pests and disease as a result of the proposal. Proposal activities over water have a small potential to introduce marine pests if vessels, equipment or plant are used if controls are not implemented.

#### **4.1.6 Commercial and recreational fishing**

The proposal is unlikely to substantially impact populations of marine species important to recreational fishing as discussed in Section 4.1.3. However, temporary disruption to recreational fishing in the construction site would be experienced during construction and the continuation of recreational fishing from the new structure is likely to be restricted to areas which would not disrupt ferry operations. These conditions for recreational fishing during operation are unlikely to substantially differ from existing conditions.

#### **4.1.7 Key Threatening Processes**

Eight Key Threatening Processes (KTPs) have potential to be triggered by the proposal. These are discussed below.

##### **(1) Introduction of Non-indigenous Fish and Marine Vegetation to the Coastal Waters of NSW (FM Act)**

Threat abatement actions prioritised in the *Priority Action Statement – Actions for the introduction of non-indigenous fish and marine vegetation to coastal waters of NSW* (Fisheries Scientific Committee, 1994) surrounds community and stakeholder liaison and awareness, legislative development and implementation, eradication and control and research, monitoring and mapping. The proposal is unlikely to interfere with any of these threat abatement actions albeit the potential to introduce/facilitate the spread of non-indigenous fish and marine vegetation. However, vessels and equipment should be sourced from local areas (see Section 5) to avoid introducing non-indigenous fish and marine vegetation. Thus, proposal activities are unlikely to further exacerbate this KTP.

##### **(2) Clearing of Native Vegetation (BC Act) and (3) Land Clearance (EPBC Act)**

The proposal would include the clearing of native vegetation although none are remnant native vegetation but rather landscape plantings. Hence, although the proposal temporarily triggers this KTP, the native vegetation to be cleared does not constitute remnant vegetation. Furthermore, areas of clearing would be rehabilitated and landscaped with native species to the Sydney region following the completion of construction.

There are currently no Threat Abatement Plans (TAPs) for these KTPs however recovery actions have been identified. These surround community and stakeholder liaison and awareness, legislative development and implementation, eradication and control and research and monitoring. The proposal would not interfere with any of these actions or further exacerbate this KTP.

**(4) Invasion and Establishment of Exotic Vines and Scramblers (BC Act), (5) Invasion of Native Plant Communities by Exotic Perennial Grasses (BC Act), (6) Loss and Degradation of Native Plant and Animal Habitat by Invasion of Escaped Garden Plants, Including Aquatic Plants (EPBC Act) and (7) Novel Biota and Their Impact on Biodiversity (EPBC ACT)**

These KTPs surround the risk of the spread or establishment of exotic species. This KTP is unlikely to be triggered/further exacerbated by the proposal as:

- areas to be disturbed would be rehabilitated with native species, local to the Sydney region and maintained following construction completion
- controls would be implemented to avoid the introduction/spread of exotic species during construction.

**(8) Installation and Operation of Instream Structures and Other Mechanisms That Alter Natural Flow Regimes of Rivers and Streams (FM Act)**

The proposal would install six piles and a floating pontoon and remove the existing wharf structures. The size of these structures are small in comparison to the extent of the estuary thus would not interfere with fish passage. Due to the size of these structures in proportion to the estuary, alterations to hydrodynamics are likely to be localised and unlikely to impact any threatened species listed under the FM Act.

The identified threat abatement actions for this KTP include advice to consent authorities, community and stakeholder engagement, research and monitoring and habitat rehabilitation and protection. The proposal is unlikely to interfere with these actions with habitat rehabilitation proposed following proposal completion. Thus, the proposal is unlikely to further exacerbate or trigger this KTP.

## **4.2 Operational impacts**

### **4.2.1 Marine vegetation and habitat**

The gangway and pontoon components of the proposal would sit permanently on or above the water's surface and avoid impacts to the seabed. However, these structures would shade a portion of intertidal rocky reef, subtidal rocky reef and subtidal soft sediment habitat. As a result, less than 0.01 hectares of subtidal rocky reef habitat assemblage may change and manifest in a reduction of macroalgae (Table 4-1 and Figure 4-1). This impact area is a very small proportion of subtidal rocky reef habitat in the study area and the wider harbour and is not considered ecologically significant. Shading of intertidal (<0.01 hectares horizontal and vertical areas) and soft sediment habitat (about 0.04 hectares) is not expected to substantially change community assemblages as these areas generally lack marine vegetation (Table 4-1 and Figure 4-1). Removal of the existing wharf interchange would leave portions of intertidal rocky reef (<0.01 hectares) and subtidal rocky reef (<0.01 hectares) and soft sediment habitat (0.02 hectares) exposed to sunlight. This is not expected to have any substantial impacts to soft sediment communities.

The relocation of the ferry terminal also translates to the relocation of localised ferry wash and underwater turbulence. Great Sirius Cove currently experiences substantial vessel traffic and ferry routes are likely to vary from time to time. Impacts from the small changes to the docking and departing ferry route at the new terminal are unlikely to be detectable in the highly variable boating environment of Great Sirius Cove. There is potential for soft sediment habitat to be scoured from ferry jets while docking and departing the new terminal. However, these habitats are quick to recover as discussed in Section 4.1.2. Sediment mobilisation from ferry jets may affect nearby rocky reef habitat, however, communities in the study area are likely to be well-adapted to turbidity and sedimentation from existing vessel traffic (also see Section 4.1.2). Furthermore, installation of the new pontoon in deeper water is likely to

reduce disturbance of the seabed and impacts from sediment mobilisation to nearby rocky reef habitat.

The structures of the new terminal are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. The proposal would install six piles and a floating pontoon while removing the existing wharf interchange structures (piles and pontoon). The size of these structures are small in comparison to the extent of the estuary thus would not interfere with fish passage. Due to the size of these structures in proportion to the estuary, alterations to hydrodynamics are likely to be localised and unlikely to produce substantial impacts to marine biodiversity.

### 4.3 Cumulative impacts

Projects within the Milson Precinct and the Sydney Ferries Network have been considered for the purposes of this cumulative impact assessment as per the REF.

Projects identified that could create cumulative impacts with the proposal have been detailed in Table 4.2.

**Table 4-2:** Past, present and future projects

Project	Construction impacts	Operational impacts
<p>TfNSW Ferry Wharf Upgrade Program</p> <p>Program described as per the REF.</p>	<p>Upgrade of South Mosman wharf would require additional movements within Sydney Harbour. There would be a potential minor short term cumulative increase in vessel movements within the study area and the harbour. However, the harbour currently experiences a high level of vessel traffic and this increase is unlikely to generate substantial cumulative impacts on biodiversity.</p> <p>Other upgrades could potentially require the removal of coastal and marine vegetation. However, these areas are generally modified and the proportion of these areas to other similar areas in the harbour is very small, even when combined. This is relevant to the removal of vegetation (terrestrial and marine) and potential habitat for native, threatened and/or migratory species.</p>	<p>Operational impacts of all ferry upgrade locations are likely to resemble those discussed above. Most locations would require the removal of existing structures in place of new structures. This is generally a temporary disturbance to coastal and marine vegetation and habitat and ecologically acceptable for coastal and marine species in the harbour.</p>
<p>African Savannah and Congo Exhibits, Taronga Zoo (State Significant Development).</p>	<p>Redevelopment of the enclosures would require removal of vegetation. This may include remnant vegetation but is likely to be planted vegetation in target enclosures. The enclosures are</p>	<p>See construction impacts.</p>

Project	Construction impacts	Operational impacts
<p>Partial demolition of the African Safari and Orangutan Rainforest exhibits and redevelopment to form the new exhibit including minor earthworks and regrading of the site.</p> <p>The project would be staged as follows:</p> <ul style="list-style-type: none"> <li>• Stage 1 – the African Savannah exhibit</li> <li>• Stage 2 – the Congo Forest exhibit intended to commence construction in May 2021 and open in October 2022.</li> </ul>	<p>likely to be revegetated as part of the redevelopment thus, the overall impact on vegetation clearing is not expected to be substantial or become a cumulative impact with the vegetation clearing required for this proposal.</p>	

## 5 Avoid, minimise and mitigation

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Under the TfNSW *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority (RTA), 2011) the management of biodiversity should aim to:

1. Avoid and minimise impacts first
2. Mitigate impacts where avoidance is not possible
3. Offset where residual impacts cannot be avoided.

Table 5-1 details measures to avoid, minimise or mitigate proposal impacts. These should be included in the construction environmental management plan and any associated sub-plans prior to construction.

**Table 5-1: Mitigation measures**

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
B1	All project impacts	<p>Integrate the management of flora and fauna into the construction environmental management plan (either as a standalone flora and fauna management plan or a subplan). This is to include all terrestrial and marine flora and fauna and include but not be limited to such measures as:</p> <ul style="list-style-type: none"> <li>• Documenting and establishing site clearing limits</li> <li>• Establishment of no go zones</li> <li>• Implementation of tree protection measures</li> <li>• Pre-clearing surveys, vegetation removal, unexpected finds measures in line with the <i>Biodiversity Guidelines</i> (RTA, 2011).</li> </ul>	Contractor	Pre-construction	Effective	None
B2	Removal of native vegetation, threatened species habitat and habitat features	Native vegetation and habitat removal will be minimised through detailed design with a focus to retain vegetation along the boundary of the compound site and 2 Musgrave Street.	TfNSW	Detailed design	Effective	<p>Up to 0.04 ha of native/exotic gardens to be removed.</p> <p>Up to 0.03 ha to be reinstated and landscaped following construction completion.</p>
B3	Removal of native vegetation, threatened species habitat and habitat features	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). Any roosting microbats in the vegetation and wharf structures to be removed and the escarpment area to be impacted will be captured and relocated to similar or higher condition habitat. Release will only be done	Contractor	Pre-construction	Effective	<p>Up to 0.01 ha of native/exotic gardens to be permanently removed.</p> <p>As per 'Removal of marine vegetation and habitat'</p>

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
		at dusk and roosting individuals should be kept in a secure, dark and warm location until then. Injured individuals or unfurred juveniles are to be transported to a veterinarian.				
B4	Removal of native vegetation, threatened species habitat and habitat features	Vegetation and habitat removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction	Effective	
B5	Removal of native vegetation, threatened species habitat and habitat features	Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). Replacement plantings (species and number) will be determined in consultation with Mosman Council to reinstate habitat and minimise visual impacts.	Contractor	Detailed design/Post construction	Effective	
B6	Removal of native vegetation, threatened species habitat and habitat features	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the project site.	Contractor	Construction	Proven	

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
B7	Removal of marine vegetation and habitat	Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).	Contractor	Detailed design	Effective	Permanent loss of habitat from the removal of existing structures. However, similar habitat would be reinstated with the installation of new structures.
B8	Removal of marine vegetation and habitat	Minimise anchoring where possible and avoid anchoring on subtidal rocky reef habitat.	Contractor	Construction	Effective	
B9	Removal of marine vegetation and habitat	Complete a targeted survey for Black Rockcod and White's Seahorse within 24 hours prior to the commencement of water-based construction activities. Black Rockcod individuals will be encouraged to move away from the study area and White's Seahorse will be captured and relocated to nearby similar habitat. A White's Seahorse relocation plan will be developed in consultation with NSW DPI (Fisheries) to dictate this activity.	TfNSW	Pre-construction	Effective	
B10	Removal of marine vegetation and habitat	A Section 37 permit under the FM Act to relocate Syngnathids collected during the targeted pre-clearance survey will be required as part of the White's Seahorse relocation.	TfNSW	Pre-construction	Effective	
B11	Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and guidelines for fish habitat</i>	Contractor	Construction	Effective	Potential localised sediment mobilisation.

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
		<i>conservation and management Update 2013 (NSW DPI, 2013).</i>				
LS8	Aquatic impacts	<p>Prior to commencement of construction activities, sediment control device (such as sediment boom and curtain) will be installed around the construction footprint to contain disturbed sediment from water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will extend from a minimum of 100 millimetres above the water line to a minimum of 2.5 metres below the water line before starting work.</p> <p>Installation should be undertaken during high tide periods from a boat. The device should be designed to rise and fall with the tide to prevent disturbance. Inspection of the device should be undertaken on a daily basis after ebbing tides, with additional inspection be carried following storm events. Monitoring of turbidity inside and outside of the device should also be performed, using a portable turbidity meter/logger. Prior to removing the sediment control device, conditions within the curtain will be assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.</p>	Contractor	Construction	Effective	Potential localised sediment mobilisation.
LS11	Aquatic impacts	Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts.	Contractor	Construction	Effective	None
WQ1	Aquatic impacts	<ul style="list-style-type: none"> <li>A spill management plan will be developed and communicated to all staff working on site.</li> </ul>	Contractor	Construction	Effective	None

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
		<ul style="list-style-type: none"> <li>Appropriate land and aquatic spill kits are to be maintained on site and on barges. Aquatic spill kits must be specific for working within the marine environment. The spill kit must be appropriately sized for the volume of substances at the work site.</li> <li>All workers will be advised of the location of the spill kit and trained in its use.</li> </ul>				
B12	Aquatic impacts	Piling to stop if marine mammals are observed within 100 metres of the project area and only to recommence once they have moved beyond 100 metres of the project site or are not seen for at least 20 minutes.	Contractor	Construction	Effective	None
B13	Changes to coastal processes	The detailed design will aim to avoid/minimise any impact to coastal processes and hydrology.	TfNSW	Detailed design	Effective	Potential localised changes to currents.
B14	Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction	Effective	None
B15	Invasion and spread of weeds, pests and diseases	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction	Effective	None
B16	Invasion and spread of weeds, pests and diseases	Marine pest species will be managed within the project site.	Contractor	Construction	Effective	None

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
B17	Invasion and spread of weeds, pests and diseases	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011).	Contractor	Construction	Effective	None
B18	Invasion and spread of weeds, pests and diseases	Water-based equipment and vessels to be sourced from local suppliers. Equipment and vessels must be cleaned and inspected prior to entering the project site.	Contractor	Construction	Effective	None
B19	Invasion and spread of weeds, pests and diseases	Occurrence of any marine pests must be reported to NSW DPI (Fisheries).	Contractor	Construction	Effective	None
B20	Noise, light and vibration	Shading and artificial light impacts will be minimised through detailed design.	TfNSW	Detailed design	Effective	None

## 6 Offset strategy

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The proposal is not expected to clear any remnant native vegetation (or PCTs) and would only clear up to 0.04 hectares of native/exotic gardens. Offsets are not required for the clearing of this vegetation.

The proposal is expected to impact less than 0.01 hectares of marine vegetation on intertidal and subtidal rocky reefs as well as about 0.01 hectares of vertically colonised marine vegetation on the existing wharf structures to be removed (Table 4-1). About 0.02 hectares of submerged surface area would be available for recolonisation of marine vegetation and other habitat-forming species as part of the new wharf to replace the areas removed during construction. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).

## 7 Conclusion

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The proposal forms part of the Ferry Wharf Upgrade Program and the TAP and is focused on the upgrade of the South Mosman wharf interchange. This includes a number of land and water-based activities and a new location for the new wharf and removal of the existing wharf.

A biodiversity assessment was completed to describe the existing coastal and marine environment within the study area and to assess impacts to coastal and marine biodiversity as a result of the construction and operation of the proposal. The biodiversity assessment was informed by a review of existing information and data in the study area and the wider study locality, as well as a field survey of the study area.

The study area is located in Great Sirius Cove, an embayment on the northern foreshores of Sydney Harbour. The terrestrial portion of the study area is on reclaimed land while the marine portion was comprised of a vertical sandstone seawall bound by a corridor of intertidal and subtidal rocky reef and soft sediment habitat in the deeper areas. There was no remnant native vegetation in the study area but rather a landscape park and a garden area with native and exotic plantings. There were no mangroves, saltmarsh or seagrass in or next to the study area however, a mosaic of macroalgae and habitat-forming species colonise the intertidal and subtidal rocky reef (Type 2 KFH) and debris in the soft sediment habitats (Type 3 KFH).

The vegetation and habitat in the study area provides potential habitat for a number of urban, disturbance tolerant native species. Vegetation and habitat in the study area forms potential habitat for eight terrestrial and two marine threatened fauna species:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act
- Black Rockcod (*Epinephelus daemeli*) listed as endangered under the FM Act and vulnerable under the EPBC Act
  - Seven microchiropteran bats (microbats):
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
  - Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
  - Little Bent-winged Bat (*Miniopterus australis*)
  - Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
  - Southern Myotis (*Myotis macropus*)
  - Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

The proposal would include the removal of up to 0.04 hectares of native/exotic garden vegetation. The removal of habitat resources is unlikely to have a substantial impact on native fauna as there is an abundance of similar habitat across the study locality and up to 0.03 hectares would be restored with native vegetation local to the Sydney region.

The risks of the spread/introduction of weeds and diseases and the potential for erosion and sediment mobilisation associated with vegetation clearing and construction activities would be managed during construction in accordance with the relevant TfNSW guidelines.

With respect to water-based impacts, six piles (two at 467 millimetres in diameter and four at 760 millimetres in diameter) would be driven into subtidal soft sediment habitat. The area of soft sediment habitat (Type 3 KFH) under the footprint of the piles would be permanently lost while the anchor areas for the barge during construction would be temporarily impacted. This would include the direct removal of epifauna and infauna from soft sediment habitats. However, soft sediment habitats in the study area are characteristic of the majority of subtidal

habitat in the harbour and community assemblages are generally ubiquitous and quick to recolonise following disturbance.

Removal of the existing wharf structure and piles would result in the removal of about 0.01 hectares of marine vegetation, habitat and sessile/less mobile fauna on the piles and pontoon. These species are common in subtidal rocky reefs and would quickly colonise the piles of the new wharf and pontoon (0.02 hectares of available space) provided suitable materials are used for the new structures. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).

There is potential for fragments of the existing seawall to dislodge during the installation of the land-based jetty piles. An area of <0.01 hectares of the rocky reef platform and the vertical rocky reef has potential to be crushed or dislodged. If this were to happen, the seawall would be remediated to a similar or better condition and habitat-forming species are likely to recolonise these areas following construction completion.

The new wharf structures would also shade less than 0.01 hectares of intertidal and subtidal rocky reef habitat and about 0.04 hectares of soft sediment habitat and some vertical intertidal rocky reef habitat. This impact area is a very small proportion of subtidal rocky reef habitat in the study area and the wider harbour and areas where existing structures would be removed would no longer be shaded thus, is not considered ecologically significant.

Under Section 199 of the FM Act, consultation with NSW DPI (Fisheries) is required for any dredging and reclamation works. 'Dredging' under the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013) is classified as disturbance of the seabed/streambed. In this case, this refers to removal of structures and piling. Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required. However, through consultation with NSW DPI (Fisheries) (dated 16 November 2020), this is not required for the piling and pile removal works associated with this project.

Sediment mobilisation and vessel wash and scour were also identified as likely proposal impacts. However, the study area is likely to be frequently exposed to elevated levels of sediment, associated with rainfall and sea conditions, and vessel traffic in Great Sirius Cove.

The proposal is unlikely to significantly impact threatened species and disturbances to potential habitat would largely be temporary and constitute a very small proportion of available habitat. The proposal would not fragment or isolate threatened species populations or substantially impact any species' lifecycle. Additional controls could be implemented to survey for the Black Rockcod and White's Seahorse prior to the commencement of water-based activities so that individuals in the area at the start of construction are not harmed. Species impact statements (SISs) or referrals were not considered to be required for the proposal.

Considering the above, the proposal is unlikely to significantly impact coastal and marine biodiversity.

## 8 References

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# Annexure A

## Species recorded

## Recorded flora

Family	Scientific name	Common name	Native/exotic	Priority weed
Acanthaceae	<i>Justicia carnea</i>	Brazilian Plume Flower	Exotic	-
Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	Exotic	-
	<i>Plumeria alba</i>	Frangipani	Exotic	-
Araceae	<i>Monstera deliciosa</i>	Fruit Salad Plant	Exotic	-
Araucariaceae	<i>Araucaria heterophylla</i>	Norfolk Island Pine	Native/endemic to Norfolk Island	-
Arecaceae	<i>Phoenix canariensis</i>	Canary Island Date Palm	Exotic	-
Asparagaceae	<i>Asparagus aethiopicus</i>	Ground Asparagus	Exotic	✓
Asteraceae	<i>Ageratina adenophora</i>	Crofton Weed	Exotic	-
	<i>Bidens pilosa</i>	Cobbler's Pegs	Exotic	-
	<i>Conyza sp.</i>	Fleabane	Exotic	-
	<i>Euryops chrysanthemoides</i>	-	Exotic	-
	<i>Senecio madagascariensis</i>	Fireweed	Exotic	✓
Basellaceae	<i>Anredera cordifolia</i>	Madeira Vine	Exotic	✓
Bignoniaceae	<i>Jacaranda mimosifolia</i>	Jacaranda	Exotic	-
Cannabaceae	<i>Celtis sinensis</i>	Japanese Hackberry	Exotic	-
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak	Native	-
Commelinaceae	<i>Tradescantia fluminensis</i>	Trad	Exotic	-

Family	Scientific name	Common name	Native/exotic	Priority weed
Cyperaceae	<i>Carex sp.</i>	-	Native	-
Dilleniaceae	<i>Hibbertia scandens</i>	Climbing Guinea Flower	Native	-
Elaeocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	Native	-
Fabaceae	<i>Acacia decurrens</i>	Sydney Green Wattle	Native	-
	<i>Acacia elata</i>	Cedar Wattle	Native	-
	<i>Acacia longifolia subsp. sophorae</i>	Coastal Wattle	Native	-
	<i>Senna pendula</i>	-	Exotic	-
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Native	-
Lomariopsidaceae	<i>Nephrolepis cordifolia</i>	Fishbone Fern	Native from north of the Clarence River	-
Malvaceae	<i>Abutilon grandifolium</i>	-	Exotic	-
	<i>Brachychiton acerifolius</i>	Flame Tree	Native	-
	<i>Hibiscus spp.</i>	-	Ornamental	-
	<i>Malva parviflora</i>	Small-flowered Mallow	Exotic	-
Moraceae	<i>Ficus pumila</i>	Creeping Fig	Exotic	-
	<i>Ficus macrophylla</i>	Moreton Bay Fig	Native	-
	<i>Ficus virens</i>	White Fig	Native	-
Myrtaceae	<i>Angophora costata</i>	Smooth-barked Apple	Native	-

Family	Scientific name	Common name	Native/exotic	Priority weed
	<i>Callistemon viminalis</i>	Weeping Bottlebrush	Native from north of Gloucester area	-
	<i>Eucalyptus botryoides</i>	Bangalay	Native	-
	<i>Eucalyptus saligna</i>	Sydney Blue Gum	Native	-
	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree	Native	-
	<i>Syzygium australe</i>	Brush Cherry	Native	-
Oleaceae	<i>Olea sp.</i>	Olive	Exotic	-
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum	Native	-
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongue	Exotic	-
Poaceae	<i>Cynodon dactylon</i>	Couch	Native	-
	<i>Ehrharta erecta</i>	Panic Veldtgrass	Exotic	-
	<i>Stenotaphrum secundatum</i>	Sir Walter Buffalo	Exotic	-
Polygonaceae	<i>Acetosa sagittata</i>	Turkey Rhubarb	Exotic	-
Proteaceae	<i>Banksia integrifolia</i>	Coast Banksia	Native	-
	<i>Grevillea robusta</i>	Silky Oak	Native from north of Coffs Harbour	-
Rosaceae	<i>Cotoneaster glaucophyllus</i>	Cotoneaster	Exotic	-
Rutaceae	<i>Murraya paniculata</i>	Murraya	Exotic	-
Solanaceae	<i>Solanum nigrum</i>	Blackberry Nightshade	Exotic	-
Strelitziaceae	<i>Ravenala madagascariensis</i>	Traveller's Palm	Exotic	-

Family	Scientific name	Common name	Native/exotic	Priority weed
Urticaceae	<i>Parietaria judaica</i>	Asthma Weed	Exotic	-
Verbenaceae	<i>Lantana camara</i>	Lantana	Exotic	✓

#### Recorded fauna

Family	Scientific name	Common name	Native/exotic
Apogonidae	<i>Ostorhinchus fasciatus</i>	Striped Cardinalfish	Native
Atherinidae	<i>Atherinomorus vaigiensis</i>	Common Hardyhead	Native
Girellidae	<i>Girella tricuspidata</i>	Luderick	Native
Kyphosidae	<i>Scorpiis lineolate</i>	Silver Sweep	Native
Labridae	<i>Pseudolabrus guentheri</i>	Gunther's Wrasse	Native
Laridae	<i>Chroicocephalus novaehollandiae</i>	Silver Gull	Native
Latridae	<i>Morwong fuscus</i>	Red Morwong	Native
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	Native
Monacanthidae	<i>Scobinichthys granulatus</i>	Rough Leatherjacket	Native
Mullidae	<i>Upeneichthys vlamingii</i>	Blue-spotted Goatfish	Native
Ostreidae	<i>Saccostrea glomerata</i>	Sydney Rock Oyster	Native
Plesiopidae	<i>Trachinops taeniatus</i>	Eastern Hulafish	Native
Sparidae	<i>Acanthopagrus australis</i>	Yellowfin Bream	Native
Sturnidae	<i>Acridotheres tristis</i>	Common Myna	Exotic

# Annexure B

## Habitat assessment table

## Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (5 kilometre) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (5 kilometre). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.

### Threatened species habitat assessment table

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Amphibians						
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 metres from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by <i>Typha</i> spp. and other aquatics, free from predatory fish.	(PMST)	None. No suitable habitat within the study area.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	(PMST)	None. No suitable habitat within the study area.
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-	It has restricted distribution from Pokolbin to Nowra and west to Mt Victoria. Occurs in open forests and wet drainage lines below sandstone ridges that often have shale lenses or cappings in the Hawkesbury and Narrabeen Sandstones.	45 (BioNet)	None. No suitable habitat within the Study area.
Flora						

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Acacia bynoeana</i>	Bynoe's Tiny Wattle	E	V	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood ( <i>Corymbia gummifera</i> ), Scribbly Gum ( <i>Eucalyptus haemastoma</i> ), Drooping Red Gum ( <i>E. parramattensis</i> ), Old Man Banksia ( <i>Banksia serrata</i> ) and Small-leaved Apple ( <i>Angophora bakeri</i> ).	(PMST)	None. No suitable habitat within the study area.
<i>Acacia pubescens</i>	Downy Wattle	V	V	Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravelly soils, often with ironstone.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Acacia terminalis</i> <i>subsp. terminalis</i>	Sunshine Wattle	E	E	Very limited distribution between Botany Bay to the northern foreshore of Port Jackson. Recent collections have only been made from the Quarantine Station, Clifton Gardens, Dover Heights, Parsely Bay, Nielson Park, Cooper Park, Chifley and Watsons Bays. Coastal scrub and dry sclerophyll woodland on sandy soils. Habitat is generally sparse and scattered. Most areas of habitat or potential habitat are small and isolated.	106 (BioNet) (PMST)	None. No suitable habitat within the study area.
<i>Allocasuarina glareicola</i>	-	E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Found in open woodland with <i>Eucalyptus parramattensis</i> , <i>Eucalyptus fibrosa</i> , <i>Angophora bakeri</i> , <i>Eucalyptus sclerophylla</i> and <i>Melaleuca decora</i> . Common associated understorey species include <i>Melaleuca nodosa</i> , <i>Hakea dactyloides</i> , <i>Hakea sericea</i> , <i>Dillwynia tenuifolia</i> , <i>Micromyrtus minutiflora</i> , <i>Acacia elongata</i> , <i>Acacia brownei</i> , <i>Themeda australis</i> and <i>Xanthorrhoea minor</i> .	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	E	E	The original known habitat of the Neilsen Park She-oak is at Nielsen Park, in Woollahra local government area. There are no plants left at the original site where it was discovered. However, propagation material has been planted successfully at a number of locations at Nielsen Park and other locations in the local area, e.g. Gap Bluff, Hermit Point and Vacluse House. The original habitat is tall closed woodland. Canopy species include: <i>Ficus rubiginosa</i> , <i>Angophora costata</i> , <i>Elaeocarpus reticulatus</i> and <i>Glochidion ferdinandi</i> with a shrub layer of <i>Pittosporum revolutum</i> , <i>Kunzea ambigua</i> and <i>Monotoca elliptica</i> . The original habitat occurs above a sandstone shelf approximately 20 metres above the harbour. The shallow sandy soils are highly siliceous, coarsely textured and devoid of a soil profile. The plantings have occurred on similar soils.	49 (BioNet) (PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Asterolasia elegans</i>	-	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine ( <i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i> ), Smooth-barked Apple ( <i>Angophora costata</i> ), Sydney Peppermint ( <i>Eucalyptus piperita</i> ), Forest Oak ( <i>Allocasuarina torulosa</i> ) and Christmas Bush ( <i>Ceratopetalum gummiferum</i> ).	(PMST)	None. No suitable habitat within the study area.
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	E	V	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Callistemon linearifolius</i>	Netted Bottlebrush	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Was more widespread across its distribution in the past. Some populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park and Werakata National Park. Grows in dry sclerophyll forest on the coast and adjacent ranges.	2 (BioNet)	None. No suitable habitat within the study area.
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. The larger populations typically occur in woodland dominated by Scribbly Gum ( <i>Eucalyptus sclerophylla</i> ), Silvertop Ash ( <i>E. sieberi</i> ), Red Bloodwood ( <i>Corymbia gummifera</i> ) and Black Sheoak ( <i>Allocasuarina littoralis</i> ); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid ( <i>C. subulata</i> ) and the Tartan Tongue Orchid ( <i>C. erecta</i> ).	(PMST)	None. No suitable habitat within the study area.
<i>Doryanthes palmeri</i>	Giant Spear Lily	V	-	Hardy, low maintenance monocot endemic to north east New South Wales and south east Queensland. It is listed as vulnerable due to the fact that it occurs in so few regions of Australia.	1 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Darwinia biflora</i>	-	V	V	Occurs at 129 sites in the northern and north-western suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai local government areas. Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury sandstone. Associated overstorey species include <i>Eucalyptus haemastoma</i> , <i>Corymbia gummifera</i> and/or <i>E. squamosa</i> . The vegetation structure is usually woodland, open forest or scrub-heath.	(PMST)	None. No suitable habitat within the study area.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	-	V	-	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence.	5 (BioNet)	None. No suitable habitat within the study area.
<i>Eucalyptus camfieldii</i>	Camfields Stringybark	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of Narrow-leaved Stringybark ( <i>Eucalyptus oblonga</i> ), Brown Stringybark ( <i>E. capitellata</i> ) and Scribbly Gum ( <i>E. haemastoma</i> ).	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	This species is sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield, being most common in central portions of its range. Found largely on private property and roadsides, and occasionally conservation reserves. Planted as urban trees, windbreaks and corridors. Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or meta-sedimentary rock.	1 (Bionet)	None. No suitable habitat within the study area.
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	E	E	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Hygrocybe reesiae</i>	-	V		<i>Hygrocybe reesiae</i> is a mushroom of the waxcap genus <i>Hygrocybe</i> . It is pink or lilac in colour, and generally grows in moist, shady conditions. A rare species, it is only found near Sydney and Tasmania.	1 (Bionet)	None. No suitable habitat within the study area.
<i>Melaleuca biconvexa</i>	Biconvexa Paperbark	V	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	(PMST)	None. No suitable habitat within the study area.
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	(PMST)	None. No suitable habitat within the study area.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	The Hairy Geebung has been recorded in the Sydney coastal area, the Blue Mountains area and the Southern Highlands. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Pimelea curviflora</i> - <i>var. curviflora</i>		V	V	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	(PMST)	None. No suitable habitat within the study area.
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	Broad distribution in western Sydney, occurring on the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas). Another smaller population is recorded in districts (Landsdowne to Shellharbour to northern Kiama) Illawarra. It grows on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coastal Banksia open woodland with a more well developed shrub and grass understorey.	(PMST)	None. No suitable habitat within the study area.
<i>Prostanthera junonis</i>	Somersby Mintbush	E	E	Has a north-south range of approximately 19 kilometres on the Somersby Plateau in the Gosford and Wyong local government areas. The species is restricted to the Somersby Plateau. It occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub. It occurs in both disturbed and undisturbed sites.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	-	Shrub or small tree to 25 metres high occurring in coastal districts north from Batemans Bay in New South Wales approximately 280 kilometres south of Sydney, to areas inland of Bundaberg in Queensland. Populations typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 metres asl with rainfall of 1,000-1,600 mm. Commonly occurs in all rainforest subforms except cool temperate rainforest.	1 (Bionet)	None. No suitable habitat within the study area.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	70 (Bionet) (PMST)	None. No suitable habitat within the study area.
<i>Thesium australe</i>	Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass ( <i>Themeda australis</i> ).	(PMST)	None. No suitable habitat within the study area.

## Invertebrates

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Synemon plana</i>	Golden Sun Moth	E	CE	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by Wallaby Grasses ( <i>Austrodanthonia</i> spp.). Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly Spear-grasses ( <i>Austrostipa</i> spp.) or Kangaroo Grass ( <i>Themeda australis</i> ).	(PMST)	None. No suitable habitat within the study area.

## Birds

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	Temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature Eucalypts and Sheoaks.	(PMST)	Low. No records in the study locality. Presence of associated overstorey species considered to be in suboptimal environment.
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	V	M, Ma	Ranges throughout the Pacific and Indian Oceans. There are two main breeding areas in the world: one in the South West Pacific includes Lord Howe Island and New Zealand; the other along the coast of Western Australia. Nest on LHI on sandy soils from Ned's Beach to Clear Place, with smaller colonies below Transit Hill and at Old Settlement Beach. Eggs are laid at the end of a burrow 1-2 metres in length.	(PMST)	Low. Has potential to fly through and forage in the study area however, available habitat is suboptimal and widespread.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.	1 (BioNet) (PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	Occurs in open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	1 (BioNet)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Calidris canutus</i>	Red Knot	-	E, Mi, Ma	Common in all the main suitable habitats around the coast of Australia. Mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	CE, Mi, Ma	The breeding range of the Curlew Sandpiper is mainly restricted to the Arctic of northern Siberia, including Yamal Peninsula east to Kolyuchiskaya Gulf, Chokotka Peninsula, and also New Siberian Island. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Calidris tenuirostris</i>	Great Knot	V	CE, Mi, Ma	In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November.	(PMST)	Low.  Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	1 (BioNet)	None.  No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Calyptorhynchus lathamii</i>	Glossy Black Cockatoo	V	-	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak ( <i>Allocasuarina littoralis</i> ) and Forest Sheoak ( <i>A. torulosa</i> ) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, <i>Allocasuarina diminuta</i> and <i>A. gymnathera</i> . Belah ( <i>Casuarina cristata</i> ) is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah.	2 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Charadrius leschenaultii</i>	Greater Sand Plover	V	V, Mi, Ma	In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly while it is common on the west coast. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Charadrius mongolus</i>	Lesser Sand Plover	V	E, Mi, Ma	In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.	(PMST)	Low.  Prefers specific habitat that is available in the study area but is suboptimal in condition and size.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	1 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground Nature Reserve, Budderoo Nature Reserve, Woronora Plateau, Jervis Bay National Park, Booderee National Park and Beecroft Peninsula and Southern - Nadgee Nature Reserve and Croajingalong National Park in the vicinity of the NSW/Victorian border. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	(PMST)	None. No suitable habitat within the study area.
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples ( <i>Angophora</i> spp.), paperbarks ( <i>Melaleuca</i> spp.) and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.	6 (BioNet)	Low. Potential foraging habitat present in the study area albeit highly disturbed and widely available.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Grantiella picta</i>	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	(PMST)	None. No suitable habitat within the study area.
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V	-	Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels.	2 (BioNet)	Low. Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	Ma	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea).	34 (BioNet) (PMST)	Low. May fly through and forage in study area however, study area habitat is widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	The Little Eagle is found throughout the Australian mainland except in the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open Eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	2 (BioNet)	None. No suitable habitat within the study area
<i>Hirundapus caudacutus</i>	White-throated Needletail		V, Mi, Ma	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 metres up to more than 1000 metres above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	(PMST)	Low. May fly through and forage in study area however, study area habitat is widely distributed and suboptimal.
<i>Ixobrychus flavicollis</i>	Black Bittern	V	-	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.	2 (BioNet)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Lathamus discolor</i>	Swift Parrot	E	CE, Ma	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ), Red Bloodwood ( <i>C. gummifera</i> ), Red Ironbark ( <i>E. sideroxylon</i> ), and White Box ( <i>E. albens</i> ).	4 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Individuals appear to occupy large hunting ranges of more than 100 km <sup>2</sup> . They require large living trees for breeding, particularly near water with surrounding woodland/forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	1 (BioNet)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Limosa lapponica baueri</i>	Bar-tailed Godwit	-	V	<p>The Bar-tailed Godwit is a migratory wader which undertakes the largest non-stop flight of any bird. The trans-Pacific route from its breeding grounds in the Arctic to its non-breeding grounds in the southern hemisphere covers over 11,000 kilometre. Birds arrive in New South Wales between August and October and then leave between February and April, with a small number of individuals overwintering. The subspecies is most frequently recorded along major coastal river estuaries and sheltered embayments, particularly the Tweed, Richmond, Clarence, Macleay, Hastings, Hunter and Shoalhaven river estuaries, Port Stephens and Botany Bay. It is a rare visitor to wetlands away from the coast with scattered records as far west as along the Darling River and the Riverina.</p> <p>It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms. It often occurs around beds of seagrass, and sometimes in nearby saltmarsh or the outer margins of mangrove areas. It forages at low to mid tide in shallow water or along the water's edge on sandy substrates on intertidal flats, banks and beaches or on soft mud substrates.</p>	(PMST)	<p>Low.</p> <p>Prefers specific habitat not in the study area however, it may fly through.</p>

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Limosa lapponica menzbieri</i>	Northern Siberian Bar-tailed Godwit	-	CE	The Bar-tailed Godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. Occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats	(PMST)	Low. Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Limosa</i>	Black-tailed Godwit	V	Mi, Ma	A migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently found at Kooragang Island (Hunter River estuary). Occurs in sheltered bays, estuaries and lagoons with large intertidal mudflats and sand flats. Also found at inland mudflats, swamps.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Macronectes halli</i>	Northern Giant Petrel	V	V, Mi, Ma	The Northern Giant-Petrel has a circumpolar pelagic distribution, usually between 40-64°S in open oceans. Their range extends into subtropical waters (to 28°S) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer. Adults usually remain near the breeding colonies throughout the year (though some do travel widely) while immature birds make long and poorly known circumpolar and trans-oceanic movements. Hence most birds recorded in NSW coastal waters are immature birds. Northern Giant-Petrels seldom breed in colonies but rather as dispersed pairs, often amidst tussocks in dense vegetation and areas of broken terrain.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Ninox connivens</i>	Barking Owl	V	-	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	3 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Ninox strenua</i>	Powerful Owl	V	-	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine ( <i>Syncarpia glomulifera</i> ), Black Sheoak ( <i>Allocasuarina littoralis</i> ), Blackwood ( <i>Acacia melanoxylon</i> ), Rough-barked Apple ( <i>Angophora floribunda</i> ), Cherry Ballart ( <i>Exocarpus cupressiformis</i> ) and a number of Eucalypt species.	196 (BioNet)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Numerius madagascariensis</i>	Eastern Curlew	-	CE, Mi, Ma	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Onychoprion fuscata</i>	Sooty Tern	V	Ma	The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW only known to breed at Lord Howe Island. Occasionally seen along coastal NSW, especially after cyclones. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	1 (BioNet)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Pachyptila turtur subantarctica</i>	Fairy Prion (Southern)	-	V	The southern subspecies (subantarctica) of the Fairy Prion was first recorded on Macquarie Island in 1956, with breeding confirmed in 1978. Breeding has also been recorded on two offshore rock stacks at Macquarie Island, one near Langdon Point, the other near Davis Point. A second sub-population was found on Bishop and Clerk Islands in 1993. The species as a whole has been recorded breeding on subantarctic and cool temperate islands. The southern subspecies of the Fairy Prion is a marine bird, found mostly in temperate and subantarctic seas. The species' oceanic distribution is poorly known. The Fairy Prion sometimes forages over continental shelves and the continental slope, but it can come close inshore in rough weather. It may also feed in deep coastal waters. Off Wollongong, NSW, 79% of Fairy Prions were seen in waters over the continental slope while 21% were counted over neritic water (water more than 200 metres deep). Data from the south-eastern Australian Seabird Atlas confirm this pattern, with 83% (of 24 505 individuals) seen over the continental slope, 9% over continental shelf and only 8% over open ocean. The southern Fairy Prion is found flying over the ocean where sea surface temperatures are 8.6° to 20.2 °C.	(PMST)	Low.  Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Pandion cristatus</i>	Eastern Osprey	V	Mi, Ma	Total range of this species is from Esperance in Western Australia to NSW and into Victoria and Tasmania. In some states (Victoria and Tasmania and southern NSW) the species is a rare vagrant. The only single historical breeding record in NSW is from the St. Georges Basin. Occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Mostly found in coastal areas but occasionally travel inland along major rivers.	1 (BioNet) (PMST)	Low. May fly through and forage in study area however, study area habitat is widely distributed.
<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	V	E, Ma	Breeds on both Cabbage Tree Island, 1.4 kilometres offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding petrels are unknown. The first arrival of Gould's petrel on cabbage tree Island occurs from mid to late September. Principal nesting habitat is located within two gullies which are characterised by steeply, sloping rock scree with a canopy of Cabbage Tree Palms. They nest predominantly in natural rock crevices among the rock scree and also in hollow fallen palm trunks, under mats of fallen palm fronds and in cavities among the buttresses of fig trees. Seizes prey (squid and fish) from the sea surface.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Pterodroma neglecta neglecta</i>	Kermadec Petrel	V	V, Ma	Ranges over subtropical and tropical waters of the South Pacific. Balls Pyramid (near Lord Howe Island) and Phillip Island (near Norfolk Island) are the only known breeding sites in Australian waters. Breeds on islands across the South Pacific. In Australia it breeds on Ball's Pyramid and Phillip Island (near Norfolk Island). Nests in a crevice amongst rocks. Feeds on squid, fish, crustaceans by skimming and diving into the sea surface.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Ptilinopus superbus</i>	Superb Fruit-dove	V	Ma	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	5 (BioNet)	None. No suitable habitat within the study area.
<i>Rostratula australis</i>	Australian Painted Snipe	E	E, Ma	Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Sternula albifrons</i>	Little Tern	E	Mi, Ma	Migrates from eastern Asia, this species is found along the north, east and south-east Australian coasts. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire coast from Tasmania to northern Queensland. This species is almost exclusively coastal, preferring sheltered environments.	1 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Sternula nereis</i>	Australian Fairy Tern	-	V	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there. The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night. Predates small bait-sized fish via shallow dives in shallow water.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Thalassarche bulleri</i>	Buller's Albatross	-	V, Ma, Mi	Buller's Albatross breed in New Zealand (Snares, Solander and Chatham Islands), but are regular visitors to Australian waters. They are frequently seen off the coast from Coffs Harbour, south to Tasmania and west to Eyre Peninsula. In Australia, Buller's Albatross are seen over inshore, offshore and pelagic waters. They appear to congregate over currents where water temperature exceeds 16 °C. Feeds mostly on squid, fish, krill and tunicates via surface seizing.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Thalassarche bulleri platei</i>	Northern Buller's Albatross	-	V, M, Ma	The Pacific Albatross is a non-breeding visitor to Australian waters. Foraging birds are mostly limited to the Pacific Ocean and the Tasman Sea, although birds do reach the east coast of the Australian mainland. Occurrence within the Australian Fishing Zone is likely, however, the threat from longline injury is considered low. The Pacific Albatross is a marine, pelagic species. It occurs in subtropical and subantarctic waters of the South Pacific Ocean. Habitat preferences are poorly known. In New Zealand, the species has been observed in association with fishing boats close inshore and over waters of 180–360 metres depth although it is not so strongly associated with fishing grounds as are other albatrosses.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Thalassarche cauta cauta</i>	Shy Albatross	V	V, Ma, Mi	<p>This species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat. In Australian waters, the Shy Albatross occurs along the east coast from Stradbroke Island in Queensland along the entire south coast of the continent to Carnarvon in Western Australia. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park. This pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea. Occasionally the species occurs in continental shelf waters, in bays and harbours. Known breeding locations include Albatross Island off Tasmania, Auckland Island, Bounty Island and The Snares, off New Zealand, where nesting colonies of 6-500 nests occur and may contain other species such as the Australian Gannet. Located on sheltered sides of islands, on cliffs and ledges, in crevices and slopes, nests are used annually and consist of a mound of mud, bones, plant matter and rocks.</p>	(PMST)	<p>Low.</p> <p>Some foraging habitat present in the study area however, is suboptimal and widely distributed.</p>

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Thalassarche melanophris</i>	Black-browed Albatross	V	V, Ma, Mi	The Black-browed Albatross has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. This species migrates to waters off the continental shelf from approximately May to November and is regularly recorded off the NSW coast during this period. The species has also been recorded in Botany Bay National Park. Inhabits Antarctic, subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents. Can tolerate water temperatures between 0 °C and 24 °C. Spends most of its time at sea, breeding on small isolated islands.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Thalassarche salvini</i>	Salvin's Albatross	-	V, Ma, Mi	Salvin's Albatross breeds on Bounty, Snares and Chatham Islands, south of New Zealand, as well as on Crozet Island in the Indian Ocean. The species forages over most of the southern Pacific Ocean, where it is particularly common in the Humboldt Current, off South America. There are small numbers in the Indian Ocean and sometimes in the South Atlantic Ocean. During the non-breeding season, the species occurs over continental shelves around continents. It occurs both inshore and offshore and enters harbours and bays. Salvin's Albatross is scarce in pelagic waters. Feeds primarily in shelf waters and takes prey from surface or just below, it has been seen diving up to 2 metres.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Thinornis rubricollis rubricollus</i>	Hooded Plover	CE	V, Ma	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay, NSW, south through Victoria and Tasmania to the western side of the Eyre Peninsula (South Australia). In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beachcast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.	(PMST)	Low. Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry Eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	1 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist Eucalypt forests.	1 (BioNet)	None. No suitable habitat within the study area.
<b>Fish and Syngnathids</b>						
<i>Hippocampus whitei</i>	White's Seahorse	E (FM Act)	Ma (nominated for endangered listing)	Endemic temperate Australian species found only between Forster and Wollongong, NSW. White's seahorse inhabits shallow inshore areas in estuaries, harbours and bays, where it lives on rocky reefs, sponges, seagrass beds, and under piers and jetties to 25 m.	(DPI) (PMST)	High. Sedentary populations known in the harbour in similar habitats.
<i>Epinephelus daemeli</i>	Black Rockcod	E (FM Act)	V	In Australia, the distribution of black cod ranges from southern Queensland through NSW to northern Victoria. However, records from Queensland and Victoria are rare, and the NSW coastline forms the species' main range, both in Australia and internationally. Adults are usually found in caves, gutters and beneath bommies on rocky reefs from nearshore areas to at least 50 metres depth. Small juveniles are often recorded in coastal rock pools while larger juveniles are found around rocky shores in estuaries. The use of estuaries may be an important part of the ecology of juvenile black cod in NSW waters. The black cod is territorial and often have a high site fidelity.	(DPI) (PMST)	High. Known to occur in the harbour and suitable resident habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Prototroctes maraena</i>	Eastern Grayling	E (FM Act)	V	The Australian grayling occurs in rivers and streams on the eastern and southern flanks of the Great Dividing Range but is diadromous. During the freshwater phase of the life cycle, this species inhabits lower altitude reaches of both large rivers and smaller streams spawning in the tidal freshwater reaches of rivers, presumably among a gravel streambed. Very little is known of the Australian grayling's specific habitat requirements during the estuarine or marine phase of the life cycle.	(DPI) (PMST)	Low. May occur in the study area during the marine phase of life-cycle albeit at the end of its range and habitat is widespread.
<i>Mammals</i>						
<i>Arctocephalus forsteri</i>	New Zealand Fur Seal	V	Ma	Occurs in Australia and New Zealand. Reports of non-breeding animals along southern NSW coast particularly on Montague Island, but also at other isolated locations to north of Sydney. Prefers rocky parts of islands with jumbled terrain and boulders.	4 (BioNet)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Arctocephalus pusillus</i>	Australian Fur Seal	V	Ma	Reported to breed at Seal Rocks, near Port Stephens and Montague Island in southern NSW. Haul outs are observed at isolated places along the NSW coast. Prefers rocky parts of islands with flat, open terrain. They occupy flatter areas than do New Zealand fur-seals where they occur together. The Australian fur-seal prefers to utilise oceanic waters of the continental shelf for foraging and generally does not dive deeper than 150 m.	3 (BioNet)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	V	-	Found in a broad range of habitats from rainforest through to wet and dry sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred.	1 (BioNet)	None. No suitable habitat within the study area.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	1 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Dasyurus maculatus maculatus</i>	Spotted-tail Quoll	V	E	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	1 (BioNet) (PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Eubalaena australis</i>	Southern Right Whale	E	E, Mi	This species occurs in temperate and subpolar waters of the Southern Hemisphere, with a circumpolar distribution between about 20° S and 55° S with some records further south to 63° S. The Southern Right Whale migrates between summer feeding grounds in Antarctica and winter breeding grounds around the coasts of southern Australia, New Zealand, South Africa and South America. This species feed in the open oceans in summer and move inshore in winter for calving and mating with calving females usually remaining very close to the coast. The Southern Right Whale is not believed to feed in Australian waters at all. The Southern Right Whale is constrained in their ability to colonise unused areas of potentially suitable habitat due to a high degree of site fidelity (individuals returning to the same breeding site each year).	2 (BioNet) (PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	1 (BioNet)	Moderate. Potential roosting habitat is present in the study area albeit widespread.
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern/south eastern)	E	E	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	(PMST)	None. No suitable habitat within the study area.

<i>Megaptera novaeangliae</i>	Humpback Whale	V	V, Mi	Occurs in oceanic and coastal waters worldwide. The population of Australia's east coast migrates from summer, cold-water feeding grounds in Subantarctic waters to warm-water winter breeding grounds in the central Great Barrier Reef. They are regularly observed in NSW waters in June and July, on the northward migration and October and November, on the southward migration. As with the western Australian population, the eastern Australian population also tend to migrate further offshore during their northward migration. Three major aggregation areas have been previously identified for the eastern Australian population in Queensland around the southern end of the Great Barrier Reef, Hervey Bay and in the Gold Coast region. The southern end of the Great Barrier Reef is a suspected calving area. The breeding area for the eastern population of the humpback whale is presumed to be off the coast between central and northern Queensland. Some feeding has been observed in Australia's coastal waters but this is thought to primarily be opportunistic and forms only a small portion of their nutritional requirements. Feeding has been observed close to shore off Eden, NSW, from late September until late November. Feeding behaviour has also been reported off Fraser Island, Queensland. Feeding may also occur in northern waters of the Great Barrier Reef, as well as Victoria, as sightings of humpback whales have been reported in these areas in summer months.	7 (BioNet) (PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	-	Found along the east coast from south Queensland to southern NSW. Occurs in dry sclerophyll forest, woodland swamp forests and mangrove forests east of the Great Dividing Range. Roosts mainly in	10 (BioNet)	Moderate. Potential roosting habitat is present

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				tree hollows but will also roost under bark or in manmade structures. Usually solitary but have been recorded to roost communally.		in the study area albeit widespread.
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	5 (BioNet)	Moderate. Potential roosting habitat is present in the study area albeit widespread.
<i>Miniopterus oriana oceanensis</i>	Large Bent-winged Bat	V	-	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	70 (BioNet)	Moderate. Potential roosting habitat is present in the study area albeit widespread.
<i>Myotis macropus</i>	Southern Myotis	V	-	Generally, roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	45 (BioNet)	Moderate. Potential roosting habitat is present in the study area albeit widespread.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	1 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Petauroides volans</i>	Greater Glider	-	V	<p>The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 metres above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands.</p> <p>The broad extent of occurrence is unlikely to have changed appreciably since European settlement. However, the area of occupancy has decreased substantially mostly due to land clearing. This area is probably continuing to decline due to further clearing, fragmentation impacts, fire and some forestry activities. An arboreal, nocturnal marsupial largely restricted to Eucalypt forests and woodlands with a diet of eucalypt leaves and occasionally flowers. Found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows although, distribution may be patchy, even in suitable habitat. Favours forests with a diversity of Eucalypt species due to seasonal variation its preferred tree species. Shelters in tree hollows during the day. Home ranges are typically 1-4 ha.</p>	(PMST)	<p>None.</p> <p>No suitable habitat within the study area.</p>

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	(PMST)	None. No suitable habitat within the study area.
<i>Phascolarctos cinereus</i>	Koala (combined populations Qld, NSW and the ACT)	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 Eucalypt species and 30 non-Eucalypt species, but in any one area will select preferred browse species.	3 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	V	V	Generally, found within 200 kilometres of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	1,060 (BioNet) (PMST)	High. Potential foraging habitat is present in the study area albeit widespread.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	1 (BioNet)	Moderate. Potential roosting habitat is present in the study area albeit widespread.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	1 (BioNet)	Moderate. Potential foraging habitat is present in the study area albeit widespread.

## Reptiles

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Caretta caretta</i>	Loggerhead Turtle	E	E, Mi, Ma	The Loggerhead Turtle has a worldwide distribution in coastal tropical and subtropical waters. In Australia, Loggerheads occur in coral reefs, bays and estuaries in tropical and warm temperate waters off the coast of Queensland, Northern Territory, Western Australia and New South Wales.	1 (BioNet) (PMST)	Low. May swim through the study area albeit widespread.
<i>Chelonia mydas</i>	Green Turtle	V	V, Mi, Ma	Green Turtles occur in seaweed-rich coral reefs and coastal seagrass pastures in tropical and subtropical areas of Australia. Usually ocean-dwelling but also occurs in coastal waters on the north or central coast with some straying south of the central coast. Green Turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with driftlines and rafts of Sargassum (a floating marine plant that is also carried by currents). Once Green Turtles reach 30 to 40 cm curved carapace length, they settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The shallow foraging habitat of adults contains seagrass beds or algae mats on which Green Turtles mainly feed. In Australia there are seven separate genetic management units for the green turtle, and three of these occur in Queensland. The entire Great Barrier Reef area is an important feeding area for turtles which nest locally, as well as for those which nest in other regions and countries.	(PMST)	Low. May swim through the study area albeit widespread.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Dermochelys coriacea</i>	Leatherback Turtle	E	E, Mi, Ma	Throughout the world's tropical and temperate seas and in all coastal waters of Australia. Most sightings are in temperate waters. Occurs in inshore and offshore marine waters. Rarely breeds in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago. Occasional breeding records from NSW coast, including between Ballina and Lennox Head in northern NSW.	1 (BioNet) (PMST)	Low. May swim through the study area albeit widespread.
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	-	V, Mi, Ma	Major nesting of Hawksbill Turtles in Australia occurs at Varanus Island and Rosemary Island in Western Australia, and in the northern Great Barrier Reef and Torres Strait, Queensland. hawksbill turtles spend their first five to ten years drifting on ocean currents. Hawksbill Turtles spend their first five to ten years drifting on ocean currents. During this pelagic phase, they are often found in association with rafts of <i>Sargassum</i> sp. (floating marine algae that is also carried by currents). Once Hawksbill Turtles reach 30 to 40 cm curved carapace length, they settle and forage in tropical tidal and sub-tidal coral and rocky reef habitat. They primarily feed on sponges and algae. They have also been found, though less frequently, within seagrass habitats of coastal waters, as well as the deeper habitats of trawl fisheries. Hawksbill Turtles have been seen in temperate regions as far south as northern NSW.	(PMST)	Low. May swim through the study area albeit widespread.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 metres of escarpments in summer.	(PMST)	None. No suitable habitat within the study area.
<i>Natator depressus</i>	Flatback Turtle	-	V, Mi, Ma	The Flatback Turtle is only found in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya and is one of only two species of sea turtle without a global distribution. Post-hatchling and juvenile Flatback Turtles do not have the wide dispersal phase in the oceanic environment like other sea turtles. Adults inhabit soft bottom habitat over the continental shelf of northern Australia, extending into Papua New Guinea and Irian Jaya although the extent of their range is not fully known. Hatchling to subadult Flatback Turtles lack a pelagic life stage and reside in the Australian continental shelf. Flatback Turtles require sandy beaches to nest. Sand temperatures between 25 °C and 33 °C are needed for successful incubation. Beaches free from light pollution are required to prevent disorientation, disturbance, and to allow nesting females to come ashore.	(PMST)	Low. May swim through the study area albeit widespread.

## Elasmobranchs

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Carcharias taurus</i>	Grey Nurse Shark (east coast population)	CE (FM Act)	CE	<p>Grey Nurse Sharks are usually found in inshore coastal waters usually less than 40 metres in depth. This species congregates at a number of rocky reef sites with gravel or sand filled gutters, overhangs or caves known as 'aggregate sites' and key aggregate sites refer to those areas occupied by a larger number of grey nurse sharks. Individuals spend most of their time within or in close proximity to aggregate sites but may undertake excursions of varying lengths of time away from site. In NSW, aggregations of grey nurse sharks (east coast population as listed under the EPBC Act) can be found at reefs off the following locations: Byron Bay, Brooms Head, Solitary Islands, South West Rocks, Laurieton, Forster, Seal Rocks, Port Stephens, Sydney, Bateman's Bay, Narooma and Montague Island. Relatively little is known about the migratory habits of Grey Nurse Sharks in Australian waters but tagged sharks have been recorded moving over 800 kilometres between sites in relatively short periods of time.</p>	(DPI) (PMST)	<p>Low.</p> <p>May swim through the study area albeit widespread. No aggregate sites know in the harbour.</p>

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Carcharodon carcharias</i>	Great White Shark	V (FM Act)	V, Mi	In Australia, White Sharks have been recorded from central Queensland around the south coast to north-west Western Australia, but may occur further north on both coasts. White Sharks are widely, but not evenly, distributed in Australian waters. This species can be found from close inshore around rocky reefs, surf beaches and shallow coastal bays to outer continental shelf and slope areas. The majority of recorded White Shark movements occur between the coast and 100 metres in depth but have been recorded to dive to depth of over 1,200 m. Individuals may travel long distances in a relatively short time, but can remain in the same areas for weeks to months. In NSW, the Stockton Beach/Hawks Nest area are identified as primary residency areas for juvenile White Sharks.	(PMST)	Low.  May swim through the study area albeit widespread.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Rhincodon typus</i>	Whale Shark	-	V, Mi	In Australia, the Whale Shark is known from NSW, Queensland, Northern Territory, Western Australia and occasionally Victoria and South Australia, but it is most commonly seen in waters off northern Western Australia, Northern Territory and Queensland. The Whale Shark is an oceanic and coastal, tropical to warm-temperate pelagic shark. It is often seen far offshore, but also comes close inshore and sometimes enters lagoons of coral atolls. The Whale Shark is generally encountered close to or at the surface, as single individuals or occasionally in schools or aggregations of up to hundreds of sharks. This species is generally found in areas where the surface temperature is 21–25 °C, preferably with cold water of 17 °C or less upwelling into it, and salinity of 34 to 34.5 parts per thousand.	(PMST)	Low. May swim through the study area albeit widespread.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
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\* Distribution and habitat requirement information adapted from:

Australian Government DAWE <https://www.environment.gov.au/biodiversity/threatened/species>.

NSW DPIE-EES <http://www.environment.nsw.gov.au/threatenedSpeciesApp/>. and

NSW DPI (Fisheries) listed threatened species, populations and ecological communities <https://www.dpi.nsw.gov.au/fishing/species-protection/what-current>.

+ Data source includes

The NSW DPI (Fisheries) Threatened species lists <https://www.dpi.nsw.gov.au/fishing/species-protection/what-current>.

Number of records from the NSW DPIE-EES Wildlife Atlas record data (Accessed April 2020) <http://www.bionet.nsw.gov.au/>. and

Australian Government DAWE PMST <http://www.environment.gov.au/epbc/protected-matters-search-tool>.

Key:

EP = endangered population

CE = critically endangered

E = endangered

V = vulnerable

Mi = migratory (EPBC Act only)

Ma = marine (EPBC Act only)

## Migratory species habitat assessment table

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Birds					
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, Ma	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	(PMST)	Low. Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Anous stolidus</i>	Common Noddy	Mi, Ma	Mainly occurs in ocean off the Queensland coast. Breeds on or near islands, on rocky islets and stacks with precipitous cliffs, or on shoal or cays or coral or sand. This species feeds main on fish but are known to take squid, molluscs and aquatic insects in offshore areas.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Apus pacificus</i>	Fork-tailed Swift	Mi, Ma	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 metres to at least 300 metres above ground and probably much higher.	(PMST)	Low. Almost exclusively aerial so unlikely to land in the study area but may fly through.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Ardenna grisea</i>	Sooty Shearwater	Mi, Ma	In Australia, the Sooty Shearwater breeds on islands off New South Wales (NSW) and Tasmania. The Sooty Shearwater forages in pelagic (open ocean) sub-tropical, sub-Antarctic and Antarctic waters. The Sooty Shearwater breeds mainly on subtropical and sub-Antarctic islands, as well as on the mainland of New Zealand. The Sooty Shearwater forages in pelagic (open ocean) sub-tropical, sub-Antarctic and Antarctic waters. The species migrates and forages in the North Pacific and Atlantic Oceans during the non-breeding season. Sooty Shearwaters may forage inshore occasionally, especially during rough weather.	(PMST)	Low.  Some foraging habitat present in the study area however, is widely distributed and not preferred.
<i>Arenaria interpres</i>	Ruddy Turnstone	Mi, Ma	Coastline and only occasionally inland. They are mainly found on exposed rocks or reefs, often with shallow pools, and on beaches.	(PMST)	Low.  Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, Ma	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	(PMST)	Low.  Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi, Ma	In NSW, the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Calidris ruficollis</i>	Red-necked Stint	Mi, Ma	It is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. The Red-necked Stint breeds in Siberia and sporadically in north and west Alaska, probably from Taymyr region to Anadyr Territory and Koryakland. The Red-necked Stint mostly forages on bare wet mud on intertidal mudflats or sandflats, or in very shallow water; mostly in areas with a film of surface water and mostly close to edge of water. Roosts on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle, sometimes in saltmarsh or other vegetation.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Calonectris leucomelas</i>	Streaked Shearwater	Mi, Ma	Found in the western Pacific, breeding on the coast and on offshore islands of Japan, Russia, and on islands off the coasts of China, North Korea and South Korea. This marine species can be found over both pelagic and inshore waters.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Charadrius bicinctus</i>	Double-banded Plover	Mi, Ma	The Double-banded Plover can be found in both coastal and inland areas. The Double-banded Plover is found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers.	(PMST)	Low. Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi	Occurs from the coastal region of the Northern Territory to the south of NSW coast. This species is very secretive inhabiting forests, occurring in coniferous, deciduous and mixed forest.	(PMST)	None. No suitable habitat within the study area.
<i>Fregata ariel</i>	Lesser Frigate Bird	M, Ma	Breeding populations are found in the tropical waters of Indian and Pacific Oceans, except in the east Pacific, and the South Atlantic on remote tropical and sub-tropical islands. Mainly feeds on fish but can snatch bird eggs and chicks as well as scavenge.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Fregata minor</i>	Great Frigate Bird	Mi, Ma	Breeding populations found on small, remote tropical and sub-tropical islands of the Indian and Pacific Oceans and the South Atlantic. Kleptoparasitic behaviour leads to stealing fish and squid from other bird species as well as snatching small chicks.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi, Ma	Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 metres above sea-level.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Limosa lapponica</i>	Bar-tailed Godwit	Mi, Ma	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi, Ma	Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.	(PMST)	None. No suitable habitat within the study area.
<i>Monarcha trivirgatus</i>	Spectacled Monarch	Mi, Ma	Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges.	(PMST)	None. No suitable habitat within the study area.
<i>Motacilla flava</i>	Yellow Wagtail	Mi, Ma	Breeds in northern latitudes and travels south before the onset of winter. Occurs in a variety of damp or wet habitats with low vegetation. Outside of the breeding season, it is also found in cultivated areas.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi, Ma	Widespread in eastern Australia and vagrant to New Zealand. Inhabit heavily vegetated gullies in Eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Numenius phaeopus</i>	Whimbrel	Mi, Ma	The Whimbrel is a regular migrant to Australia and New Zealand, with a primarily coastal distribution. The Whimbrel is often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Philomachus pugnax</i>	Ruff	Mi, Ma	The Ruff is a rare but regular non-breeding visitor to Australia, being recorded in all States and Territories. In NSW the species has been recorded at Kurnell, Tomki, Casino, Ballina, Kooragang Island, Broadwater Lagoon and Little Cattai Creek. The Ruff is found on generally fresh, brackish or saline wetlands with exposed mudflats at the edges.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Pluvialis fulva</i>	Pacific Golden Plover	Mi, Ma	Most Pacific Golden Plovers occur along the east coast, and are especially widespread along the Queensland and NSW coastlines. In non-breeding grounds in Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as <i>Sarcocornia</i> , or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi, Ma	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by Eucalypts such as Tallow-wood ( <i>Eucalyptus microcorys</i> ), Mountain Grey Gum ( <i>E. cypellocarpa</i> ), Narrow-leaved Peppermint ( <i>E. radiata</i> ), Mountain Ash ( <i>E. regnans</i> ), Alpine Ash ( <i>E. delegatensis</i> ), Blackbutt ( <i>E. pilularis</i> ) or Red Mahogany ( <i>E. resinifera</i> ); usually with a dense shrubby understorey often including ferns.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Tringa brevipes</i>	Grey-tailed Tattler	Mi, Ma	In NSW the Grey-tailed Tattler is distributed along most of the coast from the Queensland border, south to Tilba Lake. The Grey-tailed Tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide.	(PMST)	Low. Prefers specific habitat that is available in the study area but is suboptimal in condition and size.
<i>Tringa nebularia</i>	Common Greenshank	Mi, Ma	The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Mi, Ma	Fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

#### Mammals and Elasmobranchs

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Balaenoptera edeni</i>	Bryde's Whale	Mi	Bryde's whales occur in temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40° N and 40° S, or the 20 °C isotherm. Bryde's whales have been recorded from all Australian states except the Northern Territory, including one sighting each in Victoria and NSW and 11 reported strandings in South Australia, NSW, Victoria and Queensland. Bryde's whales are found year-round primarily in temperatures exceeding 16.3 °C. The coastal form of Bryde's whale appears to be limited to the 200 metres depth isobar, moving along the coast in response to availability of suitable prey. The offshore form is found in deeper water (500 metres to 1000 m). Dive times are relatively short, averaging 1.27 minutes but potentially lasting 9 minutes. This suggests that Bryde's whales use the upper layers of the ocean, and can therefore be considered pelagic.	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Caperea marginata</i>	Pygmy Right Whale	Mi	Records of pygmy right whales in Australian waters are distributed between 32° S and 47° S, but are not uniformly spread around the coast. The northern distribution of pygmy right whales may be limited on the west and east coasts of Australia by the warm, south-flowing Leeuwin and East Australian currents. Few or no records are available for NSW, eastern Victoria, and the northern part of the Great Australian Bight, while Western Australia has fewer records than comparative eastern Australian states. Concentrations of stranded animals have occurred at the entrance of the gulfs in South Australia and around Tasmania, but live sightings have predominated in the former region. The numerous strandings in Tasmania may be due to the proximity of the Subtropical Convergence, an apparently important feeding zone for pygmy right whales. Pygmy right whales have primarily been recorded in areas associated with upwellings and with high zooplankton abundance, particularly copepods and small euphausiids which constitute their main prey. There is some evidence to indicate that the area south of 41° S is important for weaned pygmy right whales, possibly because of the higher prey abundance in these waters.	(PMST)	Low.  Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Lagenorhynchus obscurus</i>	Dusky Dolphin	Mi	In Australia, dusky dolphins are known from only 13 reports since 1828, with two sightings in the early 1980s. They occur across southern Australia from Western Australia to Tasmania, with unconfirmed sightings south of continental Australia but confirmed sightings near Kangaroo Island, South Australia, and off Tasmania, and a recent stranding in the latter State. Given the lack of understanding of the species' distribution in Australian waters, no key localities have yet been identified. Dusky dolphins occur mostly in temperate and subantarctic waters. They are considered to primarily inhabit inshore waters but may also be pelagic at times.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Lamna nasus</i>	Porbeagle	Mi	The Porbeagle is wide-ranging and inhabits temperate, subarctic and subantarctic waters of the North Atlantic and Southern Hemisphere. The Porbeagle primarily inhabits oceanic waters and areas around the edge of the continental shelf. They occasionally move into coastal waters, but these movements are temporary. The Porbeagle utilises a broad vertical range of the water column and is known to dive to depths exceeding 1300 m. The Porbeagle is thought to be reasonably flexible in the types of habitat used for foraging.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Manta alfredi</i>	Reef Manta Ray	Mi	Distributed in the Indo-West Pacific: Red Sea, South Africa, Thailand to Western Australia; north to Japan (Yaeyama Island), to Solitary Island, Australia as far east as French Polynesia and the Hawaiian Islands. Reported in the Atlantic (Canary and Cape Verde islands) but this species may be restricted more or less to the Indian and Western Pacific only. Adults are commonly sighted inshore, within a few kilometers of land; found around coral and rocky reefs as well as along productive coastlines with consistent upwelling, tropical island groups, atolls and bays.	(PMST)	None. No suitable habitat within the study area.
<i>Manta birostris</i>	Giant Manta Ray	Mi	The Giant Manta Ray occurs in tropical, sub-tropical and temperate waters of the Atlantic, Pacific and Indian Oceans. Commonly sighted along productive coastlines with regular upwelling, oceanic island groups and particularly offshore pinnacles and seamounts. Widespread, although relatively uncommon in Australian waters; also Cocos (Keeling) Islands and Christmas Island in the eastern Indian Ocean. Elsewhere the species is circumglobal, usually offshore, often around oceanic islands, sometimes coastal, and most common in tropical waters. Giant Manta Rays aggregate around Ningaloo Reef during autumn and winter.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Sousa chinensis</i>	Indo-Pacific Humpback Dolphin	Mi	In Australia, Indo-Pacific Humpback Dolphins are known to occur along the northern coastline, extending to Exmouth Gulf on the west coast (25° S), and the Queensland/NSW border region on the east coast (34° S). Within their geographical range, Australian Humpback Dolphins are found primarily in coastal waters however, this species is known to inhabit shallow coastal, estuarine, and occasionally riverine habitats, in tropical and subtropical regions.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

\* Distribution and habitat requirement information adapted from:

Australian Government DAWE <https://www.environment.gov.au/biodiversity/threatened/species>.

NSW DPIE-EES <http://www.environment.nsw.gov.au/threatenedSpeciesApp/>. and

NSW DPI (Fisheries) listed threatened species, populations and ecological communities <https://www.dpi.nsw.gov.au/fishing/species-protection/what-current>.

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Australian Government DAWE PMST <http://www.environment.gov.au/epbc/protected-matters-search-tool>.

Key:

Mi = migratory (EPBC Act only)

Ma = marine (EPBC Act only)

## Protected species habitat assessment table

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Birds						
<i>Ardea alba</i>	Great Egret	-	Ma	The Eastern Great Egret is a widespread species of southern and eastern Asia and Australasia. Eastern Great Egrets are widespread in Australia. They occur in all states/territories of mainland Australia and in Tasmania. They have also been recorded as vagrants on Lord Howe, Norfolk and Macquarie Islands. The Eastern Great Egret has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Ardea ibis</i>	Cattle Egret	-	Ma	The Cattle Egret was originally native to Africa, south-west Europe, and Asia. Originally the bird's Asian distribution was from Pakistan, south to Sri Lanka, north to the Himalayas and east to Korea, Japan, and the Philippines. Two major distributions have been located; from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	Ma	The Red-capped Plover is widespread throughout Australia. Found in wetlands, especially in arid areas, and prefers saline and brackish waters.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Himantopus himantopus</i>	Pied Stilt	-	Ma	The Black-winged Stilt has a wide range, including Australia, Central and South America, Africa, southern and south-eastern Asia and parts of North America and Eurasia Prefer freshwater and saltwater marshes, mudflats, and the shallow edges of lakes and rivers.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
<i>Merops ornatus</i>	Rainbow Bee-eater	-	Ma	The Rainbow Bee-eater is widely distributed throughout Australia and eastern Indonesia. The Rainbow Bee-eater is distributed across much of mainland Australia, and occurs on several near-shore islands. The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal and widely distributed.
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	-	Ma	The Red-necked Avocet is found throughout mainland Australia, but breeds mainly in the south-western interior. Out of breeding season, it visits most of the rest of Australia, but is only an accidental visitor to Tasmania or the Cape York Peninsula. The Red-necked Avocet is found in large shallow freshwater or saltwater wetlands and estuarine mudflats.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

#### Fish, Syngnathids and reptiles

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Acentronura tentaculata</i>	Shortpouch Pygmy Pipehorse	P	Ma	This species is found on tropical inshore reefs. It also occurs in temperate waters associated with shallow sandflats in protected and somewhat silty coastal areas among sparse low plant growth and in algae on rocks. This species inhabits waters of 7-40 metres in depth. Pipefishes feed on small living crustaceans.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Anampses elegans</i>	Elegant Wrasse	P	-	Elegant Wrasse are a widespread but uncommon species found on coral reef and rocky reef habitats at depths from 2 to 35 m. The distribution of elegant wrasse extends from southern Queensland to Montague Island on the NSW south coast, particularly around inshore islands. The species is also found at Lord Howe Island, especially in the shallow lagoon habitat, and at nearby Elizabeth and Middleton Reefs, and they have also been recorded from Norfolk Island, the Kermadec Islands, New Zealand and Easter Island. Elegant wrasse are a subtropical, warm-temperate species that are active during the day.	(DPI)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Epinephelus coioides</i>	Estuary Cod	P	-	<p>Occurs in tropical and warm temperate marine waters of the Indo-Pacific including the Persian Gulf, India, the Philippines, Singapore, Hong Kong, Taiwan, Fiji and around numerous other islands. In Australia they are most common in Queensland, the Northern Territory and Western Australia; however, they are known to occur as far southwards as the Sydney area.</p> <p>Estuary cod inhabit turbid coastal reefs and are often found in brackish water over mud and rubble. They are frequently misidentified as Greasy Grouper (<i>Epinephelus tauvina</i>) or Malabar Grouper (<i>Epinephelus malabaricus</i>), which look similar and have overlapping distributions. Estuary cod also have a variety of common names including estuary rock cod, orange-spotted grouper, orange-spotted cod, green grouper, greasy cod, spotted river cod and brown-spotted grouper.</p>	(DPI)	<p>High.</p> <p>Potential habitat is present in the study area.</p>
<i>Epinephelus lanceolatus</i>	Queensland Groper	P	Ma	<p>This species has a wide distribution throughout the tropical waters of the Indo-West Pacific. In Australia they occur along all tropical and warm temperate coasts but are rarely found in cooler waters to the south. Queensland Groper occupy a variety of habitats throughout their growth stages including estuaries and coral reefs. This species is usually solitary and inhabit caves and around wrecks and structures. They are ambush predators that swallow prey whole.</p>	(DPI)	<p>Moderate.</p> <p>Potential habitat is present in the study area albeit towards the end of the species range.</p>

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Festucalex cinctus</i>	Girdled Pipefish	P	Ma	Endemic to tropical and temperate waters of the Northern Territory, Queensland and New South Wales. Usually inhabits sheltered coastal bays and estuaries, on patches of rubble, sand or in areas of sparse seagrass, algal and sponge growth. Most specimens were dredged or trawled in depths of 8-31 metres but divers collected some specimens over rubble bottoms in depths of 12 m. In Sydney Harbour it is most common in depths of 10-20 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Filicampus tigris</i>	Tiger Pipefish	P	Ma	The tiger pipefish is relatively common in subtropical waters of Australia's east and west coasts. A relic population also occurs in the warmer waters of Spencer Gulf, South Australia. Inhabits areas near channels in inshore sheltered bays and estuaries with sandy or muddy bottoms, or along seagrass bed edges at 2-30 m. Feeds on aggregations of mysid shrimps in sheltered bays adjacent to tidal channels.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Heraldia nocturna</i>	Upside-down Pipefish	P	Ma	Endemic to temperate waters of southern and south-eastern Australia, from about Hastings, New South Wales, southwards to Victoria, to Port Davey on the west coast of Tasmania, westwards through South Australia to Geographe Bay, Western Australia.  Upside-down Pipefish inhabit sheltered inshore rocky reefs in harbours, bays and coves where they are found under ledges, in holes, crevices and small caves at 2-30 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Hippichthys penicillus</i>	Beady Pipefish	P	Ma	Widespread in the tropical Indo-west-central Pacific, from the Red Sea and East Africa across the Indian Ocean to north-eastern Australia, north to Taiwan, Japan, Micronesia and east to Samoa and Tonga. This species usually inhabits brackish waters in mangrove estuaries, tidal creeks and sometimes in freshwater reaches in the lower parts of rivers and streams.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Hippocampus abdominalis</i>	Big-belly Seahorse	P	Ma	Known from temperate waters of New Zealand and southern Australia, where it occurs from about South West Rocks, New South Wales, southwards to the northern Great Australian Bight, South Australia, and south to the Derwent Estuary, Tasmania.  Big-belly Seahorses live in a range of habitats from low rocky reefs in shallow estuaries, to deep tidal channels and deeper coastal reefs to 100 m. They cling to seagrasses, sponges, macroalgae such as kelp holdfasts and other structures on reefs.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Histiogamphelus briggsii</i>	Crested Pipefish	P	Ma	Endemic to temperate waters of south-eastern Australia, from New South Wales, south to Victoria and Tasmania, and westwards to Gulf St Vincent.  Crested pipefish inhabit inshore sandy areas, singly or in small aggregations, often amongst detached seaweed or along the margins of Posidonia seagrass beds and in open sandy areas at 3–20 m; most common in Bass Strait.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Lissocampus runa</i>	Javelin Pipefish	P	Ma	Endemic to temperate waters of southern and eastern Australia; known from southern Qld, southwards to Tasmania, and across to about Rottnest Island, south-western Australia. Usually inhabits tidepools and sheltered bays, usually in seagrass and algal beds, and rocky and shelly rubble substratum to about 20 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Maroubra perserrata</i>	Sawtooth Pipefish	P	Ma	Endemic to temperate southern Australian waters from southern Queensland to Rottnest Island, Western Australia. The sawtooth pipefish inhabits coastal rocky reefs at 3-25 m, sheltering beneath ledges and in caves during day.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Notiocampus ruber</i>	Red Pipefish	P	Ma	Endemic to temperate waters of southern and south-eastern Australia from Sydney Harbour, New South Wales, south and west to Flinders Island in Bass Strait, Tasmania, Victoria, South Australia and the Recherche Archipelago, Western Australia; usually inhabits rocky reefs, often in crevices, in association with sponges and encrusting and filamentous red algae at 5–20 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Paraplesiops bleekeri</i>	Eastern Blue Devil	P	-	Eastern Blue Devil are a shy, secretive fish found in caves, crevices and under ledges on inshore reefs and estuaries. Eastern blue devil fish are distributed from southern Queensland to Montague Island on the NSW south coast. They can be found in waters between 3-30 metres and are generally solitary occupying caves, crevices or under ledges.	(DPI)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Pelamis platurus</i>	Yellow-bellied Seasnake	-	Ma	The Yellow-bellied Seasnake is the most widely distributed of all sea snake species. In the beginning of the 21st century, the species was found to range from the east coast of Africa through the Indian and Pacific Oceans to the west coast of the Americas. It was found in most Australian waters with the exception of the colder southern coastline. The greatest density of populations was thought to exist south of the tropics where it was most commonly found on beaches after storms. Populations were also found in tropical seas and the Gulf of Carpentaria. The population living near the central coast of NSW was thought to be permanent and breeding, though no new studies have confirmed this. Most Australian specimens have been washed ashore by a combination of ebbing tides and onshore winds. The Yellow-bellied Seasnake is usually found within a few kilometres of the coast and prefers shallow inshore waters found to be between 11.7–36 °C. Nevertheless, the species is the most pelagic of all known sea snakes, occurring in the open waters well away from coasts and reefs.	(PMST)	Low. Prefers specific habitat not in the study area however, it may get washed into the harbour.
<i>Phyllopteryx taeniolatus</i>	Weedy Seadragon	P	Ma	Endemic to temperate coastal waters of southern Australia, from about Newcastle (New South Wales) south to Actaeon Island (Tasmania) and across southern Australia to about Geraldton (Western Australia).  Common seadragons inhabit shallow estuaries to deeper offshore reefs, living seagrass beds and on rocky reefs covered in macroalgae, especially kelp beds, in depths of 1-50 m. Individuals usually remain within a broad home range.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Solegnathus spinosissimus</i>	Spiny Pipefish	P	Ma	Known from temperate waters of Australia and New Zealand. In Australian waters, spiny pipehorses have been recorded from off Caloundra, southern Queensland, to southern Tasmania, throughout Bass Strait to south of Cape Otway, Victoria. In the southern part of their range, Spiny Pipehorses inhabit relatively shallow waters. Specimens have been collected from muddy, silty, shelly and rubble substrates, and rocky reefs, and may be washed ashore after storms. Spiny Pipehorses use their prehensile tails to cling to macroalgae and sessile invertebrates on the substrate.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Solenostomus cyanopterus</i>	Robust Ghost Pipefish	P	Ma	Widespread in the tropical Indo-west Pacific, from East Africa and the Red Sea, eastwards to Fiji and southern Japan, and south to Australia. Known in Australian waters from the Shark Bay region, Western Australia, around the tropical north and southwards to at least Sydney Harbour, New South Wales. Robust Ghost Pipefish live in protected coastal and lagoon reefs, deeper coastal reefs and deep, clear estuaries with seagrass or macro-algae in 15-25 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Solenostomus paradoxus</i>	Ornate Ghost Pipefish	P	Ma	Widespread in tropical and warm-temperate regions of the Indo-west Pacific, from East Africa, eastwards to Fiji and Tonga, north to southern Japan, south to Australia and New Caledonia. Ornate ghost pipefish inhabit protected coastal, lagoon and outer reef areas with drop-offs or rock faces, in depths of 3-35 m. They often associate with Crinoids (featherstars), Gorgonians and black corals. Although usually solitary, they may be seen in pairs, or even in small groups.	(DPI) (PMST)	Low. Prefers specific habitat not characterised by study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Stigmatopora argus</i>	Spotted Pipefish	P	Ma	Found from the Hawkesbury River, NSW to Shark Bay, WA in temperate waters. Usually among vegetation in bays and estuaries, but sometimes offshore among floating Sargassum.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Stigmatopora nigra</i>	Widebody Pipefish	P	Ma	Known from temperate waters of southern Australia and New Zealand. The Widebody Pipefish occurs from about Fraser Island in southern Queensland to north of Perth (Western Australia), and around Tasmania. It is common in sheltered seagrass and algal beds from intertidal depths to 35 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Syngnathoides biaculeatus</i>	Double-end Pipefish	P	Ma	In Australian waters, known from Geraldton to Shark Bay, and north to Ashmore and Cartier Reefs, Western Australia, and from the Timor Sea, the Northern Territory, eastwards to Queensland and south to Batemans Bay (NSW). Inhabits shallow, protected waters of bays, lagoons and estuaries including mangrove areas, in association with seagrass beds and macroalgae in depths at 0-10 m. Juveniles sometimes found clinging to floating algae and plant debris including Sargassum sp. rafts.	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Trachyrhamphus bicoarctatus</i>	Bentstick Pipefish	P	Ma	Widespread in the tropical Indo-west Pacific. Bentstick Pipefish are known in Australian waters from the central coast of Western Australia, northwards throughout the waters of the Northern Territory and Queensland to central New South Wales. They live in sheltered coastal lagoon and reef areas on sandy and rubble habitats amongst seagrasses and macroalgae at 1-30 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
<i>Urocampus carinirostris</i>	Hairy Pipefish	P	Ma	In Australia, known from the Shoalwater Bay region (Queensland) to northern Tasmania, Victoria, and to the Ceduna region of South Australia, and in south-western Australia where it reaches the Perth region. Rare in South Australia. Inhabits the lower reaches of rivers, sheltered estuaries and shallow reefs in seagrass and algal beds a 0-6 m. One of the most common estuarine pipefishes in eastern Australia, occurring year-round in seagrass beds in Western Port (Victoria), and abundant in seagrass beds in Moreton Bay (Queensland).	(DPI) (PMST)	High. Potential habitat is present in the study area.
<i>Vanacampus margaritifer</i>	Mother-of-Pearl Pipefish	P	Ma	Endemic to sub-tropical and temperate Australia, from North Stradbroke island, Queensland, southwards to Jurien Bay, Western Australia, absent from Tasmania. Inhabits shallow estuarine and coastal waters in seagrass beds), macroalgae (Ecklonia spp. and other brown algae), rocky reef, boulder, rubble, sandy and muddy habitats between 2-15 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
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\* Distribution and habitat requirement information adapted from:

Australian Government DAWE <https://www.environment.gov.au/biodiversity/threatened/species>.

NSW DPIE-EES <http://www.environment.nsw.gov.au/threatenedSpeciesApp/>. and

NSW DPI (Fisheries) listed threatened species, populations and ecological communities <https://www.dpi.nsw.gov.au/fishing/species-protection/what-current>.

+ Data source includes

Number of records from the NSW DPIE-EES Wildlife Atlas record data (Accessed April 2020) <http://www.bionet.nsw.gov.au/>. and

Australian Government DAWE PMST <http://www.environment.gov.au/epbc/protected-matters-search-tool>.

Key:

P = protected (FM Act only)

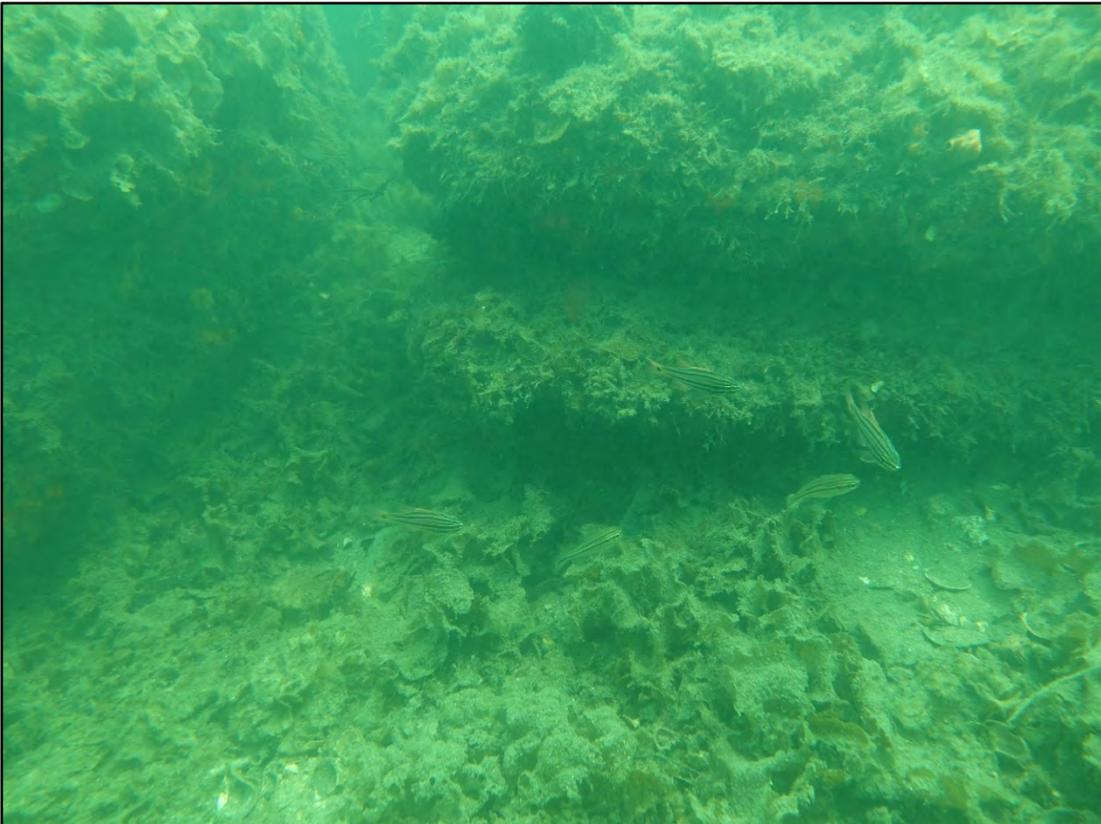
Ma = marine (EPBC Act only)

# Annexure C

## Aquatic habitat complexity examples



**Plate C1:** Example of high relief subtidal rocky reef in the Sydney Harbour area



**Plate C2:** Example of medium relief subtidal rocky reef in the Sydney Harbour area



**Plate C3:** Example of low relief subtidal rocky reef in the Sydney Harbour area

# Annexure D

## Assessments of Significance

## Preamble

The Assessments of Significance (AoSs) have been completed by Jake Ludlow (BSc) and Dilys Zhang (BSc Hons.), ecologists for Cardno, for marine and coastal threatened species listed under the BC Act, FM Act and the EPBC Act that was identified as having a moderate to high potential to occur within the study area due to the presence of nearby records and/or the presence of suitable habitat. These species were identified in Section 3.11 and include:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act
- Black Rockcod (*Epinephelus daemeli*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Seven microchiropteran bats (microbats):
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
  - Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) listed as vulnerable under the BC Act
  - Little Bent-winged Bat (*Miniopterus australis*) listed as vulnerable under the BC Act
  - Large Bent-winged Bat (*Miniopterus orianae oceanensis*) listed as vulnerable under the BC Act
  - Southern Myotis (*Myotis macropus*) listed as vulnerable under the BC Act
  - Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*) listed as vulnerable under the BC Act
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

No threatened ecological communities (TECs) occur within or next to the study area thus, no AoSs are required for this proposal.

Under the BC Act a 5-part test of significance is applied to determine whether an activity is likely to have a significant impact on listed threatened species, ecological communities, or their habitats, or will be carried out in a declared area of outstanding biodiversity value. The test of significance is set out in section 7.3 of the BC Act.

Part 7A of the FM Act lists threatened species, populations and ecological communities and key threatening processes (KTPs) for species, populations and ecological communities in NSW waters. Section 220ZZ of the FM Act outlines significant impact considerations to threatened species, populations and ecological communities listed under the FM Act. Under the FM Act, a '7-part test' is carried out to assess the likelihood of significant impact upon threat-listed species, populations or ecological communities listed under the FM Act. The document *Threatened Species Assessment Guidelines: The Assessment of Significance* (NSW DPI, 2008) outlines a set of guidelines to help proponents of a development or activity with interpreting and applying the factors of assessment in the 7-part test. The guidance provided by the NSW DPI (2008) has been used here in preparing the 7-part test.

For the species listing under the EPBC Act, a significance assessment has been completed in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (DoE, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening. It is sufficient if a significant impact on the environment is a real or not remote chance or possibility (DoE, 2013).

Species listed under the BC Act/FM Act and the EPBC Act have been assessed using the corresponding assessment guidelines separately. Species with similar life stage/habitat requirements (i.e. tree-roosting and cave-roosting microbats) have been assessed together.

## Assessment of significance (BC Act)

### Tree-roosting microbats (Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Yellow-bellied Sheath-tailed-bat (*Saccolaimus flaviventris*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*))

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

1. *In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

Eastern False Pipistrelles prefer hollows in Eucalypts usually over 20 m tall in wet sclerophyll forest and coastal mallee (Atlas of Living Australia, 2020a). Eastern Coastal Free-tailed Bats are known to roost and breed in dry Eucalypt Forest, wet sclerophyll forest and riparian habitat (Atlas of Living Australia, 2020b). Breeding habitat has also been recorded for this species in mangrove forests. Yellow-bellied Sheath-tailed-bat and the Greater Broad-nosed Bats can occupy a range of habitat but the latter are most frequently found in tall wet forests (NSW DPIE, 2017b; Atlas of Living Australia, 2020c). Although foraging and roosting habitat is generally known for the Greater Broad-nosed Bat, the breeding ecology remains more obscure. All four species have preference to roost in tree hollows but would also inhabit man-made structures including under wharf/bridges and in rooves, which occur within the study area. They may roost in colonies but can also be solitary. There are no known maternity sites in or next to the study area.

The proposed works would require the removal of vegetation comprising planted native/exotic trees over a mostly exotic understorey and the existing wharf structure. The areas of potential roosting habitat in the existing wharf structure include the gangway and footpath canopy, underneath the gangway and the pontoon canopy. The fissures in the sandstone escarpment can also provide potential roosting habitat. The vegetation to be removed and the escarpment where the new wharf structures would be anchored to is not considered optimal roosting/breeding habitat for these species as it does not form part of the native forests preferred by these species. The removal of the native/exotic gardens would temporarily remove some foraging habitat however, is unlikely to affect foraging for these species as they are mostly aerial and this foraging habitat will become available following construction completion. Their nocturnal foraging times are unlikely to coincide with land-based construction during the day however, any roosting individuals would need to be removed prior to vegetation clearing, removal of wharf structures and disturbance to the escarpment (see Section 5). Thus, the proposal is unlikely to adversely affect the life cycle of these species such that a viable local population of these species is likely to be placed at risk of extinction.

2. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
  - (a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

3. *In relation to the habitat of a threatened species or ecological community:*
  - (a) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
  - (b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
  - (c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The proposal would remove up to 0.04 hectares of potential foraging and roosting habitat for these species. The vegetation in the study area forms part of a fragmented landscape of urban, landscaped/modified vegetation. The removal of this area of vegetation is not predicted to further fragment or isolate habitat for these species. Furthermore, vegetation is likely to be restored following construction completion rendering this disturbance to be temporary in most areas. The proposal would also remove the existing wharf structures which also forms potential roosting habitat however, similar habitat would be reinstated when the new structures are installed. As discussed in (1), the habitat to be removed is not considered optimal for the roosting or breeding of these species. The proposal is also not going to substantially affect the foraging habitat for these species during construction (see (1)). Thus, the project is unlikely to modify, fragment or isolate habitat important to the long-term survival of these species in the locality.

4. *Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).*

There are no Areas of Outstanding Biodiversity Value (AOBVs) listed for these species. This question is not applicable, as no AOBVs have been listed for these species.

5. *Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.*

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community.

Of the KTPs listed under the BC Act, *Clearing of native vegetation* has the greatest potential to impact potential foraging habitat and suboptimal roosting habitat for these microbat species but is considered to impose only minimal impact on the total extent of potential habitat in the locality. Furthermore, the native vegetation to be cleared do not form part of a native forest community and no remnant native vegetation would be impacted by the proposal (also see Section 4.1.7).

*Invasion and establishment of exotic vines and scramblers and Invasion of native plant communities by exotic perennial grasses* are likely to occur as a result of the proposal if weed controls are not implemented during and after the construction. However, vegetation in the study area is currently mostly exotic and removal of this vegetation and reinstatement of native vegetation local to the Sydney region is likely to be an improvement in habitat condition (also see Section 4.1.7).

## **Conclusion**

While there is potential foraging and suboptimal roosting habitat for the four tree-roosting microbats throughout the study area, this habitat is widespread and not optimal for these species. The proposal would remove potential roosting habitat for these species however, the vegetation to be removed does not form part of a native forest community. However, any individuals roosting in the vegetation to be cleared or the wharf structures to be removed would be relocated prior to construction. The proposal would also remove up to 0.04 hectares of potential foraging habitat for these species. However, this was not considered to substantially impact these species due to their nocturnal foraging preference and being mostly aerial during that time. Furthermore, the proposal would remove exotic vegetation, landscape and reinstate the majority of these areas following construction completion. Based on this, the proposal is unlikely to significantly impact these species and a species impact statement (SIS) is not required.

### **Cave-roosting microbats (Large Bent-winged Bat (*Miniopterus orianae oceanensis*), Little Bent-winged Bat (*Miniopterus australis*), Southern Myotis (*Myotis macropus*))**

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

1. *In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

Little and Large Bent-winged Bats have known maternity sites in caves across south-eastern Australian spanning from the NSW/Queensland border to South Australia (Dwyer & Hamilton-Smith, 1965). These sites are not in the Sydney region and in most cases, have specific temperature and humidity characteristics. There are no known breeding locations for the Southern Myotis but roosting habitat include under bridges/wharves and in rooves.

The study area does not occur within or next to any known maternity sites for these species thus, the proposal is unlikely to interfere for breeding. The proposal would remove some potential roosting habitat by removing the existing wharf structures. Individuals may roost in the canopies and the gangway however, new wharf structures are likely to provide similar habitat to those being removed and any roosting individuals would be relocated prior to demolition. The removal of the vegetation would temporarily remove some foraging habitat but is unlikely to affect foraging for these species as they are purely aerial. Furthermore, their nocturnal foraging times are unlikely to coincide with land-based construction during the day and most of these areas would be reinstated as better condition landscaped vegetation following construction completion.

The proposal would create some disturbance over the water during water-based construction activities which would render this foraging habitat unavailable for the Southern Myotis during construction. However, the proposal would not substantially modify this foraging resource to permanently preclude it from the species foraging territory and upon completion of construction, this area would be once again available as foraging territory for the Southern Myotis. Furthermore, the proportion of potential habitat to be impacted by the proposal is very small compared to what is available in the wider locality. Thus, the proposal is unlikely to adversely affect the life cycle of these species such that a viable local population of the species is likely to be placed at risk of extinction.

2. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
  - (a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

3. *In relation to the habitat of a threatened species or ecological community:*
  - (a) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
  - (b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
  - (c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The proposal would remove up to 0.04 hectares of potential foraging habitat for these species and come potential roosting habitat. The vegetation in the study area and the existing wharf structures form part of a fragmented landscape of urban, landscaped/modified vegetation and structures. The removal of this area of vegetation and the existing wharf structures is not predicted to further fragment or isolate habitat for these species. Furthermore, better condition, landscaped habitat is

likely to be restored following construction completion and similar wharf structures would be installed rendering this disturbance to be temporary in most areas. As discussed in (1), water-based activities may render potential foraging habitat for the Southern Myotis unavailable during construction. However, this is not expected to be a surmountable impact to the species foraging range. Thus, proposal is also not going to substantially affect the foraging habitat for these species during construction and is unlikely to modify, fragment or isolate habitat important to the long-term survival of these species in the locality.

4. *Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).*

There are no AOBVs listed for these three species. This question is not applicable, as AOBVs have been listed for these species.

5. *Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.*

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community.

Of the KTPs listed under the BC Act, *Clearing of native vegetation* has the greatest potential to impact potential foraging habitat and suboptimal roosting habitat for these microbat species but is considered to impose only minimal impact on the total extent of potential habitat in the locality. Furthermore, the native vegetation to be cleared do not form part of a PCT and no remnant native vegetation would be impacted by the proposal (also see Section 4.1.7).

*Invasion and establishment of exotic vines and scramblers* and *Invasion of native plant communities by exotic perennial grasses* are likely to occur as a result of the proposal if weed controls are not implemented during and after the construction. However, vegetation in the study area is currently mostly exotic and removal of this vegetation and reinstatement of native vegetation local to the Sydney region is likely to be an improvement in habitat condition (also see Section 4.1.7).

## **Conclusion**

While there is potential foraging habitat for these three species throughout the study area, this habitat is widespread and not optimal. The proposal would remove up to 0.04 hectares of potential foraging habitat for these species and render the estuarine area not suitable for foraging for the Southern Myotis during construction. However, this was not considered to substantially impact these species due to their nocturnal foraging preference (in relation to land-based works) and being purely aerial during that time. Furthermore, the proposal would landscape and reinstate the majority of these areas following construction completion and estuarine habitat would be available as a foraging resource upon completion of water-based construction activities. The removal of existing wharf structures which form potential roosting habitat is considered temporary as similar new structures would be install as part of the proposal. Any individuals roosting in these structures would be relocated prior to demolition. Based on this, the proposal is unlikely to significantly impact these three species and a SIS is not required.

## Grey-headed Flying-fox (*Pteropus poliocephalus*)

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

1. *In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

The Grey-headed Flying-fox (*Pteropus poliocephalus*) occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometre of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Annual mating commences in January and conception occurs in April or May; a single young is born in October or November.

There are no roost camps located within the study area. As such, the impacts of the proposal to the Grey-headed Flying-fox will be limited to loss of potential feeding habitat caused by clearing during the construction phase. The proposal would remove up to 0.04 hectares which could provide potential foraging habitat while in bloom/fruitletting. Foraging habitat mainly comprises nectar resources from native trees and shrubs as well as fruit resources. The impact to potential foraging habitat would represent a very small percentage of the total extent of foraging vegetation present in the locality. The proposal is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species.

Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of the camps located near the study area, the proposal is not expected to significantly affect the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

2. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
  - (a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

3. *In relation to the habitat of a threatened species or ecological community:*
  - (a) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
  - (b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
  - (c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The potential habitat of the Grey-headed Flying-fox within the study area is limited to foraging habitat. The extent of habitat for the Grey-headed Flying-fox will be reduced by no more than 0.04 hectares. This amount of habitat removal is small when the amount of available foraging habitat in the locality is considered. Furthermore, this habitat is not considered optimal foraging habitat for the species due to the prevalence of exotic ornamental species in the vegetation to be removed. The figs (*Ficus* spp.) to the south of the compound site would be left intact and continue to provide foraging habitat for the species during construction and operation.

Importantly, the proposal will not result in fragmentation of habitat for the Grey-headed Flying-fox. This species is highly mobile and will freely fly long distances (up to 50 kilometre) over open areas including urbanised city centres to move between roost camps and foraging sites. The proposal will

not affect the movement of the Grey-headed Flying-fox between habitat patches. The proposal will not impact on the most important habitats for Grey-headed Flying-fox within the locality, which are roosting camps outside of the study area. Considering this, the proposal is unlikely to modify, fragment or isolate habitat important to the long-term survival of this species in the locality.

4. *Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).*

There are no AOBVs listed for this species. This question is not applicable, as no AOBVs have been listed for this species.

5. *Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.*

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community.

Of the KTPs listed under the BC Act, *Clearing of native vegetation* has the greatest potential to impact potential foraging habitat for the Grey-headed Flying-fox but is considered to impose only minimal impact on the total extent of potential habitat in the locality. Furthermore, the native vegetation to be cleared do not form part of a PCT and no remnant native vegetation would be impacted by the proposal (also see Section 4.1.7).

*Invasion and establishment of exotic vines and scramblers* and *Invasion of native plant communities by exotic perennial grasses* are likely to occur as a result of the proposal if weed controls are not implemented during and after the construction. However, vegetation in the study area is currently mostly exotic and removal of this vegetation and reinstatement of native vegetation local to the Sydney region is likely to be an improvement in habitat condition (also see Section 4.1.7).

## **Conclusion**

The Grey-headed Flying-fox will experience a small reduction in the extent of potential foraging habitat as a result of the proposal. The majority of areas to be cleared would be reinstated with native vegetation, local to the Sydney region inherently improving existing vegetation condition by removing exotic vegetation. No roosting camps or other important habitat will be impacted. The proposal is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. Thus, the proposal is unlikely to significantly impact the Grey-headed Flying-fox and a SIS is not required.

## 7-part test (FM Act)

### White's Seahorse (*Hippocampus whitei*) – endangered (FM Act)

The following questions test whether a proposed development or activity is likely to significantly affect White's Seahorse:

1. *In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

White's Seahorse has limited geographical distribution in Australia and is endemic to nine estuaries, coastal lakes and embayments from Wallis Lake in the north to Lake Illawarra in the south, along approximately 300 kilometre of the NSW coast (Harasti, et al., 2014). White's seahorse is known to occur at depths of between one and 15 metres and can be found in a wide range of habitat types (both natural and artificial). Natural habitat for White's Seahorse in estuaries includes marine vegetation (ie seagrass, macroalgae on rocky reef and mangroves) as well as sponges and corals (Australian Museum, 2020; Harasti, et al., 2014; Kuitert, 2009). In Sydney, they are often found associated with artificial structures, particularly protective swimming net enclosures and jetty pylons. Their use of artificial habitats appears to be most common in areas where natural habitat (such as seagrass, sponges and soft corals) has been lost (Fisheries Scientific Committee, 2019). The species is found to prefer habitats with dense epibiotic growth and avoids areas devoid of growth, possibly in relation to the greater availability of shelter and prey in these areas (Harasti, et al., 2010). Densities in artificial habitats such as swimming nets can be as much as one per square metre, but estimates in natural habitat have been around an order of magnitude less (Harasti, et al., 2012).

Data collected on breeding pairs found that White's Seahorse displays life-long monogamy, with three pairs observed remaining bonded over three consecutive breeding years (Harasti, et al., 2012). The breeding season for White's Seahorse extends between October to April (Australian Museum, 2020).

The study area is considered to provide suitable habitat for White's Seahorse in low to medium relief rocky reef (about 0.10 hectares) and existing piles and pontoon (vertical area of up to 0.01 ha). The loss of individuals from the removal of suitable habitat could affect the viability of local populations due to their monogamous breeding behaviour and site fidelity although the proportion of suitable habitat to be impacted is small relative to that available in the harbour. The precise number of White's Seahorse with potential to be impacted by the proposal, although likely to be small, is uncertain. Targeted surveys could be completed prior to the commencement of water-based construction activities to capture and relocate individuals in the study area (see Section 5). With this measure, the proposal is unlikely to adversely affect the life cycle of the White's Seahorse such that a viable local population of the species is likely to be placed at risk of extinction.

2. *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

Not applicable.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
  - (a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Not applicable.

4. *In relation to the habitat of a threatened species, population or ecological community:*

- (a) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
- (b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
- (c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality*

As indicated in (1), White's Seahorse are found in subtidal rocky reef and artificial structures which are both present in the study area. However, the optimal habitat and known populations are found elsewhere in the harbour (e.g. Clifton Gardens). It is also likely that the frequent exposure to ferry and other vessel wash may render habitat in the study area suboptimal. The proposal would permanently remove existing piles and the pontoon which forms suitable habitat for the species. The proposal would also shade <0.01 hectares of subtidal rocky reef which may lead to a change in assemblages in this area. These are considered small proportions of potential habitat for the species in the study area and the wider harbour. Furthermore, the six piles and pontoon to be installed would form potential habitat for the species once habitat-forming species have colonised. Thus, although the proposal will remove habitat important for the long-term survival of the species, replacement habitat would be reinstated and habitat removal would not fragment or isolate potential habitat for the species in the harbour.

5. *Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)*

Critical habitat refers to those areas listed in the Register of Critical Habitat kept by NSW DPI (Fisheries). This question is not applicable, as no critical habitat has been listed for White's Seahorse.

6. *Whether the proposed development or activity is consistent with a recovery plan or threat abatement plan*

There is no recovery plan or threat abatement plan (TAP) for this species. It was, however, in the opinion of the Fisheries Scientific Committee that White's Seahorse is eligible to be listed nationally as endangered under the Common Assessment Method (Fisheries Scientific Committee, 2019). Since then, White's Seahorse has also been nominated for endangered-listing under the EPBC Act. Invitation to comment on the proposed listing came to a close 15 April 2020 and DAWE are currently reviewing the proposition.

In the interim, the Scientific Committee has recommended management actions for White's Seahorse, including:

- collate and synthesise data collected to quantify the significance of high and moderate risk threat interactions with *H. whitei* (medium priority)
- reduce the impact of public and private boat moorings that impact on *H. whitei* habitats (high priority)
- councils to maintain best practice management of protective swimming nets by using the suggested NSW DPI seahorse friendly cleaning methods (high Priority)
- consider information on *H. whitei* distribution, abundance and habitat preferences during development and review of Marine Park Zoning Plans (medium priority)
- negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on *H. whitei* habitats (medium priority)
- continue to monitor the distribution and abundance of *H. whitei* at important sites (Port Stephens and Sydney Harbour) to inform population status and to assist in determining the effectiveness of recovery actions (high priority)

- develop and trial artificial habitats to promote recovery of *H. whitei* populations (high priority).
- implement research using eDNA to investigate the occurrence of *H. whitei* in estuaries and embayments across its range (high priority)
- implement genetics research to investigate population structure of *H. whitei* across its entire range (NSW and Qld) (medium priority)
- encourage the reporting of sightings of seahorses along the east coast of Australia to iSeahorse and iNaturalist (medium priority).

The proposal would not interfere with any of the above recommendations. Targeted surveys during pre-construction to capture and relocate the species could be completed in consultation with NSW DPI to align with some of the above management recommendations (see Section 5).

7. *Whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community.

The KTP of *Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams* (FM Act) is of relevance given instream structures would be placed in or adjacent to White's Seahorse habitat. This KTP is discussed in Section 0. However, these structures are unlikely to substantially alter nearshore natural tidal flow and therefore would not be exacerbated by the proposal to impact White's Seahorse.

## **Conclusion**

White's Seahorse are known to occur in the harbour and the study area provides suitable habitat for the species in subtidal rocky reefs and existing subtidal jetty structures. The proposal would include control measures to capture and relocate individuals prior to water-based construction activities, which would avoid any mortality to individuals in the study area. The proposal would also replace suitable habitat proposed to be removed such that there would not be a substantial loss, fragmentation or isolation of White's Seahorse habitat. Thus, the proposal is unlikely to have a significant impact on White's Seahorse with the implementation of construction measures and a small proportion of White's Seahorse habitat to be impacted in relation to that available in the harbour determines a SIS is not required.

## **Black Rockcod (*Epinephelus daemeli*) – endangered (FM Act)**

The following questions test whether a proposed development or activity is likely to significantly affect Black Rockcod:

1. *In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

Black Rockcod, also known as Black Cod or Saddled Rockcod, occurs from southern Queensland to Kangaroo Island in South Australia and are found offshore at Lord Howe Island, Norfolk Island, Kermadec Islands and the North Island of New Zealand (Heemstra & Randall, 1993). New South Wales is the centre of the species distributional range in Australia. They are protogynous hermaphrodites (ie change sex from female to male) and at the time of spawning, males establish a harem within their territory. Black Rockcod are opportunistic carnivores, eating mainly other fish and crustaceans.

Black Rockcod are mostly found in caves and gutters in coastal areas. Dispersal of eggs is thought to be pelagic and juveniles can recruit to rockpools (Griffiths, 2002). Adults are highly territorial, usually adopting a cave as core territory. Black Rockcod have been observed by divers or caught by anglers in estuaries, including Sydney Harbour. Although the locations of these occurrences have generally been at the mouths of estuaries and involved juvenile fish, there is anecdotal evidence that Black Rockcod have been caught in embayments of the harbour. Although the species may have been prevalent in estuaries in the past (NSW Department of Industry and Investment, 2009), it is unlikely that viable populations of Black Rockcod currently occur in the estuary. The few individuals that occur are more likely to be part of one or many populations in nearby coastal areas. Since any Black Rockcod in the harbour are likely to form a very small proportion of a viable population of the species, and with the appropriate proposal controls to complete targeted surveys for individuals prior to water-based construction activities, proposal impacts would be negligible and would not affect the viability of local populations such that the species is placed at risk of extinction.

2. *In the case of an endangered population, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction*

Not applicable.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
  - (a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Not applicable.

4. *In relation to the habitat of a threatened species, population or ecological community:*
  - (a) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
  - (b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
  - (c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality*

As indicated in (1), Black Rockcod are mostly found in caves and gutters in coastal areas. Dispersal of eggs is thought to be pelagic and juveniles can recruit to rockpools (Griffiths, 2002). Adults are highly territorial, usually adopting areas of high relief rocky reef, such as a cave, for core territory. Although very few, if any, Black Rockcod may occur in suitable habitat within the study area now, more individuals probably occurred there in the past when the species was more prevalent, as there are past reports of many large individuals being caught in estuaries (NSW Department of Industry and Investment, 2009). In the future, if populations of Black Rockcod were to recover, the medium relief rocky reef areas in the study area may again become more commonly occupied.

Generally, the study area is occupied by low to medium relief rocky reef along the seawall. The proposal would not remove this habitat but would generate some temporary disturbance from vessel/barge traffic, piling noise and vibration and anchoring during construction. This disturbance is not considered to result in the fragmentation or isolation of Black Rockcod habitat and the disturbance in the study area is temporary and the species is likely to move away and return once construction is complete. Shading of a small portion of subtidal rocky reef habitat could trigger changes to community assemblages in this area. However, the removal of the existing structure is likely to encourage macroalgae to recolonise a similar area to the shaded area, inherently improving habitat condition. Thus, the proposal would not fragment or isolate habitat important to the long-term survival of the species.

5. *Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)*

Critical habitat refers only to those areas listed in the Register of Critical Habitat kept by NSW DPI (Fisheries). This question is not applicable, as no critical habitat has been listed for Black Rockcod.

6. *Whether the proposed development or activity is consistent with a recovery plan or threat abatement plan*

A draft recovery plan for the Black Rockcod was placed on public exhibition in November 2009 (NSW Department of Industry and Investment, 2009). The specific objectives of the recovery plan are to:

- mitigate medium and high risk threats to Black Rockcod
- initiate and support scientific research to increase knowledge of the distribution, abundance, reproductive biology, life history, ecology, migratory patterns and genetics of Black Rockcod
- monitor fishery management strategies where necessary to reduce potential for interaction with Black Rockcod (either directly or indirectly)
- establish an on-going monitoring program to document the status of Black Rockcod populations and their habitats and to evaluate the effectiveness of recovery actions
- provide enhanced compliance and protection for important Black Rockcod habitats
- educate the community about the identification of Black Rockcod, increase awareness of the status of and threats to Black Rockcod populations, and enhance community support for recovery actions
- improve understanding of the threats to the survival of Black Rockcod and contribute to management actions to ameliorate identified threats.

The key objectives of the recovery plan are to mitigate medium and high risk threats to Black Rockcod. Included among these risks are the loss or degradation of estuarine and intertidal nursery habitats. As the proposal would temporarily impact a very small proportion of Black Rockcod habitat in the estuary, it is not considered a substantial loss or degradation of estuarine habitat. Thus, the proposal is not considered to interfere with any recovery objectives for the Black Rockcod.

7. *Whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community.

The KTP of *Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams* (FM Act) is of relevance given instream structures would be placed in or adjacent to Black Rockcod habitat. This KTP is discussed in Section 0. However, these structures are unlikely to substantially alter nearshore natural tidal flow and therefore would not be exacerbated by the project to impact Black Rockcod.

#### Conclusion

Black Rockcod are known to occur in estuaries, particularly on medium to high relief rocky reefs. The project would temporarily disturb potential habitat for the species from vessel/barge traffic, piling noise and vibration and anchoring during construction. However, high condition habitat occurs in many areas in the harbour and due to the temporary nature of the disturbance, the project is unlikely to significantly impact Black Rockcod and a SIS is not required.

## Significant impact assessment (EPBC Act)

### Black Rockcod (*Epinephelus daemeli*) – vulnerable (EPBC Act)

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

- (a) Lead to a long-term decrease in the size of an important population of a species

Black Rockcod, also known as Black Cod or Saddled Rockcod, occur from southern Queensland to Kangaroo Island in South Australia and are found offshore at Lord Howe Island, Norfolk Island, Kermadec Islands and the North Island of New Zealand (Heemstra & Randall, 1993). New South Wales is the centre of the species distributional range in Australia. They are protogynous hermaphrodites (ie change sex from female to male) and at the time of spawning, males establish a harem within their territory. Black Rockcod are opportunistic carnivores, eating mainly other fish and crustaceans.

Black Rockcod are mostly found in caves and gutters in coastal areas. Dispersal of eggs is thought to be pelagic and juveniles can recruit to rockpools (Griffiths, 2002). Adults are highly territorial, usually adopting a cave as a core territory. Black Rockcod have been observed by divers or caught by anglers in estuaries, including Sydney Harbour. Although the locations of these occurrences have generally been at the mouths of estuaries and involved juvenile fish, there is anecdotal evidence that Black Rockcod have been caught in embayments of the harbour. Although the species may have been prevalent in estuaries in the past (NSW Department of Industry and Investment, 2009), it is unlikely that viable populations of Black Rockcod currently occur in the estuary but rather a few individuals that occur would form part of one or many important populations in nearby coastal areas. Any Black Rockcod in the harbour are likely to form a very small proportion of an important population of the species, and appropriate proposal controls to complete targeted surveys for individuals prior to water-based construction activities so that individuals could be encouraged away from the proposal area, would be implemented. Thus, the proposal impacts would unlikely impact the species such that an important population of the species would experience a long-term decrease in size.

- (b) Reduce the area of occupancy of an important population

As indicated in (a), Black Rockcod are mostly found in caves and gutters in coastal areas thus, the small number of individuals in the harbour are likely to form part of an important population in nearby coastal areas. There is low to medium relief rocky reef habitat in the study area which can form habitat for the species although the availability of gutters and caves may be limited compared to high relief reef habitat in other elsewhere in the harbour. The proposal would not remove any of this habitat but disturbance from vessel/barge movement, piling noise and vibration and anchoring would be experienced during construction. Shading of a small portion of subtidal rocky reef habitat could trigger changes to community assemblages in this area. However, the removal of the existing structure is likely to encourage macroalgae to recolonise a similar area to the shaded area, inherently improving habitat condition. These impacts are unlikely to permanently reduce the area of occupancy of an important population as the study area would become available for Black Rockcod upon completion of construction.

- (c) Fragment an existing important population into two or more populations

As indicated in (a), the small number of individuals in the harbour are likely to form part of an important population in nearby coastal areas. The occupancy of these individuals in the harbour are likely to mostly surround medium to high relief rocky reef areas, as refuges, and open water as transiting areas. The proposal would not install any structures or remove substantial areas of habitat to fragment important populations of Black Rockcod as connectivity in the study area and the wider harbour would be maintained.

- (d) Adversely affect habitat critical to the survival of a species

See (b).

- (e) Disrupt the breeding cycle of an important population

Black Rockcod are protogynous hermaphrodites (ie change sex from female to male) and at the time of spawning males establish a harem within their territory. Dispersal of eggs is thought to be pelagic and juveniles can recruit to rockpools (Griffiths, 2002). As indicated in (a), Black Rockcod individuals in the harbour are likely to form part of an important population in nearby coastal areas, the habitat in the harbour is only a small proportion of habitat occupied by the species in its breeding cycle. Since any Black Rockcod in the harbour are likely to form a very small proportion of a viable population of the species, and with the appropriate proposal controls to complete targeted surveys for individuals prior to water-based construction activities to encourage any individuals in the study areas to vacate, proposal impacts would be negligible and would not disrupt the breeding cycle of an important population.

- (f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

See (b) and (c).

- (g) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Use of equipment and movement of vessels and barges have potential to act as vectors for introduced species. However, there are no known invasive species that could be introduced that could directly cause Black Rockcod to decline. Invasive species that would alter Black Rockcod habitat could be introduced via the aforementioned vectors however, proposal controls would be in place to avoid introductions. Thus, the proposal is unlikely to introduce or spread invasive species that are harmful to Black Rockcod.

- (h) Introduce disease that may cause the species to decline

As per (g).

- (i) Interfere substantially with the recovery of the species

State and Commonwealth recovery plans have been developed for the Black Rockcod. The specific objectives of the Commonwealth recovery plan are to:

- mitigate moderate and high risk threats to Black Rockcod
- initiate and support scientific research to increase knowledge of the distribution, abundance, reproductive biology, life history, ecology, migratory patterns and genetics of Black Rockcod
- monitor fishery management strategies where necessary to reduce potential for interaction with Black Rockcod (either directly or indirectly)
- establish an on-going monitoring program to document the status of Black Rockcod populations and their habitats and to evaluate the effectiveness of recovery actions
- provide enhanced compliance and protection for important Black Rockcod habitats
- educate the community about the identification of and 'best practice' catch and release methods for Black Rockcod, increase awareness of the status of and threats to Black Rockcod populations, and enhance community support for recovery actions
- improve understanding of the threats to the survival of Black Rockcod and contribute to management actions to ameliorate identified threats.

The key objectives of the recovery plan are to mitigate medium and high risk threats to Black Rockcod. Included among these risks are that juvenile Black Rockcod are impacted by the loss or degradation of estuarine and intertidal nursery habitats. As the proposal would temporarily impact a very small proportion of Black Rockcod habitat in the estuary, it is not considered a substantial loss or degradation of estuarine habitat. Thus, the proposal is not considered to interfere with any recovery objectives for the Black Rockcod.

## Conclusion

Black Rockcod are known to occur in estuaries, particularly on medium to high relief rocky reefs. The proposal would cause some temporary disturbance during construction. However, ambient

habitat condition would return following construction completion and high condition habitat occurs in many areas in the harbour and the study area only forms a very small proportion of available habitat for important populations of Black Rockcod. Thus, the proposal is unlikely to significantly impact Black Rockcod and a referral is not required.

## **Grey-headed Flying-fox (*Pteropus poliocephalus*) – vulnerable (EPBC Act)**

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

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

There have been no roosting camps currently identified in the study area thus, the proposal would not directly affect any known breeding site of the Grey-headed Flying-fox. Therefore, the impacts of the proposal would be confined to loss of foraging habitat caused by direct clearing during the construction phase.

The proposal would directly remove up to 0.04 hectares of native/exotic gardens which form potential foraging habitat. Foraging habitat mainly comprises nectar resources from native trees as well as fruits of some exotic trees. This area of habitat may be defined as a portion of the potential area of occupancy for feeding lifecycle attributes of important populations. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the study area. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of populations in the region, the proposal is not expected to lead to a long-term decrease in the size of an important population of the Grey-headed Flying-fox.

(b) reduce the area of occupancy of an important population

See (a). The proposal will reduce the area of foraging habitat available to the species however, the area occupied by this species will remain the same and disturbed areas would be landscaped and reinstated following construction completion.

(c) fragment an existing important population into two or more populations

There is currently a high degree of habitat fragmentation across the wide locality. Highly mobile species, such as Grey-headed Flying-foxes, are expected to be less impacted by fragmentation and this species is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. Thus, the proposal would not fragment an important population of the Grey-headed Flying-fox.

(d) adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- to maintain genetic diversity and long-term evolutionary development
- for the reintroduction of populations or recovery of the species.

The proposed area of habitat loss represents a very small proportion of potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of the study area and known roosting camps in the region. This species typically exhibits very large home ranges and Grey-headed Flying-foxes are known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources (Eby, 1996). No evidence of a Grey-headed Flying-fox camp has been identified in or next to the study area.

The draft recovery plan for the Grey-headed Flying-fox (Department of the Environment and Energy, 2017) identifies trees of the Myrtaceae family as important foraging habitat for this species. The proposal would require the removal of five of these trees however, the affected area of foraging habitat represent a small proportion of the total extent of important foraging vegetation types present within a 50 kilometre radius of the study area. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the proposal is not expected to adversely affect habitat critical to the survival of the species.

(e) disrupt the breeding cycle of an important population

As stated above there would be a minor impact on foraging habitat identified as important during the breeding cycle of the species. The proposal would not directly affect a known roosting camp/breeding site.

(f) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

As stated above, no evidence of a roosting camp has been identified in or next to the study area and there would be a relatively minor impact on critical foraging habitat. Thus, the proposal is not expected to lead to a decline of populations of this species.

(g) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The potential for weed invasion was considered possible with a proposal of this nature and appropriate controls would be implemented during construction and operation to reduce this threat.

(h) introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the proposal. The proposal would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

(i) interfere substantially with the recovery of the species.

The Draft Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) (Department of the Environment and Energy, 2017) outlines the following actions:

- identify, protect and enhance native foraging habitat critical to the survival of Grey-headed Flying-foxes.
- identify, protect and enhance roosting habitat of Grey-headed Flying-foxes camps.
- determine population trends in Grey-headed Flying-foxes so as to monitor species' national distribution and conservation status.
- build community capacity to coexist with flying-foxes and minimise the impacts on urban settlements from existing camps without resorting to dispersal.
- increase public awareness and understanding of Grey-headed Flying-foxes and the recovery program, and involve the community in the recovery program where appropriate.
- improve the management of Grey-headed Flying-fox camps in sensitive areas.
- significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture.
- support research activities that will improve the conservation status and management of Grey-headed Flying-foxes.
- assess and reduce the impact on Grey-headed Flying-foxes of electrocution on power lines, and entanglement in netting and on barbed-wire.

The recovery actions listed above are largely not applicable to the proposal as they focus on priority conservation lands that are outside of the study area, community awareness and research and development. In addressing action 1, given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the proposal is not expected to interfere substantially with this recovery action by removing a very small proportion of a foraging resource. Furthermore, vegetation prevalent with exotic species would be replaced with native species local to the Sydney region during landscaping.

## Conclusion

The Grey-headed Flying-fox will suffer a small reduction in extent of suitable foraging habitat from the proposal. No roosting/breeding camps or other important habitat will be impacted. The proposal

is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. The proposal will not interfere with the recovery of the Grey-headed Flying-fox and will not contribute to the key threats to this species. Thus, the proposal is unlikely to significantly impact the Grey-headed Flying-fox and a referral is not required.



# Appendix E

## Noise and vibration impact assessment

# Noise and Vibration Impact Assessment

South Mosman Wharf Upgrade

AWE200198



Prepared for  
Transport for NSW

December 2020

## Document Information

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## Executive summary

This noise and vibration impact assessment was conducted on behalf of Transport for NSW (TfNSW), for inclusion in the Review of Environmental Factors prepared for the proposed South Mosman wharf. South Mosman wharf is a commuter wharf located approximately two kilometres from Circular Quay, Sydney. Currently, the wharf interchange does not provide equitable access to ferry services.

The water based features of the proposal would include:

- > Installation of a new covered 18.9 metre gangway located to the north of the existing wharf to provide access to the new pontoon
- > Installation of a new 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- > Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- > Removal of the existing gangway and pontoon including existing piles
- > Remediation of the seawall following removal of the existing wharf, if required.

The land based features of the proposal would include:

- > Installation of a new 16-metre high lift and new covered stairs
- > Installation of a new covered street level waiting area
- > Installation of a covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- > Installation of three bicycle parking hoops
- > Demolition of existing shelter and stairs from Musgrave Street to the existing wharf
- > Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

Figure 2-2 shows the key features of the proposal including the water-based and land-based features.

This assessment has been carried out to determine the predicted noise and vibration impacts associated with the construction of the proposed South Mosman wharf upgrade. Noise modelling has been carried out to determine whether the proposed construction works associated with the proposal are likely to impact nearby noise sensitive receivers.

This assessment considers the following impacts on nearby noise sensitive receivers:

- > Noise impacts from construction of the project in accordance with NSW EPA (formerly the Department of Environment & Climate Change (DECC)) and Roads & Maritime guidelines for the control of construction noise impacts
- > Construction vibration from the project in accordance with NSW EPA (formerly the Department of Environment & Conservation (DEC)) and Roads & Maritime guidelines for assessing vibration.

### Construction noise and vibration guidelines

This assessment considers the following policies and guidelines:

- > *Interim Construction Noise Guideline* (DECC 2009) (ICNG)
- > *Construction Noise and Vibration Guideline* (RMS 2016) (CNVG)
- > *Assessing Vibration – A Technical Guideline* (DEC 2006) (AVATG).

## Assessment conclusions

The assessment identified the following conclusions:

- > In accordance with the noise management levels stipulated in Section 5.1, dwellings exposed to levels of construction noise above 75 dB(A) are considered highly noise affected, with dwellings exposed to levels above the daytime RBL +10 dB(A) considered noise affected
- > Construction noise levels are predicted to exceed the NSW ICNG noise management levels (NML) for “standard” hours at all NCAs for standard construction hours for all construction scenarios
- > Construction noise levels are predicted to exceed noise management levels for “non-standard” hours of operation for Scenario 3, 4a, 4b and 4c at the nearby residential receivers in both NCAs, particularly for receivers located on Herron Walk and Musgrave Street in NCA 1. This is due to the proximity of receivers to the construction works
- > Predicted levels are expected to be highly intrusive at a number of receivers in NCA 1 & 2 for Scenario 3, 4a, 4b and 4c for works during OOH1 and OOH2 time periods. Construction noise is likely to have the highest impact on and cause sleep disturbance at sensitive receivers located on Herron Walk and Musgrave Street in NCA 1 and Cremorne Road in NCA 2, due to their proximity to the proposed work site
- > It should be noted that this assessment has endeavoured to carry out “worst case” noise modelling, and noise levels are predicted based on all modelled sources operating simultaneously. Should the work sites or plant and equipment be amended, the predicted noise levels will change accordingly
- > The predicted exceedances are generally a result of works being located in close proximity to the adjacent receivers. This modelling has been carried out to provide a worst case scenario and it may be possible to reduce the number of plant operating simultaneously, particularly at night, once detailed construction schedules are known
- > Provision of temporary noise barriers where practical. The height and location of these barriers will be determined during preparation of the construction noise and vibration management plan (CNVMP) when more information regarding the proposed plant to be used for each construction scenario is available.
- > Best practice mitigation measures are recommended in Section 8 of this report
- > An indicative assessment only of expected  $L_{Amax}$  impact has been carried out for this assessment as it is difficult to predict  $L_{Amax}$  for construction noise sources. It is generally expected that sleep disturbance criteria are likely to be exceeded unless the proposed number and type of plant are reduced for out of hours works
- > The minimum working distances indicated in Table 7-1 for cosmetic damage must be complied with at all times, unless otherwise approved by TfNSW or under the environmental license as relevant, as stipulated in the CNVG
- > A detailed CNVMP would be prepared for the project prior to construction commencement to incorporate the recommendations detailed in Section 8 and updated to reflect the proposed staging and plant to be adopted for the project.

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## Technical terms

Term	Definition
Adverse Weather	Weather effects that enhance noise (that is, wind and rain) that occur at a site for a significant period of time (that is, wind exceeding 5 m/s and rain exceeding 0.5 mm per hour during any measurement period.)
A-weighted Level	As per dB(A) defined below.
Ambient Sound	Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far.
AV:ATG	New South Wales Office of Environment and Heritage Assessing Vibration: A Technical Guide (DEC 2006)
Background Sound Level	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources.
CNVG	Construction Noise and Vibration Guideline (RMS, 2016)
CNVMP	Construction Noise and Vibration Management Plan
CoRTN	Calculation of Road Traffic Noise, HMSO 1988
dB(A)	Unit of acoustic measurement electronically weighted to approximate the sensitivity of human hearing to sound frequency.
DEC	NSW Department of Environment and Conservation, now known as the NSW Office of Environment and Heritage
DECC	NSW Department of Environment and Climate Change, now known as the NSW Office of Environment and Heritage
DECCW	NSW Department of Environment and Climate Change and Water, now known as the NSW Office of Environment and Heritage
Decibel, dB	Unit of acoustic measurement. Measurements of power, pressure and intensity may be expressed in dB relative to standard reference levels.
ECRTN	New South Wales superseded Office of Environment and Heritage Environmental Criteria for Road Traffic Noise (EPA 1999).
ENMM	The New South Wales Department of Roads and Maritime Safety Environmental Noise Management Manual (RTA 2001).
EPA	New South Wales Environmental Protection Authority
ICNG	New South Wales Office of Environment and Heritage Interim Construction Noise Guideline (DECCW 1999).
INP	New South Wales Office of Environment and Heritage Industrial Noise Policy (EPA 2000).
L90, L10 etc.	A statistical measurement giving the sound pressure level which is exceeded for the given percentile of an observation period, i.e. L90 is the level which is exceeded for 90 percent of an observation period. L90 is commonly referred to as a basis for measuring the background sound level.
LAbg, T	The A-weighted background sound level measured over a time interval T.
LAeq, T	Equivalent continuous A-weighted sound pressure level. This is the value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.
NSW	New South Wales
RBL	Rating Background Level
RNP	New South Wales Office of Environment and Heritage Road Noise Policy (DECCW 2011).
RTA	NSW Roads and Traffic Authority, now known as the NSW Department of Transport, Roads and Maritime Services

Term	Definition
Roads and Maritime	NSW Roads and Maritime Services (now known as Transport for NSW)
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Pressure Level, Lp, dB, of a sound	A measurement obtained directly obtained using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the r.m.s. sound pressure to the reference sound pressure of 20 microPascals.
Sound Power Level, Lw, dB of a source	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power level is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt.
TfNSW	Transport for NSW

# 1 Introduction

---

This noise and vibration impact assessment was conducted on behalf of Transport for NSW (TfNSW), for inclusion in the Review of Environmental Factors prepared for the proposed South Mosman wharf upgrade.

The South Mosman wharf is located off Musgrave Street on the northern side of Sydney Harbour within the suburb of Mosman. The existing wharf consists of the ferry jetty, associated shade structure and existing stairway providing access from Musgrave Street.

The assessment has been carried out to determine the predicted noise and vibration impacts associated with the construction of the proposed South Mosman wharf upgrade.

Noise modelling has been carried out to identify any potential noise impacts on nearby noise sensitive receivers as a result of proposed construction works associated with the proposal.

This assessment considers the following policies and guidelines:

- > *Interim Construction Noise Guideline* (DECC 2009) (ICNG)
- > *Construction Noise and Vibration Guideline* (RMS 2016) (CNVG)
- > *Assessing Vibration – A Technical Guideline* (DEC 2006) (AV:ATG).

In undertaking the assessment, unattended noise monitoring was conducted to measure the existing ambient noise levels at two noise sensitive locations near the proposed South Mosman wharf construction work site.

3D noise modelling software (SoundPLAN 8.2) was used to create a noise model of the existing scenario. The 3D model was then used to predict construction noise levels associated with the proposed works impacting on nearby noise sensitive receivers by adopting the appropriate construction staging scenarios.

## 1.1 Assessment objectives

The assessment objectives are to determine the predicted levels of construction noise and vibration impact on sensitive receivers located near to the proposal, and to determine the levels of mitigation that are likely to be required, if applicable, to enable compliance with the current NSW legislation.

## 2 Proposal description

### 2.1 Proposal description

The water based features of the proposal would include:

- > Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- > Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- > Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- > Removal of the existing gangway and pontoon including existing piles.
- > Remediation of the seawall following removal of the existing wharf, if required

The land based features of the proposal would include:

- > Installation of a new 16 metre high lift and new covered stairs
- > Installation of a new covered street level waiting area
- > Covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- > Installation of three bicycle parking hoops
- > Demolition of existing shelter and stairs from Musgrave Street to the existing wharf
- > Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

Figure 2-1 shows a visual perspective of the proposal from a waterside perspective. Figure 2-2 shows the key features of the proposal including the water-based and land-based components.



Figure 2-1 Key features of the proposal

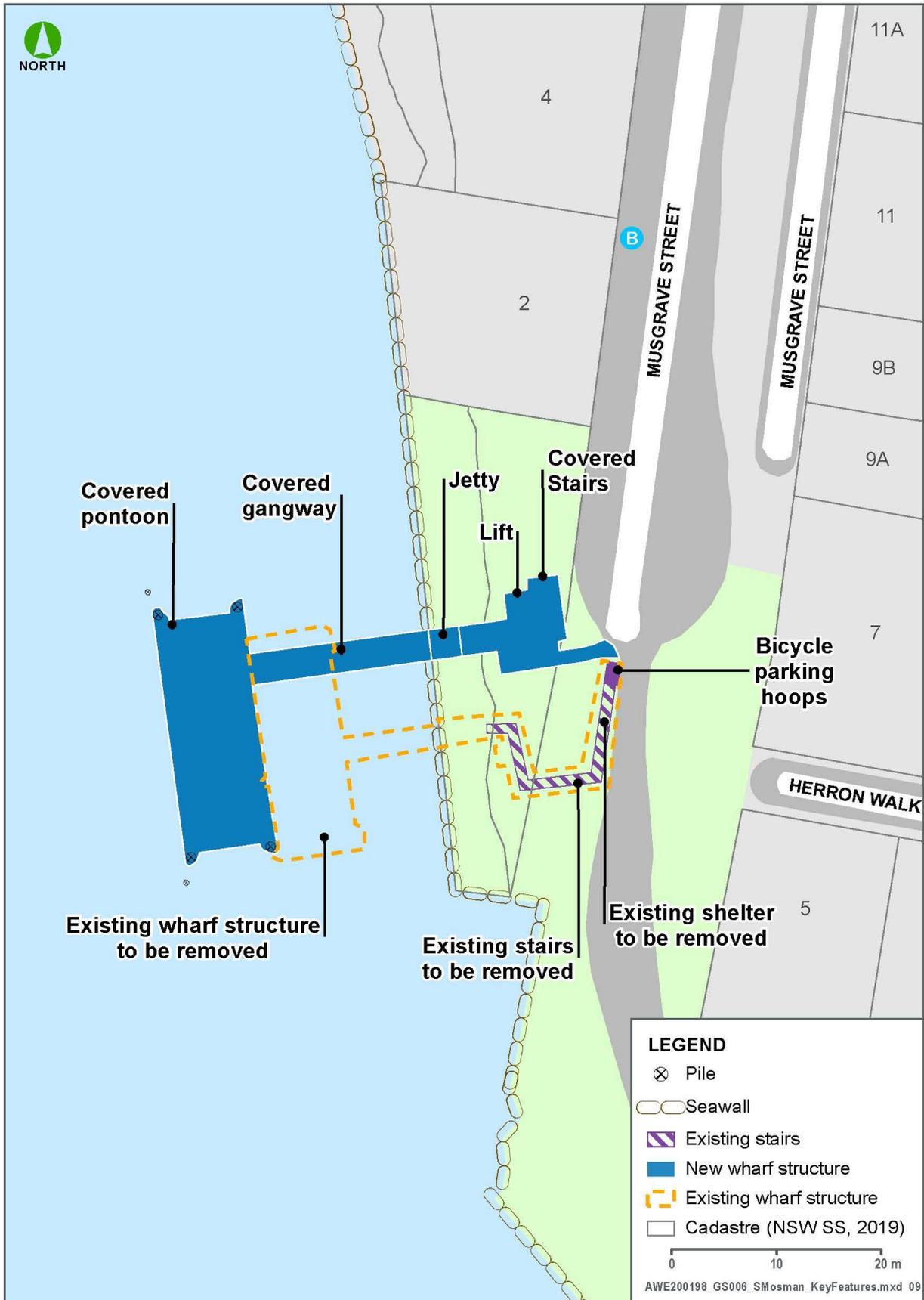


Figure 2-2 Key features of the proposal

## 2.2 Existing site description

The South Mosman wharf is located on Musgrave Street on the south eastern bank of Mosman Bay approximately 270 metres from residential properties located to the west along Cremorne Reserve Path. The existing wharf is surrounded by a range of noise sensitive receivers, mostly residential. Non-residential receivers include recreational areas such as the Sydney Amateur Sailing Club, Cremorne Point Garden & Walk and Cremorne Reserve Parkland.

The assessment area for the southern section of the proposal, is shown in Figure 2-3 and includes the land uses listed in Table 2-1.

Table 2-1 Existing land uses

Label	Description	Land Use
1	Sydney Amateur Sailing Club	Passive Recreation
2	Residential East	Residential
3	Residential West	Residential
4	Cremorne Point Garden & Walk	Passive Recreation
5	Cremorne Reserve Parkland	Passive Recreation
6	Residential North East	Residential
7	Residential North West	Residential
8	Curraghbeena Park	Passive Recreation



Figure 2-3 Site location and surrounding land uses

## 2.3 The proposal

The proposed upgrade to the existing South Mosman wharf is a TfNSW initiative to provide a modern and integrated upgrade to transport infrastructure in NSW.

The proposal generally comprises of the following construction scenarios, onsite activities and timing listed in Table 2-2.

Table 2-2 Construction scenarios

Construction Scenario	Proposed Activities
<b>Scenario 1 - Site establishment</b> (up to one month)	<ul style="list-style-type: none"> <li>▪ The existing wharf would be closed.</li> <li>▪ Given that there is little space available on land it is likely that the majority of the site compound (materials storage, laydown, site sheds, ablutions, etc.) would need to be established on a construction barge moored adjacent to the existing wharf. It may be possible to use the existing wharf for site offices and ablutions once the wharf is closed to the public.</li> <li>▪ Traffic control measures (including for vehicles, watercraft, pedestrians and cyclists) would be established in accordance with the traffic management plan. Appropriate wayfinding signage would be installed advising of alternative transport options where necessary.</li> <li>▪ Environmental controls would be established in accordance with the CEMP.</li> <li>▪ A small excavator (about eight tonnes) would be installed at water's edge by crane barge, to undertake clearing and grubbing of water's edge and rock face areas. Spoil would be removed by barge.</li> </ul>
<b>Scenario 2 - Demolition of the existing wharf</b> (1 to 2 months)	<ul style="list-style-type: none"> <li>▪ The construction work area would be delineated using floating booms. This would make allowance for the outward reach of the construction barge's four anchorage points, over which marine vessels may not cross for safety reasons. The anticipated size of the barges is up to about 20 metres by 30 metres in size.</li> <li>▪ Up to three barges would travel to the site from the off-site facility. One barge would be fitted with a crane. When on-site, it would be anchored by four points but would reposition around the site during the work, as required</li> <li>▪ The existing shelter, wharf furniture and gantry would be cut away from the piles and loaded onto a barge by crane to be transported to an appropriately approved and licensed facility for reuse and/or disposal.</li> <li>▪ The existing pontoon would be floated away for disposal.</li> <li>▪ The existing steel piles would be removed by vibratory methods. If a pile is unable to be extracted by vibratory methods, it would be cut off level with the harbour bed. Divers would cut the pile at seabed level using appropriate underwater equipment. Piles would be transported by barge to an appropriately approved and licensed facility for reuse and/or disposal.</li> <li>▪ Remediation of the seawall following removal of the existing wharf, if required.</li> </ul>
<b>Scenario 3 - Construction of works on the water's edge</b> (up to 2 months)	<ul style="list-style-type: none"> <li>▪ Install a medium sized excavator (about 13 tonnes) with rock hammer at water's edge by crane barge.</li> <li>▪ Excavate stair well and lift slot. The excavation may require rock bolting and/or shotcrete to support the face. This would require specialised equipment to be lifted into position and removed by a large crane barge. Spoil would be removed by barge.</li> <li>▪ Install a small excavator-mounted piling rig at water's edge by barge crane.</li> <li>▪ Install piles for platform, lift shaft and gantry abutment foundations. It is assumed piles will be five to ten metres in depth and 600 – 750 millimetres in diameter. Concrete and reinforcement can be delivered from Musgrave Street. Spoil would be removed by barge. It is assumed piles would need</li> </ul>

Construction Scenario	Proposed Activities
	<p>to be either cased or be CFA piles given the uncohesive soils and high water table.</p> <ul style="list-style-type: none"> <li>▪ Remove piling rig by barge crane.</li> <li>▪ Break down piles. Spoil would be removed by barge.</li> </ul>
<p><b>Scenario 3 - Construction of superstructure works</b> (up to 2 months)</p>	<ul style="list-style-type: none"> <li>▪ Construct base slab and pile caps for stairs, lift platform and lift tower. Formwork, concrete and reinforcement would be delivered from Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked.</li> <li>▪ Construct piers and headstocks for stairs and lift platform. Formwork, concrete and reinforcement would be delivered from Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked.</li> <li>▪ Lift precast column capping beams (for platform) using large mobile crane on Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked.</li> <li>▪ Install precast concrete stairs units by large mobile crane installed in Musgrave Street.</li> <li>▪ Saw cut Musgrave Street concrete pavement and excavate to abutment foundation level (assuming rock is within one metre of pavement level, otherwise piles will also be required). Musgrave Street would be closed to buses at this time as there would be no provision for turning around. Steel road plates would be required to allow cul-de-sac to be opened to buses between works.</li> <li>▪ Construct platform abutment in Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around. Steel road plates would be required to allow cul-de-sac to be opened to buses between works</li> <li>▪ Demolish existing Musgrave Street pavement below platform. Musgrave Street would be closed to buses at this time as there would be no provision for turning around.</li> <li>▪ Install precast planks between abutment and columns using large mobile crane on Musgrave Street. A detailed lift study would be required to confirm that planks can be delivered to site (probably by reversing trucks) and lifted into position by crane within the limited footprint. Musgrave Street would be closed to buses at this time as there would be no provision for turning around.</li> <li>▪ Construct concrete deck slab on platform. Formwork, concrete and reinforcement would be delivered from Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around.</li> <li>▪ Construct tie-in pavement between platform and Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around.</li> <li>▪ Install lift tower and lift car using large mobile crane on Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave street would be blocked.</li> <li>▪ Demolition of the existing stairs. Spoil would be removed by barge.</li> <li>▪ Finishing works (landscaping, paving, handrails, etc.) and demobilisation.</li> <li>▪ It is likely that a new electricity supply would need to be installed to power the lifts. This may require the installation of a new electrical cable (either underground or overhead) along streets accessing the site. This could require extensive works.</li> </ul>
<p><b>Scenario 4 - Installation of steel piles</b> (up to 1 month)</p>	<ul style="list-style-type: none"> <li>▪ Steel locator piles for the pontoon and foundation piles for the jetty would be installed into bedrock. These piles would be transported by barge to the site from the off-site facility</li> </ul>

Construction Scenario	Proposed Activities
	<ul style="list-style-type: none"> <li>▪ The installation of the piles for the jetty would likely be undertaken by a barge mounted piling rig. The jetty would be an independent structure to the seawall.</li> <li>▪ Construct pile foundation systems in bedrock as follows:                             <ul style="list-style-type: none"> <li>○ Pre-drilling into rock</li> <li>○ Positioning steel pile casing with crane mounted driving unit and piling guide</li> <li>○ Driving or screwing the steel pile casings into position</li> </ul> </li> <li>▪ Cutting the steel pile casings to length and backfilling with concrete.</li> </ul>
<b>Scenario 5 - Installation of the pontoon and gangway</b> (up to 1 month)	<ul style="list-style-type: none"> <li>▪ Lifting and placement of components for the new wharf would be carried out using a barge mounted crane.</li> <li>▪ The new pontoon structure would be fabricated at an off-site facility and floated to site. The pontoon would be secured to the locator piles and packing plates used to trim the plan position. The roof structure may be installed in a separate lift.</li> <li>▪ The new gangway would be fabricated at an off-site facility and floated to site by barge. The gangway would be lifted into position a large barge mounted crane.</li> <li>▪ Finishing works completed (architectural, services, handrails, etc.).</li> </ul>
<b>Scenario 5 - Installation of new or improved facilities</b> (up to 1 month)	<ul style="list-style-type: none"> <li>▪ Installation of way-finding signage.</li> <li>▪ Re-landscaping of the construction areas.</li> </ul>
<b>Scenario 6 – Site Clean Up</b> (up to 1 month)	<ul style="list-style-type: none"> <li>▪ The site would be cleaned up and restored to its previous state</li> <li>▪ Sedimentation controls and temporary structures would be removed.</li> </ul>

## 3 Existing noise environment

The existing acoustic environment is generally dominated by road traffic noise on local roads and noise from boats on the Mosman Bay.

### 3.1 Unattended noise monitoring methodology

Unattended noise monitors were installed at the following two locations to measure ambient (i.e. background) noise levels for a period of seven days to determine the ambient background noise levels. Noise monitors were configured to measure 15-minute statistics, between the 30 April and 7 May 2020.

The unattended noise monitors were configured to measure noise levels as follows:

- > 'A' weighting
- > 'Fast' response
- > 15 minute statistical intervals
- > Measurement descriptors  $L_{A_{Max}}$ ,  $L_{A_{eq}}$ ,  $L_{A1}$ ,  $L_{A10}$ ,  $L_{A90}$ .

The loggers were deployed at the following locations (Figure 3-1):

- > **Logger 1** was approximately 22 metres from 5 Herron Walk and approximately 18 metres from the South Mosman wharf pontoon.
- > **Logger 2** was located approximately 11 metres from 45 Cremorne Road and approximately 280 metres from the South Mosman wharf site.

Unattended noise monitoring was carried out using the equipment listed in Table 3-1.

Table 3-1 Noise monitoring equipment

Location	Logger Type	Serial Number
1	ARL EL-316	16-203-502
2	ARL EL-316	16-707-037

#### 3.1.2 Potentially altered noise environment

It should be noted that the background noise monitoring was conducted during COVID 19 and may represent non-typical background noise levels on this basis. Therefore, background noise levels may need to be re-determined (with short term monitoring) prior to construction to ensure that they are similar to those measured, and used as a basis for the noise management levels in this report.



Figure 3-1 Noise monitoring locations

### 3.2 Equipment calibration

Calibration of the sound monitoring equipment was conducted before and after the measurement period, with a variance of less than  $\pm 0.3\text{dB}$  recorded.

### 3.3 Metrological monitoring conditions

A summary of the environmental conditions noted during the measurement period were as follows (source weather station located on site):

#### 3.3.1 Monitoring period – 30 April to 7 May 2020

- Conditions: Mostly fine with some showers on 30 April and 5 May.
- Wind: 1 - 8 m/s predominantly from a west south west (WSW) direction
- Humidity: 30 – 89 per cent
- Temperature: 10 – 25°C

Detailed weather information recorded at the site during the monitoring period is detailed in Appendix B. Data was excluded for rain periods during the monitoring period.

Slightly elevated winds occurred intermittently on two of the monitoring days only. It should be noted that Bureau of Meteorology wind speed was recorded at seven metres above the ground and that the ground level wind speed is significantly less. Adjustments have been made for this in Appendix B. As shown in Appendix B, adjusted wind speed of more than 5 m/s was observed on occasions. However, these

exceedances occurred for a short period of time and did not affect the monitored noise levels on-site. As such, no data was removed from the monitoring results.

### 3.4 Measurement parameters

As environmental noise varies with time, the use of statistical descriptors is necessary to understand and describe these variations. For road traffic noise these descriptors are further classified for day time (7am - 10pm) and night time (10pm - 7am).

For environmental noise, the assessment period for day time is further split into day (7am – 6pm) and evening (6pm – 10pm). A-weighted statistical levels are used to describe ambient noise levels. The common descriptors used to describe environmental noise are described as follows:

- L<sub>Amax</sub>:** the A-weighted maximum noise level measured during the measurement period
- L<sub>A1</sub>:** the A-weighted noise level exceeded for 1 per cent (%) of the measurement period
- L<sub>A10</sub>:** the noise A-weighted level exceeded for 10 per cent (%) of the measurement period, generally referred to as the average maximum sound pressure level
- L<sub>A90</sub>:** the A-weighted noise level exceeded for 90 per cent (%) of the measurement period, generally referred to as the background noise level (refer AS 1055.1 – 1997)
- L<sub>Aeq</sub>:** the equivalent continuous noise level over the measurement period, generally referred to as the energetical average sound pressure level over the measurement period.

### 3.5 Measured noise levels

Measured noise levels at each logger location were observed to be affected by the following:

Table 3-2 Observed existing noise environment

Logger	Location	Observed Noise Environment
1	Musgrave Street/Wharf Site	The primary source of noise was from local traffic along Musgrave Street and general noise from nearby waterway vessels.
2	Cremorne Road	The primary source of noise was from nearby waterway vessels. Intermittent traffic from the Cremorne Road was also audible while on site.

#### 3.5.2 Rating background noise level

The Rating Background Level (RBL) for each site was determined in accordance with the Noise Policy for Industry (EPA, 2017) (NSW NPI). The RBL is defined by the NSW NPI as follows:

“Rating background level (RBL)—the overall single figure background level representing each assessment period (day / evening / night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). The rating background level is the level used for assessment purposes. Where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A).”

The weather affected data (due to wind or rain) was excluded from the analysis in accordance with the NPI requirements. The RBL applicable to each site is detailed below in Table 3-3.

The measured RBLs from Table 3-3 have been used to formulate the noise objectives for construction noise impacts as detailed in Section 5.1.

Table 3-3 Rating background noise level

Logger	Measurement Location	Measured Rating Background Noise Level, dB(A)		
		07:00-18:00	18:00-22:00	22:00-07:00
1	Musgrave Street/Wharf Site	45	41	38
2	Cremorne Road	38	33	28

The measured RBLs from Table 3-3 have been used to formulate the noise objectives for construction noise impacts as detailed in Section 5.1. Typical measured noise levels, averaged from measured data, are shown below in Figure 3-2 for Logger 1 and Figure 3-3 for Logger 2. Full noise charts are displayed in Appendix A.

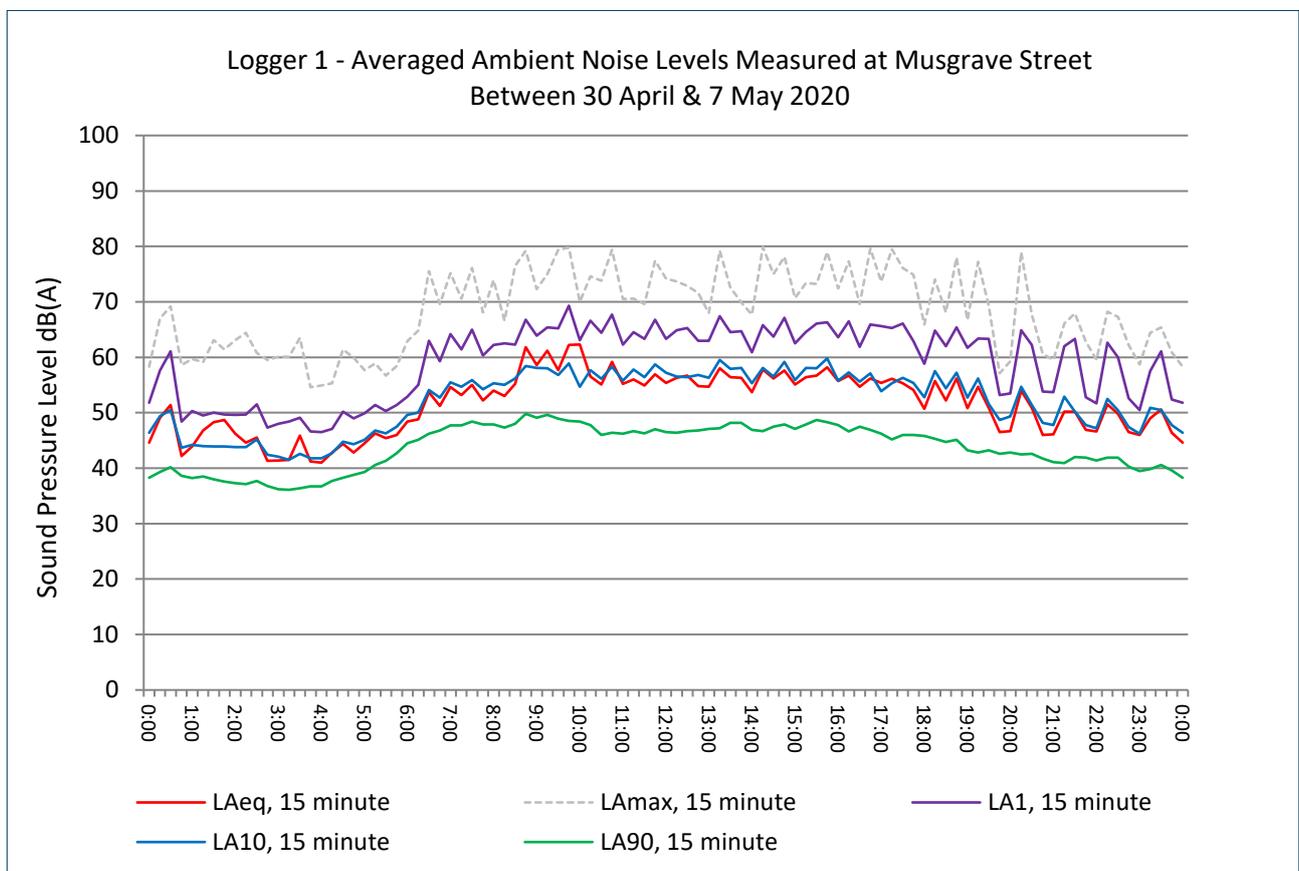


Figure 3-2 Averaged measured noise levels – logger 1

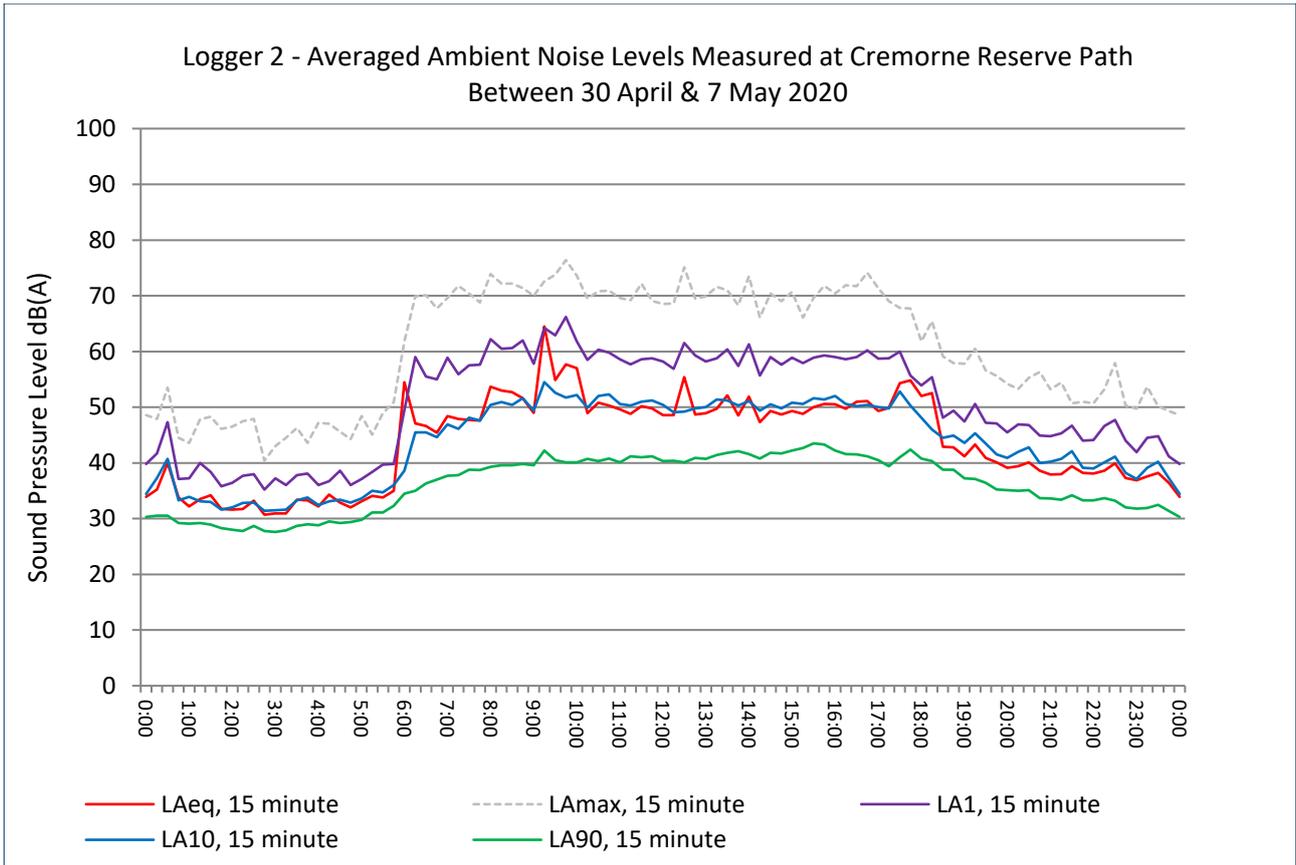


Figure 3-3 Averaged measured noise levels – logger 2

## 4 Statutory noise and vibration criteria

### 4.1 Noise criteria

#### 4.1.1 Roads and Maritime Construction Noise and Vibration Guideline

The Roads and Maritime Construction Noise and Vibration Guideline (Roads and Maritime 2016) (CNVG) provides a framework for the assessment of noise during the construction phase of the proposal. The CNVG references the following documents to provide the criteria for the assessment of construction noise and vibration impacts:

- > EPA Interim Construction Noise Guideline
- > EPA Assessing Vibration – Technical Guideline
- > EPA Road Noise Policy (RNP).

The CNVG provides recommended minimum separation distances between vibration intensive plant and sensitive receivers for minimising the risk of cosmetic damage. The CNVG further states that the minimum working distance for cosmetic damage must be complied with at all times, unless otherwise approved by Transport for NSW or under the environmental licence as relevant. The minimum working distances are summarised below in Section 7.2.2

#### 4.1.2 Interim Construction Noise Guideline

##### 4.1.2.1 Airborne construction noise

NSW Office of Environment & Heritage (OEH) provides guidance for assessing construction noise impacts in the Interim Construction Noise Guideline (DECC, 2009) (NSW ICNG).

The level of noise impact and the requirement for mitigation measures is generally determined by the timing and duration of the noise emissions and the perceived impact of the noise above existing background noise levels.

It is important to note that the guideline distinguishes between qualitative and quantitative noise assessments based on the type and duration of construction activities. For example, a qualitative assessment is warranted for road maintenance type works of short duration, whereas a quantitative assessment is preferred for major infrastructure works.

Section 4 of the guideline outlines the quantitative assessment method, which establishes noise management levels and assessment requirements for proposed construction activities over three weeks duration.

The noise management level for potentially affected residential properties, as taken from Section 4.2 of the ICNG, is detailed in Table 4-1.

Table 4-1 Noise at residences using quantitative assessment (Source: DECC, 2009)

Time of day	Management level $L_{Aeq} (15 \text{ min})^*$	How to apply
Recommended standard hours:  Monday to Friday: 7am to 6pm Saturday 8am to 1pm: No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise.  Where the predicted or measured $L_{Aeq} (15 \text{ min})$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.  The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Time of day	Management level $L_{Aeq}$ (15 min)*	How to apply
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise.  Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:  Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences  If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours.  The proponent should apply all feasible and reasonable work practices to meet the noise affected level.  Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.  For guidance on negotiating agreements see section 7.2.2.

*Notes:*

(1) *For Residential receivers - Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 metre from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

(2) *Other sensitive use receivers - Internal noise levels are to be assessed at the centre of the occupied room. External noise levels are to be assessed at the most affected point within 50 m of the area boundary*

A strong justification would typically be required for works outside the recommended standard hours (see Table 4-1). The proponent should apply all feasible and reasonable work practices to meet the noise affected level. The definition of feasible and reasonable work practices is outlined in Section 1.4 of the NSW ICNG, with the following excerpts providing a brief description:

“A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.”

“Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.”

A number of factors may be considered in selecting reasonable measures, including the level of impact, the number of people affected, and the order of treatments applied to previous, similar projects. Where all feasible and reasonable practices have been applied and noise remains more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community on suitable mitigation measures. For guidance on negotiating agreements see section 7.2.2 of the NSW ICNG.

#### 4.1.2.2 Sleep disturbance

Section 4.3 of the NSW ICNG defines the assessment of sleep disturbance as follows:

*“Where construction works are planned to extend over more than two consecutive nights, and a quantitative assessment method is used, the analysis should cover the maximum noise level, and the extent and the number of times that the maximum noise level exceeds the RBL. Some guidance indicating the potential for sleep disturbance is in the now superseded NSW Environmental Criteria for Road Traffic Noise (EPA 1999).”*

The NSW Environmental Criteria for Road Traffic Noise (EPA, 1999) (NSW ECRTN) discusses a number of methodologies with respects to sleep disturbance. In general, the methodologies address sleep disturbance due to continuous noise (expressed in terms of a  $L_{Aeq, \tau}$ ) and the affect multiple short duration noise events (expressed as a  $L_{Amax}$ ).

In addition to the night time noise criteria specified in Table 4-1 (which addresses the continuous noise component generated by construction activities), the application of a noise criteria addressing the maximum noise level from construction activities is appropriate when works are planned to extend over more than two consecutive nights. The NSW ECRTN draws the following conclusions with respects to noise limits for sleep disturbance:

Considering all of the foregoing information the following conclusions can be drawn:

- > Maximum internal noise levels below 50–55 dB(A) are unlikely to cause awakening reactions.
- > One or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

The NSW EPA confirm that a sleep disturbance criterion of  $L_{A1, 1min} \leq L_{A90, 15min} + 15dB(A)$ , is used for initial assessment for the purpose of this Review of environmental Factors (REF). It should only be used as a first step guide and where the criteria is not met, more detailed analysis is required to be incorporated into the detailed design and Construction Noise and Vibration Management Plan. The Application Notes of the NSW Industrial Noise Policy (2010) note the detailed analysis should include:

- > The extent to which the maximum noise level exceeds the background level
- > The number of times this happens during the night-time period
- > The time of day (normally between 10 pm and 7 am).

## 4.2 Vibration criteria

### 4.2.1 Assessing Vibration: A Technical Guideline (Human Comfort)

Vibration from activities associated with the proposal could potentially impact on the amenity of the occupants of dwellings or buildings located close to the site. Generally, vibration impact can be summarised into two categories:

- > Effect on human comfort
- > Structural or cosmetic damage to buildings.

Human comfort vibration criteria is addressed in the NSW ICNG and refers to Section 2.5 of the document Assessing Vibration: A Technical Guideline (NSW AV:ATG) issued by DEC (2006).

The NSW AV:ATG outlines vibration limits in relation to human comfort. Criteria in this guideline are based on the British Standard BS6472-1992 Evaluation of human exposure to vibration in buildings (1-80Hz).

Vibration sources are defined as continuous, impulsive or intermittent. Table 4-2 provides a definition and examples of each type of vibration.

Table 4-2 Types of vibration

Type of Vibration	Definition	Examples
Continuous	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.

Type of Vibration	Definition	Examples
	that the duration is short, typically less than 2 seconds.	
Intermittent	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude.	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

The criteria are to be applied to a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states: 'Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).' When applying the criteria, it is important to note that vibration may enter the body along different orthogonal axes, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). The three axes are referenced to the human body. Thus, vibration measured in the horizontal plane should be compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y and z- axis criteria if the concern is for people in the lateral position. Preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced below in Section 5 of this report.

#### 4.2.2 German standard DIN 4150 (Building Damage)

In relation to structural damage, there is currently no Australian Standard that provides criteria for the assessment of structural damage to buildings. However, the German Standard DIN 4150-3 : 1999-02 - 'Structural vibration - Effects of vibration on structures', provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration. This standard also presents recommended maximum limits over a range of frequencies measured in any direction at the foundation or in the plane of the uppermost floor.

These criteria are summarised below in Section 5.

#### 4.2.3 Summary of minimum working distances for vibration intensive plant

The following table provides a summary of the minimum working distance for different types of sensitive receivers referenced from the standards described above.

Table 4-3 Recommended minimum working distances for vibration intensive plant from sensitive receivers

Plant Item	Rating / Description	Minimum Working Distance		
		Cosmetic Damage (BS 7385)	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human Response (OH&E Vibration Guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	14 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	16 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	33 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	41 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	54 m	100 m
	> 300 kN (> 18 tonnes)	25 m	68 m	100 m

Plant Item	Rating / Description	Minimum Working Distance		
		Cosmetic Damage (BS 7385)	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human Response (OH&E Vibration Guideline)
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	19 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	60 m	73 m
Vibratory Pile Driver	Sheet Piles	2 m to 20 m	50 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	40 m	4 m
Jackhammer	Hand Held	1 m (nominal)	2 m	2 m

The minimum working distances are indicative and will vary depending on the particular item of plant, local geotechnical conditions and the dominant frequency of the construction vibration levels. They apply to cosmetic damage of typical light-framed residential buildings and heritage/fragile buildings and assume that construction vibration could include low frequency content with associated increased risk of cosmetic damage. Vibration monitoring is recommended to confirm the minimum working distances at specific sites. Additionally, further detailed analysis based on the frequency dependent guideline vibration levels in BS7385-2:1993 and DIN4150-3:2016 may be utilised in conjunction with site-specific measurements to derive alternative cosmetic damage objectives and minimum working distances. For heritage listed / fragile structures, specialist advice from an appropriately qualified structural engineer who is familiar with heritage structures is required to support any proposed relaxation of the initial cosmetic damage screening criterion. Any such relaxation shall be approved by TfNSW or under the environmental license as relevant.

### 4.3 Operational noise criteria

Operational noise has not been assessed as noise from ferry operation is not expected to differ as a result of the proposal.

### 4.4 Australian Standards

The following Australian Standards provide criteria and methodologies that have been adopted in this assessment:

- > Australian Standard AS1055: Acoustics – Description and measurement of environmental noise.

## 5 Design benchmarks

### 5.1 Construction noise

The proposal area has been divided into noise catchment areas (NCA) where ambient noise levels are likely to be similar to assess the potential construction noise impacts on surrounding receivers. These catchment areas are shown in Figure 6-1.

Works may be carried out, outside of standard hours due to the nature of the proposal. For this reason noise management levels (NMLs) have been calculated for both standard and non-standard hours. The NMLs are detailed below in Table 5-1.

Taking into consideration the measured RBLs in Section 3.5.2 and the criteria from Section 4.1, the applicable construction noise management levels for standard and non-standard hours for the proposal are shown in Table 5-1.

Table 5-1 Construction noise management levels

Noise Catchment Area	Logger Label	Noise Management Level, dB(A)			*Sleep Disturbance LA <sub>1</sub> , 1 min
		Standard Hours (RBL + 10 dB(A))	Outside Standard Hours (RBL + 5 dB(A))		
		Day	Evening	Night	
1	1	55	46	43	60
2	2	48	38	33	60

\*Sleep disturbance criteria has been calculated based on an assumed typical internal LA<sub>eq</sub> noise level of 35 dB(A) referenced from Australian Standard AS:2107 and corrected with a typical inside to outside noise reduction of 10 dB(A).

### 5.2 Construction vibration

#### 5.2.1 Human comfort criteria

The following vibration criteria for human comfort apply to this proposal.

Table 5-2 Preferred and maximum levels for human comfort

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x & y axis	z-axis	x & y axis
<b>Continuous vibration<sup>3</sup> (Weighted RMS Acceleration, m/s<sup>2</sup>, 1-80Hz)</b>					
Critical areas <sup>2</sup>	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
<b>Impulsive vibration<sup>3</sup> (Weighted RMS Acceleration, m/s<sup>2</sup>, 1-80Hz)</b>					
Critical areas <sup>2</sup>	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92
<b>Intermittent vibration<sup>4</sup> (Vibration Dose Values, VDV, m/s<sup>1.75</sup>, 1-80Hz)</b>					

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x & y axis	z-axis	x & y axis
Critical areas <sup>2</sup>	Day- or night-time	0.10	0.20	-	-
Residences	Daytime	0.20	0.40	-	-
	Night-time	0.13	0.26	-	-
Offices, schools, educational institutions and places of worship	Day- or night-time	0.40	0.80	-	-

- Notes:
1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am
  2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.
  3. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472-2008
  4. For continuous and impulsive vibration the preferred and maximum values are weighted acceleration rms values ( $m/s^2$ )
  5. For intermittent vibration the preferred and maximum values are vibration dose values (VDVs), based on the weighted acceleration values ( $m/s^{1.75}$ )

## 5.2.2 Building damage criteria

The minimum 'safe limit' of vibration at low frequencies for commercial and industrial buildings are presented in DIN 4150.3 is provided in Table 5-3.

Table 5-3 DIN 4150-3 structural damage criteria

Group	Type of Structure	Vibration Velocity, mm/s			
		At Foundation at Frequency of			Plane of Floor uppermost Storey
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 - 40	40 - 50	40
2	Dwellings and buildings of similar design and/or use	5	5 - 15	15 - 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (e.g. buildings under a preservation order)	3	3 - 8	8 - 10	8
Note:	At frequencies above 100 Hz, the values given in this column may be used as minimum values				

## 6 Construction noise impact assessment

### 6.1 Construction noise assessment methodology

An assessment on the potential level of construction noise impact has been carried out to determine whether mitigation will be required, and to determine appropriate management controls.

Details of proposed plant to be used for each construction scenario was provided by TfNSW. Sound power levels for various items of plant and equipment were adopted based upon construction plant noise data provided in Table F-1 of the Roads and Maritime Construction Noise and Vibration Guideline (CNVG). Plant noise levels were also sourced from AS2436 – Guide To Noise Control on Construction, Maintenance and Demolition Sites and measured library data where applicable.

This assessment has been prepared based on construction staging provided by TfNSW. A further assessment may be required to prepare a Construction Noise and Vibration Management Plan (CNVMP) once final construction staging detail becomes available during the next phase of the proposal.

The proposed works, with the potential to generate the most noise, are detailed in Section 6.6. To provide an indicative assessment of construction noise impact, a noise model was created for each of the construction scenario (Section 6.3).

### 6.2 Noise modelling inputs and assumptions

#### 6.2.1 General modelling input data

The modelling inputs and assumptions made for the modelling are shown in Table 6-1.

Table 6-1 Modelling assumptions

Modelling Element	Input / Assumption /Source Reference
Ground Elevation Geometry	Provided by Cardno
Proposed Elevation Geometry	Provided by Cardno
Road Alignment	Provided by Cardno
Ground Absorption	50% over soft ground 0% over water
Assessment Standard	ISO 9613-2:1996 – Acoustics – Attenuation of Sound During Propagation Outdoors (Part 2: General Method of Calculation)
Weather conditions	Receiver is downwind of the source, as per the assumptions of ISO 9613.
Receiver Height	Assumed to be 1.2 m above ground level for noise logger microphone heights for the verification model and 1.5 m above ground for prediction models for ground floor. Subsequent floor level receiver heights have been modelled at + 2.8 m above the floor below.

### 6.3 Modelled construction scenarios

The construction stages in Table 6-2 have been modelled for the proposed South Mosman wharf upgrade.

Table 6-2 Modelled construction stages

Scenario No.	Construction Scenario Description
1a	Site establishment
2a	Demolition of gangway & pontoon
2b	Demolition of stairs & wharf
3	Construction of pathways, stairs & lift (outside of hours)
4a	Installation of Piles Within Waterway – Drilling (outside of hours)
4b	Installation of Piles Within Waterway – Hammering (outside of hours)

Scenario No.	Construction Scenario Description
4c	Installation of Piles Within Waterway – Piling (outside of hours)
4d	Installation of Piles Within Waterway – Cutting steel
5	Installation of gangway & pontoon
6	Site Clean Up

To provide an indicative assessment of construction noise impact, a noise model was created for each of the above construction scenarios.

### 6.4 Noise catchment areas

Noise modelling was conducted to determine the predicted level of noise impact at sensitive locations surrounding the proposal. Works associated with the modelled scenarios are likely to remain within a finite work area. Therefore construction works have been modelled as a number of point sources operating simultaneously for each construction scenario to provide the worst case predicted noise levels at each sensitive location. Sensitive areas have been grouped into noise catchment areas as shown below in Figure 6-1.



Figure 6-1 Noise catchment areas

Noise contour maps showing the predicted noise levels for the modelled construction works are detailed in Appendix D.

## 6.5 Construction timing

We understand that some construction works are likely to be proposed for outside of standard hours as well as during standard hours for traffic safety reasons. All night work would be undertaken in accordance with Roads and Maritime CNVG where feasible, or in consultation with the adjacent community.

## 6.6 Construction plant and equipment

The construction plant included in the noise models are presented in Table 6-3. The equipment sound power levels were sourced from the Roads and Maritime CNVG, AS2436 and Cardno's measurement library.

Table 6-3 Construction plant sound power levels

Plant	Number of Plant	Sound Power Level, L <sub>Aeq</sub> , dB(A)
<b>Scenario 1 – Site Establishment</b>	<b>Total L<sub>Aeq</sub></b>	<b>111</b>
Truck (medium rigid)	1	103
Road Truck	1	108
Franna Crane	1	98
EWP	1	98
Floating Boom (Crane)	1	105
<b>Scenario 2a – Demolition of Gangway &amp; Pontoon</b>	<b>Total L<sub>Aeq</sub></b>	<b>121</b>
Work Boat	1	108
Excavator	1	108
Floating Boom (Crane)	1	105
Pneumatic Drill	1	115
Rock Breaker (mounted)	1	118
Barge Crane	1	110
Barge	1	108
<b>Scenario 2b – Demolition of Existing stairs and old wharf</b>	<b>Total L<sub>Aeq</sub></b>	<b>121</b>
Workboat	2	108
Excavator	1	108
Floating Boom (Crane)	1	105
Pneumatic Drill	1	115
Rock Breaker (mounted)	1	118
Barge Crane	1	110
Generator	1	98
<b>Scenario 3 – Construction of Pathways, Stairs &amp; Lift - outside of standard working hours.</b>	<b>Total L<sub>Aeq</sub></b>	<b>119</b>
Pneumatic Drill	1	115
Franna Crane	1	98
Truck (medium rigid)	1	103
Concrete truck	1	109
Concrete pump	1	109
Hand Tools	1	94

Plant	Number of Plant	Sound Power Level, $L_{Aeq}$ , dB(A)
Generator	1	98
Crane	1	113
Landside Piling Rig	1	112
<b>Scenario 4a Installation of steel piles within the waterway – drilling - outside of standard working hours</b>	<b>Total <math>L_{Aeq}</math></b>	<b>118</b>
Rock Drill	1	118
Truck	1	110
Oxy Acet Cutting	1	96
Generator	1	98
Workboat	1	108
Daymaker	2	98
Crane	1	113
<b>Scenario 4b – Installation of steel piles within the waterway – hammering - outside of standard working hours</b>	<b>Total <math>L_{Aeq}</math></b>	<b>116</b>
Pneumatic hammer	1	115
Oxy Acet Cutting	1	96
Truck	1	110
Generator	1	98
Workboat	1	108
Daymaker	2	98
Crane	1	113
<b>Scenario 4c – Installation of steel piles within the waterway – piling - outside of standard working hours</b>	<b>Total <math>L_{Aeq}</math></b>	<b>116</b>
Piling rig - bored	1	118
Oxy Acet Cutting	1	96
Truck	1	110
Generator	1	98
Workboat	1	108
Day-maker	2	98
<b>Scenario 4d – Installation of steel piles within the waterway - cutting</b>	<b>Total <math>L_{Aeq}</math></b>	<b>113</b>
Oxy Acet Cutting	1	96
Concrete truck	1	109
Concrete pump	1	109
Truck	1	110
Generator	1	98
Workboat	1	108
Daymaker	2	98
Crane	1	113
<b>Scenario 5 – Installation of the pontoon and gangway</b>	<b>Total <math>L_{Aeq}</math></b>	<b>113</b>
Barge Crane	1	110
Generator	1	98

Plant	Number of Plant	Sound Power Level, L <sub>Aeq</sub> , dB(A)
Truck (medium rigid)	1	103
Hand Tools	1	94
Workboat	1	108
<b>Scenario 6 – Site Clean Up</b>	<b>Total L<sub>Aeq</sub></b>	<b>113</b>
Bobcat	1	105
Truck (medium rigid)	1	103
Franna Crane	1	98
Road Truck	1	108
Tug Boat	1	108
Excavator	1	108

## 6.7 Predicted construction noise levels

The predicted noise impact from construction activities in the form of noise contour maps is presented in Appendix D with predicted levels at discrete receivers included in Appendix C. Predicted construction noise levels at each modelled NCA for each scenario are shown below in Table 6-4 to Table 6-7. The levels below represent the worst case predicted noise impact at the most affected receivers in each NCA. Noise levels as a result of construction activities are predicted to be lower than these levels for the remaining receivers within each associated NCA.

A full list of predicted noise levels at all modelled receivers is included in Appendix C.

The predicted reduction of expected construction noise impact with distance is shown in the noise contour maps

Table 6-4 Predicted construction noise levels – Scenario 1 –Site establishment – Proposed during standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> <sup>15hr</sup>	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
2 Musgrave Street	148	GF	E	1	80	55	-	25	-
3 Wulworra Avenue	109	GF	E	2	59	48	-	11	-

The above results for Scenario 1, indicate moderately intrusive and highly intrusive noise levels, and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Musgrave Road, where the worksites would be located, would experience the highest exceedances.

If night works are considered to be necessary for reasons, reduced operations are recommended and careful planning would be required for proposed works for all time periods to manage potential impacts.

Table 6-5 Predicted construction noise levels – Scenario 2a – Demolition of gangway and pontoon – Proposed for standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> <sup>15hr</sup>	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
5 Herron Walk	86	F2	W	1	86	55	-	31	-
1 Kareela Road	133	F2	SE	2	68	48	-	20	-

The above results for Scenario 2a, indicate moderately intrusive and highly intrusive noise levels, and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances.

If night works are considered to be necessary for safety reasons, reduced operations are recommended and careful planning would be required for proposed works for all time periods to manage potential impacts.

Table 6-6 Predicted construction noise levels – Scenario 2b – Demolition of existing stairs and wharf works – Standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> <sup>15hr</sup>	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
5 Herron Walk	86	F2	W	1	86	55	-	31	-
1 Kareela Road	133	F2	SE	2	68	48	-	20	-

The above results for Scenario 2b, indicate moderately intrusive and highly intrusive noise levels, and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances.

If night works are considered to be necessary for safety reasons, reduced operations are recommended and careful planning would be required for proposed works for all time periods to manage potential impacts.

Table 6-7 Predicted construction noise levels – Scenario 3 – Construction of pathways, stairs and lift – Proposed for outside of standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> <sup>15hr</sup>	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						OOHW1 Hours	OOHW2 Hours	Evening	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
<b>OOHW1 (Evening) - Period 1 - Mon – Fri (6pm – 10pm), Sat (7am – 8am &amp; 1pm – 10pm), Sun/Pub Hol (8am – 6pm)</b>									
<b>OOHW2 (Night) - Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Hol (6pm – 7am)</b>									
5 Herron Walk	86	GF	W	1	87	46	43	41	44
1 Kareela Road	133	F2	SE	2	66	38	33	28	33

The above results for Scenario 3, indicate exceedances of the ICNG NMLs for all time periods for both NCAs. Some highly intrusive exceedances are predicted during both the evening and the night periods.

It is proposed that Scenario 3 works would take place outside of standard working hours (early morning). Reduced operations are recommended and careful planning would be required for the proposed works to manage potential impacts on both NCAs.

Table 6-8 Predicted construction noise levels – Scenario 4a – Installation of steel piles – drilling. – Proposed for outside of standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> <sup>15hr</sup>	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						OOHW1 Hours	OOHW2 Hours	Evening	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
<b>OOHW1 (Evening) - Period 1 - Mon – Fri (6pm – 10pm), Sat (7am – 8am &amp; 1pm – 10pm), Sun/Pub Hol (8am – 6pm)</b>									
<b>OOHW2 (Night) - Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Hol (6pm – 7am)</b>									
5 Herron Walk	86	GF	W	1	85	46	43	39	42
1 Kareela Road	133	F2	SE	2	67	38	33	30	34

The above results for Scenario 4a, indicate highly intrusive noise levels and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances.

It is proposed that Scenario 4a works would take place outside of standard working hours for safety reasons when the harbour is least busy and the water is calm. Reduced operations are recommended and careful planning would be required for the proposed works to manage potential impacts on both NCAs.

Table 6-9 Predicted construction noise levels – Scenario 4b – Installation of steel piles – hammering. – Proposed for outside of standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> <sup>15hr</sup>	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						OOHW1 Hours	OOHW2. Hours	Evening	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
<b>OOHW1 (Evening) - Period 1 - Mon – Fri (6pm – 10pm), Sat (7am – 8am &amp; 1pm – 10pm), Sun/Pub Hol (8am – 6pm)</b>									
<b>OOHW2 (Night) - Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Hol (6pm – 7am)</b>									
5 Herron Walk	86	GF	W	1	84	46	43	38	41
1 Kareela Road	133	F2	SE	2	65	38	33	27	32

The above results for Scenario 4b, indicate highly intrusive noise levels and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances.

It is proposed that Scenario 4b works would take place outside of standard working hours for safety reasons when the harbour is least busy and the water is calm. Reduced operations are recommended and careful planning would be required for the proposed works to manage potential impacts on both NCAs.

Table 6-10 Predicted construction noise levels – Scenario 4c – Installation of steel piles – piling. – Outside of standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> <sup>15hr</sup>	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						OOHW1 Hours	OOHW2. Hours	Evening	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
<b>OOHW1 (Evening) - Period 1 - Mon – Fri (6pm – 10pm), Sat (7am – 8am &amp; 1pm – 10pm), Sun/Pub Hol (8am – 6pm)</b>									
<b>OOHW2 (Night) - Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Hol (6pm – 7am)</b>									
5 Herron Walk	86	GF	W	1	85	46	43	39	42
1 Kareela Road	133	F2	SE	2	66	38	33	28	33

The above results for Scenario 4c, indicate highly intrusive noise levels and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances.

It is proposed that Scenario 4c works would take place outside of standard working hours for safety reasons when the harbour is least busy and the water is calm. Reduced operations are recommended and careful planning would be required for the proposed works to manage potential impacts on both NCAs.

Table 6-11 Predicted construction noise levels – Scenario 4d – Installation of steel piles – cutting – Proposed for standard hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), $L_{Aeq}$ 15hr	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
5 Herron Walk	86	GF	W	1	84	55	-	29	-
1 Kareela Road	133	F2	SE	2	64	48	-	16	-

The above results for Scenario 4d, indicate moderately intrusive and highly intrusive noise levels, and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances.

If night works are considered to be necessary road safety reasons, reduced operations are recommended and careful planning would be required for proposed works for all time periods to manage potential impacts.

Table 6-12 Predicted construction noise levels – Scenario 5 – Installation of pontoon and gangway – Proposed for standard hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), $L_{Aeq}$ 15hr	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
5 Herron Walk	86	GF	W	1	77	55	-	22	-
1 Kareela Road	133	F2	SE	2	60	48	-	12	-

The above results for Scenario 5, indicate moderately intrusive and highly intrusive intrusive noise levels, and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances.

If night works are considered to be necessary road safety reasons, reduced operations are recommended and careful planning would be required for proposed works for all time periods to manage potential impacts.

Table 6-13 Predicted construction noise levels – Scenario 6 – Site clean up – Proposed for standard hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), L <sub>Aeq</sub> 15hr	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
5 Herron Walk	86	GF	W	1	81	55	43	26	38
1 Kareela Road	133	F2	SE	2	61	48	33	13	28

The above results for Scenario 6, indicate moderately intrusive and highly intrusive noise levels, and exceedances of the ICNG noise management levels for all time periods for all NCAs to varying extents. Properties located on Herron Walk, near where the worksites would be located, would experience the highest exceedances. For this reason, it is recommended that Scenario 6 works are not carried out at night. If night works are considered to be necessary for road safety reasons, reduced operations are recommended and careful planning would be required for proposed works for all time periods to manage potential impacts.

## 6.8 Construction noise results summary

In accordance with the noise management levels stipulated in Section 5.1, residential sensitive receivers exposed to levels of construction noise above 75 dB(A) are considered highly noise affected, with dwellings exposed to levels above the noise management level (NML) or daytime RBL +10 dB(A) considered noise affected. The numbers of each are detailed below based on the modelling results. A modelled receiver has been applied to each floor of each exposed façade of each building expected to be affected by construction noise.

### 6.8.1 Predicted number of exceedances

The number of predicted exceedances for the worksite are detailed below in Table 6-14.

Table 6-14 Predicted number of receivers where NMLs are exceeded

Construction Stage	Standard Hours	Evening	Night	Highly Noise Affected
Scenario 1	191	-	-	14
Scenario 2a	212	-	-	19
Scenario 2b	212	-	-	19
Scenario 3	-	213	213	22
Scenario 4a	-	213	213	25
Scenario 4b	-	213	213	25
Scenario 4c	-	213	213	24
Scenario 4d	208	-	-	19
Scenario 5	181	-	-	7
Scenario 6	199	-	-	20

Some receivers are expected to be highly noise affected for all construction scenarios associated with the wharf proposal.

Construction noise levels are predicted to exceed management levels for “standard” and “non-standard” hours of operation for all construction stages at the nearby residential receivers.

It should be noted that this assessment has endeavoured to carry out “worst case” noise modelling, and noise levels are predicted based on all sources operating simultaneously within the worksite. This is therefore likely to represent the worst case scenario and construction noise levels would generally be less than those predicted.

## 6.8.2 Sleep disturbance

### 6.8.2.1 Scenarios 3, 4A, 4B and 4C

The most likely source of potential sleep disturbance from outside of construction hours works would be from construction of pathways and lift and hammering, pile screwing, and drilling proposed as early morning works.

Maximum noise levels have been predicted to the nearest affected residential receivers to allow a review of the potential for sleep disturbance from construction activities at night. In the absence of measurement data typical construction source  $L_{Amax}$  noise levels were assumed to be 10 dB(A) above the predicted  $L_{Aeq}$  noise levels, on the basis of measurements from previous projects. On this basis, the receivers where the sleep disturbance criteria is likely to be exceeded are summarised in Table 6-15.

Table 6-15 Predicted construction maximum ( $L_{Amax}$ ) noise levels – Scenarios 3

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), $L_{Amax}$				Criteria, (RBL + 15 dB(A))
					Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	
1 Herron Walk	84	GF	W	1	90	90	89	91	60
1 Herron Walk	84	F 1	W	1	92	90	90	92	60
1 Herron Walk	84	F 2	W	1	92	90	90	92	60
1 Herron Walk	84	F 3	W	1	92	91	90	92	60
1 Wulworra Avenue	108	GF	E	1	74	75	74	74	60
1 Wulworra Avenue	108	F 1	E	1	74	75	74	75	60
1 Wulworra Avenue	108	F 2	E	1	74	75	74	75	60
1 Wulworra Avenue	108	F 3	E	1	74	75	74	75	60
1a Kareela Road	135	GF	E	1	74	75	74	74	60
1a Kareela Road	135	F 1	E	1	75	75	74	74	60
2 Musgrave Street	148	GF	E	1	87	89	89	89	60
2 Musgrave Street	148	F 1	E	1	87	90	90	90	60
2 Musgrave Street	89	GF	W	1	91	93	90	94	60
2 Musgrave Street	89	F 1	W	1	91	94	92	94	60
2 Raglan Street	83	GF	W	1	67	68	67	69	60
2 Raglan Street	83	F 1	W	1	67	68	67	69	60
2 Raglan Street	83	F 2	W	1	68	68	67	69	60
2 Raglan Street	83	F 3	W	1	68	68	67	70	60
2 Raglan Street	83	F 4	W	1	67	68	67	69	60
2 Raglan Street	83	F 5	W	1	68	68	67	70	60
3 Herron Walk	85	GF	N	1	69	77	77	78	60
3 Herron Walk	85	F 1	N	1	69	78	78	78	60
3 Herron Walk	85	F 2	N	1	70	78	78	79	60
3 Herron Walk	85	F 3	N	1	71	79	79	79	60
4-5a Herron Walk	87	GF	W	1	83	86	86	84	60
4-5a Herron Walk	87	F 1	W	1	84	87	87	84	60
4-5a Herron Walk	87	F 2	W	1	86	87	87	84	60
4-5a Herron Walk	87	F 3	W	1	86	87	87	84	60
4 Musgrave Street	150	GF	E	1	79	83	82	82	60
4 Musgrave Street	150	F 1	E	1	81	84	84	84	60
4 Musgrave Street	90	GF	W	1	75	78	77	84	60
4 Musgrave Street	90	F 1	W	1	78	78	78	86	60
5 Herron walk	86	GF	W	1	97	95	94	95	60
5 Herron walk	86	F 1	W	1	96	95	94	95	60
5 Herron walk	86	F 2	W	1	96	95	94	94	60
5 Herron walk	86	F 3	W	1	96	94	93	94	60
5 Herron walk	86	F 4	W	1	95	94	93	94	60
5 Herron walk	86	F 5	W	1	95	93	93	94	60
6 Musgrave Street	152	F 1	E	1	75	79	79	79	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L <sub>AMax</sub>				Criteria, (RBL + 15 dB(A))
					Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	
6 Musgrave Street	91	GF	W	1	79	75	75	86	60
6 Musgrave Street	91	F 1	W	1	79	76	76	86	60
7 Herron Walk	88	GF	W	1	89	90	90	90	60
7 Herron Walk	88	F 1	W	1	90	91	90	91	60
7 Herron Walk	88	F 2	W	1	91	91	91	91	60
7 Herron Walk	88	F 3	W	1	92	91	91	91	60
8 McLeod Street	102	GF	W	1	57	61	60	62	60
8 McLeod Street	102	F 1	W	1	61	63	63	66	60
8 Musgrave Street	154	GF	E	1	72	76	76	76	60
8 Musgrave Street	154	F 1	E	1	73	77	77	77	60
8 Musgrave Street	92	GF	W	1	69	69	68	72	60
8 Musgrave Street	92	F 1	W	1	70	71	70	76	60
8a McLeod Street	103	GF	S	1	69	68	67	73	60
8a McLeod Street	103	F 1	S	1	70	71	69	73	60
9b Musgrave Street	149	GF	W	1	87	90	90	89	60
9b Musgrave Street	149	F 1	W	1	88	90	90	89	60
10 McLeod Street	104	GF	SW	1	71	72	70	72	60
10 McLeod Street	104	F 1	SW	1	71	72	70	72	60
10 Musgrave Street	156	GF	E	1	70	69	68	68	60
10 Musgrave Street	156	F 1	E	1	72	72	71	72	60
10 Musgrave Street	93	GF	W	1	68	72	72	75	60
10 Musgrave Street	93	F 1	W	1	69	73	72	78	60
11 Musgrave Street	151	GF	W	1	82	85	85	85	60
11 Musgrave Street	151	F 1	W	1	83	86	86	86	60
11a Musgrave Street	162	GF	W	1	78	81	81	82	60
11a Musgrave Street	162	F 1	W	1	79	82	82	83	60
12 Musgrave Street	158	GF	E	1	71	74	73	73	60
12 Musgrave Street	158	F 1	E	1	72	75	74	74	60
12 Musgrave Street	94	GF	W	1	68	73	72	81	60
12 Musgrave Street	94	F 1	W	1	69	73	73	81	60
14 Musgrave Street	95	GF	W	1	69	71	70	80	60
14 Musgrave Street	95	F 1	W	1	71	71	71	80	60
14 Musgrave Street	160	GF	E	1	68	72	72	72	60
14 Musgrave Street	160	F 1	E	1	69	73	73	73	60
15 Musgrave Street	153	GF	W	1	75	78	78	78	60
15 Musgrave Street	153	F 1	W	1	76	79	79	79	60
16-18 Musgrave Street	96	GF	W	1	63	64	63	66	60
16-18 Musgrave Street	96	F 1	W	1	64	67	66	70	60
16a Musgrave Street	97	GF	S	1	73	72	70	78	60
16a Musgrave Street	97	F 1	S	1	73	73	71	78	60
17 Musgrave Street	155	GF	W	1	69	69	68	69	60
17 Musgrave Street	155	F 1	W	1	71	74	74	74	60
18 Musgrave Street	98	GF	S	1	73	74	72	78	60
18 Musgrave Street	98	F 1	S	1	73	75	73	78	60
19 Musgrave Street	157	GF	W	1	73	76	76	76	60
19 Musgrave Street	157	F 1	W	1	74	78	77	78	60
20a Musgrave Street	99	GF	W	1	63	63	62	67	60
20a Musgrave Street	99	F 1	W	1	65	65	64	68	60
21 Musgrave Street	159	GF	W	1	73	77	77	77	60
21 Musgrave Street	159	F 1	W	1	73	77	77	77	60
22a Musgrave Street	100	GF	W	1	71	68	67	76	60
22a Musgrave Street	100	F 1	W	1	71	69	68	76	60
22b Musgrave Street	101	GF	S	1	71	73	71	75	60
22b Musgrave Street	101	F 1	S	1	71	74	71	75	60
23 Musgrave Street	161	GF	W	1	72	74	74	73	60
23 Musgrave Street	161	F 1	W	1	72	74	74	74	60
1 Kareela Road	133	GF	SE	2	76	76	75	76	60
1 Kareela Road	133	F 1	SE	2	76	77	75	76	60
1 Kareela Road	133	F 2	SE	2	76	77	75	76	60
2 Wulworra Avenue	107	GF	E	2	74	74	73	74	60
2 Wulworra Avenue	107	F 1	E	2	74	75	73	74	60
2 Wulworra Avenue	107	F 2	E	2	74	75	73	74	60
2 Wulworra Avenue	107	F 3	E	2	74	75	74	74	60
3 Green Street	131	GF	E	2	74	75	73	74	60
3 Green Street	131	F 1	E	2	74	75	74	74	60
3 Green Street	131	F 2	E	2	75	75	74	75	60
3 Kareela Road	136	GF	E	2	74	75	73	74	60
3 Kareela Road	136	F 1	E	2	74	75	73	74	60
3 Wulworra Avenue	105	GF	E	2	70	71	70	70	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L <sub>AMax</sub>				Criteria, (RBL + 15 dB(A))
					Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	
3 Wulworra Avenue	105	F 1	E	2	70	71	70	70	60
3 Wulworra Avenue	105	F 2	E	2	70	71	70	71	60
3 Wulworra Avenue	105	F 3	E	2	70	71	70	71	60
3 Wulworra Avenue	109	GF	E	2	75	76	74	75	60
3 Wulworra Avenue	109	F 1	E	2	75	76	74	75	60
3 Wulworra Avenue	109	F 2	E	2	75	76	75	75	60
3 Wulworra Avenue	109	F 3	E	2	75	76	75	75	60
5 Green Street	132	GF	E	2	75	75	74	74	60
5 Green Street	132	F 1	E	2	75	75	74	75	60
5 Green Street	132	F 2	E	2	75	76	74	75	60
5 Kareela Road	137	GF	E	2	74	75	73	74	60
5 Kareela Road	137	F 1	E	2	74	75	73	74	60
5 Wulworra Avenue	110	GF	E	2	73	74	73	73	60
5 Wulworra Avenue	110	F 1	E	2	73	74	73	73	60
5 Wulworra Avenue	110	F 2	E	2	73	74	73	73	60
5 Wulworra Avenue	110	F 3	E	2	73	74	73	74	60
6 Kareela Road	134	GF	S	2	74	75	74	74	60
6 Kareela Road	134	F 1	S	2	75	75	74	74	60
6 Wulworra Avenue	106	GF	E	2	73	74	72	73	60
6 Wulworra Avenue	106	F 1	E	2	73	74	72	73	60
6 Wulworra Avenue	106	F 2	E	2	73	74	72	73	60
6 Wulworra Avenue	106	F 3	E	2	73	74	73	73	60
7 Kareela Road	138	GF	E	2	74	74	73	73	60
7 Kareela Road	138	F 1	E	2	74	75	73	74	60
7 Wulworra Avenue	111	GF	NE	2	73	74	73	73	60
7 Wulworra Avenue	111	F 1	NE	2	73	75	73	74	60
7 Wulworra Avenue	111	F 2	NE	2	73	75	74	74	60
7 Wulworra Avenue	111	F 3	NE	2	74	75	74	74	60
9 Kareela Road	139	GF	NE	2	73	74	72	73	60
9 Kareela Road	139	F 1	NE	2	73	74	73	73	60
9 Wulworra Avenue	112	GF	E	2	73	75	73	74	60
9 Wulworra Avenue	112	F 1	E	2	74	75	73	74	60
9 Wulworra Avenue	112	F 2	E	2	74	75	74	74	60
9 Wulworra Avenue	112	F 3	E	2	74	75	74	74	60
11 Wulworra Avenue	113	GF	E	2	74	75	73	74	60
11 Wulworra Avenue	113	F 1	E	2	74	75	74	74	60
11 Wulworra Avenue	113	F 2	E	2	74	75	74	74	60
11 Wulworra Avenue	113	F 3	E	2	74	75	74	74	60
13 Wulworra Avenue	114	GF	E	2	74	75	74	74	60
13 Wulworra Avenue	114	F 1	E	2	74	75	74	74	60
13 Wulworra Avenue	114	F 2	E	2	74	75	74	74	60
15 Kareela Road	140	GF	E	2	75	76	74	75	60
15 Kareela Road	140	F 1	E	2	75	76	75	75	60
15 Wulworra Avenue	115	GF	E	2	74	75	74	74	60
15 Wulworra Avenue	115	F 1	E	2	74	75	74	74	60
15 Wulworra Avenue	115	F 2	E	2	74	75	74	74	60
15a Kareela Road	141	GF	NE	2	72	74	72	73	60
15a Kareela Road	141	F 1	NE	2	73	74	72	73	60
17 Kareela Road	142	GF	E	2	75	76	74	75	60
17 Kareela Road	142	F 1	E	2	75	76	74	75	60
17 Wulworra Avenue	116	GF	E	2	74	75	74	74	60
17 Wulworra Avenue	116	F 1	E	2	75	75	74	75	60
17 Wulworra Avenue	116	F 2	E	2	75	76	74	75	60
19-21 Kareela Road	143	GF	E	2	72	73	72	72	60
19-21 Kareela Road	143	F 1	E	2	72	73	72	73	60
21 Wulworra Avenue	117	GF	E	2	74	75	74	74	60
21 Wulworra Avenue	117	F 1	E	2	75	75	74	75	60
21 Wulworra Avenue	117	F 2	E	2	75	76	74	75	60
23 Kareela Road	144	GF	E	2	72	73	71	72	60
23 Kareela Road	144	F 1	E	2	72	73	71	72	60
23 Wulworra Avenue	118	GF	NE	2	74	75	73	74	60
23 Wulworra Avenue	118	F 1	NE	2	75	75	74	74	60
23 Wulworra Avenue	118	F 2	NE	2	75	75	74	75	60
25 Wulworra Avenue	119	GF	E	2	75	75	74	75	60
25 Wulworra Avenue	119	F 1	E	2	75	76	74	75	60
25 Wulworra Avenue	119	F 2	E	2	75	76	74	75	60
27 Kareela Road	145	GF	NE	2	62	64	62	62	60
27 Kareela Road	145	F 1	NE	2	66	68	66	66	60
27 Wulworra Avenue	120	GF	E	2	75	75	74	75	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L <sub>Amax</sub>				Criteria, (RBL + 15 dB(A))
					Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	
27 Wulworra Avenue	120	F 1	E	2	75	76	74	75	60
27 Wulworra Avenue	120	F 2	E	2	75	76	74	75	60
29 Wulworra Avenue	121	GF	E	2	75	75	74	75	60
29 Wulworra Avenue	121	F 1	E	2	75	76	74	75	60
29 Wulworra Avenue	121	F 2	E	2	75	76	74	75	60
31 Kareela Road	146	GF	E	2	71	72	70	71	60
31 Kareela Road	146	F 1	E	2	71	72	70	71	60
31 Wulworra Avenue	122	GF	NE	2	75	76	74	75	60
31 Wulworra Avenue	122	F 1	NE	2	75	76	74	75	60
31 Wulworra Avenue	122	F 2	NE	2	75	76	74	75	60
33 Kareela Road	147	GF	E	2	69	71	69	67	60
33 Kareela Road	147	F 1	E	2	70	71	69	67	60
33 Wulworra Avenue	123	GF	E	2	75	76	74	75	60
33 Wulworra Avenue	123	F 1	E	2	75	76	74	75	60
33 Wulworra Avenue	123	F 2	E	2	75	76	74	75	60
39 Wulworra Avenue	124	GF	E	2	75	76	74	75	60
39 Wulworra Avenue	124	F 1	E	2	75	76	74	75	60
39 Wulworra Avenue	124	F 2	E	2	75	76	74	75	60
41 Wulworra Avenue	125	GF	E	2	75	76	74	75	60
41 Wulworra Avenue	125	F 1	E	2	75	76	74	75	60
41 Wulworra Avenue	125	F 2	E	2	75	76	74	75	60
45 Wulworra Avenue	126	GF	E	2	75	76	74	75	60
45 Wulworra Avenue	126	F 1	E	2	75	76	74	75	60
45 Wulworra Avenue	126	F 2	E	2	75	76	74	75	60
49 Wulworra Avenue	127	GF	E	2	75	75	74	75	60
49 Wulworra Avenue	127	F 1	E	2	75	76	74	75	60
49 Wulworra Avenue	127	F 2	E	2	75	76	74	75	60
51 Wulworra Avenue	128	GF	E	2	75	76	74	75	60
51 Wulworra Avenue	128	F 1	E	2	75	76	74	75	60
51 Wulworra Avenue	128	F 2	E	2	75	76	74	75	60
55 Wulworra Avenue	129	GF	E	2	75	76	74	75	60
55 Wulworra Avenue	129	F 1	E	2	75	76	74	75	60
55 Wulworra Avenue	129	F 2	E	2	75	76	75	75	60
57 Wulworra Avenue	130	GF	E	2	75	76	74	75	60
57 Wulworra Avenue	130	F 1	E	2	75	76	74	75	60

The predicted L<sub>Amax</sub> results detailed above indicate that maximum construction noise levels at NCA 1 & 2 are likely to exceed the sleep disturbance criteria for all “outside of standard hours” construction scenarios, at all assessed receivers when construction works are located nearby. For this reason it is recommended that activities with potentially high maximum levels such as the use of pneumatic tools and drilling are minimised at these locations during the quietest periods of the overall night-time period.

## 7 Construction vibration assessment

### 7.1 Vibration limits

Vibration from construction activities associated with the proposal could potentially impact on the amenity of the occupants of dwellings or buildings located close to the construction works. Generally, vibration impact can be summarised into two categories:

- > Effect on human comfort
- > Structural or cosmetic damage to buildings.

Vibration criteria is addressed in the NSW ICNG and refers to Section 2.5 of the document Assessing Vibration: A Technical Guideline (NSW AVATG) issued by DEC (2006). The NSW AVATG outlines vibration limits in relation to human comfort. Criteria in this guideline are based on the British Standard BS6472-1992 Evaluation of human exposure to vibration in buildings (1-80Hz). A summary of these criteria are detailed in Table 5-2.

In relation to structural damage, there is currently no Australian Standard that provides criteria for the assessment of structural damage to buildings. However, the British Standard BS7385 Part 2 can be used to assess structural damage to buildings. It defines damage in several categories including, for example, “cosmetic”, “minor” and “major” damage. Alternatively, the German Standard DIN4150 Part 3 provides maximum vibration levels, which are assessed over a frequency range. These criteria are summarised in Table 5-3.

The recommended minimum working distance between vibration intensive plant and sensitive receivers for minimising the risk of cosmetic damage are listed in the Roads and Maritime Construction Noise and Vibration Guideline and are shown in Table 7-1.

The minimum working distances for cosmetic damage as outlined in Table 7-1 must be adhered to unless otherwise approved by TfNSW.

### 7.2 Vibration assessment

For the purposes of this assessment, the following proposed plant with the potential to generate the most vibration have been considered:

- > Bored piling rig
- > Vibratory roller
- > Rock hammers
- > Rock drill
- > Truck movements.

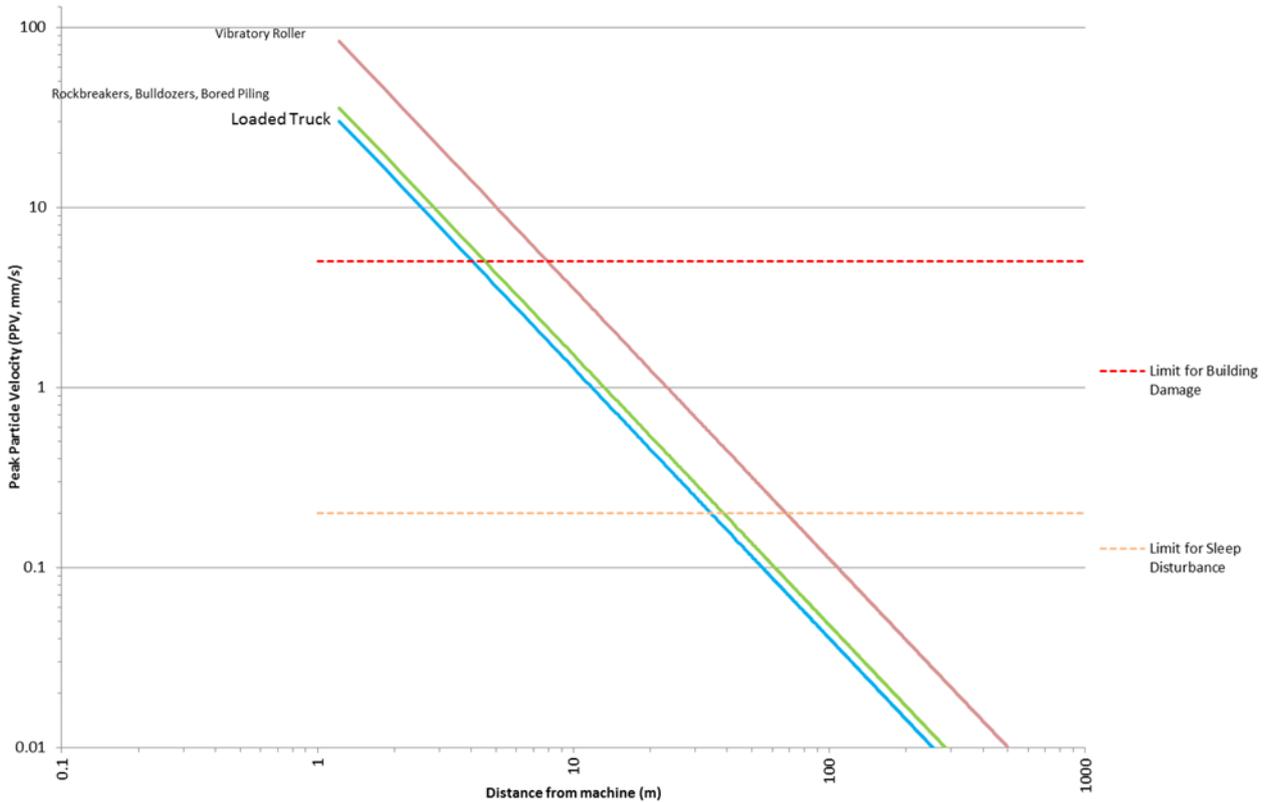
Construction vibration levels vary depending on the distance from the equipment in use, the energy level imparted to the ground by the construction process, and the bedrock type. The most vibration generating sources associated with the construction work would be vibratory rollers and piling rigs. It is anticipated that no blasting would be required as part of this proposal.

The Transit Noise and Vibration Impact Assessment (TNVIA) (US Federal Transit Administration (FTA), 2006) outlines calculation methods for construction equipment vibration levels. These levels are expressed in terms of Peak Particle Velocity (PPV, mm/s), with vibration levels provided for a number of plant items. The TNVIA specifies that:

“It should be noted that there is a considerable variation in reported ground vibration levels from construction sites. The data provides a reasonable estimate for a wide range of soil conditions.”

The data provided by the TNVIA results in a graph as shown in Figure 7-1.

Depending on the actual ground conditions (i.e. greater density of rock) vibration levels may increase and affect residents to a greater extent subjectively.



Note: The predicted vibration levels in the figure above include a safety margin for carrying ground types.

Figure 7-1 Estimates of vibration levels generated by common construction activities / equipment at various distances (Source: FTA 2006).

Construction works including bored piling may be undertaken with a minimum separation distance of 4-5 metres from the nearest residential buildings, based on the expected plant to be used for the proposal as detailed in Table 6-3. Where impacted buildings are heritage listed or of similar more sensitive construction the minimum separation distance should be increased to 40 metres.

However for rock hammers and vibratory rollers the minimum required safe working distance is increased as detailed in Table 7-1 between construction activities and sensitive receivers to reduce vibration to within levels unlikely to cause building damage.

### 7.2.2 Minimum working distance (Roads and Maritime CNVG)

The minimum working distance for vibration intensive plant from sensitive receivers is listed in Table 2 of the CNVG. Table 7-1 below presents these recommended minimum working distances for specific construction activities.

Table 7-1 Recommended minimum working distances for vibration intensive plant from sensitive receivers

Plant Item	Rating / Description	Minimum Working Distance		
		Cosmetic Damage (BS 7385)	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human Response (OH&E Vibration Guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	14 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	16 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	33 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	41 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	54 m	100 m
	> 300 kN (> 18 tonnes)	25 m	68 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	19 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	60 m	73 m
Vibratory Pile Driver	Sheet Piles	2 m to 20 m	50 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	40 m	4 m
Jackhammer	Hand Held	1 m (nominal)	2 m	2 m

**7.2.3 Heritage structures**

Heritage structures are located in proximity the proposal as shown in Figure 7-2.



Figure 7-2 Heritage listings located in proximity to the proposal

The closest heritage structures are located at 5 and 10 metres from the proposed piling works (the existing sea wall (Figure 7-2, A491) and the Divided Road, (Figure 7-2, I411) respectively). The proposed works would involve piling and the use of a rock hammer and other vibration intensive plant. These works would be located within the minimum safe working distance for cosmetic damage, which is identified in the CNVG and Table 7-1 above as 50 metres. Based on Figure above, this requirement indicates that vibration levels of greater than 0.5 mm/s should not occur at the heritage structures, which is 6 times less than that recommended in DIN 4150.3.

Based on the above, a predicted vibration level of  $> 1$  mm/s could be experienced at the rock face of the Divided Road which is lower than the limits stated in DIN 4150.3, but within the safe working distances stated in the CNVG.

Similar results to those structures assessed above apply to the other heritage structures in proximity to the proposal to a lesser extent due to their larger separation distance of around 20 metres.

In summary, vibrations associated with the piling, hammering and additional plant have the potential to cause impacts to the archaeological remains in the area, including the extant remains of the original Musgrave Street Wharf seawall and the later retaining wall at the south end of the construction footprint. However, only a small number of piles are required, the rock hammering would primarily be located on the opposite side of the construction footprint, the extant remains of the original seawall are already subject to some movement as a result of being within the water, and as stated above, the later retaining wall contributes little to the significance of South Mosman wharf site (Figure 7-2, A491).

The potential impacts could also be largely mitigated through control measures (see mitigation measures and recommendations in Section 8). As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

Where works are proposed within the safe working limits, specialist advice should be sought from an appropriately qualified structural engineer who is familiar with heritage structures to support any proposed relaxation of the initial cosmetic damage screening criterion. Any such relaxation shall be approved by TfNSW or under the environmental license as relevant.

In addition and in conjunction with the above specialist advice from a structural engineer, test vibration measurements of piling and other vibration intensive plant at the work location closest to the structure should be carried out prior to works commencing to determine the level of vibration at the sensitive structure. If vibration levels exceed the Heritage Building limits detailed in Table 5-3, alternative work methods should be sought.

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## 8 Recommended mitigation measures

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### 8.1 ICNG & AS 2436 recommended mitigation measures

The best practice construction noise and vibration mitigation measures in Table 8-1 are based on recommendations provided within the NSW ICNG and Australian Standard AS 2436-1981: Guide to Noise Control on Construction, Maintenance and Demolition Sites, and apply to the proposed construction activities.

Table 8-1 Noise and vibration safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
NV1	Noise and vibration	<p>Preparation of a noise and vibration management plan based on recommendations provided within the NSW ICNG and Australian Standard AS 2436-1981: Guide to Noise Control on Construction, Maintenance and Demolition Sites. This is to include, but not be limited to:</p> <ul style="list-style-type: none"> <li>• Plant controls:                             <ul style="list-style-type: none"> <li>– Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc.</li> <li>– Plant and equipment will be in good working order to prevent excess noise generation.</li> <li>– Locating static sources of noise such as the generators as remotely as possible from noise sensitive receivers</li> <li>– Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations</li> <li>– Use of temporary noise barriers where practical. The height and location of these barriers will be determined during preparation of the construction noise and vibration management plan when more information regarding the proposed plant to be used for each construction stage is available.</li> <li>– Investigate whether “at plant” mitigation or muffled plant is available for plant with high source noise levels such as rock hammers and piling rigs, and plant emitting continuous noise such as generators.</li> <li>– Acoustic curtains (generally loaded vinyl based products), attached to wire construction fencing or laid over steel scaffold can also provide practical temporary noise barriers. Acoustic curtains will be investigated for stationery plant within the worksites once a detailed schedule of works and plant is available.</li> </ul> </li> <li>• Management and behavioural controls:                             <ul style="list-style-type: none"> <li>– Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings.</li> <li>– Avoid the need for reversing in the construction area by creating a loop road or similar.</li> <li>– Avoid dropping materials from height.</li> <li>– Workers will avoid shouting, minimise talking loudly, and avoid slamming vehicle doors.</li> </ul> </li> <li>• Allowing construction to occur only during approved construction hours, unless otherwise required as a condition of TfNSW safety requirements</li> <li>• Conducting noise monitoring during all construction phases/scenarios considering the potential exceedances for the purposes of assisting in noise mitigation and to verify the findings of this noise assessment.</li> </ul>	Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately.</li> <li>Conducting additional monitoring if complaints are received or proposed activities and number of plant exceed those assumed in this assessment</li> <li>Modifying of work activities where noise or vibration is found to cause unacceptable impact.</li> <li>Implementation of additional mitigation measures in accordance with the CNVG including notification, respite periods and alternate accommodation as reasonable and feasible.</li> </ul>		
NV2	Noise and vibration	<ul style="list-style-type: none"> <li>Carrying out works within standard daytime hours as follows:                             <ul style="list-style-type: none"> <li>7:00 am to 6:00 pm Monday to Friday</li> <li>8:00 am to 1:00 pm Saturdays, no work on Sundays or public holidays.</li> </ul> </li> <li>Do not carry out operations during evening or night-time hours, unless required for safety reasons when the water is calmer during the night period (including early morning) or due to requirements to enable bus access.</li> <li>Should operations be required outside standard hours, an Out of Hours procedure detailing works schedule, approval process, communications requirements and management measure will be prepared.</li> <li>All reasonable and feasible efforts should be undertaken to ensure noise levels would not exceed the ICNG noise management levels stated in Section 5.1 of this assessment by carrying out night-works with reduced numbers of plant for example.</li> </ul>	Contractor	Construction
NV3	Noise and vibration	<ul style="list-style-type: none"> <li>Notification of potentially affected receivers detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the work (where applicable) and contact telephone number.</li> <li>Notification should be a minimum of 7 calendar days prior to the start of work.</li> <li>A contact telephone number and email address will be available for community feedback</li> </ul>	TfNSW / Contractor	Pre-construction
NV4	Noise	Conduct short term background noise monitoring prior to construction to confirm the ambient noise levels presented in this report, which were carried out during COVID 19 and may not be representative of typical levels.	TfNSW / Contractor	Pre-construction
NV5	Vibration impact to heritage structures	Where works are proposed within the safe working limits for the heritage structures (the original seawall and retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183)), specialist advice will be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works will potentially result in impacts to heritage structures. Vibration monitoring will be carried out to confirm vibration levels prior to construction commencement.	Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
NV6	Vibration impact to heritage structures	<p>Regular inspections of the construction activities and work areas should be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology and confirm the integrity of the seawall and retaining wall in Musgrave Street wharf site (SHI no. 4920109 and LEP no. A491), the rock face of the Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183). Assessment and monitoring of vibration impacts will adhere to:</p> <ul style="list-style-type: none"> <li>• British Standard BS 7385: Part 2: Evaluation and Measurement for Vibrations in Buildings –Part 2 Guide to Damage Levels from Ground-Borne Vibration</li> <li>• German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.</li> </ul>	Contractor	Construction
NV7	Vibration	Where buildings are located within the safe working distance zone, dilapidation surveys will be carried out prior to construction.	Contractor	Pre-construction / Construction
NV8	Vibration	Where receivers are located within the safe work distance zones, vibration monitoring will be carried out to ensure compliance with the required criteria. If exceedances are recorded, works will be modified accordingly to reduce vibration levels.	Contractor	Pre-construction / Construction

## 8.2 CNVG noise management recommendations

The RMS CNVG stipulates that additional noise management measures may be required where noise levels are predicted to exceed the noise management levels.

The range of additional mitigation measures include, but are not limited to:

- > Notification via letterbox or phone call
- > Respite periods
- > Alternative accommodation.

Identification of where additional mitigation measures may be required is based on the information presented below in Table 8-2.

Table 8-2 Triggers for additional mitigation measures – airborne noise

Predicted airborne $L_{Aeq(15min)}$ noise level at receiver				
Perception	dB(A) above RBL	dB(A) above NML	Type of Additional Mitigation Measures	Mitigation Levels:
<b>All hours</b>				
75dBA or greater			N, V, PC, RO	HA
<b>Standard Hours: Mon - Fri (7am - 6pm), Sat (8am - 1pm), Sun/Pub Hol (Nil)</b>				
Noticeable	5 to 10	0	-	NML
Clearly audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML + 10
Highly intrusive	> 30	> 20	N, V	NML + 20
<b>OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am &amp; 1pm - 10pm), Sun/Pub Hol (8am - 6pm)</b>				
Noticeable	5 to 10	< 5	-	NML
Clearly audible	10 to 20	5 to 15	N, R1, DR	NML + 5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML + 15
Highly intrusive	> 30	> 25	V, IB, N, R1, DR, PC, SN	NML + 25
<b>OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6am - 7am)</b>				
Noticeable	5 to 10	< 5	N	NML
Clearly audible	10 to 20	5 to 15	V, N, R2, DR	NML + 5
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML + 15
Highly intrusive	> 30	> 25	AA, V, IB, N, PC, SN, R2, DR	NML + 25
<b>Notes:</b>				
AA = Alternative Accommodation		R1 = Respite Period 1		
V = Verification		R2 = Respite Period 2		
IB = Individual Briefings		DR = Duration Respite		
N = Notification		Perception = relates to level above RBL		
PC = Phone Calls		NML = Noise Management Level		
SN = Specific Notifications		HA = Highly Affected (> 75 dB(A) - applies to residences only)		

A detailed description of each additional mitigation measure is presented below.

Additional mitigation measures may be required where noise levels are predicted to exceed the noise management levels. Refer to Appendix D for areas where this is predicted to occur.

The range of additional mitigation measures are itemised below.

### **Notification (N)**

Notification using letterbox drop or equivalent for advanced warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.

### **Specific notifications (SN)**

Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops.

The exact conditions under which specific notifications would proceed are defined in Table 8-3 below. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

### **Phone calls (PC)**

Phone calls detailing relevant information made to identified/affected stakeholders within seven calendar days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs. Where the resident cannot be telephoned then an alternative form of engagement should be used.

### **Individual briefings (IB)**

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. Where the resident cannot be met with individually then an alternative form of engagement should be used.

### **Respite Offers (RO)**

Respite Offers should be considered made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.

The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis, and may not be applicable to all projects.

### **Respite Period 1 (R1)**

Out of hours construction noise in out of hours period 1 shall be limited to no more than three consecutive evenings per week except where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and no more than 6 evenings per month.

### **Respite Period 2 (R2)**

Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month. Where possible, high noise generating works shall be completed before 11pm.

### **Duration Respite (DR)**

Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly.

The project team should engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite.

Where there are few receivers above the NML each of these receivers should be visited to discuss the project to gain support for Duration Respite.

### **Alternative Accommodation (AA)**

Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels. The specifics of the offer will be identified on a project-by-project basis. Additional aspects for consideration shall include whether the highly intrusive activities occur throughout the night or before midnight.

### **Verification (V)**

Routine checks of noise levels or following reasonable complaints. This verification should include measurement of the background noise level and construction noise. Note this is not required for projects less than three weeks unless to assist in managing complaints.

Table 8-3 identifies required additional mitigation measures that may be implemented where exceedances of the NML are predicted.

Table 8-3 Additional mitigation measures where exceedances of the NML are predicted

Construction Activity	Out of Hours Work	Type of Additional Mitigation Measures for Noise Catchment Area	
		1	2
<b>(3)</b> Construction of pathways, stairs and lift	Period 1	V, IB, N, R1, DR, PC, SN	V, IB, N, R1, DR, PC, SN
	Period 2	AA, V, IB, N, PC, SN, R2, DR	AA, V, IB, N, PC, SN, R2, DR
<b>(4a)</b> Installation of Steel Piles – Drilling	Period 1	V, IB, N, R1, DR, PC, SN	V, IB, N, R1, DR, PC, SN
	Period 2	AA, V, IB, N, PC, SN, R2, DR	AA, V, IB, N, PC, SN, R2, DR
<b>(4b)</b> Installation of Steel Piles – Hammering	Period 1	V, IB, N, R1, DR, PC, SN	V, IB, N, R1, DR, PC, SN
	Period 2	AA, V, IB, N, PC, SN, R2, DR	AA, V, IB, N, PC, SN, R2, DR
<b>(4c)</b> Installation of Steel Piles – Piling	Period 1	V, IB, N, R1, DR, PC, SN	V, IB, N, R1, DR, PC, SN
	Period 2	AA, V, IB, N, PC, SN, R2, DR	AA, V, IB, N, PC, SN, R2, DR

## 9 Conclusions

This assessment has determined the following conclusions:

- > In accordance with the noise management levels stipulated in Section 5.1, dwellings exposed to levels of construction noise above 75 dB(A) are considered highly noise affected, with dwellings exposed to levels above the daytime RBL +10 dB(A) considered noise affected.
- > Construction noise levels are predicted to exceed the NSW ICNG noise management levels (NML) for “standard” hours at all NCAs for standard construction hours for all construction scenarios.
- > Construction noise levels are predicted to exceed noise management levels for “non-standard” hours of operation for Scenario 3, 4a, 4b and 4c at the nearby residential receivers in both NCAs, particularly for receivers located on Herron Walk and Musgrave Street in NCA 1. This is due to the proximity of receivers to the construction works.
- > Predicted levels are expected to be highly intrusive at a number of receivers in NCA 1 & 2 for Scenario 3, 4a, 4b and 4c for works during OOH1 and OOH2 time periods. Construction noise is likely to have the highest impact on and cause sleep disturbance at sensitive receivers located on Herron Walk and Musgrave Street in NCA 1 and Cremorne Road in NCA 2, due to their proximity to the proposed work site.
- > It should be noted that this assessment has endeavoured to carry out “worst case” noise modelling, and noise levels are predicted based on all modelled sources operating simultaneously. Should the work sites or plant and equipment be amended, the predicted noise levels will change accordingly.
- > The predicted exceedances are generally a result of works being located in close proximity to the adjacent receivers. This modelling has been carried out to provide a worst case scenario and it may be possible to reduce the number of plant operating simultaneously, particularly at night, once detailed construction schedules are known.
- > Provision of temporary noise barriers where practical. The height and location of these barriers will be determined during preparation of the construction noise and vibration management plan (CNVMP) when more information regarding the proposed plant to be used for each construction scenario is available.
- > Best practice mitigation measures are recommended in Section 8 of this report.
- > An indicative assessment only of expected  $L_{Amax}$  impact has been carried out for this assessment as it is difficult to predict  $L_{Amax}$  for construction noise sources. It is generally expected that sleep disturbance criteria are likely to be exceeded unless the proposed number and type of plant are reduced for out of hours works.
- > The minimum working distances indicated in Table 7-1 for cosmetic damage must be complied with at all times, unless otherwise approved by TfNSW or under the environmental license as relevant, as stipulated in the NSW Construction Noise and Vibration Guideline.
- > A detailed CNVMP would be prepared for the project prior to construction commencement to incorporate the recommendations detailed in Section 8 and updated to reflect the proposed staging and plant to be adopted for the project.

South Mosman  
Wharf Upgrade

**APPENDIX A**  
NOISE  
MONITORING  
CHARTS



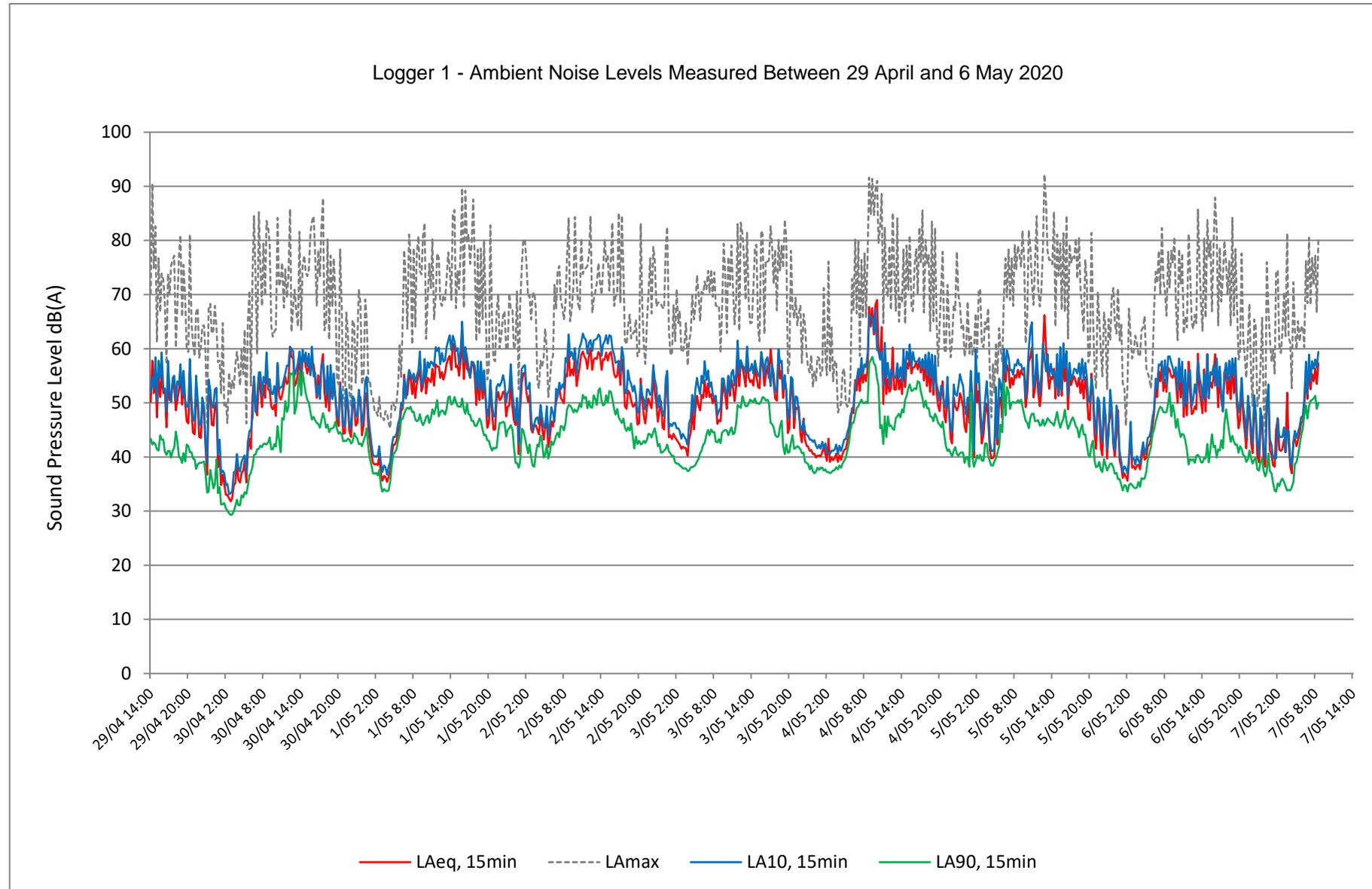


Figure A1 Ambient noise levels measured between 29 April and 6 May 2020 at logger location 1.

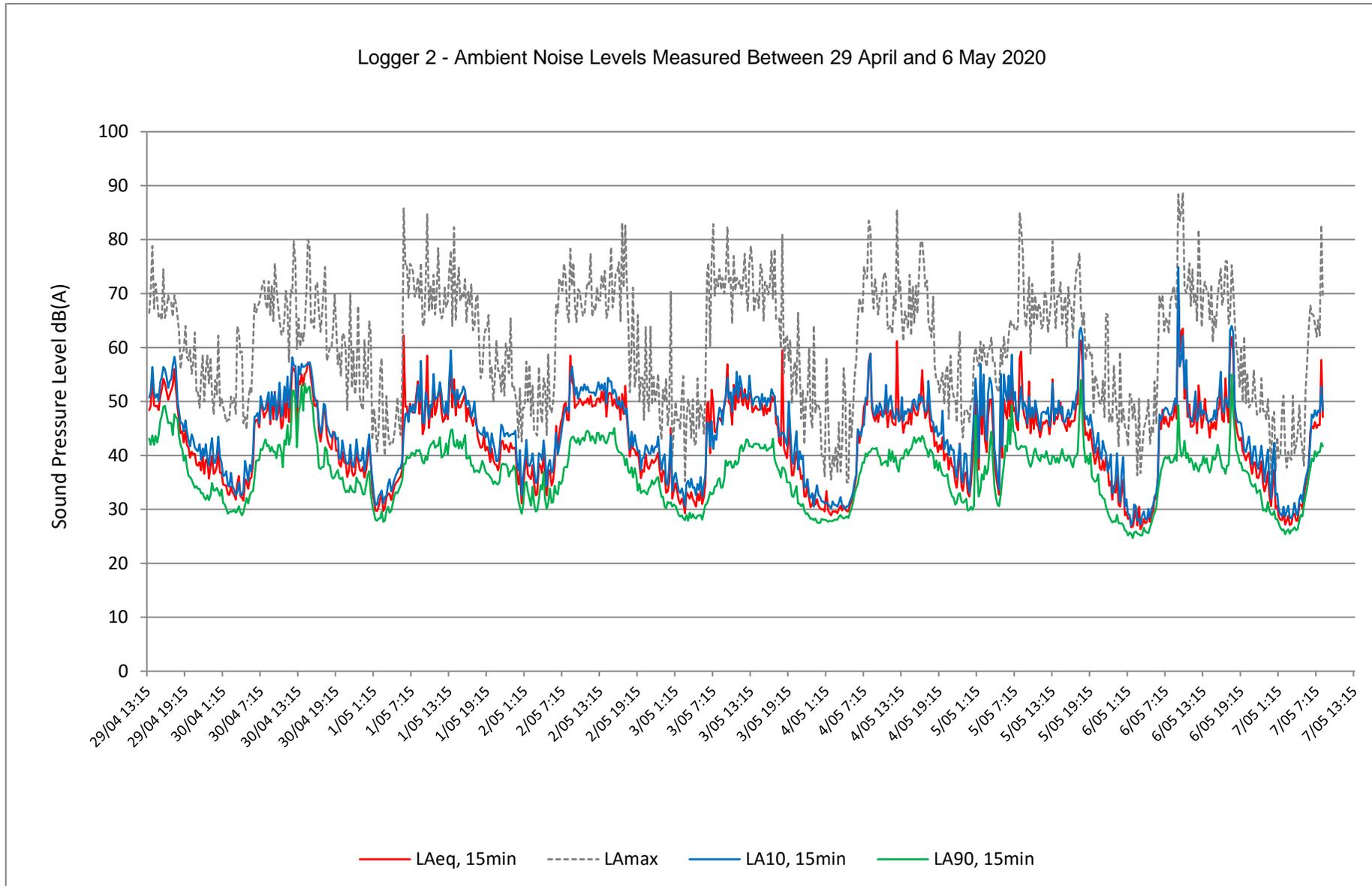


Figure A2 Ambient noise levels measured between 29 April and 6 May 2020 at logger location 2

South Mosman  
Wharf Upgrade

**APPENDIX B**  
WEATHER DATA  
DURING THE  
MONITORING  
PERIOD



The following weather conditions occurred during the monitoring period.

Table B1: Weather conditions during the monitoring period

Date & Time	Temp °C	Humidity %	Wind Speed m/s	Wind Direction	Rain / 10 mins mm
30/04/2020 0:30	20.2	68.7	2.1	NE	0
30/04/2020 1:00	20.5	71	2.9	NE	0
30/04/2020 1:30	20.9	71	1.5	NE	0
30/04/2020 2:00	21.1	75	1.5	NE	0
30/04/2020 2:30	21	77	1.9	NE	0
30/04/2020 3:00	20.9	77	1.9	NNE	0
30/04/2020 3:30	20.9	73	1.7	NE	0
30/04/2020 4:00	20.6	72.3	1.3	NE	0
30/04/2020 4:30	20.4	73	1.7	NE	0
30/04/2020 5:00	20.3	72.7	2.3	NNE	0
30/04/2020 5:30	20.5	71.3	2.4	N	0
30/04/2020 6:00	20.6	70.3	2	NNE	0
30/04/2020 6:30	20.6	69.7	2.4	NNE	0
30/04/2020 7:00	20.5	70.7	2.4	NNE	0
30/04/2020 7:30	20.2	72.7	2.3	NNE	0
30/04/2020 8:00	20.3	72	1.7	NNE	0
30/04/2020 8:30	20.4	72	1.6	N	0
30/04/2020 9:00	21	70.7	2	NNE	0.2
30/04/2020 9:30	21	70	1.5	NNE	0
30/04/2020 10:00	20.8	71.3	1	NNE	0
30/04/2020 10:30	20.4	74	1.2	NNE	0.2
30/04/2020 11:00	19.1	78.7	4.1	WNW	0.4
30/04/2020 11:30	16.8	80.3	4.8	W	1.8
30/04/2020 12:00	14.9	80.3	5.9	WSW	1
30/04/2020 12:30	13.8	84.7	3.5	WSW	0.8
30/04/2020 13:00	14	85.7	2.7	W	0
30/04/2020 13:30	14.1	86.3	2.7	W	1.6
30/04/2020 14:00	14.2	87.7	2.1	W	1.6
30/04/2020 14:30	14.1	87.7	1.6	WSW	1.8
30/04/2020 15:00	14.1	88	1.9	WSW	1.8
30/04/2020 15:30	14	87.7	2.3	WSW	1
30/04/2020 16:00	13.9	86.3	3.2	WNW	0.4
30/04/2020 16:30	13.2	78.3	2.6	NW	0
30/04/2020 17:00	12.9	77.7	3	WNW	0
30/04/2020 17:30	12.9	79.3	3.6	WNW	0.2
30/04/2020 18:00	12.5	81.3	3.3	NW	0.2
30/04/2020 18:30	12.5	81.3	2.9	NW	0
30/04/2020 19:00	12.4	79	2.6	NW	0
30/04/2020 19:30	12.4	79.3	3.4	NW	0
30/04/2020 20:00	12.2	77	2.7	WNW	0
30/04/2020 20:30	12.1	75.3	2.4	WNW	0
30/04/2020 21:00	11.8	75	2.9	NW	0
30/04/2020 21:30	11.8	74.7	3.9	NNW	0
30/04/2020 22:00	11.8	71.3	4.3	NNW	0
30/04/2020 22:30	11.8	69.7	4.6	NW	0
30/04/2020 23:00	11.8	69	4.3	NW	0
30/04/2020 23:30	11.9	65	3.2	WNW	0
1/05/2020 0:00	12	63.7	4.1	NW	0
1/05/2020 0:30	11.8	63.7	4.2	WNW	0
1/05/2020 1:00	11.8	61	2.5	NW	0
1/05/2020 1:30	11.7	60	2.5	NW	0
1/05/2020 2:00	11.6	58.3	3.3	NW	0
1/05/2020 2:30	11.6	57	2.5	NW	0
1/05/2020 3:00	11.2	57.3	2.5	N	0
1/05/2020 3:30	11.1	56.3	3.3	N	0
1/05/2020 4:00	10.8	58.3	3	N	0
1/05/2020 4:30	10.6	61	3.4	N	0
1/05/2020 5:00	11	60.7	4	N	0

Date & Time	Temp °C	Humidity %	Wind Speed m/s	Wind Direction	Rain / 10 mins mm
1/05/2020 5:30	11.1	58.3	3.7	N	0
1/05/2020 6:00	11	58.7	4	NNW	0
1/05/2020 6:30	11	58.3	3.8	N	0
1/05/2020 7:00	11.4	57.3	4.1	NNW	0
1/05/2020 7:30	11.8	57	3.5	NNW	0
1/05/2020 8:00	12.7	54	2.5	NW	0
1/05/2020 8:30	12.7	53	3.3	NW	0
1/05/2020 9:00	13.5	48	4	NW	0
1/05/2020 9:30	14	46.3	4.7	NW	0
1/05/2020 10:00	14.4	43.3	4.7	NW	0
1/05/2020 10:30	14.8	41.3	5	NW	0
1/05/2020 11:00	15	36.7	5.1	NW	0
1/05/2020 11:30	15.3	34.3	6.6	WNW	0
1/05/2020 12:00	15.8	34.3	5.5	WNW	0
1/05/2020 12:30	16.2	32.7	5.9	W	0
1/05/2020 13:00	15.9	35	5	WNW	0.2
1/05/2020 13:30	16.3	35.3	5.8	WNW	0
1/05/2020 14:00	16.1	33.3	5.3	WNW	0
1/05/2020 14:30	16.4	34	5.9	NW	0
1/05/2020 15:00	16.6	31.7	6.5	NW	0
1/05/2020 15:30	16.1	32.7	5.6	NW	0
1/05/2020 16:00	15.9	31.7	6.1	WNW	0
1/05/2020 16:30	15.5	32.7	5.6	WNW	0
1/05/2020 17:00	15	34	3.8	WNW	0
1/05/2020 17:30	14.8	35.3	3.6	NW	0
1/05/2020 18:00	14.4	37.7	3.6	NW	0
1/05/2020 18:30	14	43	3.9	NW	0
1/05/2020 19:00	13.8	44.7	4.1	NW	0
1/05/2020 19:30	13.5	45.3	3.9	NNW	0
1/05/2020 20:00	13.3	46	3.9	NNW	0
1/05/2020 20:30	13	47.3	4	N	0
1/05/2020 21:00	12.8	49	4.5	N	0
1/05/2020 21:30	12.9	51	6.6	NNW	0
1/05/2020 22:00	12.8	52.3	6.4	NNW	0
1/05/2020 22:30	12.8	53	5.5	NNW	0
1/05/2020 23:00	13.4	53	5.1	NNW	0
1/05/2020 23:30	13.5	53.3	5.2	NW	0
2/05/2020 0:00	13.4	53	2.9	NW	0
2/05/2020 0:30	13.3	53	2.4	NW	0
2/05/2020 1:00	13.4	53.7	4.3	NW	0
2/05/2020 1:30	13.2	54.7	3.6	NW	0
2/05/2020 2:00	13	55.3	4.1	NW	0
2/05/2020 2:30	13	56.3	4.9	NW	0
2/05/2020 3:00	13	53.7	3.9	NNW	0
2/05/2020 3:30	12.8	53	5	NNW	0
2/05/2020 4:00	12.9	54.3	5.2	NNW	0
2/05/2020 4:30	13	53.7	2.9	NW	0
2/05/2020 5:00	13.5	50.7	3.6	NW	0
2/05/2020 5:30	13.6	51	4	NW	0
2/05/2020 6:00	13.7	50	4	NW	0
2/05/2020 6:30	13.4	50.7	3.4	NW	0
2/05/2020 7:00	13.6	51	3.9	NW	0
2/05/2020 7:30	14	50.3	4.7	NW	0
2/05/2020 8:00	14.5	47.3	4.9	NW	0
2/05/2020 8:30	14.3	43.3	5.9	WNW	0
2/05/2020 9:00	14.6	39.3	5.5	NW	0
2/05/2020 9:30	14.7	36.3	8.3	WNW	0
2/05/2020 10:00	14.8	35.7	7.3	W	0
2/05/2020 10:30	15.4	36.3	6.4	W	0
2/05/2020 11:00	16.1	35.3	7	WNW	0
2/05/2020 11:30	16.7	33.3	6.4	W	0

Date & Time	Temp °C	Humidity %	Wind Speed m/s	Wind Direction	Rain / 10 mins mm
2/05/2020 12:00	17.4	31.7	6.7	WNW	0
2/05/2020 12:30	17.9	31	6.8	WNW	0
2/05/2020 13:00	18.3	31.7	7.3	NW	0
2/05/2020 13:30	18.2	30.3	7.8	NW	0
2/05/2020 14:00	18.4	29.7	5.5	WNW	0
2/05/2020 14:30	18.3	30.3	6	WNW	0
2/05/2020 15:00	18.3	30	6.8	WNW	0
2/05/2020 15:30	18	29.3	5.8	WNW	0
2/05/2020 16:00	17.4	30.3	6.4	WNW	0
2/05/2020 16:30	16.8	31.7	6.2	W	0
2/05/2020 17:00	16.2	34.7	6.8	W	0
2/05/2020 17:30	15.7	35.7	5.4	W	0
2/05/2020 18:00	15.3	39.3	5.4	W	0
2/05/2020 18:30	15.1	39.7	4	W	0
2/05/2020 19:00	14.5	40.3	3.9	W	0
2/05/2020 19:30	14.2	40.7	2.9	WSW	0
2/05/2020 20:00	13.9	41	3.5	W	0
2/05/2020 20:30	13.6	42	4.3	W	0
2/05/2020 21:00	13.4	40.7	4.2	W	0
2/05/2020 21:30	13.2	41	4.6	W	0
2/05/2020 22:00	13.1	41.7	5.2	W	0
2/05/2020 22:30	13.2	40.3	4.8	W	0
2/05/2020 23:00	13	41.3	3.7	W	0
2/05/2020 23:30	12.6	42.3	3.2	WNW	0
3/05/2020 0:00	12.5	44.7	2.9	NW	0
3/05/2020 0:30	12.3	46.7	2.6	NW	0
3/05/2020 1:00	12.1	48.3	2.6	NW	0
3/05/2020 1:30	12.3	51	2.9	W	0
3/05/2020 2:00	12.1	51	2.5	NW	0
3/05/2020 2:30	12.1	52.7	3.3	W	0
3/05/2020 3:00	12.2	53.3	3.3	W	0
3/05/2020 3:30	12.1	53	2.7	W	0
3/05/2020 4:00	12.1	52.3	3.5	W	0
3/05/2020 4:30	12	52	3.7	W	0
3/05/2020 5:00	11.8	53.3	3.4	W	0
3/05/2020 5:30	11.5	54.3	3.2	W	0
3/05/2020 6:00	11.4	54	3.2	W	0
3/05/2020 6:30	11.4	54	3.6	W	0
3/05/2020 7:00	11.5	54	3.4	W	0
3/05/2020 7:30	12	53	4	W	0
3/05/2020 8:00	13	48.7	4.1	W	0
3/05/2020 8:30	13.1	49.7	3.6	W	0
3/05/2020 9:00	13.6	48	4.8	W	0
3/05/2020 9:30	14	45.7	5.2	W	0
3/05/2020 10:00	14.9	44.7	5.1	W	0
3/05/2020 10:30	15.6	41.7	3.9	WSW	0
3/05/2020 11:00	16.2	41	3.5	SW	0
3/05/2020 11:30	17.3	39.7	4.2	S	0
3/05/2020 12:00	18.5	36.7	4.2	SSW	0
3/05/2020 12:30	19.1	34.3	3.9	S	0
3/05/2020 13:00	19.4	33.3	3.8	SSW	0
3/05/2020 13:30	20	33.7	4	SSW	0
3/05/2020 14:00	19.8	31.7	3.3	SSW	0
3/05/2020 14:30	20	32.3	3.9	SSW	0
3/05/2020 15:00	19.6	31.7	3.6	SSW	0
3/05/2020 15:30	19.3	34.3	3.3	SSW	0
3/05/2020 16:00	18.4	35.7	2.6	S	0
3/05/2020 16:30	17.2	39	2.6	SSE	0
3/05/2020 17:00	16.4	42	1.8	SSE	0
3/05/2020 17:30	15.8	44.3	0.7	SSE	0
3/05/2020 18:00	15.4	46.7	0.9	SSE	0

Date & Time	Temp °C	Humidity %	Wind Speed m/s	Wind Direction	Rain / 10 mins mm
3/05/2020 18:30	15.3	48	0.8	S	0
3/05/2020 19:00	15.3	49	0.8	SW	0
3/05/2020 19:30	14.7	59.7	2	WNW	0
3/05/2020 20:00	13.8	63	1.9	W	0
3/05/2020 20:30	13.4	64.7	2.2	W	0
3/05/2020 21:00	12.9	68.7	2.6	W	0
3/05/2020 21:30	12.6	71.7	3	W	0
3/05/2020 22:00	12.2	71.3	3.2	W	0
3/05/2020 22:30	12.3	64	3.3	W	0
3/05/2020 23:00	12.5	60.3	3.4	W	0
3/05/2020 23:30	12.2	61	2.9	W	0
4/05/2020 0:00	12	61.3	3.4	W	0
4/05/2020 0:30	12	62	3.6	W	0
4/05/2020 1:00	11.6	63.7	3.4	W	0
4/05/2020 1:30	11.2	65.3	3.4	W	0
4/05/2020 2:00	11.2	65.3	4	W	0
4/05/2020 2:30	11	66	4	W	0
4/05/2020 3:00	10.9	66.7	3.6	W	0
4/05/2020 3:30	10.8	66.3	3.6	W	0
4/05/2020 4:00	10.5	67.7	3.8	W	0
4/05/2020 4:30	10.4	68.3	3.8	W	0
4/05/2020 5:00	10	70.3	3.5	W	0
4/05/2020 5:30	9.9	72.7	4.2	W	0
4/05/2020 6:00	9.7	75.3	4	WNW	0
4/05/2020 6:30	9.7	75	4	W	0
4/05/2020 7:00	9.9	72.7	3.7	WNW	0
4/05/2020 7:30	10.6	69.7	4.1	WNW	0
4/05/2020 8:00	11.9	63	4	W	0
4/05/2020 8:30	12	61.7	4.3	W	0
4/05/2020 9:00	12.5	62.3	4	W	0
4/05/2020 9:30	13.4	60.3	3.4	WNW	0
4/05/2020 10:00	14.4	58	3	WNW	0
4/05/2020 10:30	15.6	55.7	1.9	WNW	0
4/05/2020 11:00	16.6	54.3	1.8	WNW	0
4/05/2020 11:30	17.3	48.3	2.7	S	0
4/05/2020 12:00	18.1	47.3	2.7	S	0
4/05/2020 12:30	19.2	43	2.7	S	0
4/05/2020 13:00	19.1	42.3	3.1	S	0
4/05/2020 13:30	19.2	42.7	3.2	SSW	0
4/05/2020 14:00	19	42	3.4	S	0
4/05/2020 14:30	18.4	42.7	3.8	S	0
4/05/2020 15:00	17.7	46	4.1	S	0
4/05/2020 15:30	17.9	46.7	3.1	S	0
4/05/2020 16:00	17.5	47.3	3.5	S	0
4/05/2020 16:30	16.6	51.3	3.3	S	0
4/05/2020 17:00	16.2	52.3	3	S	0
4/05/2020 17:30	15.9	54.3	2	S	0
4/05/2020 18:00	15.8	56.7	3.4	S	0
4/05/2020 18:30	15.5	57.7	2.9	SSW	0
4/05/2020 19:00	15.2	59.3	2.5	SSW	0
4/05/2020 19:30	15	61	2.8	SSW	0
4/05/2020 20:00	15.2	61	2.6	SSW	0
4/05/2020 20:30	15.4	60.3	2.6	SSW	0
4/05/2020 21:00	15.6	58.7	2.7	WSW	0
4/05/2020 21:30	15.5	59	2.9	WSW	0
4/05/2020 22:00	15.3	60.3	3.2	WSW	0
4/05/2020 22:30	15.3	60.7	3.1	WSW	0
4/05/2020 23:00	14.8	61	3.4	W	0
4/05/2020 23:30	14.4	62.7	3.3	W	0
5/05/2020 0:00	14	66	3.4	W	0
5/05/2020 0:30	14.1	68.7	1.9	W	0

Date & Time	Temp °C	Humidity %	Wind Speed m/s	Wind Direction	Rain / 10 mins mm
5/05/2020 1:00	13.7	72.3	1.5	NNW	0
5/05/2020 1:30	13.5	72.3	3.4	WNW	0
5/05/2020 2:00	13.1	76.3	3.1	W	0.6
5/05/2020 2:30	12.9	80.7	3.4	W	0.8
5/05/2020 3:00	13	84.7	3.6	W	2.6
5/05/2020 3:30	12.8	87	3.6	W	1
5/05/2020 4:00	12.4	86	4.1	WNW	0.2
5/05/2020 4:30	12.2	86	3.3	W	0
5/05/2020 5:00	12.1	86	3	W	0.2
5/05/2020 5:30	12.4	87	2.7	W	0.8
5/05/2020 6:00	12.4	88	3.7	W	1
5/05/2020 6:30	12.6	88	3.2	W	1.8
5/05/2020 7:00	12.6	88.7	3.3	W	0.8
5/05/2020 7:30	12.5	88	3	WNW	0
5/05/2020 8:00	12.7	88	3.6	W	0
5/05/2020 8:30	13.2	87	3.5	W	0
5/05/2020 9:00	14	85	3.5	W	0
5/05/2020 9:30	14.5	81.3	2.5	W	0
5/05/2020 10:00	15.9	79	2.5	WSW	0
5/05/2020 10:30	17	73.7	3.2	S	0
5/05/2020 11:00	17.7	68.7	3.4	S	0.2
5/05/2020 11:30	17.9	66.3	3.2	SSW	0
5/05/2020 12:00	18.4	64.3	2.9	S	0
5/05/2020 12:30	19	61.7	3.3	SSW	0
5/05/2020 13:00	19.1	60.3	3.4	S	0
5/05/2020 13:30	19.7	59.7	2.6	SSE	0
5/05/2020 14:00	19.9	58.3	2.7	S	0
5/05/2020 14:30	20.6	57.7	2.8	S	0
5/05/2020 15:00	20.5	55.7	2.3	S	0
5/05/2020 15:30	20.6	56.3	2.4	S	0
5/05/2020 16:00	20.4	55.7	2.3	SSE	0
5/05/2020 16:30	18.5	60	2	SSE	0
5/05/2020 17:00	17.6	65.7	2.1	SSE	0
5/05/2020 17:30	17	69	1	SSE	0
5/05/2020 18:00	16.7	72	0.6	S	0
5/05/2020 18:30	16.4	73.3	0.6	WSW	0
5/05/2020 19:00	15.9	76.3	0.6	WSW	0
5/05/2020 19:30	15.7	80	1.1	WNW	0
5/05/2020 20:00	15.3	81.3	1.7	WNW	0
5/05/2020 20:30	15	82.3	1.1	WNW	0
5/05/2020 21:00	14.8	83.7	1.1	NW	0
5/05/2020 21:30	14.4	84	1.3	W	0
5/05/2020 22:00	14.3	84	1.8	WNW	0
5/05/2020 22:30	14.1	85	3.2	WNW	0
5/05/2020 23:00	13.7	84	3.1	W	0
5/05/2020 23:30	13.5	84	3.3	WNW	0
6/05/2020 0:00	13.4	84	2.6	W	0
6/05/2020 0:30	13.3	83.7	2.5	WNW	0
6/05/2020 1:00	13.1	84	2.4	W	0
6/05/2020 1:30	12.9	84.7	2.2	WNW	0
6/05/2020 2:00	12.8	85.7	2.6	WNW	0
6/05/2020 2:30	12.5	86	2.7	W	0
6/05/2020 3:00	12.3	86.3	3	W	0
6/05/2020 3:30	12.1	87	2.7	W	0
6/05/2020 4:00	12.1	87	2.6	W	0
6/05/2020 4:30	12.1	87.7	2.4	W	0
6/05/2020 5:00	11.8	87.3	2.7	W	0
6/05/2020 5:30	11.8	88	3.4	W	0
6/05/2020 6:00	11.7	88	3.1	W	0
6/05/2020 6:30	11.6	88	3.3	WNW	0
6/05/2020 7:00	11.5	88	3.1	W	0

Date & Time	Temp °C	Humidity %	Wind Speed m/s	Wind Direction	Rain / 10 mins mm
6/05/2020 7:30	11.8	88	2.9	W	0
6/05/2020 8:00	12.8	83.7	2.7	W	0
6/05/2020 8:30	12.9	80.7	2.3	W	0
6/05/2020 9:00	13.2	80.3	2.9	WNW	0
6/05/2020 9:30	13.8	78.3	2.5	W	0
6/05/2020 10:00	14.7	75.3	2.5	W	0
6/05/2020 10:30	15.7	72.3	2.7	W	0
6/05/2020 11:00	16.8	67.7	2.2	W	0
6/05/2020 11:30	17.8	64.7	1.9	W	0
6/05/2020 12:00	19.1	57.7	1.7	W	0
6/05/2020 12:30	21.3	47	1.8	NNW	0
6/05/2020 13:00	22.5	38	1.8	NW	0
6/05/2020 13:30	23	34	1.4	NW	0
6/05/2020 14:00	23.6	32.7	2.1	WNW	0
6/05/2020 14:30	23.6	32	1.4	NNW	0
6/05/2020 15:00	23.6	32	2.1	NE	0
6/05/2020 15:30	23.7	31	2.3	ENE	0
6/05/2020 16:00	22.4	38.7	2.5	NE	0
6/05/2020 16:30	20.9	43.3	1.9	NNE	0
6/05/2020 17:00	19.9	47.7	1.1	N	0
6/05/2020 17:30	19.1	51.7	1	N	0
6/05/2020 18:00	18.6	55.7	0.6	NE	0
6/05/2020 18:30	18.6	62	0.6	N	0
6/05/2020 19:00	18.4	64	0.7	N	0
6/05/2020 19:30	18	63.7	0.5	NE	0
6/05/2020 20:00	17.8	65.3	1	ENE	0
6/05/2020 20:30	17.6	65.3	1.1	ENE	0
6/05/2020 21:00	17.4	65	1.1	ENE	0
6/05/2020 21:30	17	66.3	0.7	NE	0
6/05/2020 22:00	16.5	67.3	0.7	NNE	0
6/05/2020 22:30	15.7	70.3	1.2	NNW	0
6/05/2020 23:00	15.1	74	1.5	WNW	0
6/05/2020 23:30	14.5	76	2.3	WNW	0
7/05/2020 0:00	14.4	76	1.9	WNW	0
7/05/2020 0:30	14.3	76	1.7	W	0
7/05/2020 1:00	14	77	1.7	W	0
7/05/2020 1:30	14.1	75	1.9	W	0
7/05/2020 2:00	13.8	75.7	1.9	W	0
7/05/2020 2:30	13.5	77	1.8	WNW	0
7/05/2020 3:00	13.4	78.7	2.2	WNW	0
7/05/2020 3:30	13.1	79.7	1.6	W	0
7/05/2020 4:00	13	78.3	1.5	W	0
7/05/2020 4:30	12.7	78	1.4	WNW	0
7/05/2020 5:00	12.5	78	2.2	W	0
7/05/2020 5:30	12.1	78.7	1.8	WNW	0
7/05/2020 6:00	11.9	80	1.8	NW	0
7/05/2020 6:30	11.8	81.3	2.5	WNW	0
7/05/2020 7:00	11.9	81.3	2.4	WNW	0
7/05/2020 7:30	12.4	79	2.6	W	0
7/05/2020 8:00	13	74.3	1.9	NW	0
7/05/2020 8:30	13.4	73	1.5	WNW	0
7/05/2020 9:00	14	71.3	1.7	WNW	0
7/05/2020 9:30	14.5	70.7	1.8	W	0
7/05/2020 10:00	15.1	69	1.4	W	0
7/05/2020 10:30	16	67.7	1.5	W	0
7/05/2020 11:00	17.2	65.7	0.9	W	0
7/05/2020 11:30	18.7	59.3	1.9	N	0
7/05/2020 12:00	20.2	51.7	1.1	ESE	0
7/05/2020 12:30	21.4	49.7	1.5	ENE	0
7/05/2020 13:00	22.2	47.3	2.4	NNW	0
7/05/2020 13:30	23.6	44.7	2.3	N	0

Date & Time	Temp °C	Humidity %	Wind Speed m/s	Wind Direction	Rain / 10 mins mm
7/05/2020 14:00	24.3	40	2.4	N	0
7/05/2020 14:30	24.6	39.3	2.5	N	0
7/05/2020 15:00	24.4	39.3	2.5	N	0
7/05/2020 15:30	24.1	39.3	2.2	N	0
7/05/2020 16:00	23.3	41.7	2.4	NNW	0
7/05/2020 16:30	22	43.7	3.1	NW	0
7/05/2020 17:00	21.1	45.3	2.7	N	0
7/05/2020 17:30	20.7	47.7	2.6	N	0
7/05/2020 18:00	20.2	50.3	2.5	N	0
7/05/2020 18:30	19.9	50.7	2.6	N	0
7/05/2020 19:00	19.6	51.3	1.9	N	0
7/05/2020 19:30	19.4	52	2.3	NNW	0
7/05/2020 20:00	19.2	54.3	1.6	NNW	0
7/05/2020 20:30	18.9	57	1.9	NNW	0
7/05/2020 21:00	18.6	58	3	NNW	0
7/05/2020 21:30	18.5	59	2.5	NNW	0
7/05/2020 22:00	18.2	60	2	N	0
7/05/2020 22:30	18.3	60	2.8	N	0
7/05/2020 23:00	18.2	60.3	3.4	N	0
7/05/2020 23:30	17.8	61.7	3.3	NNW	0

South Mosman  
Wharf Upgrade

**APPENDIX C**  
PREDICTED  
CONSTRUCTION  
NOISE LEVELS



Table C1 Predicted construction LAeq noise levels compared to TfNSW daytime noise impact categories, dB(A). – NCA 1

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 50-55 dB(A)														
Clearly audible: 55-65 dB(A)														
Moderately intrusive: 65-75 dB(A)														
Highly Intrusive: >75 dB(A)														
1 Herron Walk	1	84	GF	W	74	80	80	-	-	-	-	79	73	77
1 Herron Walk	1	84	F 1	W	74	81	81	-	-	-	-	80	74	78
1 Herron Walk	1	84	F 2	W	74	82	82	-	-	-	-	80	74	77
1 Herron Walk	1	84	F 3	W	73	82	82	-	-	-	-	80	74	77
1 Wulworra Avenue	1	108	GF	E	58	65	65	-	-	-	-	63	57	60
1 Wulworra Avenue	1	108	F 1	E	59	65	65	-	-	-	-	63	57	60
1 Wulworra Avenue	1	108	F 2	E	59	66	66	-	-	-	-	63	57	60
1 Wulworra Avenue	1	108	F 3	E	59	66	66	-	-	-	-	63	58	60
1a Kareela Road	1	135	GF	E	56	66	66	-	-	-	-	63	58	59
1a Kareela Road	1	135	F 1	E	57	66	66	-	-	-	-	63	58	59
2 Musgrave Street	1	148	GF	E	80	66	66	-	-	-	-	75	57	77
2 Musgrave Street	1	148	F 1	E	80	67	67	-	-	-	-	79	57	78
2 Musgrave Street	1	89	GF	W	69	83	83	-	-	-	-	81	79	77
2 Musgrave Street	1	89	F 1	W	70	83	83	-	-	-	-	81	79	77
2 Raglan Street	1	83	GF	W	50	59	59	-	-	-	-	56	50	53
2 Raglan Street	1	83	F 1	W	51	59	59	-	-	-	-	56	51	53
2 Raglan Street	1	83	F 2	W	51	59	59	-	-	-	-	56	51	54
2 Raglan Street	1	83	F 3	W	51	59	59	-	-	-	-	56	51	54
2 Raglan Street	1	83	F 4	W	51	59	59	-	-	-	-	56	51	54
2 Raglan Street	1	83	F 5	W	51	60	60	-	-	-	-	56	52	54
3 Herron Walk	1	85	GF	N	62	64	67	-	-	-	-	67	62	66
3 Herron Walk	1	85	F 1	N	64	64	67	-	-	-	-	67	62	67
3 Herron Walk	1	85	F 2	N	65	65	68	-	-	-	-	68	63	68
3 Herron Walk	1	85	F 3	N	66	65	68	-	-	-	-	69	63	69
4-5a Herron Walk	1	87	GF	W	72	73	73	-	-	-	-	74	68	72
4-5a Herron Walk	1	87	F 1	W	73	73	73	-	-	-	-	74	69	73
4-5a Herron Walk	1	87	F 2	W	73	75	75	-	-	-	-	75	70	73
4-5a Herron Walk	1	87	F 3	W	72	76	76	-	-	-	-	75	70	73
4 Musgrave Street	1	150	GF	E	73	61	61	-	-	-	-	70	54	70
4 Musgrave Street	1	150	F 1	E	74	62	62	-	-	-	-	73	55	72
4 Musgrave Street	1	90	GF	W	63	76	76	-	-	-	-	70	75	66
4 Musgrave Street	1	90	F 1	W	64	76	76	-	-	-	-	70	75	67
5 Herron walk	1	86	GF	W	77	85	85	-	-	-	-	84	77	81
5 Herron walk	1	86	F 1	W	77	85	85	-	-	-	-	84	76	81

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 50-55 dB(A)														
Clearly audible: 55-65 dB(A)														
Moderately intrusive: 65-75 dB(A)														
Highly Intrusive: >75 dB(A)														
5 Herron walk	1	86	F 2	W	77	86	86	-	-	-	-	83	76	80
5 Herron walk	1	86	F 3	W	77	84	84	-	-	-	-	83	76	80
5 Herron walk	1	86	F 4	W	77	84	84	-	-	-	-	83	76	80
5 Herron walk	1	86	F 5	W	76	84	84	-	-	-	-	83	75	79
6 Musgrave Street	1	152	F 1	E	68	60	60	-	-	-	-	64	53	67
6 Musgrave Street	1	91	GF	W	61	74	74	-	-	-	-	70	71	64
6 Musgrave Street	1	91	F 1	W	62	74	74	-	-	-	-	70	71	65
7 Herron Walk	1	88	GF	W	77	76	76	-	-	-	-	78	69	77
7 Herron Walk	1	88	F 1	W	77	79	79	-	-	-	-	79	70	78
7 Herron Walk	1	88	F 2	W	77	79	79	-	-	-	-	79	71	78
7 Herron Walk	1	88	F 3	W	76	81	81	-	-	-	-	80	72	78
8 McLeod Street	1	102	GF	W	45	55	55	-	-	-	-	50	49	49
8 McLeod Street	1	102	F 1	W	49	59	59	-	-	-	-	54	53	52
8 Musgrave Street	1	154	GF	E	66	57	57	-	-	-	-	59	50	63
8 Musgrave Street	1	154	F 1	E	66	58	58	-	-	-	-	64	50	65
8 Musgrave Street	1	92	GF	W	54	64	64	-	-	-	-	57	57	56
8 Musgrave Street	1	92	F 1	W	59	65	65	-	-	-	-	59	60	60
8a McLeod Street	1	103	GF	S	50	61	61	-	-	-	-	59	57	56
8a McLeod Street	1	103	F 1	S	51	61	61	-	-	-	-	60	57	56
9b Musgrave Street	1	149	GF	W	78	73	73	-	-	-	-	77	65	77
9b Musgrave Street	1	149	F 1	W	78	75	75	-	-	-	-	77	67	77
10 McLeod Street	1	104	GF	SW	50	63	63	-	-	-	-	59	56	55
10 McLeod Street	1	104	F 1	SW	50	63	63	-	-	-	-	59	56	55
10 Musgrave Street	1	156	GF	E	61	59	59	-	-	-	-	56	52	54
10 Musgrave Street	1	156	F 1	E	63	59	59	-	-	-	-	58	52	59
10 Musgrave Street	1	93	GF	W	56	69	69	-	-	-	-	62	66	57
10 Musgrave Street	1	93	F 1	W	58	69	69	-	-	-	-	62	66	58
11 Musgrave Street	1	151	GF	W	74	68	68	-	-	-	-	72	61	73
11 Musgrave Street	1	151	F 1	W	75	69	69	-	-	-	-	73	63	74
11a Musgrave Street	1	162	GF	W	70	64	64	-	-	-	-	70	56	69
11a Musgrave Street	1	162	F 1	W	71	65	65	-	-	-	-	70	57	70
12 Musgrave Street	1	158	GF	E	63	57	57	-	-	-	-	65	50	61
12 Musgrave Street	1	158	F 1	E	64	58	58	-	-	-	-	65	52	62
12 Musgrave Street	1	94	GF	W	56	69	69	-	-	-	-	63	67	59
12 Musgrave Street	1	94	F 1	W	57	69	69	-	-	-	-	64	67	60

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 50-55 dB(A)														
Clearly audible: 55-65 dB(A)														
Moderately intrusive: 65-75 dB(A)														
Highly Intrusive: >75 dB(A)														
14 Musgrave Street	1	95	GF	W	56	67	67	-	-	-	-	63	65	60
14 Musgrave Street	1	95	F 1	W	56	68	67	-	-	-	-	63	65	60
14 Musgrave Street	1	160	GF	E	62	54	54	-	-	-	-	61	48	60
14 Musgrave Street	1	160	F 1	E	62	55	55	-	-	-	-	62	49	61
15 Musgrave Street	1	153	GF	W	67	62	62	-	-	-	-	67	54	66
15 Musgrave Street	1	153	F 1	W	68	63	63	-	-	-	-	67	55	67
16-18 Musgrave Street	1	96	GF	W	49	56	56	-	-	-	-	52	49	50
16-18 Musgrave Street	1	96	F 1	W	53	57	57	-	-	-	-	53	51	54
16a Musgrave Street	1	97	GF	S	55	66	66	-	-	-	-	64	63	59
16a Musgrave Street	1	97	F 1	S	55	66	66	-	-	-	-	64	63	60
17 Musgrave Street	1	155	GF	W	60	62	62	-	-	-	-	60	53	56
17 Musgrave Street	1	155	F 1	W	63	60	60	-	-	-	-	64	54	62
18 Musgrave Street	1	98	GF	S	55	66	66	-	-	-	-	64	62	60
18 Musgrave Street	1	98	F 1	S	55	66	66	-	-	-	-	64	62	61
19 Musgrave Street	1	157	GF	W	64	61	61	-	-	-	-	64	53	66
19 Musgrave Street	1	157	F 1	W	65	62	62	-	-	-	-	65	53	66
20a Musgrave Street	1	99	GF	W	46	57	57	-	-	-	-	53	52	49
20a Musgrave Street	1	99	F 1	W	47	58	58	-	-	-	-	55	53	51
21 Musgrave Street	1	159	GF	W	65	61	61	-	-	-	-	63	52	65
21 Musgrave Street	1	159	F 1	W	66	61	62	-	-	-	-	63	52	65
22a Musgrave Street	1	100	GF	W	52	63	63	-	-	-	-	61	60	56
22a Musgrave Street	1	100	F 1	W	52	63	63	-	-	-	-	62	60	57
22b Musgrave Street	1	101	GF	S	52	64	64	-	-	-	-	62	59	58
22b Musgrave Street	1	101	F 1	S	52	64	64	-	-	-	-	62	59	58
23 Musgrave Street	1	161	GF	W	62	60	61	-	-	-	-	62	50	61
23 Musgrave Street	1	161	F 1	W	62	60	60	-	-	-	-	63	51	61

Table C2 Predicted construction LAeq noise levels compared to TfNSW daytime noise impact categories, dB(A). – NCA 2

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 43-48 dB(A)														
Clearly audible: 48-58 dB(A)														
Moderately intrusive: 58-68 dB(A)														
Highly Intrusive: >68 dB(A)														
1 Kareela Road	2	133	GF	SE	58	68	68	-	-	-	-	64	59	60
1 Kareela Road	2	133	F 1	SE	58	68	68	-	-	-	-	64	59	61
1 Kareela Road	2	133	F 2	SE	58	68	68	-	-	-	-	64	60	61
2 Wulworra Avenue	2	107	GF	E	58	65	65	-	-	-	-	62	57	60
2 Wulworra Avenue	2	107	F 1	E	58	65	65	-	-	-	-	62	57	60
2 Wulworra Avenue	2	107	F 2	E	58	65	65	-	-	-	-	62	57	60
2 Wulworra Avenue	2	107	F 3	E	58	65	65	-	-	-	-	62	57	60
3 Green Street	2	131	GF	E	56	66	66	-	-	-	-	62	58	59
3 Green Street	2	131	F 1	E	56	66	66	-	-	-	-	63	58	59
3 Green Street	2	131	F 2	E	57	66	66	-	-	-	-	63	58	59
3 Kareela Road	2	136	GF	E	56	66	66	-	-	-	-	62	58	59
3 Kareela Road	2	136	F 1	E	56	66	66	-	-	-	-	62	58	59
3 Wulworra Avenue	2	105	GF	E	53	61	61	-	-	-	-	58	53	56
3 Wulworra Avenue	2	105	F 1	E	53	61	62	-	-	-	-	58	53	56
3 Wulworra Avenue	2	105	F 2	E	54	62	62	-	-	-	-	59	53	56
3 Wulworra Avenue	2	105	F 3	E	54	62	62	-	-	-	-	59	53	56
3 Wulworra Avenue	2	109	GF	E	59	66	66	-	-	-	-	63	58	61
3 Wulworra Avenue	2	109	F 1	E	59	66	66	-	-	-	-	63	58	61
3 Wulworra Avenue	2	109	F 2	E	59	66	66	-	-	-	-	63	58	61
3 Wulworra Avenue	2	109	F 3	E	59	66	66	-	-	-	-	63	58	61
5 Green Street	2	132	GF	E	56	66	66	-	-	-	-	63	58	59
5 Green Street	2	132	F 1	E	57	66	66	-	-	-	-	63	58	59
5 Green Street	2	132	F 2	E	57	67	67	-	-	-	-	63	58	60
5 Kareela Road	2	137	GF	E	56	66	66	-	-	-	-	62	57	58
5 Kareela Road	2	137	F 1	E	56	66	66	-	-	-	-	62	57	59
5 Wulworra Avenue	2	110	GF	E	57	64	64	-	-	-	-	61	56	59
5 Wulworra Avenue	2	110	F 1	E	57	64	64	-	-	-	-	62	56	59
5 Wulworra Avenue	2	110	F 2	E	57	64	64	-	-	-	-	62	56	59
5 Wulworra Avenue	2	110	F 3	E	58	65	65	-	-	-	-	62	57	59
6 Kareela Road	2	134	GF	S	56	66	66	-	-	-	-	63	58	59
6 Kareela Road	2	134	F 1	S	57	66	66	-	-	-	-	63	58	59
6 Wulworra Avenue	2	106	GF	E	57	64	64	-	-	-	-	61	56	59
6 Wulworra Avenue	2	106	F 1	E	57	64	64	-	-	-	-	61	56	59
6 Wulworra Avenue	2	106	F 2	E	57	64	64	-	-	-	-	61	56	59

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 43-48 dB(A)														
Clearly audible: 48-58 dB(A)														
Moderately intrusive: 58-68 dB(A)														
Highly Intrusive: >68 dB(A)														
6 Wulworra Avenue	2	106	F 3	E	57	64	64	-	-	-	-	61	56	59
7 Kareela Road	2	138	GF	E	56	65	65	-	-	-	-	61	57	58
7 Kareela Road	2	138	F 1	E	56	66	66	-	-	-	-	62	57	58
7 Wulworra Avenue	2	111	GF	NE	57	64	64	-	-	-	-	62	56	59
7 Wulworra Avenue	2	111	F 1	NE	58	65	65	-	-	-	-	62	57	59
7 Wulworra Avenue	2	111	F 2	NE	58	65	65	-	-	-	-	62	57	59
7 Wulworra Avenue	2	111	F 3	NE	58	65	65	-	-	-	-	62	57	60
9 Kareela Road	2	139	GF	NE	55	65	65	-	-	-	-	61	57	58
9 Kareela Road	2	139	F 1	NE	56	65	65	-	-	-	-	61	57	58
9 Wulworra Avenue	2	112	GF	E	58	65	65	-	-	-	-	62	57	59
9 Wulworra Avenue	2	112	F 1	E	58	65	65	-	-	-	-	62	57	59
9 Wulworra Avenue	2	112	F 2	E	58	65	65	-	-	-	-	62	57	60
9 Wulworra Avenue	2	112	F 3	E	58	65	65	-	-	-	-	62	57	60
11 Wulworra Avenue	2	113	GF	E	58	65	65	-	-	-	-	62	57	60
11 Wulworra Avenue	2	113	F 1	E	58	65	65	-	-	-	-	62	57	60
11 Wulworra Avenue	2	113	F 2	E	58	65	65	-	-	-	-	62	57	60
11 Wulworra Avenue	2	113	F 3	E	58	65	65	-	-	-	-	62	57	60
13 Wulworra Avenue	2	114	GF	E	58	65	65	-	-	-	-	62	57	60
13 Wulworra Avenue	2	114	F 1	E	58	65	65	-	-	-	-	62	57	60
13 Wulworra Avenue	2	114	F 2	E	58	65	65	-	-	-	-	62	57	60
15 Kareela Road	2	140	GF	E	57	67	67	-	-	-	-	63	59	60
15 Kareela Road	2	140	F 1	E	57	67	67	-	-	-	-	63	59	60
15 Wulworra Avenue	2	115	GF	E	58	65	65	-	-	-	-	62	57	60
15 Wulworra Avenue	2	115	F 1	E	58	66	66	-	-	-	-	63	57	60
15 Wulworra Avenue	2	115	F 2	E	59	66	66	-	-	-	-	63	58	60
15a Kareela Road	2	141	GF	NE	55	65	65	-	-	-	-	61	57	58
15a Kareela Road	2	141	F 1	NE	56	65	65	-	-	-	-	61	57	58
17 Kareela Road	2	142	GF	E	57	67	67	-	-	-	-	62	58	59
17 Kareela Road	2	142	F 1	E	57	67	67	-	-	-	-	63	58	59
17 Wulworra Avenue	2	116	GF	E	58	66	66	-	-	-	-	63	58	60
17 Wulworra Avenue	2	116	F 1	E	58	66	66	-	-	-	-	63	58	60
17 Wulworra Avenue	2	116	F 2	E	58	66	66	-	-	-	-	63	58	60
19-21 Kareela Road	2	143	GF	E	54	64	64	-	-	-	-	60	56	57
19-21 Kareela Road	2	143	F 1	E	54	64	64	-	-	-	-	60	56	57
21 Wulworra Avenue	2	117	GF	E	57	66	66	-	-	-	-	63	58	60

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 43-48 dB(A)														
Clearly audible: 48-58 dB(A)														
Moderately intrusive: 58-68 dB(A)														
Highly Intrusive: >68 dB(A)														
21 Wulworra Avenue	2	117	F 1	E	57	66	66	-	-	-	-	63	58	60
21 Wulworra Avenue	2	117	F 2	E	57	66	66	-	-	-	-	63	58	60
23 Kareela Road	2	144	GF	E	54	64	64	-	-	-	-	59	55	56
23 Kareela Road	2	144	F 1	E	54	64	64	-	-	-	-	59	55	56
23 Wulworra Avenue	2	118	GF	NE	57	66	66	-	-	-	-	63	58	59
23 Wulworra Avenue	2	118	F 1	NE	57	66	66	-	-	-	-	63	58	59
23 Wulworra Avenue	2	118	F 2	NE	57	66	66	-	-	-	-	63	58	59
25 Wulworra Avenue	2	119	GF	E	56	66	66	-	-	-	-	63	58	60
25 Wulworra Avenue	2	119	F 1	E	57	66	66	-	-	-	-	63	58	60
25 Wulworra Avenue	2	119	F 2	E	57	67	67	-	-	-	-	63	58	60
27 Kareela Road	2	145	GF	NE	45	54	54	-	-	-	-	50	46	47
27 Kareela Road	2	145	F 1	NE	49	58	58	-	-	-	-	54	49	51
27 Wulworra Avenue	2	120	GF	E	57	66	66	-	-	-	-	63	58	60
27 Wulworra Avenue	2	120	F 1	E	57	67	67	-	-	-	-	63	58	60
27 Wulworra Avenue	2	120	F 2	E	57	67	67	-	-	-	-	63	58	60
29 Wulworra Avenue	2	121	GF	E	57	66	66	-	-	-	-	63	58	60
29 Wulworra Avenue	2	121	F 1	E	57	67	67	-	-	-	-	63	58	60
29 Wulworra Avenue	2	121	F 2	E	57	67	67	-	-	-	-	63	59	60
31 Kareela Road	2	146	GF	E	53	63	63	-	-	-	-	58	54	55
31 Kareela Road	2	146	F 1	E	53	63	63	-	-	-	-	59	54	55
31 Wulworra Avenue	2	122	GF	NE	57	66	66	-	-	-	-	63	58	60
31 Wulworra Avenue	2	122	F 1	NE	57	67	67	-	-	-	-	63	58	60
31 Wulworra Avenue	2	122	F 2	NE	57	67	67	-	-	-	-	63	59	60
33 Kareela Road	2	147	GF	E	51	61	61	-	-	-	-	56	53	53
33 Kareela Road	2	147	F 1	E	52	62	62	-	-	-	-	56	53	53
33 Wulworra Avenue	2	123	GF	E	57	67	67	-	-	-	-	63	58	60
33 Wulworra Avenue	2	123	F 1	E	57	67	67	-	-	-	-	63	58	60
33 Wulworra Avenue	2	123	F 2	E	57	67	67	-	-	-	-	63	59	60
39 Wulworra Avenue	2	124	GF	E	57	66	67	-	-	-	-	63	58	60
39 Wulworra Avenue	2	124	F 1	E	57	67	67	-	-	-	-	63	58	60
39 Wulworra Avenue	2	124	F 2	E	57	67	67	-	-	-	-	63	58	60
41 Wulworra Avenue	2	125	GF	E	57	66	67	-	-	-	-	63	58	60
41 Wulworra Avenue	2	125	F 1	E	57	67	67	-	-	-	-	63	58	60
41 Wulworra Avenue	2	125	F 2	E	57	67	67	-	-	-	-	63	58	60
45 Wulworra Avenue	2	126	GF	E	57	67	67	-	-	-	-	63	58	60

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 43-48 dB(A)														
Clearly audible: 48-58 dB(A)														
Moderately intrusive: 58-68 dB(A)														
Highly Intrusive: >68 dB(A)														
45 Wulworra Avenue	2	126	F 1	E	57	67	67	-	-	-	-	63	58	60
45 Wulworra Avenue	2	126	F 2	E	57	67	67	-	-	-	-	63	59	60
49 Wulworra Avenue	2	127	GF	E	57	66	66	-	-	-	-	63	58	59
49 Wulworra Avenue	2	127	F 1	E	57	67	67	-	-	-	-	63	58	60
49 Wulworra Avenue	2	127	F 2	E	57	67	67	-	-	-	-	63	58	60
51 Wulworra Avenue	2	128	GF	E	57	67	67	-	-	-	-	63	58	60
51 Wulworra Avenue	2	128	F 1	E	57	67	67	-	-	-	-	63	59	60
51 Wulworra Avenue	2	128	F 2	E	57	67	67	-	-	-	-	63	59	60
55 Wulworra Avenue	2	129	GF	E	57	67	67	-	-	-	-	63	59	60
55 Wulworra Avenue	2	129	F 1	E	57	67	67	-	-	-	-	63	59	60
55 Wulworra Avenue	2	129	F 2	E	57	67	67	-	-	-	-	63	59	60
57 Wulworra Avenue	2	130	GF	E	58	67	67	-	-	-	-	63	59	60
57 Wulworra Avenue	2	130	F 1	E	57	67	67	-	-	-	-	63	59	60
57 Wulworra Avenue	2	130	F 2	E	57	67	67	-	-	-	-	63	59	60

Table C3 Predicted construction LAeq noise levels compared to TfNSW worst case evening (OOH1) noise impact categories, dB(A). – NCA 1

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 46-51 dB(A)														
Clearly audible: 51-61 dB(A)														
Moderately intrusive: 61-71 dB(A)														
Highly Intrusive: >71 dB(A)														
1 Herron Walk	1	84	GF	W	-	-	-	80	80	79	81	-	-	-
1 Herron Walk	1	84	F 1	W	-	-	-	82	80	80	82	-	-	-
1 Herron Walk	1	84	F 2	W	-	-	-	82	80	80	82	-	-	-
1 Herron Walk	1	84	F 3	W	-	-	-	82	81	80	82	-	-	-
1 Wulworra Avenue	1	108	GF	E	-	-	-	64	65	64	64	-	-	-
1 Wulworra Avenue	1	108	F 1	E	-	-	-	64	65	64	65	-	-	-
1 Wulworra Avenue	1	108	F 2	E	-	-	-	64	65	64	65	-	-	-
1 Wulworra Avenue	1	108	F 3	E	-	-	-	64	65	64	65	-	-	-
1a Kareela Road	1	135	GF	E	-	-	-	64	65	64	64	-	-	-
1a Kareela Road	1	135	F 1	E	-	-	-	65	65	64	64	-	-	-
2 Musgrave Street	1	148	GF	E	-	-	-	77	79	79	79	-	-	-
2 Musgrave Street	1	148	F 1	E	-	-	-	77	80	80	80	-	-	-
2 Musgrave Street	1	89	GF	W	-	-	-	81	83	80	84	-	-	-
2 Musgrave Street	1	89	F 1	W	-	-	-	81	84	82	84	-	-	-
2 Raglan Street	1	83	GF	W	-	-	-	57	58	57	59	-	-	-
2 Raglan Street	1	83	F 1	W	-	-	-	57	58	57	59	-	-	-
2 Raglan Street	1	83	F 2	W	-	-	-	58	58	57	59	-	-	-
2 Raglan Street	1	83	F 3	W	-	-	-	58	58	57	60	-	-	-
2 Raglan Street	1	83	F 4	W	-	-	-	57	58	57	59	-	-	-
2 Raglan Street	1	83	F 5	W	-	-	-	58	58	57	60	-	-	-
3 Herron Walk	1	85	GF	N	-	-	-	59	67	67	68	-	-	-
3 Herron Walk	1	85	F 1	N	-	-	-	59	68	68	68	-	-	-
3 Herron Walk	1	85	F 2	N	-	-	-	60	68	68	69	-	-	-
3 Herron Walk	1	85	F 3	N	-	-	-	61	69	69	69	-	-	-
4-5a Herron Walk	1	87	GF	W	-	-	-	73	76	76	74	-	-	-
4-5a Herron Walk	1	87	F 1	W	-	-	-	74	77	77	74	-	-	-
4-5a Herron Walk	1	87	F 2	W	-	-	-	76	77	77	74	-	-	-
4-5a Herron Walk	1	87	F 3	W	-	-	-	76	77	77	74	-	-	-
4 Musgrave Street	1	150	GF	E	-	-	-	69	73	72	72	-	-	-
4 Musgrave Street	1	150	F 1	E	-	-	-	71	74	74	74	-	-	-
4 Musgrave Street	1	90	GF	W	-	-	-	65	68	67	74	-	-	-
4 Musgrave Street	1	90	F 1	W	-	-	-	68	68	68	76	-	-	-
5 Herron walk	1	86	GF	W	-	-	-	87	85	84	85	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 46-51 dB(A)														
Clearly audible: 51-61 dB(A)														
Moderately intrusive: 61-71 dB(A)														
Highly Intrusive: >71 dB(A)														
5 Herron walk	1	86	F 1	W	-	-	-	86	85	84	85	-	-	-
5 Herron walk	1	86	F 2	W	-	-	-	86	85	84	84	-	-	-
5 Herron walk	1	86	F 3	W	-	-	-	86	84	83	84	-	-	-
5 Herron walk	1	86	F 4	W	-	-	-	85	84	83	84	-	-	-
5 Herron walk	1	86	F 5	W	-	-	-	85	83	83	84	-	-	-
6 Musgrave Street	1	152	F 1	E	-	-	-	65	69	69	69	-	-	-
6 Musgrave Street	1	91	GF	W	-	-	-	69	65	65	76	-	-	-
6 Musgrave Street	1	91	F 1	W	-	-	-	69	66	66	76	-	-	-
7 Herron Walk	1	88	GF	W	-	-	-	79	80	80	80	-	-	-
7 Herron Walk	1	88	F 1	W	-	-	-	80	81	80	81	-	-	-
7 Herron Walk	1	88	F 2	W	-	-	-	81	81	81	81	-	-	-
7 Herron Walk	1	88	F 3	W	-	-	-	82	81	81	81	-	-	-
8 McLeod Street	1	102	GF	W	-	-	-	47	51	50	52	-	-	-
8 McLeod Street	1	102	F 1	W	-	-	-	51	53	53	56	-	-	-
8 Musgrave Street	1	154	GF	E	-	-	-	62	66	66	66	-	-	-
8 Musgrave Street	1	154	F 1	E	-	-	-	63	67	67	67	-	-	-
8 Musgrave Street	1	92	GF	W	-	-	-	59	59	58	62	-	-	-
8 Musgrave Street	1	92	F 1	W	-	-	-	60	61	60	66	-	-	-
8a McLeod Street	1	103	GF	S	-	-	-	59	58	57	63	-	-	-
8a McLeod Street	1	103	F 1	S	-	-	-	60	61	59	63	-	-	-
9b Musgrave Street	1	149	GF	W	-	-	-	77	80	80	79	-	-	-
9b Musgrave Street	1	149	F 1	W	-	-	-	78	80	80	79	-	-	-
10 McLeod Street	1	104	GF	SW	-	-	-	61	62	60	62	-	-	-
10 McLeod Street	1	104	F 1	SW	-	-	-	61	62	60	62	-	-	-
10 Musgrave Street	1	156	GF	E	-	-	-	60	59	58	58	-	-	-
10 Musgrave Street	1	156	F 1	E	-	-	-	62	62	61	62	-	-	-
10 Musgrave Street	1	93	GF	W	-	-	-	58	62	62	65	-	-	-
10 Musgrave Street	1	93	F 1	W	-	-	-	59	63	62	68	-	-	-
11 Musgrave Street	1	151	GF	W	-	-	-	72	75	75	75	-	-	-
11 Musgrave Street	1	151	F 1	W	-	-	-	73	76	76	76	-	-	-
11a Musgrave Street	1	162	GF	W	-	-	-	68	71	71	72	-	-	-
11a Musgrave Street	1	162	F 1	W	-	-	-	69	72	72	73	-	-	-
12 Musgrave Street	1	158	GF	E	-	-	-	61	64	63	63	-	-	-
12 Musgrave Street	1	158	F 1	E	-	-	-	62	65	64	64	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 46-51 dB(A)														
Clearly audible: 51-61 dB(A)														
Moderately intrusive: 61-71 dB(A)														
Highly Intrusive: >71 dB(A)														
12 Musgrave Street	1	94	GF	W	-	-	-	58	63	62	71	-	-	-
12 Musgrave Street	1	94	F 1	W	-	-	-	59	63	63	71	-	-	-
14 Musgrave Street	1	95	GF	W	-	-	-	59	61	60	70	-	-	-
14 Musgrave Street	1	95	F 1	W	-	-	-	61	61	61	70	-	-	-
14 Musgrave Street	1	160	GF	E	-	-	-	58	62	62	62	-	-	-
14 Musgrave Street	1	160	F 1	E	-	-	-	59	63	63	63	-	-	-
15 Musgrave Street	1	153	GF	W	-	-	-	65	68	68	68	-	-	-
15 Musgrave Street	1	153	F 1	W	-	-	-	66	69	69	69	-	-	-
16-18 Musgrave Street	1	96	GF	W	-	-	-	53	54	53	56	-	-	-
16-18 Musgrave Street	1	96	F 1	W	-	-	-	54	57	56	60	-	-	-
16a Musgrave Street	1	97	GF	S	-	-	-	63	62	60	68	-	-	-
16a Musgrave Street	1	97	F 1	S	-	-	-	63	63	61	68	-	-	-
17 Musgrave Street	1	155	GF	W	-	-	-	59	59	58	59	-	-	-
17 Musgrave Street	1	155	F 1	W	-	-	-	61	64	64	64	-	-	-
18 Musgrave Street	1	98	GF	S	-	-	-	63	64	62	68	-	-	-
18 Musgrave Street	1	98	F 1	S	-	-	-	63	65	63	68	-	-	-
19 Musgrave Street	1	157	GF	W	-	-	-	63	66	66	66	-	-	-
19 Musgrave Street	1	157	F 1	W	-	-	-	64	68	67	68	-	-	-
20a Musgrave Street	1	99	GF	W	-	-	-	53	53	52	57	-	-	-
20a Musgrave Street	1	99	F 1	W	-	-	-	55	55	54	58	-	-	-
21 Musgrave Street	1	159	GF	W	-	-	-	63	67	67	67	-	-	-
21 Musgrave Street	1	159	F 1	W	-	-	-	63	67	67	67	-	-	-
22a Musgrave Street	1	100	GF	W	-	-	-	61	58	57	66	-	-	-
22a Musgrave Street	1	100	F 1	W	-	-	-	61	59	58	66	-	-	-
22b Musgrave Street	1	101	GF	S	-	-	-	61	63	61	65	-	-	-
22b Musgrave Street	1	101	F 1	S	-	-	-	61	64	61	65	-	-	-
23 Musgrave Street	1	161	GF	W	-	-	-	62	64	64	63	-	-	-
23 Musgrave Street	1	161	F 1	W	-	-	-	62	64	64	64	-	-	-

Table C4 Predicted construction LAeq noise levels compared to TfNSW worst case evening (OOH1) noise impact categories, dB(A). – NCA 2

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 38-43 dB(A)														
Clearly audible: 43-53 dB(A)														
Moderately intrusive: 53-63 dB(A)														
Highly Intrusive: >63 dB(A)														
1 Kareela Road	2	133	GF	SE	-	-	-	66	66	65	66	-	-	-
1 Kareela Road	2	133	F 1	SE	-	-	-	66	67	65	66	-	-	-
1 Kareela Road	2	133	F 2	SE	-	-	-	66	67	65	66	-	-	-
2 Wulworra Avenue	2	107	GF	E	-	-	-	64	64	63	64	-	-	-
2 Wulworra Avenue	2	107	F 1	E	-	-	-	64	65	63	64	-	-	-
2 Wulworra Avenue	2	107	F 2	E	-	-	-	64	65	63	64	-	-	-
2 Wulworra Avenue	2	107	F 3	E	-	-	-	64	65	64	64	-	-	-
3 Green Street	2	131	GF	E	-	-	-	64	65	63	64	-	-	-
3 Green Street	2	131	F 1	E	-	-	-	64	65	64	64	-	-	-
3 Green Street	2	131	F 2	E	-	-	-	65	65	64	65	-	-	-
3 Kareela Road	2	136	GF	E	-	-	-	64	65	63	64	-	-	-
3 Kareela Road	2	136	F 1	E	-	-	-	64	65	63	64	-	-	-
3 Wulworra Avenue	2	105	GF	E	-	-	-	60	61	60	60	-	-	-
3 Wulworra Avenue	2	105	F 1	E	-	-	-	60	61	60	60	-	-	-
3 Wulworra Avenue	2	105	F 2	E	-	-	-	60	61	60	61	-	-	-
3 Wulworra Avenue	2	105	F 3	E	-	-	-	60	61	60	61	-	-	-
3 Wulworra Avenue	2	109	GF	E	-	-	-	65	66	64	65	-	-	-
3 Wulworra Avenue	2	109	F 1	E	-	-	-	65	66	64	65	-	-	-
3 Wulworra Avenue	2	109	F 2	E	-	-	-	65	66	65	65	-	-	-
3 Wulworra Avenue	2	109	F 3	E	-	-	-	65	66	65	65	-	-	-
5 Green Street	2	132	GF	E	-	-	-	65	65	64	64	-	-	-
5 Green Street	2	132	F 1	E	-	-	-	65	65	64	65	-	-	-
5 Green Street	2	132	F 2	E	-	-	-	65	66	64	65	-	-	-
5 Kareela Road	2	137	GF	E	-	-	-	64	65	63	64	-	-	-
5 Kareela Road	2	137	F 1	E	-	-	-	64	65	63	64	-	-	-
5 Wulworra Avenue	2	110	GF	E	-	-	-	63	64	63	63	-	-	-
5 Wulworra Avenue	2	110	F 1	E	-	-	-	63	64	63	63	-	-	-
5 Wulworra Avenue	2	110	F 2	E	-	-	-	63	64	63	63	-	-	-
5 Wulworra Avenue	2	110	F 3	E	-	-	-	63	64	63	64	-	-	-
6 Kareela Road	2	134	GF	S	-	-	-	64	65	64	64	-	-	-
6 Kareela Road	2	134	F 1	S	-	-	-	65	65	64	64	-	-	-
6 Wulworra Avenue	2	106	GF	E	-	-	-	63	64	62	63	-	-	-
6 Wulworra Avenue	2	106	F 1	E	-	-	-	63	64	62	63	-	-	-
6 Wulworra Avenue	2	106	F 2	E	-	-	-	63	64	62	63	-	-	-

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 38-43 dB(A)														
Clearly audible: 43-53 dB(A)														
Moderately intrusive: 53-63 dB(A)														
Highly Intrusive: >63 dB(A)														
6 Wulworra Avenue	2	106	F 3	E	-	-	-	63	64	63	63	-	-	-
7 Kareela Road	2	138	GF	E	-	-	-	64	64	63	63	-	-	-
7 Kareela Road	2	138	F 1	E	-	-	-	64	65	63	64	-	-	-
7 Wulworra Avenue	2	111	GF	NE	-	-	-	63	64	63	63	-	-	-
7 Wulworra Avenue	2	111	F 1	NE	-	-	-	63	65	63	64	-	-	-
7 Wulworra Avenue	2	111	F 2	NE	-	-	-	63	65	64	64	-	-	-
7 Wulworra Avenue	2	111	F 3	NE	-	-	-	64	65	64	64	-	-	-
9 Kareela Road	2	139	GF	NE	-	-	-	63	64	62	63	-	-	-
9 Kareela Road	2	139	F 1	NE	-	-	-	63	64	63	63	-	-	-
9 Wulworra Avenue	2	112	GF	E	-	-	-	63	65	63	64	-	-	-
9 Wulworra Avenue	2	112	F 1	E	-	-	-	64	65	63	64	-	-	-
9 Wulworra Avenue	2	112	F 2	E	-	-	-	64	65	64	64	-	-	-
9 Wulworra Avenue	2	112	F 3	E	-	-	-	64	65	64	64	-	-	-
11 Wulworra Avenue	2	113	GF	E	-	-	-	64	65	63	64	-	-	-
11 Wulworra Avenue	2	113	F 1	E	-	-	-	64	65	64	64	-	-	-
11 Wulworra Avenue	2	113	F 2	E	-	-	-	64	65	64	64	-	-	-
11 Wulworra Avenue	2	113	F 3	E	-	-	-	64	65	64	64	-	-	-
13 Wulworra Avenue	2	114	GF	E	-	-	-	64	65	64	64	-	-	-
13 Wulworra Avenue	2	114	F 1	E	-	-	-	64	65	64	64	-	-	-
13 Wulworra Avenue	2	114	F 2	E	-	-	-	64	65	64	64	-	-	-
15 Kareela Road	2	140	GF	E	-	-	-	65	66	64	65	-	-	-
15 Kareela Road	2	140	F 1	E	-	-	-	65	66	65	65	-	-	-
15 Wulworra Avenue	2	115	GF	E	-	-	-	64	65	64	64	-	-	-
15 Wulworra Avenue	2	115	F 1	E	-	-	-	64	65	64	64	-	-	-
15 Wulworra Avenue	2	115	F 2	E	-	-	-	64	65	64	64	-	-	-
15a Kareela Road	2	141	GF	NE	-	-	-	62	64	62	63	-	-	-
15a Kareela Road	2	141	F 1	NE	-	-	-	63	64	62	63	-	-	-
17 Kareela Road	2	142	GF	E	-	-	-	65	66	64	65	-	-	-
17 Kareela Road	2	142	F 1	E	-	-	-	65	66	64	65	-	-	-
17 Wulworra Avenue	2	116	GF	E	-	-	-	64	65	64	64	-	-	-
17 Wulworra Avenue	2	116	F 1	E	-	-	-	65	65	64	65	-	-	-
17 Wulworra Avenue	2	116	F 2	E	-	-	-	65	66	64	65	-	-	-
19-21 Kareela Road	2	143	GF	E	-	-	-	62	63	62	62	-	-	-
19-21 Kareela Road	2	143	F 1	E	-	-	-	62	63	62	63	-	-	-
21 Wulworra Avenue	2	117	GF	E	-	-	-	64	65	64	64	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 38-43 dB(A)														
Clearly audible: 43-53 dB(A)														
Moderately intrusive: 53-63 dB(A)														
Highly Intrusive: >63 dB(A)														
21 Wulworra Avenue	2	117	F 1	E	-	-	-	65	65	64	65	-	-	-
21 Wulworra Avenue	2	117	F 2	E	-	-	-	65	66	64	65	-	-	-
23 Kareela Road	2	144	GF	E	-	-	-	62	63	61	62	-	-	-
23 Kareela Road	2	144	F 1	E	-	-	-	62	63	61	62	-	-	-
23 Wulworra Avenue	2	118	GF	NE	-	-	-	64	65	63	64	-	-	-
23 Wulworra Avenue	2	118	F 1	NE	-	-	-	65	65	64	64	-	-	-
23 Wulworra Avenue	2	118	F 2	NE	-	-	-	65	65	64	65	-	-	-
25 Wulworra Avenue	2	119	GF	E	-	-	-	65	65	64	65	-	-	-
25 Wulworra Avenue	2	119	F 1	E	-	-	-	65	66	64	65	-	-	-
25 Wulworra Avenue	2	119	F 2	E	-	-	-	65	66	64	65	-	-	-
27 Kareela Road	2	145	GF	NE	-	-	-	52	54	52	52	-	-	-
27 Kareela Road	2	145	F 1	NE	-	-	-	56	58	56	56	-	-	-
27 Wulworra Avenue	2	120	GF	E	-	-	-	65	65	64	65	-	-	-
27 Wulworra Avenue	2	120	F 1	E	-	-	-	65	66	64	65	-	-	-
27 Wulworra Avenue	2	120	F 2	E	-	-	-	65	66	64	65	-	-	-
29 Wulworra Avenue	2	121	GF	E	-	-	-	65	65	64	65	-	-	-
29 Wulworra Avenue	2	121	F 1	E	-	-	-	65	66	64	65	-	-	-
29 Wulworra Avenue	2	121	F 2	E	-	-	-	65	66	64	65	-	-	-
31 Kareela Road	2	146	GF	E	-	-	-	61	62	60	61	-	-	-
31 Kareela Road	2	146	F 1	E	-	-	-	61	62	60	61	-	-	-
31 Wulworra Avenue	2	122	GF	NE	-	-	-	65	66	64	65	-	-	-
31 Wulworra Avenue	2	122	F 1	NE	-	-	-	65	66	64	65	-	-	-
31 Wulworra Avenue	2	122	F 2	NE	-	-	-	65	66	64	65	-	-	-
33 Kareela Road	2	147	GF	E	-	-	-	59	61	59	57	-	-	-
33 Kareela Road	2	147	F 1	E	-	-	-	60	61	59	57	-	-	-
33 Wulworra Avenue	2	123	GF	E	-	-	-	65	66	64	65	-	-	-
33 Wulworra Avenue	2	123	F 1	E	-	-	-	65	66	64	65	-	-	-
33 Wulworra Avenue	2	123	F 2	E	-	-	-	65	66	64	65	-	-	-
39 Wulworra Avenue	2	124	GF	E	-	-	-	65	66	64	65	-	-	-
39 Wulworra Avenue	2	124	F 1	E	-	-	-	65	66	64	65	-	-	-
39 Wulworra Avenue	2	124	F 2	E	-	-	-	65	66	64	65	-	-	-
41 Wulworra Avenue	2	125	GF	E	-	-	-	65	66	64	65	-	-	-
41 Wulworra Avenue	2	125	F 1	E	-	-	-	65	66	64	65	-	-	-
41 Wulworra Avenue	2	125	F 2	E	-	-	-	65	66	64	65	-	-	-
45 Wulworra Avenue	2	126	GF	E	-	-	-	65	66	64	65	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 38-43 dB(A)														
Clearly audible: 43-53 dB(A)														
Moderately intrusive: 53-63 dB(A)														
Highly Intrusive: >63 dB(A)														
45 Wulworra Avenue	2	126	F 1	E	-	-	-	65	66	64	65	-	-	-
45 Wulworra Avenue	2	126	F 2	E	-	-	-	65	66	64	65	-	-	-
49 Wulworra Avenue	2	127	GF	E	-	-	-	65	65	64	65	-	-	-
49 Wulworra Avenue	2	127	F 1	E	-	-	-	65	66	64	65	-	-	-
49 Wulworra Avenue	2	127	F 2	E	-	-	-	65	66	64	65	-	-	-
51 Wulworra Avenue	2	128	GF	E	-	-	-	65	66	64	65	-	-	-
51 Wulworra Avenue	2	128	F 1	E	-	-	-	65	66	64	65	-	-	-
51 Wulworra Avenue	2	128	F 2	E	-	-	-	65	66	64	65	-	-	-
55 Wulworra Avenue	2	129	GF	E	-	-	-	65	66	64	65	-	-	-
55 Wulworra Avenue	2	129	F 1	E	-	-	-	65	66	64	65	-	-	-
55 Wulworra Avenue	2	129	F 2	E	-	-	-	65	66	65	65	-	-	-
57 Wulworra Avenue	2	130	GF	E	-	-	-	65	66	64	65	-	-	-
57 Wulworra Avenue	2	130	F 1	E	-	-	-	65	66	64	65	-	-	-
57 Wulworra Avenue	2	130	F 2	E	-	-	-	65	66	64	65	-	-	-

Table C5 Predicted construction LAeq noise levels compared to TfNSW night-time (OOH2) worst case noise impact categories, dB(A). – NCA 1

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 43-48 dB(A)														
Clearly audible: 48-58 dB(A)														
Moderately intrusive: 58-68 dB(A)														
Highly Intrusive: >68 dB(A)														
1 Herron Walk	1	84	GF	W	-	-	-	80	80	79	81	-	-	-
1 Herron Walk	1	84	F 1	W	-	-	-	82	80	80	82	-	-	-
1 Herron Walk	1	84	F 2	W	-	-	-	82	80	80	82	-	-	-
1 Herron Walk	1	84	F 3	W	-	-	-	82	81	80	82	-	-	-
1 Wulworra Avenue	1	108	GF	E	-	-	-	64	65	64	64	-	-	-
1 Wulworra Avenue	1	108	F 1	E	-	-	-	64	65	64	65	-	-	-
1 Wulworra Avenue	1	108	F 2	E	-	-	-	64	65	64	65	-	-	-
1 Wulworra Avenue	1	108	F 3	E	-	-	-	64	65	64	65	-	-	-
1a Kareela Road	1	135	GF	E	-	-	-	64	65	64	64	-	-	-
1a Kareela Road	1	135	F 1	E	-	-	-	65	65	64	64	-	-	-
2 Musgrave Street	1	148	GF	E	-	-	-	77	79	79	79	-	-	-
2 Musgrave Street	1	148	F 1	E	-	-	-	77	80	80	80	-	-	-
2 Musgrave Street	1	89	GF	W	-	-	-	81	83	80	84	-	-	-
2 Musgrave Street	1	89	F 1	W	-	-	-	81	84	82	84	-	-	-
2 Raglan Street	1	83	GF	W	-	-	-	57	58	57	59	-	-	-
2 Raglan Street	1	83	F 1	W	-	-	-	57	58	57	59	-	-	-
2 Raglan Street	1	83	F 2	W	-	-	-	58	58	57	59	-	-	-
2 Raglan Street	1	83	F 3	W	-	-	-	58	58	57	60	-	-	-
2 Raglan Street	1	83	F 4	W	-	-	-	57	58	57	59	-	-	-
2 Raglan Street	1	83	F 5	W	-	-	-	58	58	57	60	-	-	-
3 Herron Walk	1	85	GF	N	-	-	-	59	67	67	68	-	-	-
3 Herron Walk	1	85	F 1	N	-	-	-	59	68	68	68	-	-	-
3 Herron Walk	1	85	F 2	N	-	-	-	60	68	68	69	-	-	-
3 Herron Walk	1	85	F 3	N	-	-	-	61	69	69	69	-	-	-
4-5a Herron Walk	1	87	GF	W	-	-	-	73	76	76	74	-	-	-
4-5a Herron Walk	1	87	F 1	W	-	-	-	74	77	77	74	-	-	-
4-5a Herron Walk	1	87	F 2	W	-	-	-	76	77	77	74	-	-	-
4-5a Herron Walk	1	87	F 3	W	-	-	-	76	77	77	74	-	-	-
4 Musgrave Street	1	150	GF	E	-	-	-	69	73	72	72	-	-	-
4 Musgrave Street	1	150	F 1	E	-	-	-	71	74	74	74	-	-	-
4 Musgrave Street	1	90	GF	W	-	-	-	65	68	67	74	-	-	-
4 Musgrave Street	1	90	F 1	W	-	-	-	68	68	68	76	-	-	-
5 Herron walk	1	86	GF	W	-	-	-	87	85	84	85	-	-	-
5 Herron walk	1	86	F 1	W	-	-	-	86	85	84	85	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 43-48 dB(A)														
Clearly audible: 48-58 dB(A)														
Moderately intrusive: 58-68 dB(A)														
Highly Intrusive: >68 dB(A)														
5 Herron walk	1	86	F 2	W	-	-	-	86	85	84	84	-	-	-
5 Herron walk	1	86	F 3	W	-	-	-	86	84	83	84	-	-	-
5 Herron walk	1	86	F 4	W	-	-	-	85	84	83	84	-	-	-
5 Herron walk	1	86	F 5	W	-	-	-	85	83	83	84	-	-	-
6 Musgrave Street	1	152	F 1	E	-	-	-	65	69	69	69	-	-	-
6 Musgrave Street	1	91	GF	W	-	-	-	69	65	65	76	-	-	-
6 Musgrave Street	1	91	F 1	W	-	-	-	69	66	66	76	-	-	-
7 Herron Walk	1	88	GF	W	-	-	-	79	80	80	80	-	-	-
7 Herron Walk	1	88	F 1	W	-	-	-	80	81	80	81	-	-	-
7 Herron Walk	1	88	F 2	W	-	-	-	81	81	81	81	-	-	-
7 Herron Walk	1	88	F 3	W	-	-	-	82	81	81	81	-	-	-
8 McLeod Street	1	102	GF	W	-	-	-	47	51	50	52	-	-	-
8 McLeod Street	1	102	F 1	W	-	-	-	51	53	53	56	-	-	-
8 Musgrave Street	1	154	GF	E	-	-	-	62	66	66	66	-	-	-
8 Musgrave Street	1	154	F 1	E	-	-	-	63	67	67	67	-	-	-
8 Musgrave Street	1	92	GF	W	-	-	-	59	59	58	62	-	-	-
8 Musgrave Street	1	92	F 1	W	-	-	-	60	61	60	66	-	-	-
8a McLeod Street	1	103	GF	S	-	-	-	59	58	57	63	-	-	-
8a McLeod Street	1	103	F 1	S	-	-	-	60	61	59	63	-	-	-
9b Musgrave Street	1	149	GF	W	-	-	-	77	80	80	79	-	-	-
9b Musgrave Street	1	149	F 1	W	-	-	-	78	80	80	79	-	-	-
10 McLeod Street	1	104	GF	SW	-	-	-	61	62	60	62	-	-	-
10 McLeod Street	1	104	F 1	SW	-	-	-	61	62	60	62	-	-	-
10 Musgrave Street	1	156	GF	E	-	-	-	60	59	58	58	-	-	-
10 Musgrave Street	1	156	F 1	E	-	-	-	62	62	61	62	-	-	-
10 Musgrave Street	1	93	GF	W	-	-	-	58	62	62	65	-	-	-
10 Musgrave Street	1	93	F 1	W	-	-	-	59	63	62	68	-	-	-
11 Musgrave Street	1	151	GF	W	-	-	-	72	75	75	75	-	-	-
11 Musgrave Street	1	151	F 1	W	-	-	-	73	76	76	76	-	-	-
11a Musgrave Street	1	162	GF	W	-	-	-	68	71	71	72	-	-	-
11a Musgrave Street	1	162	F 1	W	-	-	-	69	72	72	73	-	-	-
12 Musgrave Street	1	158	GF	E	-	-	-	61	64	63	63	-	-	-
12 Musgrave Street	1	158	F 1	E	-	-	-	62	65	64	64	-	-	-
12 Musgrave Street	1	94	GF	W	-	-	-	58	63	62	71	-	-	-
12 Musgrave Street	1	94	F 1	W	-	-	-	59	63	63	71	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 43-48 dB(A)														
Clearly audible: 48-58 dB(A)														
Moderately intrusive: 58-68 dB(A)														
Highly Intrusive: >68 dB(A)														
14 Musgrave Street	1	95	GF	W	-	-	-	59	61	60	70	-	-	-
14 Musgrave Street	1	95	F 1	W	-	-	-	61	61	61	70	-	-	-
14 Musgrave Street	1	160	GF	E	-	-	-	58	62	62	62	-	-	-
14 Musgrave Street	1	160	F 1	E	-	-	-	59	63	63	63	-	-	-
15 Musgrave Street	1	153	GF	W	-	-	-	65	68	68	68	-	-	-
15 Musgrave Street	1	153	F 1	W	-	-	-	66	69	69	69	-	-	-
16-18 Musgrave Street	1	96	GF	W	-	-	-	53	54	53	56	-	-	-
16-18 Musgrave Street	1	96	F 1	W	-	-	-	54	57	56	60	-	-	-
16a Musgrave Street	1	97	GF	S	-	-	-	63	62	60	68	-	-	-
16a Musgrave Street	1	97	F 1	S	-	-	-	63	63	61	68	-	-	-
17 Musgrave Street	1	155	GF	W	-	-	-	59	59	58	59	-	-	-
17 Musgrave Street	1	155	F 1	W	-	-	-	61	64	64	64	-	-	-
18 Musgrave Street	1	98	GF	S	-	-	-	63	64	62	68	-	-	-
18 Musgrave Street	1	98	F 1	S	-	-	-	63	65	63	68	-	-	-
19 Musgrave Street	1	157	GF	W	-	-	-	63	66	66	66	-	-	-
19 Musgrave Street	1	157	F 1	W	-	-	-	64	68	67	68	-	-	-
20a Musgrave Street	1	99	GF	W	-	-	-	53	53	52	57	-	-	-
20a Musgrave Street	1	99	F 1	W	-	-	-	55	55	54	58	-	-	-
21 Musgrave Street	1	159	GF	W	-	-	-	63	67	67	67	-	-	-
21 Musgrave Street	1	159	F 1	W	-	-	-	63	67	67	67	-	-	-
22a Musgrave Street	1	100	GF	W	-	-	-	61	58	57	66	-	-	-
22a Musgrave Street	1	100	F 1	W	-	-	-	61	59	58	66	-	-	-
22b Musgrave Street	1	101	GF	S	-	-	-	61	63	61	65	-	-	-
22b Musgrave Street	1	101	F 1	S	-	-	-	61	64	61	65	-	-	-
23 Musgrave Street	1	161	GF	W	-	-	-	62	64	64	63	-	-	-
23 Musgrave Street	1	161	F 1	W	-	-	-	62	64	64	64	-	-	-

Table C6 Predicted construction LAeq noise levels (Stage 1) compared to TfNSW night (OOH2) worst case noise impact categories, dB(A). – NCA 2

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 33-38 dB(A)														
Clearly audible: 38-48 dB(A)														
Moderately intrusive: 48-58 dB(A)														
Highly Intrusive: >58 dB(A)														
1 Kareela Road	2	133	GF	SE	-	-	-	66	66	65	66	-	-	-
1 Kareela Road	2	133	F 1	SE	-	-	-	66	67	65	66	-	-	-
1 Kareela Road	2	133	F 2	SE	-	-	-	66	67	65	66	-	-	-
2 Wulworra Avenue	2	107	GF	E	-	-	-	64	64	63	64	-	-	-
2 Wulworra Avenue	2	107	F 1	E	-	-	-	64	65	63	64	-	-	-
2 Wulworra Avenue	2	107	F 2	E	-	-	-	64	65	63	64	-	-	-
2 Wulworra Avenue	2	107	F 3	E	-	-	-	64	65	64	64	-	-	-
3 Green Street	2	131	GF	E	-	-	-	64	65	63	64	-	-	-
3 Green Street	2	131	F 1	E	-	-	-	64	65	64	64	-	-	-
3 Green Street	2	131	F 2	E	-	-	-	65	65	64	65	-	-	-
3 Kareela Road	2	136	GF	E	-	-	-	64	65	63	64	-	-	-
3 Kareela Road	2	136	F 1	E	-	-	-	64	65	63	64	-	-	-
3 Wulworra Avenue	2	105	GF	E	-	-	-	60	61	60	60	-	-	-
3 Wulworra Avenue	2	105	F 1	E	-	-	-	60	61	60	60	-	-	-
3 Wulworra Avenue	2	105	F 2	E	-	-	-	60	61	60	61	-	-	-
3 Wulworra Avenue	2	105	F 3	E	-	-	-	60	61	60	61	-	-	-
3 Wulworra Avenue	2	109	GF	E	-	-	-	65	66	64	65	-	-	-
3 Wulworra Avenue	2	109	F 1	E	-	-	-	65	66	64	65	-	-	-
3 Wulworra Avenue	2	109	F 2	E	-	-	-	65	66	65	65	-	-	-
3 Wulworra Avenue	2	109	F 3	E	-	-	-	65	66	65	65	-	-	-
5 Green Street	2	132	GF	E	-	-	-	65	65	64	64	-	-	-
5 Green Street	2	132	F 1	E	-	-	-	65	65	64	65	-	-	-
5 Green Street	2	132	F 2	E	-	-	-	65	66	64	65	-	-	-
5 Kareela Road	2	137	GF	E	-	-	-	64	65	63	64	-	-	-
5 Kareela Road	2	137	F 1	E	-	-	-	64	65	63	64	-	-	-
5 Wulworra Avenue	2	110	GF	E	-	-	-	63	64	63	63	-	-	-
5 Wulworra Avenue	2	110	F 1	E	-	-	-	63	64	63	63	-	-	-
5 Wulworra Avenue	2	110	F 2	E	-	-	-	63	64	63	63	-	-	-
5 Wulworra Avenue	2	110	F 3	E	-	-	-	63	64	63	64	-	-	-
6 Kareela Road	2	134	GF	S	-	-	-	64	65	64	64	-	-	-
6 Kareela Road	2	134	F 1	S	-	-	-	65	65	64	64	-	-	-
6 Wulworra Avenue	2	106	GF	E	-	-	-	63	64	62	63	-	-	-
6 Wulworra Avenue	2	106	F 1	E	-	-	-	63	64	62	63	-	-	-
6 Wulworra Avenue	2	106	F 2	E	-	-	-	63	64	62	63	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 33-38 dB(A)														
Clearly audible: 38-48 dB(A)														
Moderately intrusive: 48-58 dB(A)														
Highly Intrusive: >58 dB(A)														
6 Wulworra Avenue	2	106	F 3	E	-	-	-	63	64	63	63	-	-	-
7 Kareela Road	2	138	GF	E	-	-	-	64	64	63	63	-	-	-
7 Kareela Road	2	138	F 1	E	-	-	-	64	65	63	64	-	-	-
7 Wulworra Avenue	2	111	GF	NE	-	-	-	63	64	63	63	-	-	-
7 Wulworra Avenue	2	111	F 1	NE	-	-	-	63	65	63	64	-	-	-
7 Wulworra Avenue	2	111	F 2	NE	-	-	-	63	65	64	64	-	-	-
7 Wulworra Avenue	2	111	F 3	NE	-	-	-	64	65	64	64	-	-	-
9 Kareela Road	2	139	GF	NE	-	-	-	63	64	62	63	-	-	-
9 Kareela Road	2	139	F 1	NE	-	-	-	63	64	63	63	-	-	-
9 Wulworra Avenue	2	112	GF	E	-	-	-	63	65	63	64	-	-	-
9 Wulworra Avenue	2	112	F 1	E	-	-	-	64	65	63	64	-	-	-
9 Wulworra Avenue	2	112	F 2	E	-	-	-	64	65	64	64	-	-	-
9 Wulworra Avenue	2	112	F 3	E	-	-	-	64	65	64	64	-	-	-
11 Wulworra Avenue	2	113	GF	E	-	-	-	64	65	63	64	-	-	-
11 Wulworra Avenue	2	113	F 1	E	-	-	-	64	65	64	64	-	-	-
11 Wulworra Avenue	2	113	F 2	E	-	-	-	64	65	64	64	-	-	-
11 Wulworra Avenue	2	113	F 3	E	-	-	-	64	65	64	64	-	-	-
13 Wulworra Avenue	2	114	GF	E	-	-	-	64	65	64	64	-	-	-
13 Wulworra Avenue	2	114	F 1	E	-	-	-	64	65	64	64	-	-	-
13 Wulworra Avenue	2	114	F 2	E	-	-	-	64	65	64	64	-	-	-
15 Kareela Road	2	140	GF	E	-	-	-	65	66	64	65	-	-	-
15 Kareela Road	2	140	F 1	E	-	-	-	65	66	65	65	-	-	-
15 Wulworra Avenue	2	115	GF	E	-	-	-	64	65	64	64	-	-	-
15 Wulworra Avenue	2	115	F 1	E	-	-	-	64	65	64	64	-	-	-
15 Wulworra Avenue	2	115	F 2	E	-	-	-	64	65	64	64	-	-	-
15a Kareela Road	2	141	GF	NE	-	-	-	62	64	62	63	-	-	-
15a Kareela Road	2	141	F 1	NE	-	-	-	63	64	62	63	-	-	-
17 Kareela Road	2	142	GF	E	-	-	-	65	66	64	65	-	-	-
17 Kareela Road	2	142	F 1	E	-	-	-	65	66	64	65	-	-	-
17 Wulworra Avenue	2	116	GF	E	-	-	-	64	65	64	64	-	-	-
17 Wulworra Avenue	2	116	F 1	E	-	-	-	65	65	64	65	-	-	-
17 Wulworra Avenue	2	116	F 2	E	-	-	-	65	66	64	65	-	-	-
19-21 Kareela Road	2	143	GF	E	-	-	-	62	63	62	62	-	-	-
19-21 Kareela Road	2	143	F 1	E	-	-	-	62	63	62	63	-	-	-
21 Wulworra Avenue	2	117	GF	E	-	-	-	64	65	64	64	-	-	-

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 33-38 dB(A)														
Clearly audible: 38-48 dB(A)														
Moderately intrusive: 48-58 dB(A)														
Highly Intrusive: >58 dB(A)														
21 Wulworra Avenue	2	117	F 1	E	-	-	-	65	65	64	65	-	-	-
21 Wulworra Avenue	2	117	F 2	E	-	-	-	65	66	64	65	-	-	-
23 Kareela Road	2	144	GF	E	-	-	-	62	63	61	62	-	-	-
23 Kareela Road	2	144	F 1	E	-	-	-	62	63	61	62	-	-	-
23 Wulworra Avenue	2	118	GF	NE	-	-	-	64	65	63	64	-	-	-
23 Wulworra Avenue	2	118	F 1	NE	-	-	-	65	65	64	64	-	-	-
23 Wulworra Avenue	2	118	F 2	NE	-	-	-	65	65	64	65	-	-	-
25 Wulworra Avenue	2	119	GF	E	-	-	-	65	65	64	65	-	-	-
25 Wulworra Avenue	2	119	F 1	E	-	-	-	65	66	64	65	-	-	-
25 Wulworra Avenue	2	119	F 2	E	-	-	-	65	66	64	65	-	-	-
27 Kareela Road	2	145	GF	NE	-	-	-	52	54	52	52	-	-	-
27 Kareela Road	2	145	F 1	NE	-	-	-	56	58	56	56	-	-	-
27 Wulworra Avenue	2	120	GF	E	-	-	-	65	65	64	65	-	-	-
27 Wulworra Avenue	2	120	F 1	E	-	-	-	65	66	64	65	-	-	-
27 Wulworra Avenue	2	120	F 2	E	-	-	-	65	66	64	65	-	-	-
29 Wulworra Avenue	2	121	GF	E	-	-	-	65	65	64	65	-	-	-
29 Wulworra Avenue	2	121	F 1	E	-	-	-	65	66	64	65	-	-	-
29 Wulworra Avenue	2	121	F 2	E	-	-	-	65	66	64	65	-	-	-
31 Kareela Road	2	146	GF	E	-	-	-	61	62	60	61	-	-	-
31 Kareela Road	2	146	F 1	E	-	-	-	61	62	60	61	-	-	-
31 Wulworra Avenue	2	122	GF	NE	-	-	-	65	66	64	65	-	-	-
31 Wulworra Avenue	2	122	F 1	NE	-	-	-	65	66	64	65	-	-	-
31 Wulworra Avenue	2	122	F 2	NE	-	-	-	65	66	64	65	-	-	-
33 Kareela Road	2	147	GF	E	-	-	-	59	61	59	57	-	-	-
33 Kareela Road	2	147	F 1	E	-	-	-	60	61	59	57	-	-	-
33 Wulworra Avenue	2	123	GF	E	-	-	-	65	66	64	65	-	-	-
33 Wulworra Avenue	2	123	F 1	E	-	-	-	65	66	64	65	-	-	-
33 Wulworra Avenue	2	123	F 2	E	-	-	-	65	66	64	65	-	-	-
39 Wulworra Avenue	2	124	GF	E	-	-	-	65	66	64	65	-	-	-
39 Wulworra Avenue	2	124	F 1	E	-	-	-	65	66	64	65	-	-	-
39 Wulworra Avenue	2	124	F 2	E	-	-	-	65	66	64	65	-	-	-
41 Wulworra Avenue	2	125	GF	E	-	-	-	65	66	64	65	-	-	-
41 Wulworra Avenue	2	125	F 1	E	-	-	-	65	66	64	65	-	-	-
41 Wulworra Avenue	2	125	F 2	E	-	-	-	65	66	64	65	-	-	-
45 Wulworra Avenue	2	126	GF	E	-	-	-	65	66	64	65	-	-	-

Receiver	NCA	Obj.- No.	Fl	Dir	Scenario 1	Scenario 2a	Scenario 2b	Scenario 3	Scenario 4a	Scenario 4b	Scenario 4c	Scenario 4d	Scenario 5	Scenario 6
Noticeable: 33-38 dB(A)														
Clearly audible: 38-48 dB(A)														
Moderately intrusive: 48-58 dB(A)														
Highly Intrusive: >58 dB(A)														
45 Wulworra Avenue	2	126	F 1	E	-	-	-	65	66	64	65	-	-	-
45 Wulworra Avenue	2	126	F 2	E	-	-	-	65	66	64	65	-	-	-
49 Wulworra Avenue	2	127	GF	E	-	-	-	65	65	64	65	-	-	-
49 Wulworra Avenue	2	127	F 1	E	-	-	-	65	66	64	65	-	-	-
49 Wulworra Avenue	2	127	F 2	E	-	-	-	65	66	64	65	-	-	-
51 Wulworra Avenue	2	128	GF	E	-	-	-	65	66	64	65	-	-	-
51 Wulworra Avenue	2	128	F 1	E	-	-	-	65	66	64	65	-	-	-
51 Wulworra Avenue	2	128	F 2	E	-	-	-	65	66	64	65	-	-	-
55 Wulworra Avenue	2	129	GF	E	-	-	-	65	66	64	65	-	-	-
55 Wulworra Avenue	2	129	F 1	E	-	-	-	65	66	64	65	-	-	-
55 Wulworra Avenue	2	129	F 2	E	-	-	-	65	66	65	65	-	-	-
57 Wulworra Avenue	2	130	GF	E	-	-	-	65	66	64	65	-	-	-
57 Wulworra Avenue	2	130	F 1	E	-	-	-	65	66	64	65	-	-	-
57 Wulworra Avenue	2	130	F 2	E	-	-	-	65	66	64	65	-	-	-

South Mosman  
Wharf Upgrade

**APPENDIX D**  
PREDICTED  
CONSTRUCTION  
NOISE IMPACTS –  
NOISE CONTOUR  
MAPS



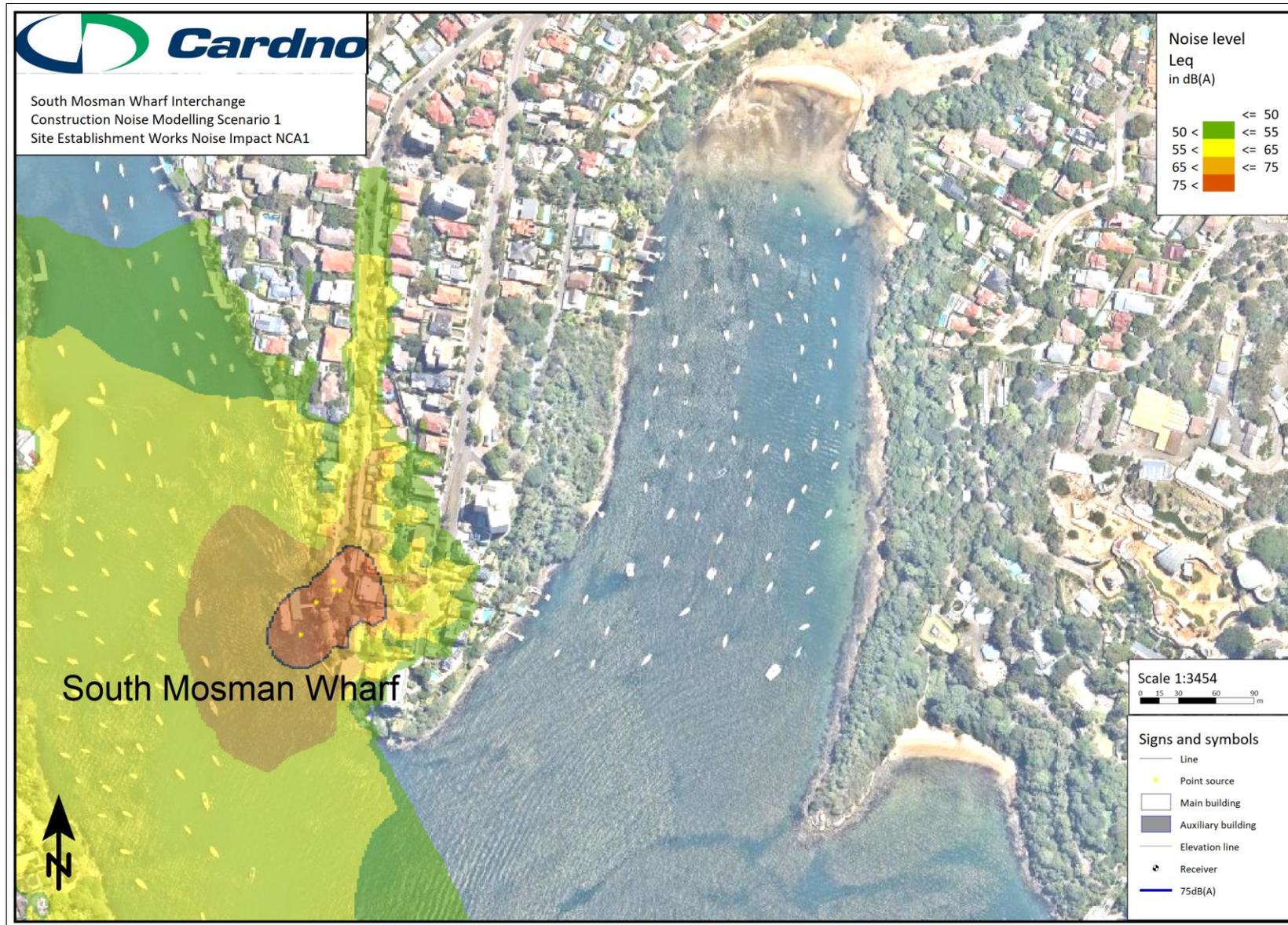


Figure D1 Predicted construction noise Scenario 1 – Site establishment, NCA1 ground level – standard hours

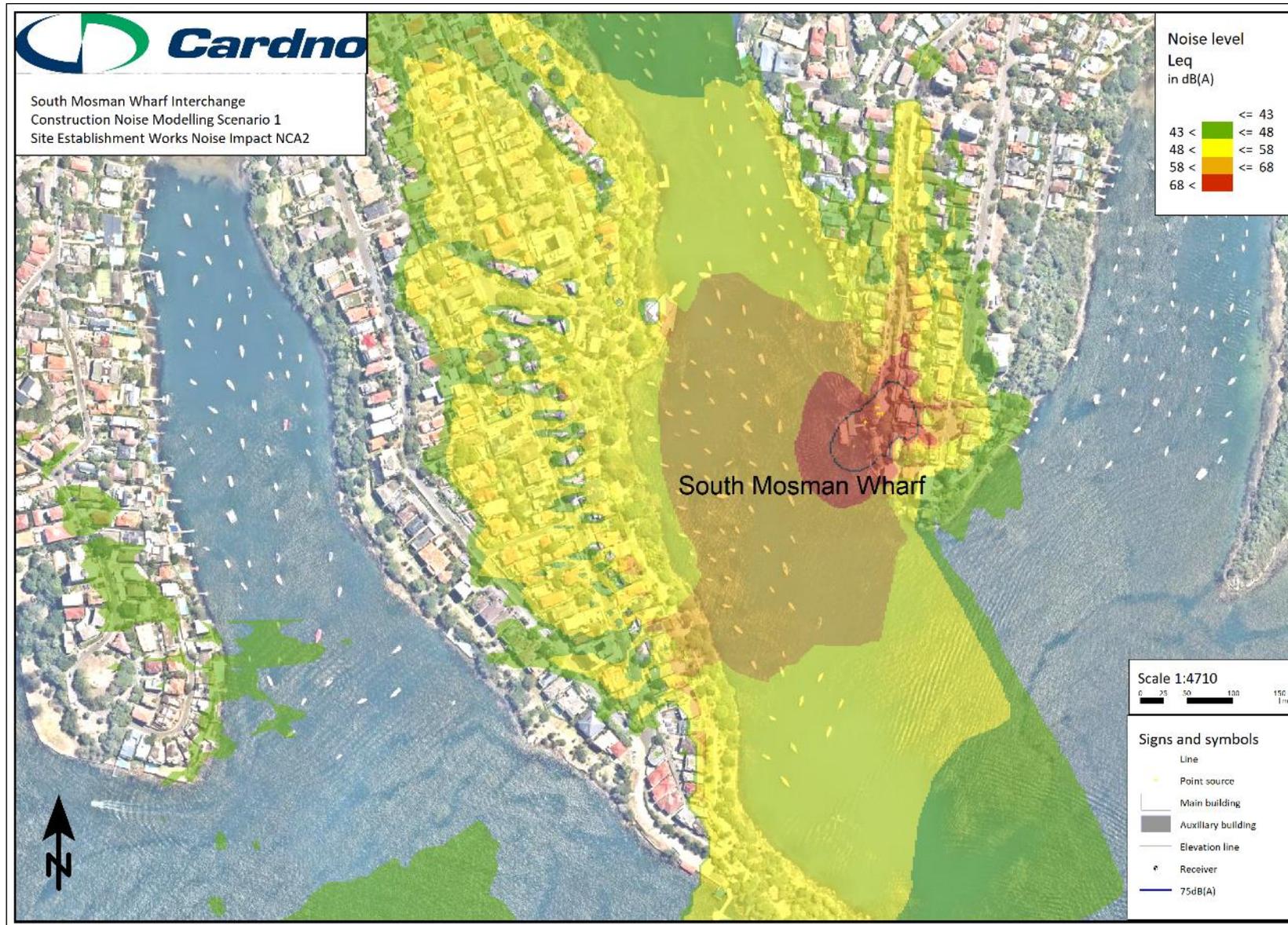


Figure D2 Predicted construction noise Scenario 1 – Site establishment, NCA2 ground level – standard hours

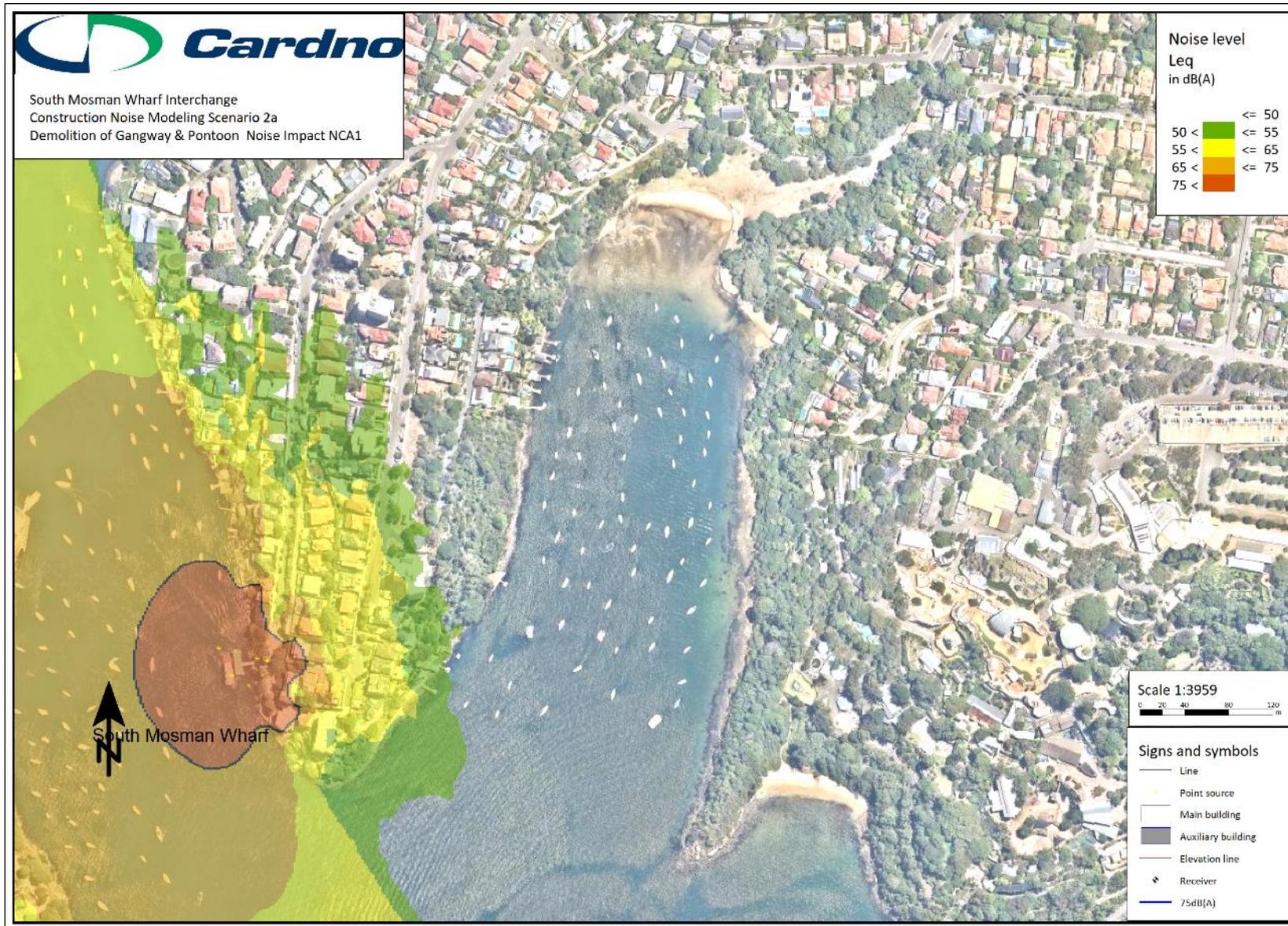


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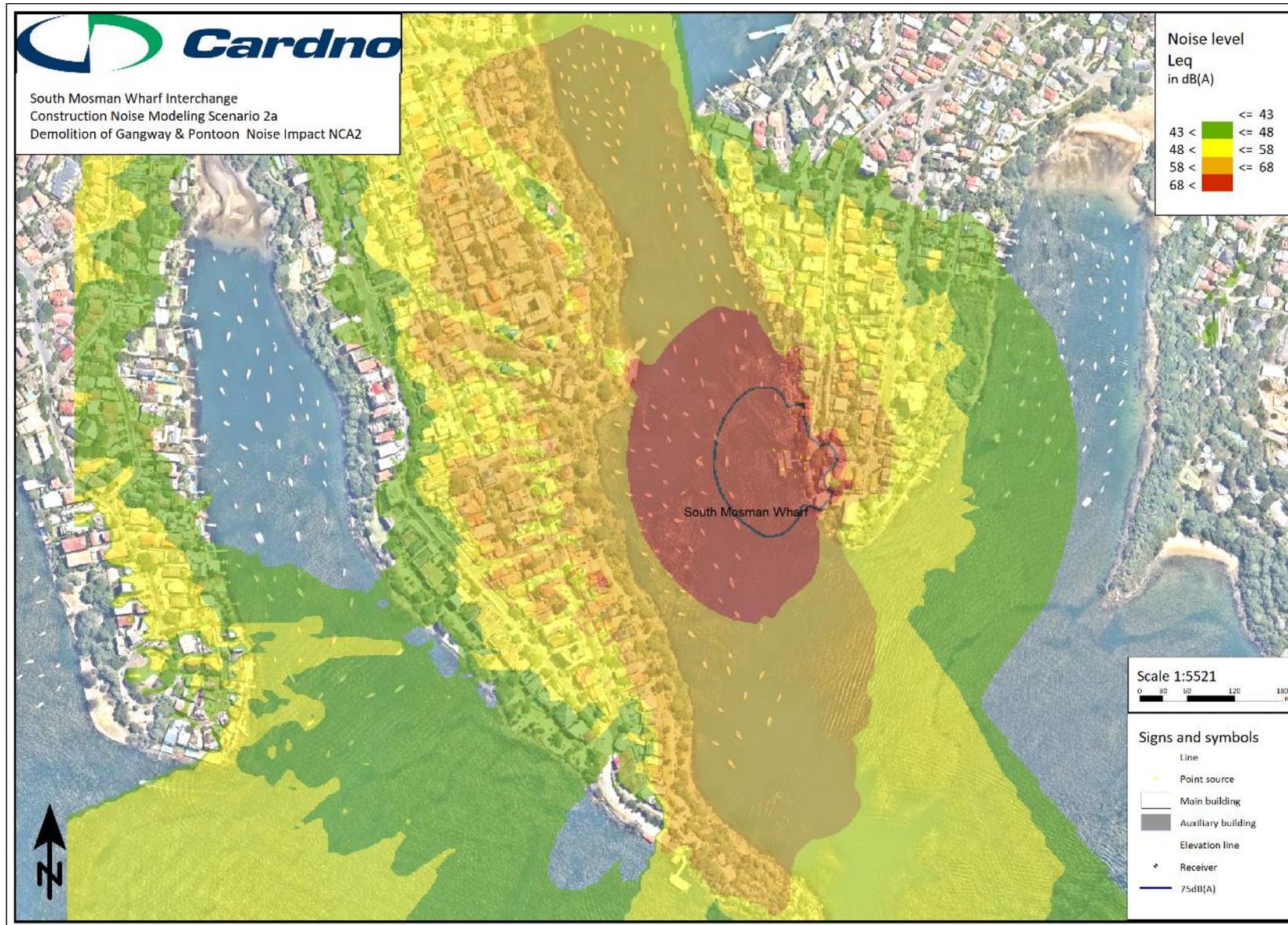


Figure D4 Predicted construction noise Scenario 2A – Site demolition of gangway and pontoon NCA2 ground level– standard hours

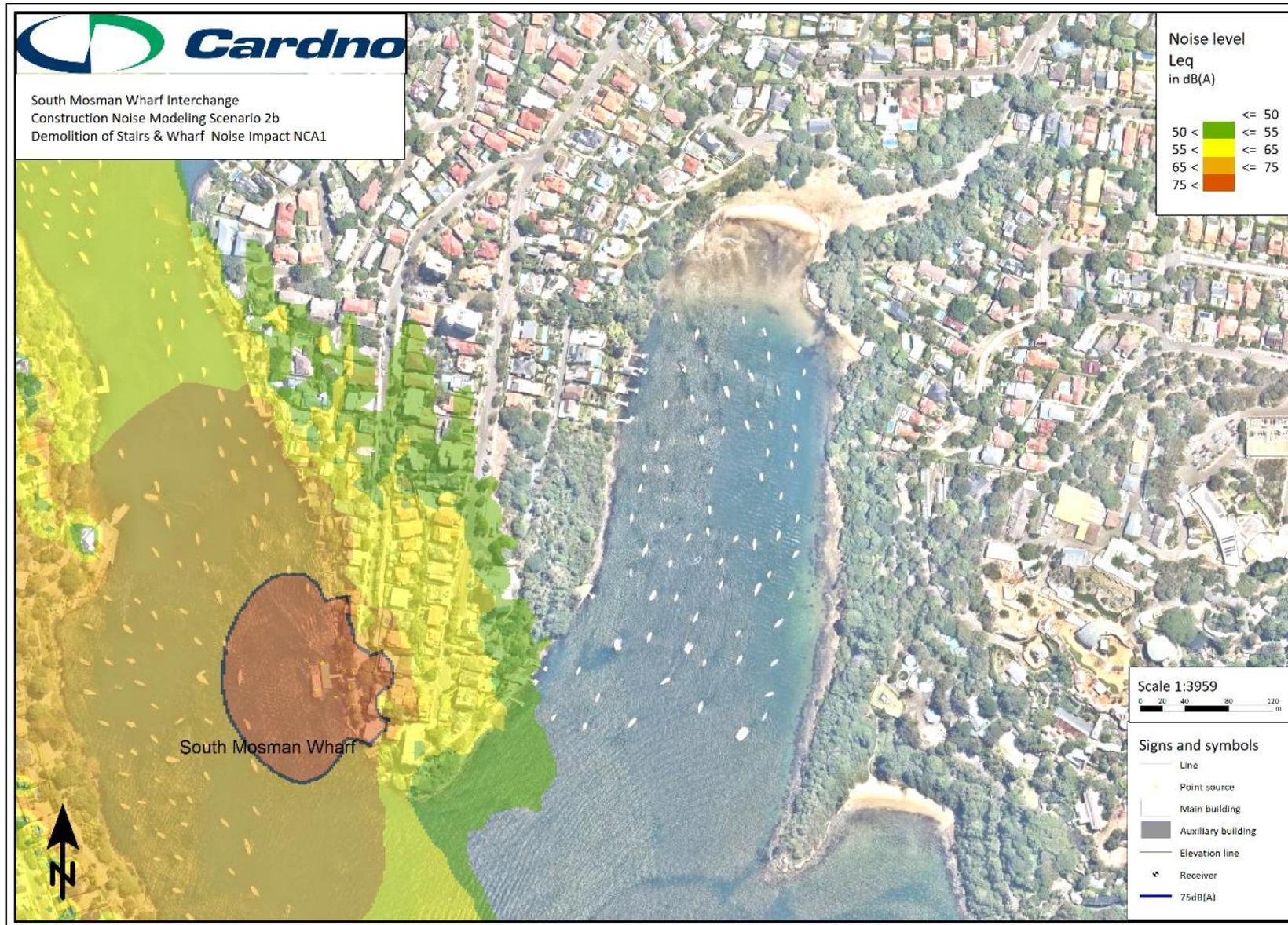


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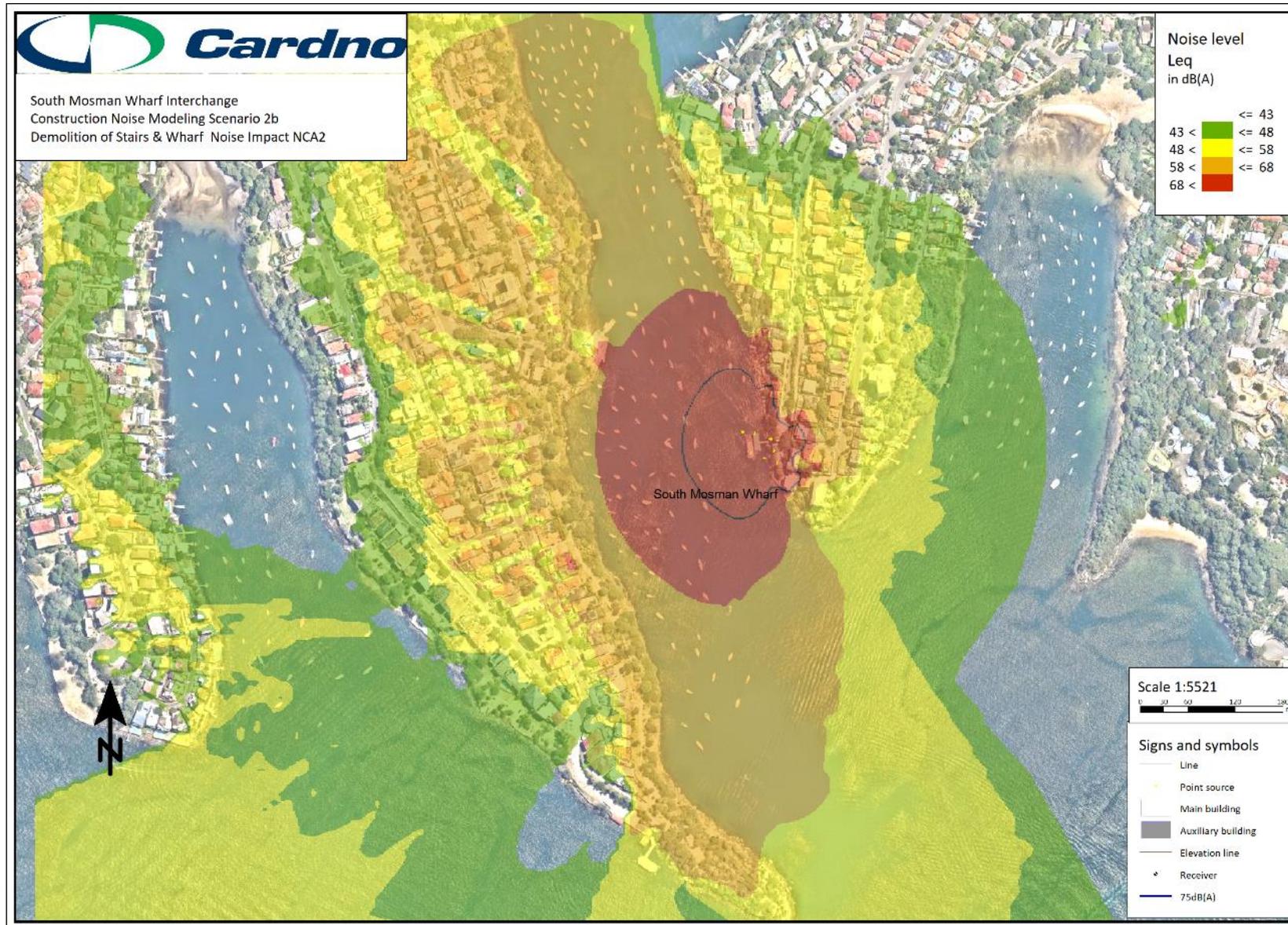


Figure D6 Predicted construction noise Scenario 2B – Demolition of stairs and wharf, NCA2 ground level – standard hours

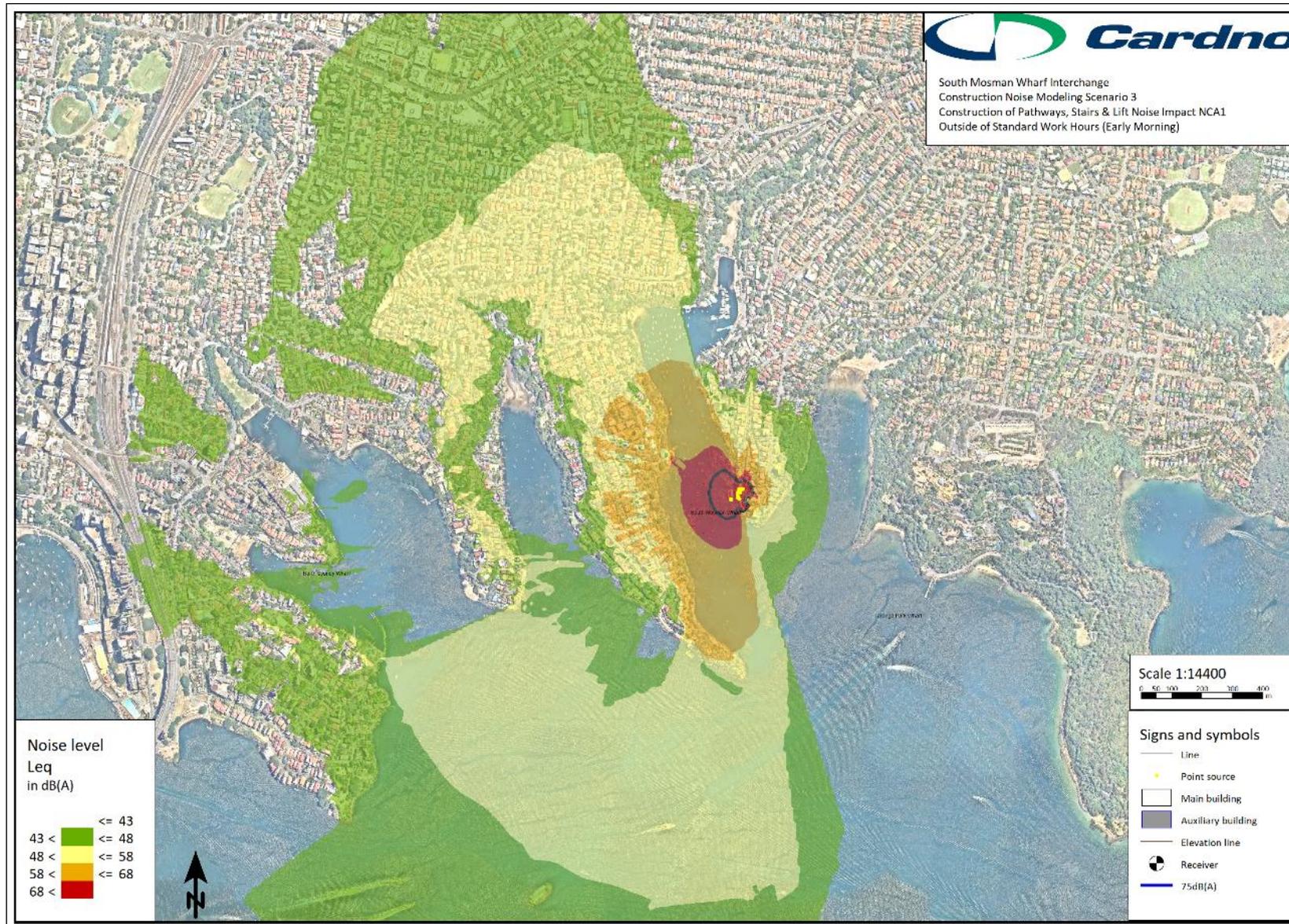


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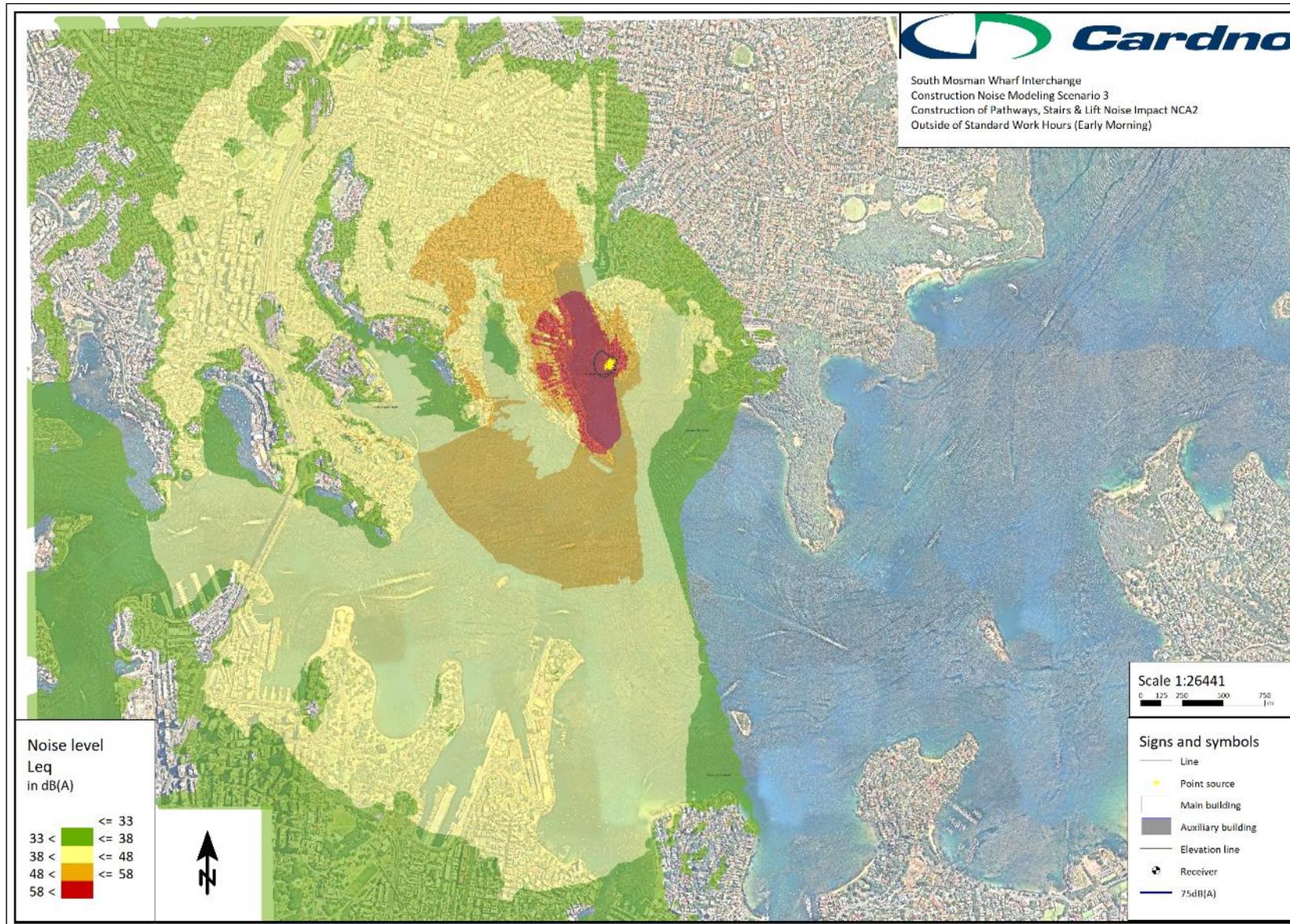


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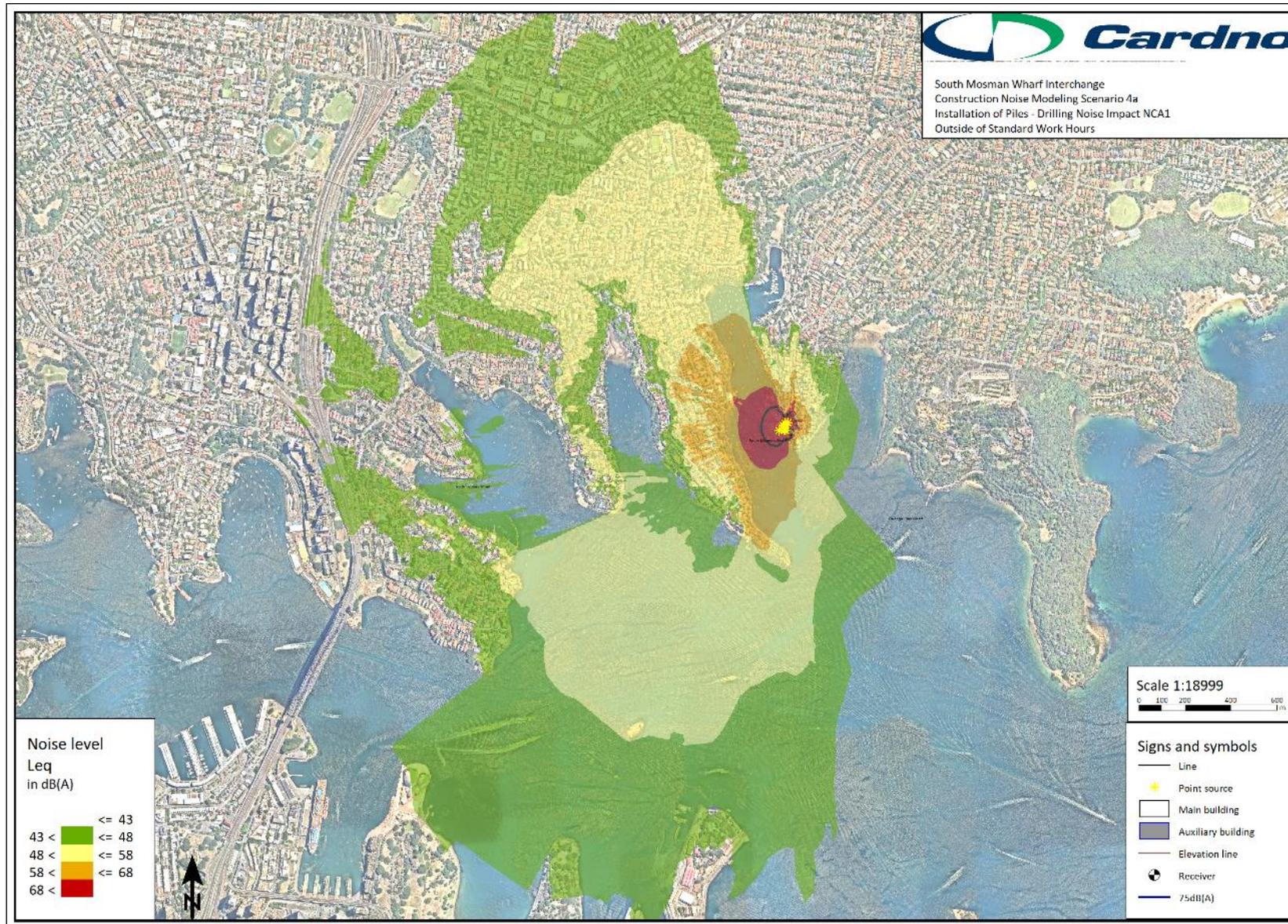


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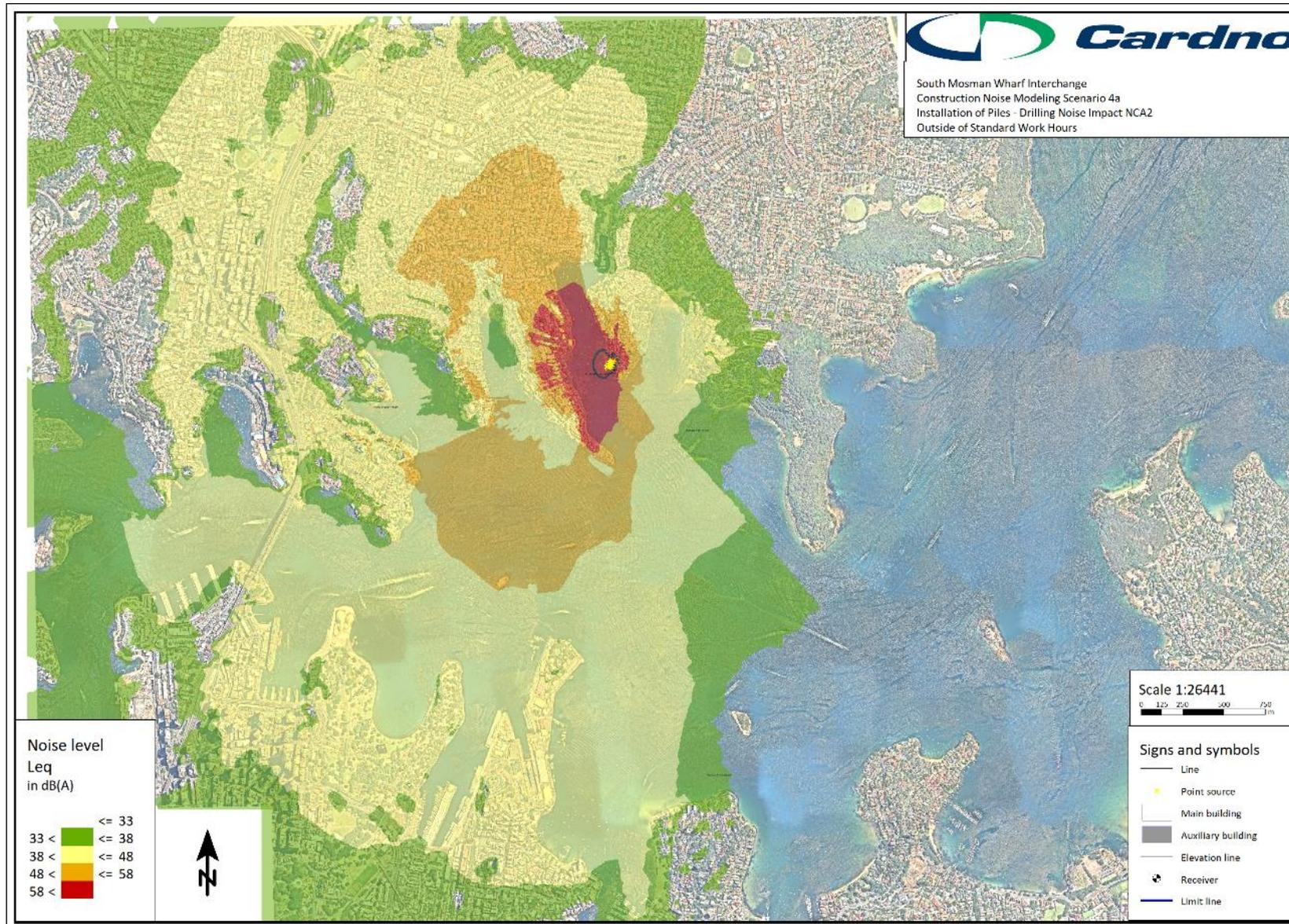


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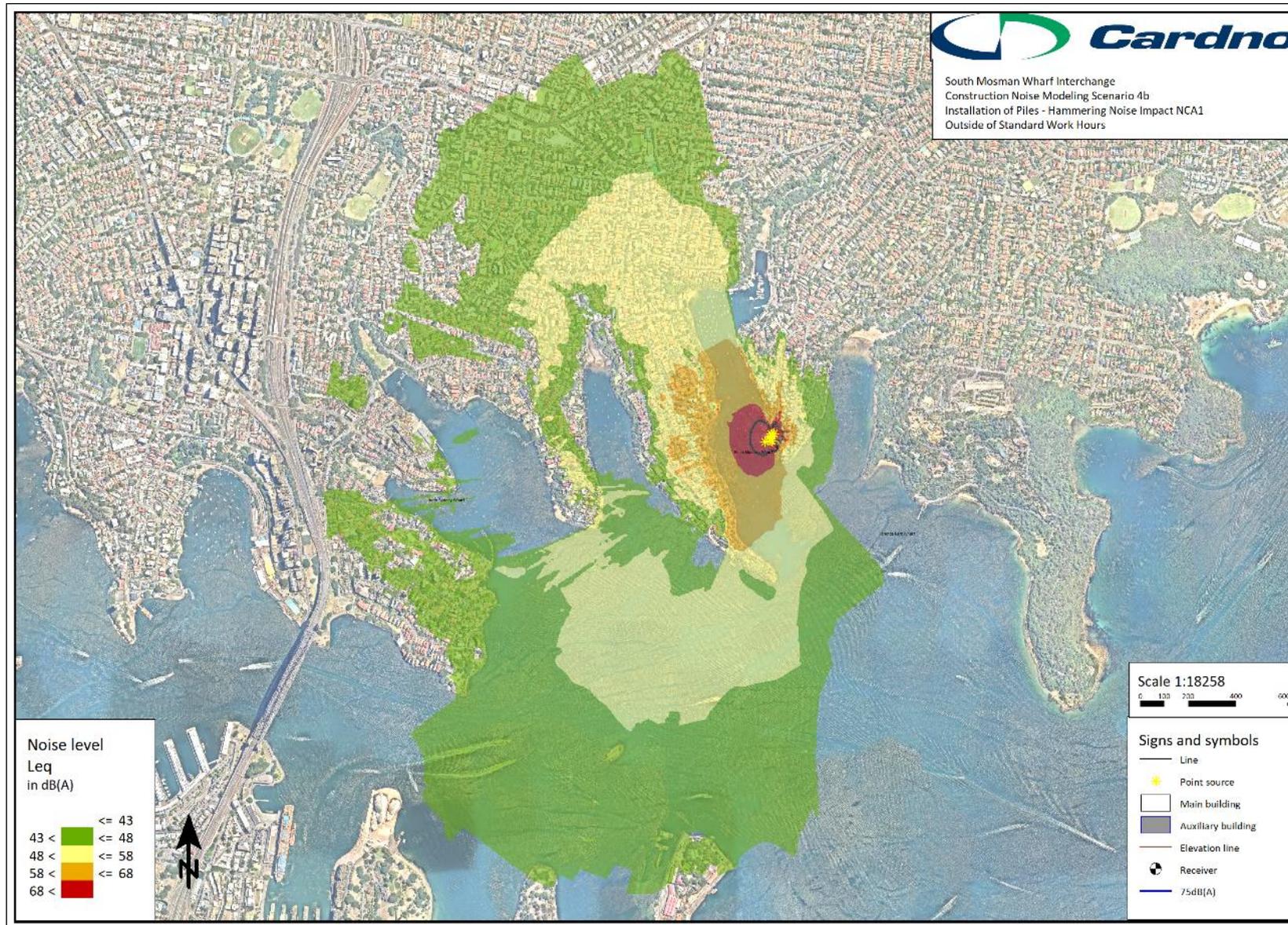


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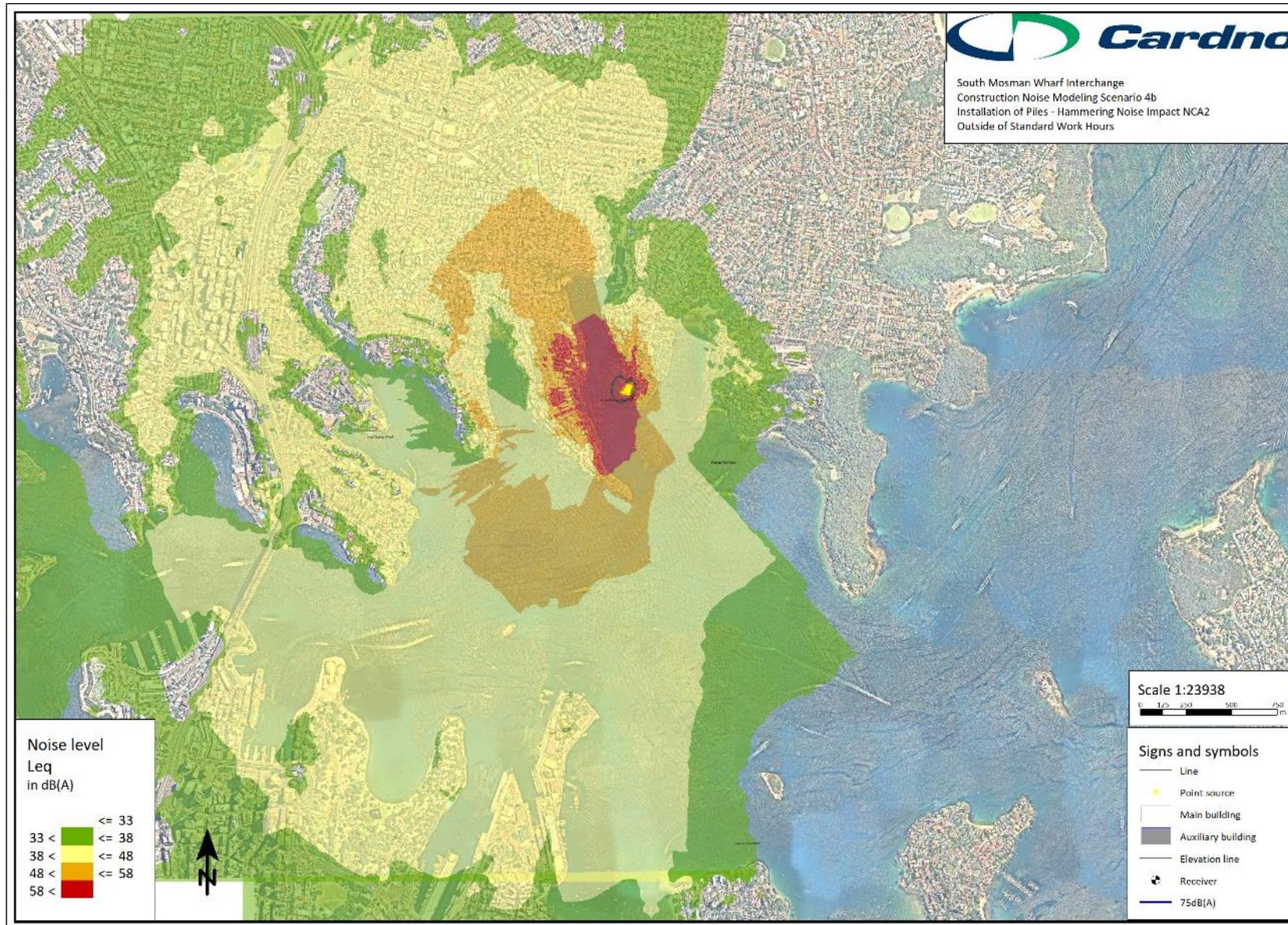


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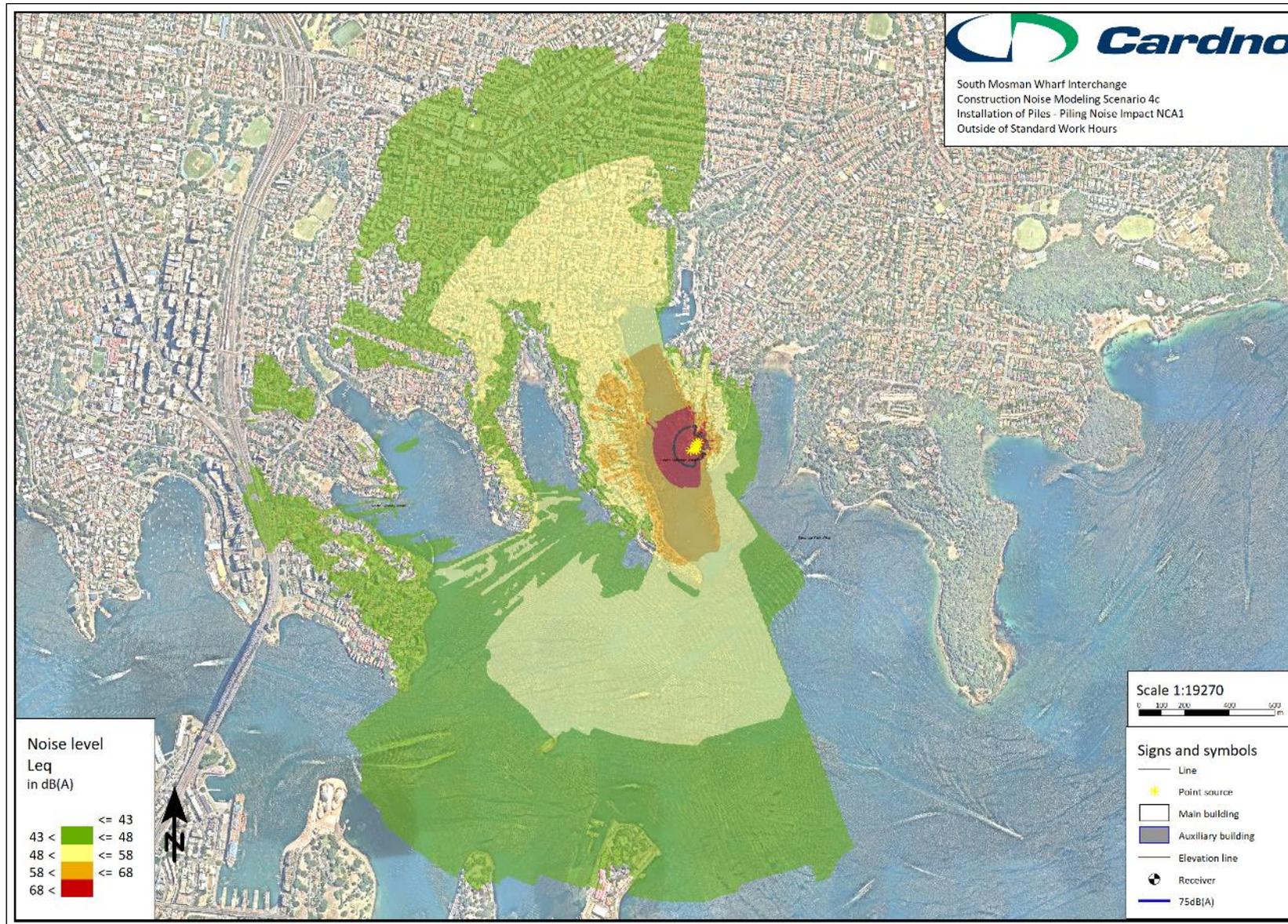


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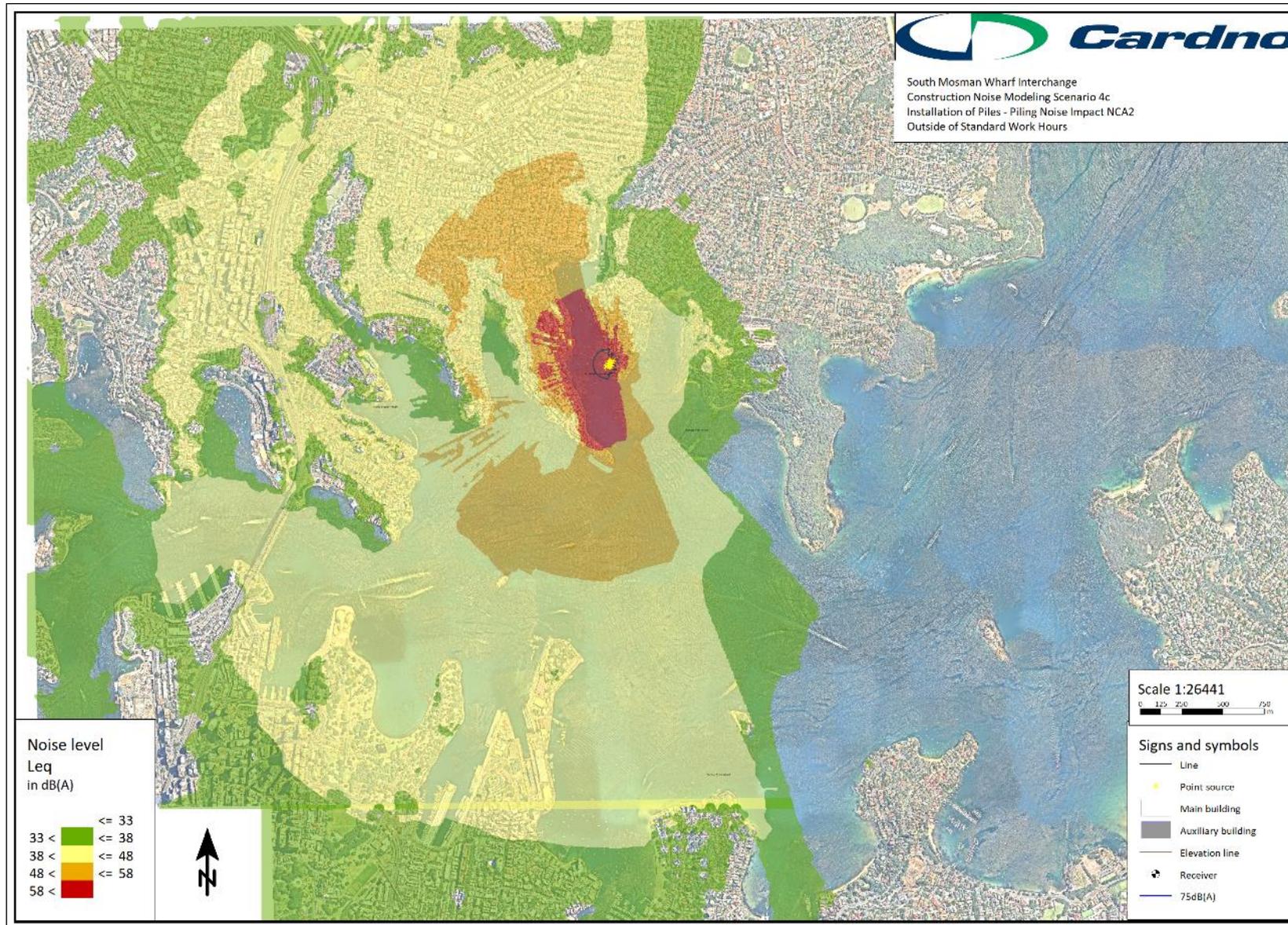


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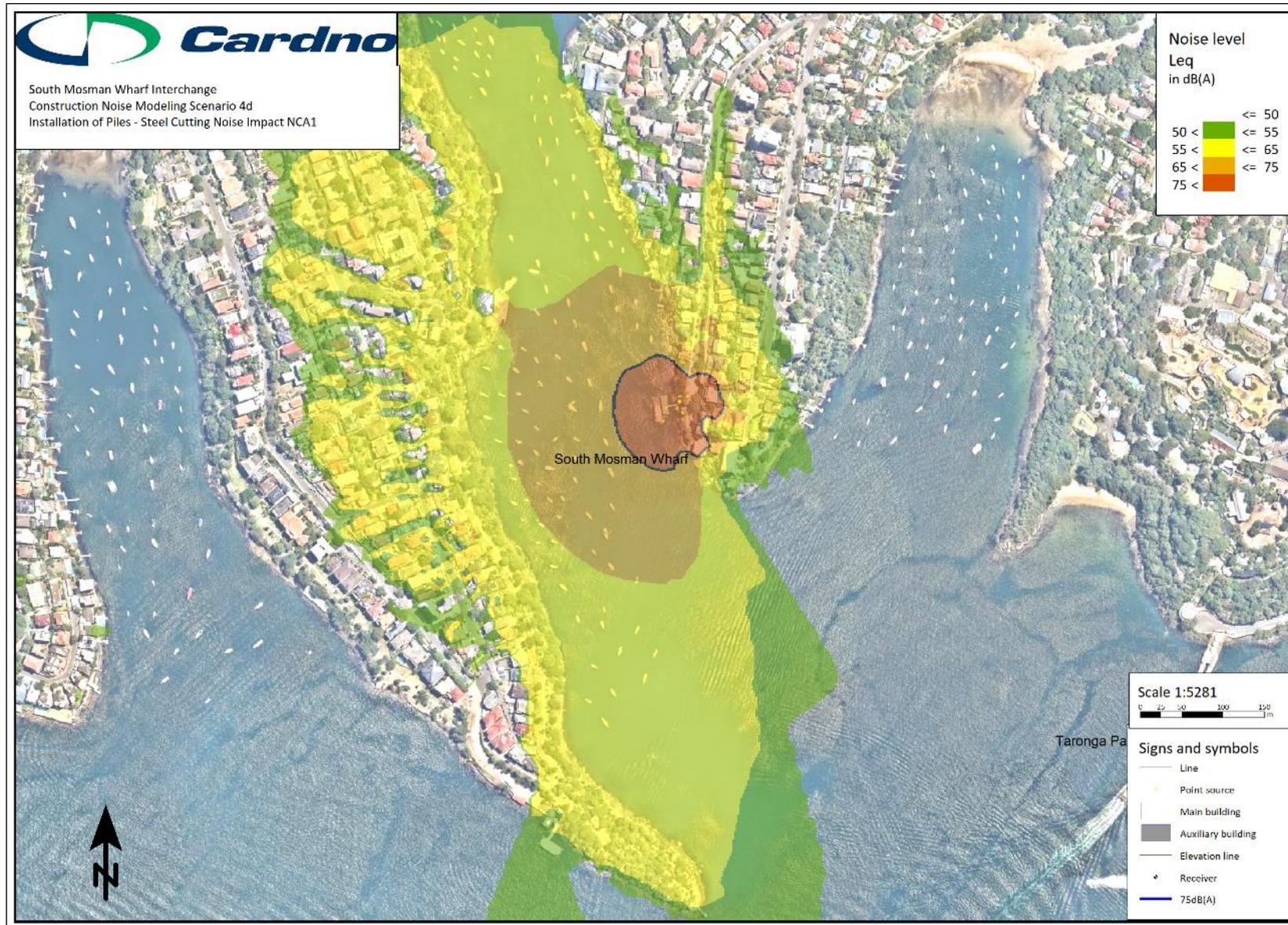


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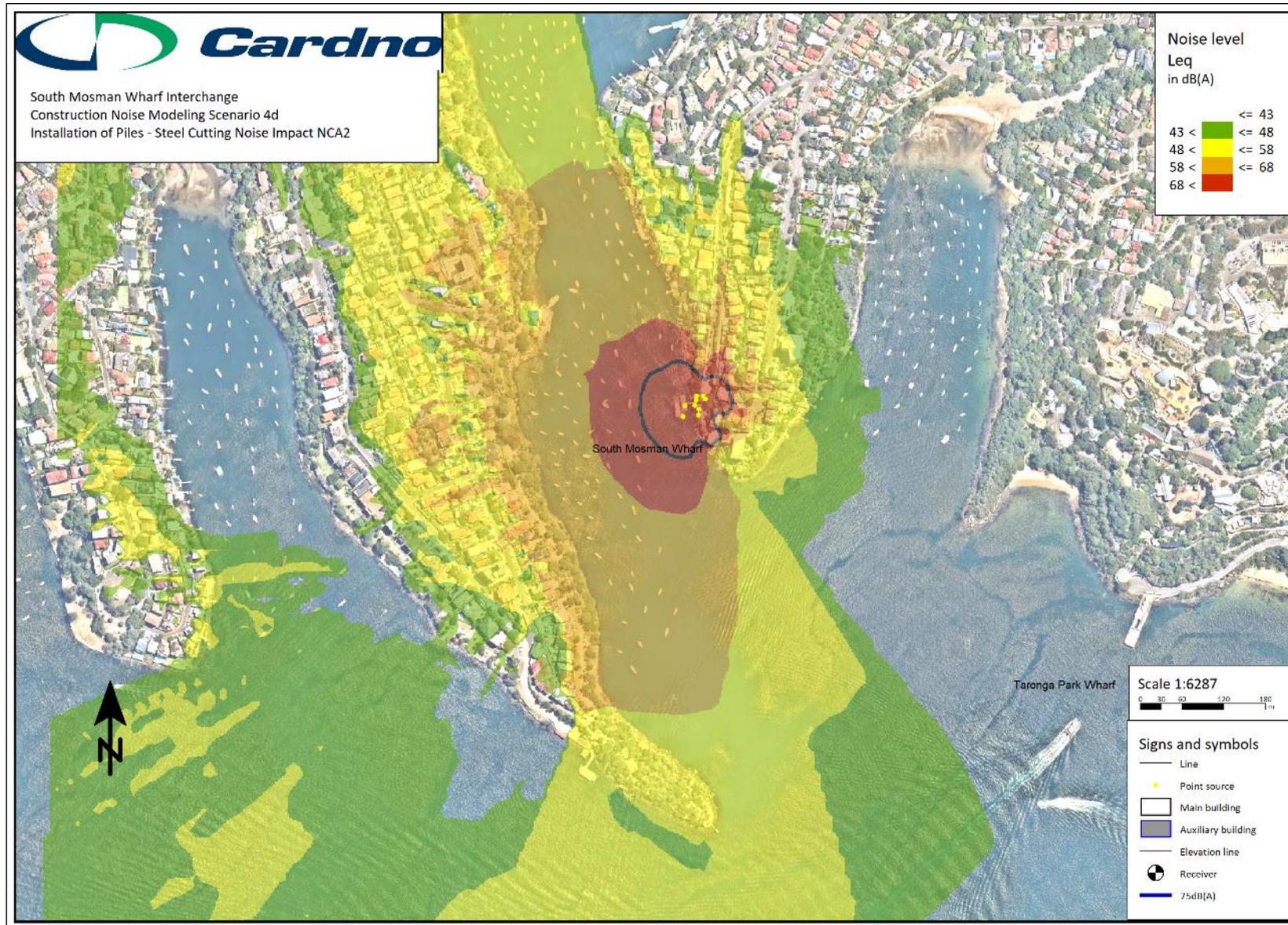


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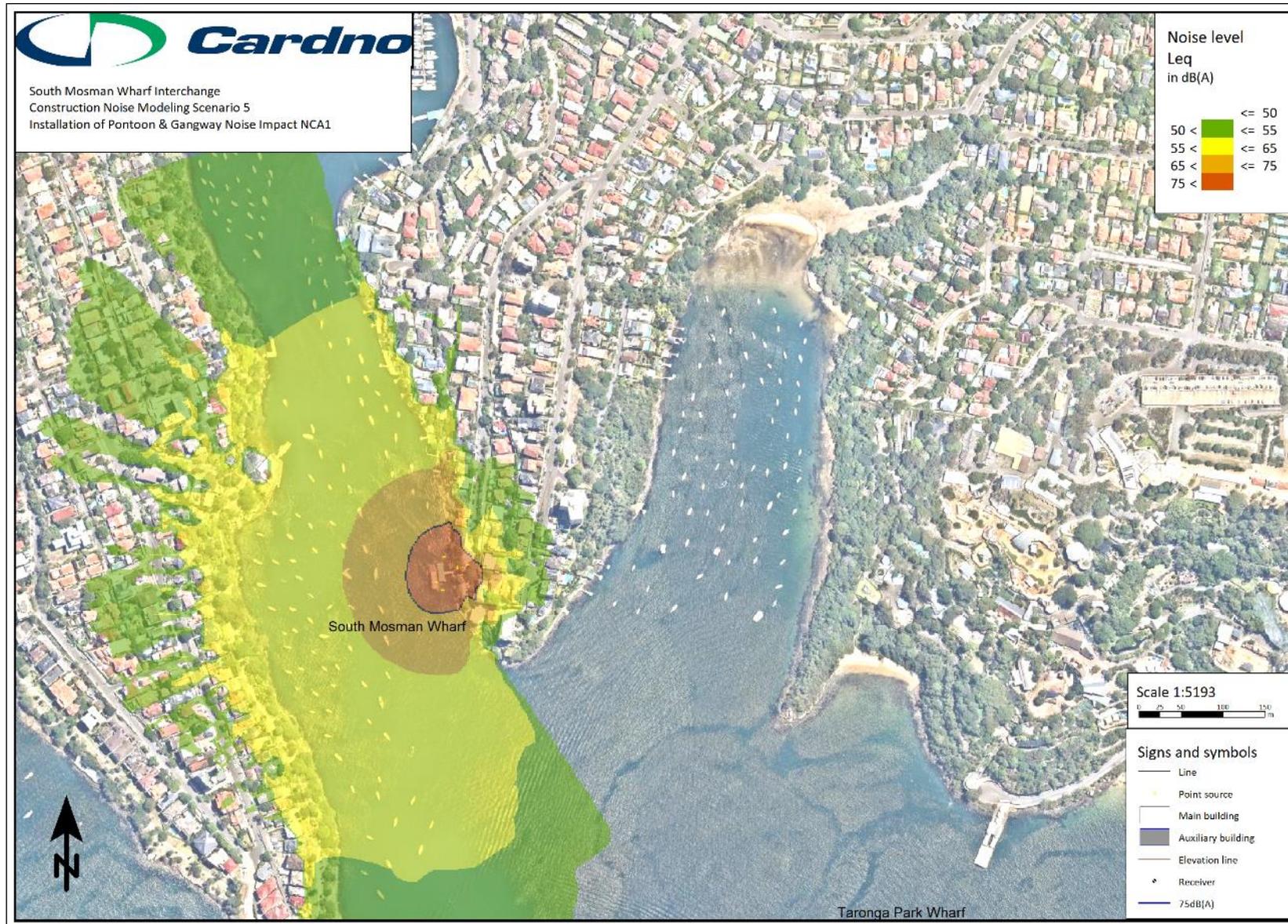


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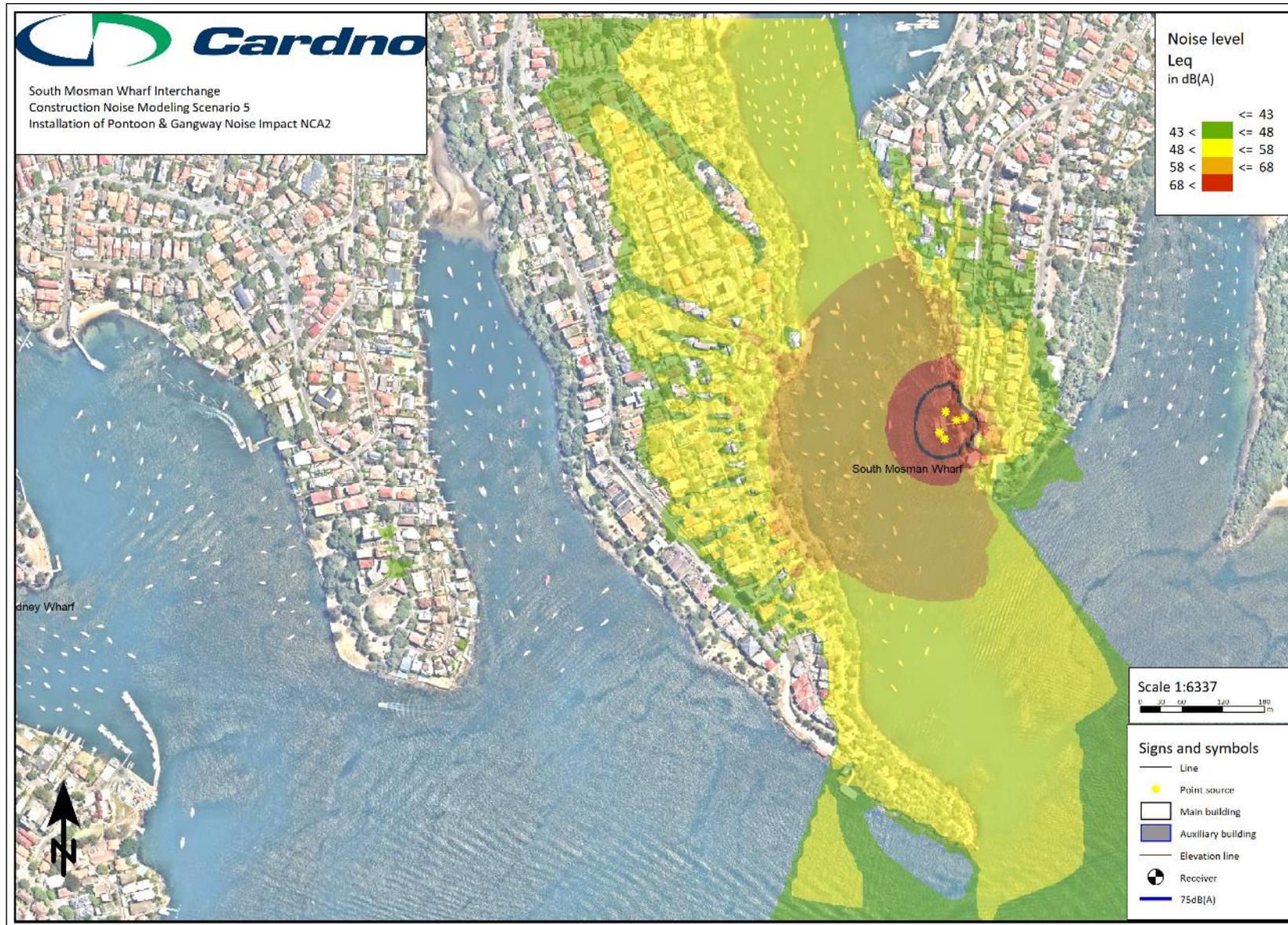


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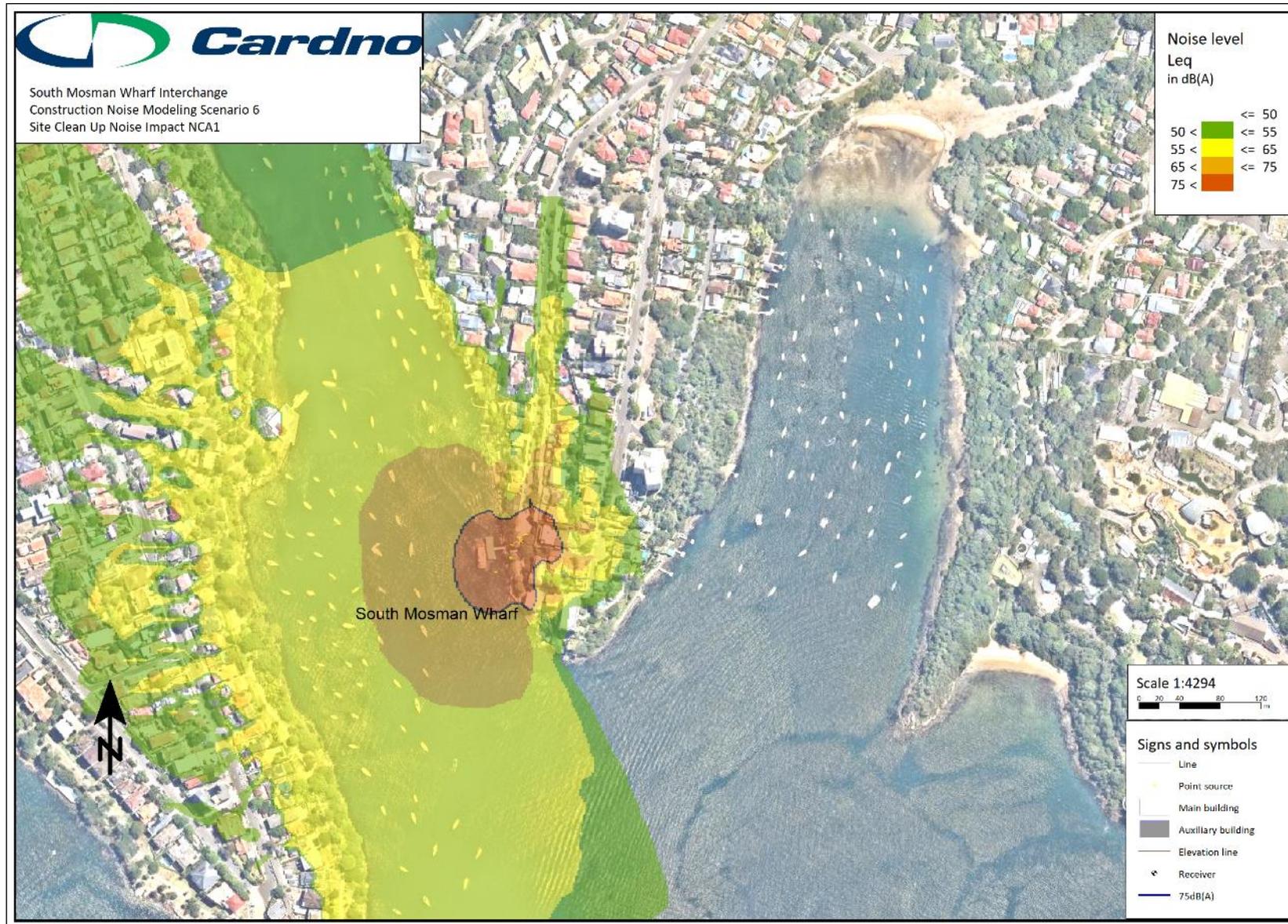


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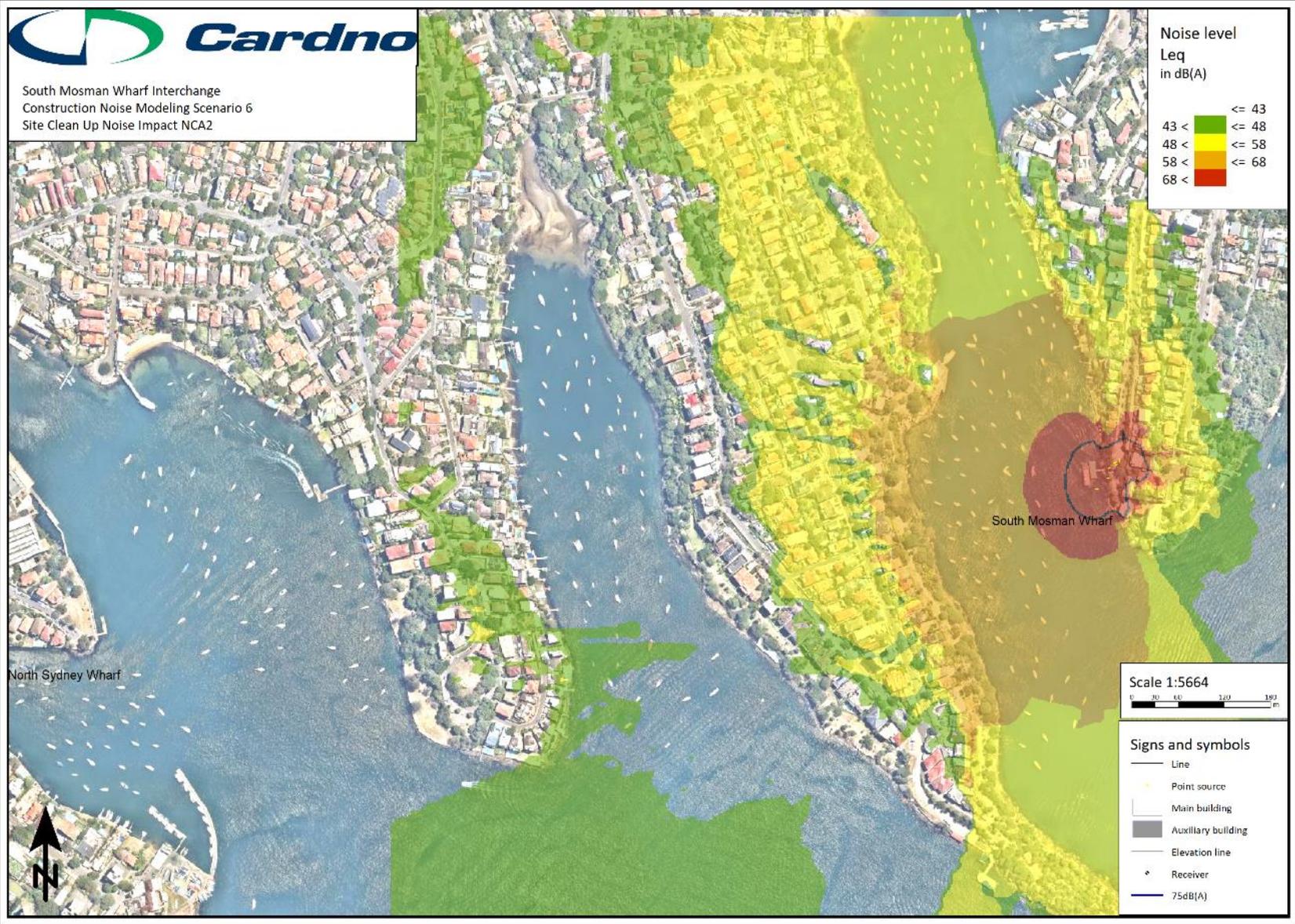


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# Appendix F

## Landscape character and visual impact assessment

# Landscape Character and Visual Impact Assessment

## South Mosman Wharf Upgrade

AWE200198

Prepared for  
Transport for NSW

19 November 2020



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Our report is based on information made available by the client. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Cardno is both complete and accurate. Whilst, to the best of our knowledge, the information contained in this report is accurate at the date of issue, changes may occur to the site conditions, the site context or the applicable planning framework. This report should not be used after any such changes without consulting the provider of the report or a suitably qualified person.

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# 1 Introduction

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Transport for NSW (TfNSW) has engaged Cardno (NSW/ACT) Pty Ltd (Cardno) to undertake an environmental assessment to upgrade the South Mosman wharf. Cardno has been asked to prepare a preliminary Landscape Character and Visual Impact Assessment (LCVIA) to inform the wharf's design and environmental assessment. The LCVIA has been prepared in accordance with the following TfNSW Guidelines:

- > *'Beyond the Pavement: urban design approach and procedures for road and maritime infrastructure planning, design and construction'* (TfNSW, 2020a)
- > *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4* Centre for Urban Design (TfNSW, 2020b).

## 1.1 Purpose and scope of this report

The LCVIA has been prepared for TfNSW as part of the Review of Environmental Factors (REFs) for the South Mosman wharf upgrade. The purposes of this report are:

- > To inform the design of the wharf so the proposal can avoid and minimise impacts on the surrounding areas and properties
- > To undertake a view analysis to and from the site from adjoining properties, key vantage points and streetscape location, including photomontages or perspectives of the proposed development
- > To provide a visual impact assessment to identify the visual changes and impacts on the site and its surrounding when viewed from key vantage points
- > To recommend management and mitigation measures to be implemented if the proposal was approved.

## 1.2 Urban design policy and guidelines

The LCVIA has been prepared in accordance with the guidelines outlined in the *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4* Centre for Urban Design (TfNSW, 2020b).

The guideline establishes the assessment tasks for a landscape character and visual assessment which are outlined below:

- > Analyse existing landscape character
- > Identify landscape character zones
- > Determine the magnitude of landscape character impacts
- > Assess landscape character impact
- > Identify the extent of the visibility of the proposal
- > Identify existing viewpoints
- > Determine the magnitude of change from each viewpoint
- > Assess the visual impact
- > Refine concept design to avoid and minimise the impact
- > Develop a strategy to manage landscape character and visual impact.

## 2 Urban and landscape design concept

### 2.1 Objectives

The objective of the LCVIA for the South Mosman wharf is to facilitate a development outcome that:

- > Ensures the proposal is compatible with the existing built, natural and community environments
- > Contributes to the character of the area
- > Protects key elements and features of the locality
- > Safeguards key and significant viewpoints to and from the site
- > Enhances the overall quality of the public domain for the community and park users
- > Upgrades facilities to meet current standards and improve amenity.

### 2.2 The proposal

#### 2.2.1 Waterside design

The proposal is to upgrade the South Mosman wharf as part of the Transport Access Program (TAP).

The water based features of the proposal would include:

- Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- Removal of the existing gangway and pontoon including existing piles
- Remediation of the seawall following removal of the existing wharf, if required.

The land based features of the proposal would include:

- Installation of a new 16-metre high lift and new covered stairs
- Installation of a new covered street level waiting area
- Installation of a covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- Installation of three bicycle parking hoops
- Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

### 2.3 Study area

Figure 2-2 identifies the Study area of the LCVIA.

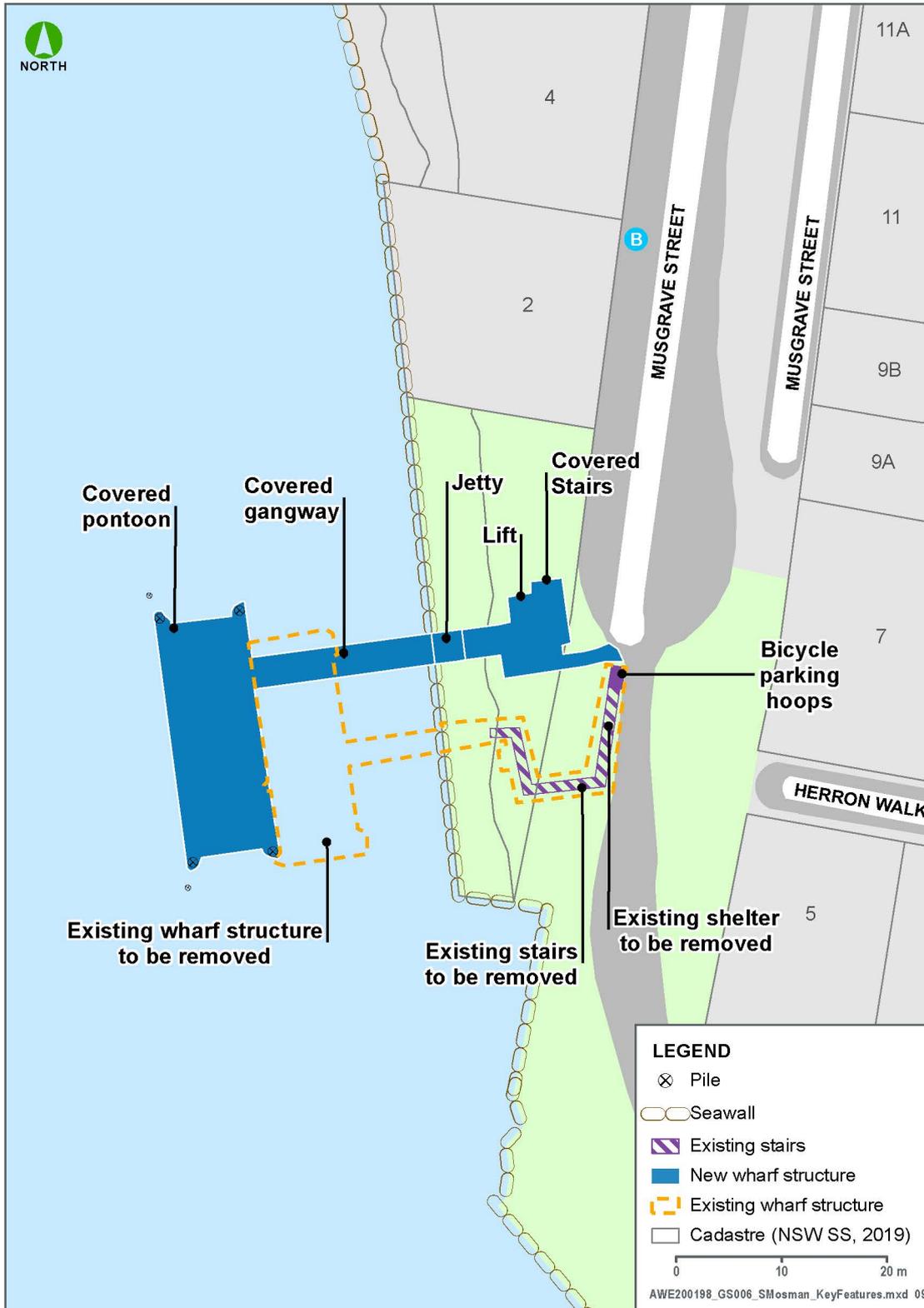


Figure 2-1 Key features of the proposal



Figure 2-2 Study area (defined by the construction footprint)

## 3 Planning context

### 3.1.1 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

Consideration is given to the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (Sydney Harbour SREP) as the existing and proposed wharf is located on water zoned as W7 Scenic Waters Casual Use. The objectives of the W7 zone are:

- > To allow certain water-dependent development close to shore to meet casual boating needs and other water access needs
- > To allow such development only where it can be demonstrated that it achieves a predominantly open and unobstructed waterway and does not dominate the landscape setting
- > To restrict development for permanent boat storage in locations that are unsuitable due to the adverse visual impact of such development or to physical constraints such as shallow water depth, severe wave action or unsafe navigation
- > To ensure that the scale and size of development are appropriate to the location and protect and improve the natural and cultural scenic quality of the surrounding area, particularly when viewed from waters in this zone and areas of public access
- > To maintain and enhance views to and from waters in this zone
- > To minimise the number and extent of structures over waters in this zone through mechanisms such as the sharing of structures between adjoining waterfront property owners
- > To ensure remnant natural features, aquatic habitat (including wetlands) and public access along the intertidal zone are not damaged or impaired in any way by development.

Additionally, the Study area is located within the Foreshores and Waterways Area.

### 3.1.2 Sydney Harbour Foreshore Area Development Control Plan

The Sydney Harbour Foreshore Area Development Control Plan (SHFA DCP) is developed to support the Sydney Harbour SREP. The DCP provides detailed design guidelines for development and criteria for natural resource protection for the area identified as Foreshores and Waterways.

Section 3 of the DCP outlines the provision requiring a consent authority to consider the visual impact of development from the waterway and foreshores. To assist in reviewing the landscape characteristics where a development is proposed, the area has been divided into several different landscape character types. The South Mosman wharf is identified as Landscape Character Type 8 and the Statement of Character and Intent are as follow:

*These areas have a high level of built form with waterside commercial, industrial and residential uses. The commercial and industrial uses play an important role in terms of tourism and maritime services which support water-based activities. There are special features in these areas that contribute to the visual character of the area that should be maintained.*

An assessment of the performance criteria is provided in Table 3-1.

Table 3-1 Landscape character assessment (Source: TfNSW, 2020b)

Performance Criteria	Comments
Vegetation is integrated with land-based development to minimise the contrast between natural and built elements.	<p>The proposal will require removal of up to 0.04 hectares of native/exotic garden vegetation within the compound area (refer Figure 2-2) including three 5-10 metre tall trees: Silky oak (<i>Grevillea robusta</i>), Canary Island Date Palm (<i>Phoenix canariensis</i>) and a Smooth-barked Apple (<i>Angophora costata</i>).</p> <p>The proposal includes planting of new trees that would attain the mature scale of the removed trees.</p>

Performance Criteria	Comments
Design and mitigation measures are provided to minimise noise and amenity impacts between incompatible land uses.	With respect to landscape character and visual amenity, the proposed wharf is not incompatible with surrounding land uses. The wharf structure and lift are of contemporary design which is considered to complement and improve the visual character of its locality.
The maritime uses on the Harbour are preserved. Pressure for these uses to relocate is minimised. New developments adjoining maritime uses are designed and sited to maintain compatibility with existing maritime uses.	The new South Mosman wharf would preserve the maritime uses on the Harbour.
Remaining natural features that are significant along the foreshore are preserved and views of these features are maintained.	The inclusion of the pedestrian lift would involve some removal of trees and would change the view of the cliff line behind the existing wharf. The visual impact of the proposal would be mitigated by replanting of trees and the low key, contemporary form and finishes to the new wharf and lift. The proposal is considered to have an acceptable impact on natural features of the foreshore.

### 3.1.3 Mosman Local Environmental Plan 2012

The wharf is located within the Mosman local government area (LGA). Therefore, consideration of the *Mosman Local Environmental Plan 2012* (MLEP) is required.

#### 3.1.3.1 Zoning

Land zoning under the MLEP is illustrated at Figure 3-1. The land based area incorporating the wharf and proposed pedestrian lift is zoned SP2. The objectives of the SP2 zone are:

- > To provide for infrastructure and related uses
- > To prevent development that is not compatible with or that may detract from the provision of infrastructure.

Land adjoining the wharf site is variously zoned RE1 – Public Recreation and R3 – Medium Density Residential under the MLEP.

The objectives of the RE1 zone are:

- > To enable land to be used for public open space or recreational purposes
- > To provide a range of recreational settings and activities and compatible land uses
- > To protect and enhance the natural environment for recreational purposes
- > To protect and enhance areas of ecological, scientific, cultural or aesthetic values
- > To maintain and provide visual open space links to a diversity of public and private spaces and facilities as an integral part of the open space system
- > To recognise the visual, aesthetic and amenity importance of bushland.

The objectives of the R3 zone are:

- > To provide for the housing needs of the community within a medium density residential environment
- > To provide a variety of housing types within a medium density residential environment
- > To enable other land uses that provide facilities or services to meet the day to day needs of residents
- > To provide for housing that is compatible with the desired future character of the area in terms of bulk, height and scale
- > To encourage residential development that has regard to local amenity and, in particular, public and private views.

The proposal would be consistent with any of the objectives of the zone or adjoining zones that are relevant to landscape character or visual amenity.

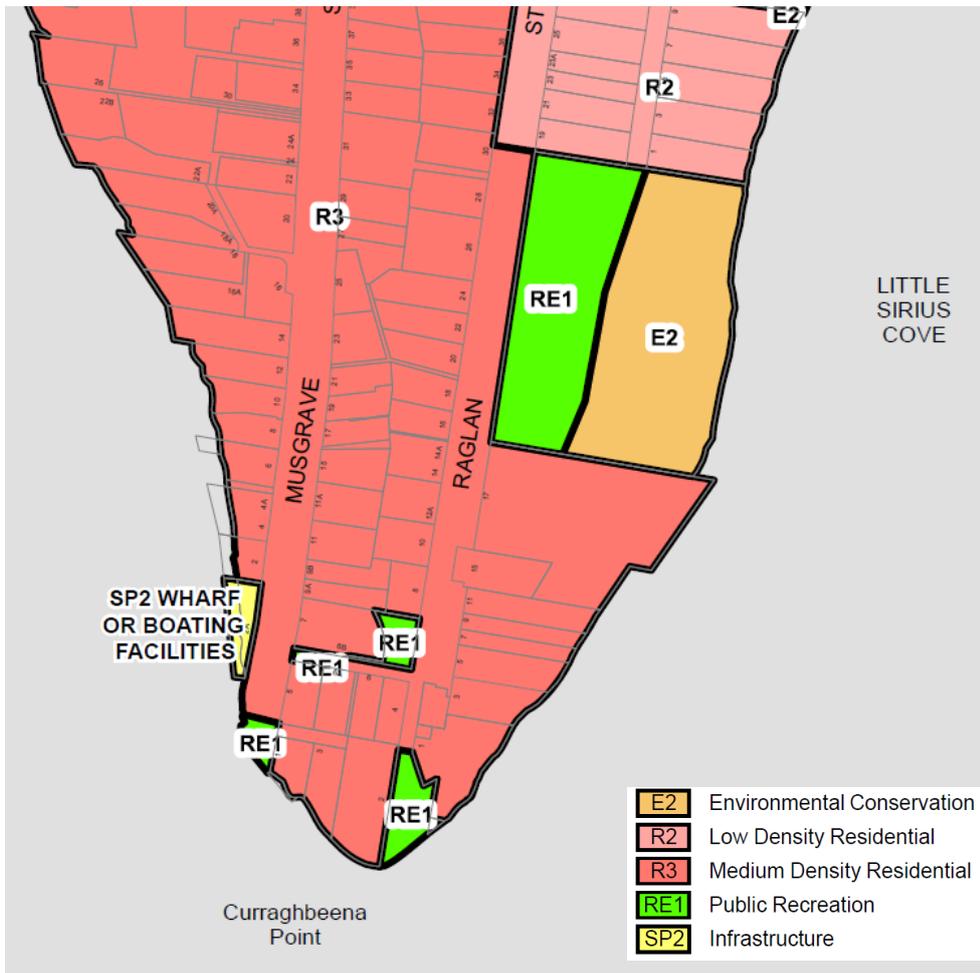


Figure 3-1 Extract Mosman Local Environmental Plan, 2012 – land zoning map (sheet 3)

### 3.1.3.2 Heritage conservation

The following items are listed as Items of Local Heritage Significance in the vicinity of the wharf in the MLEP (refer Figure 3-2):

- > Local Item I411 – Musgrave Street Divided Road
- > Local Item A491 - Musgrave Street Wharf (remains and sea wall).

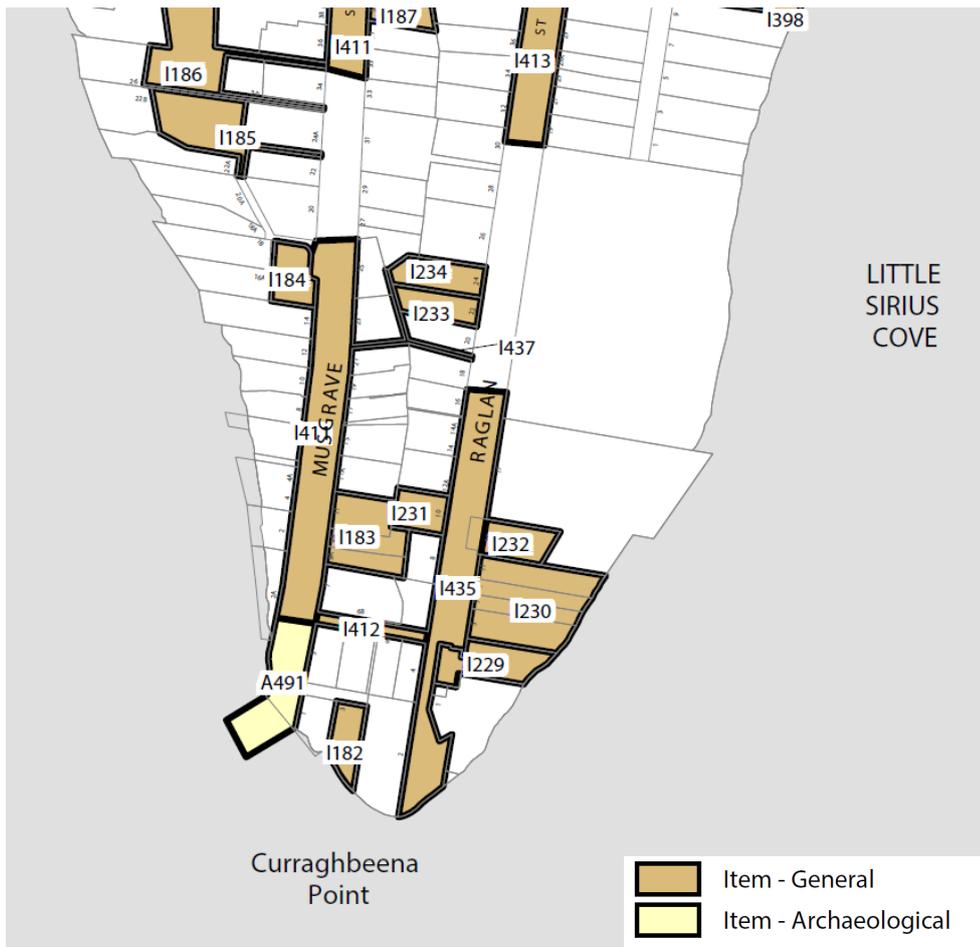


Figure 3-2 Extract Mosman Local Environmental Plan 2012 – heritage map (sheet 3)

### 3.1.3.3 Scenic Protection Areas

Cl.6.4 of the MLEP is intended to provide protection of the natural and visual environment of Mosman and Sydney Harbour. The objectives of the clause are:

- (a) to recognise and protect the natural and visual environment of Mosman and Sydney Harbour,
- (b) to reinforce the dominance of landscape over built form,
- (c) to ensure development on land to which this clause applies is located and designed to minimise its visual impact on those environments.

And the relevant controls on development are:

- (3) Development consent must not be granted to any development on land to which this clause applies unless the consent authority is satisfied that—
  - (a) measures will be taken, including in relation to the location and design of the proposed development, to minimise the visual impact of the development to and from Sydney Harbour, and
  - (b) the development will maintain the existing natural landscape and landform.

The proposed wharf is located within the Scenic Protection Area (refer Figure 3-3). As illustrated by the assessment, the proposal is consistent with the zoning objectives and the controls relevant to protection of the scenic qualities of Mosman and Sydney Harbour in the MLEP.

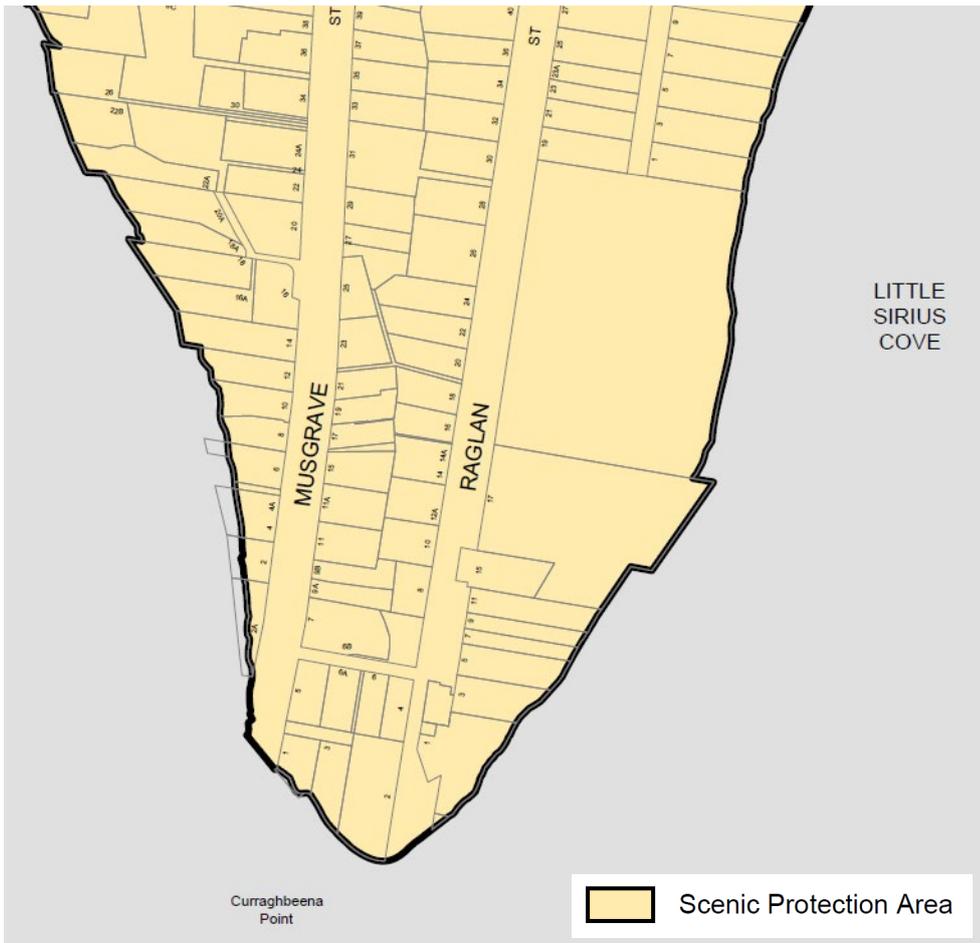


Figure 3-3 Extract *Mosman Local Environmental Plan, 2012* - scenic protection area map (sheet 3)

## 4 Existing context

---

### 4.1 Location

The existing South Mosman wharf is located on the Eastern shoreline of Mosman Bay, close to the end of the Mosman Point peninsula (refer Figure 4-1 and Figure 4-2).

The Wharf faces south west and is located at the foot of a small escarpment approximately 6 metres below street level at Musgrave Street. Existing pedestrian access to the wharf is via a set of stairs from a turning circle at the end of the Musgrave Street cul-de-sac.

The wharf is situated on the F5 Sydney Ferry Network Loop, which provides connections to Circular Quay and other northern harbour locations.

### 4.2 Landscape and urban context

The existing South Mosman wharf is a concrete wharf incorporating a jetty with single berthing and a canopy cover. Access to the shore is via a covered gangway leading to the stair connection to Musgrave Street.

The wharf site is in the context of single dwelling residential houses and a relatively natural foreshore comprised of the sandstone escarpment and a shore edge terrace supported by a sandstone sea wall. Vegetation at the terrace level includes some indigenous trees and exotic weed species. North of the terrace, existing private residential properties extend almost to the foreshore of the bay.

Mosman Bay is approximately 250 meters wide and is flanked by a mix of residential properties and public open space. The Cremorne Reserve pedestrian walkway extends along the western shoreline of the bay and provides views of the harbour which often include the South Mosman wharf.

The Sydney Amateur Sailing Club is on the opposite foreshore, north west of the South Mosman wharf site. Two other ferry wharves are within the bay, one on the western foreshore and the other on the eastern foreshore close to the head of the bay.



Figure 4-1 Location of South Mosman wharf (source: NearMap)



Figure 4-2 Perspective view of South Mosman wharf (source: Google Map)

## 5 Landscape character assessment

### 5.1 Landscape character

The *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4 Centre for Urban Design* (TfNSW, 2020b) defines landscape character as follows:

- > **Landscape character** refers to the aggregate of an area’s built, natural and cultural character.

The landscape character assessment evaluates the overall impact of the proposed wharf on the surrounding character and sense of place.

### 5.2 Assessment methodology

The potential impact of the South Mosman wharf on the existing landscape character is a combination of the sensitivity of its landscape and magnitude of the proposed works/structures. The *Guideline for Landscape Character and Visual Impact Assessment* defines sensitivity and magnitude as:

- > **Sensitivity** refers to the qualities of an area, the number and type of receivers and how sensitive the existing character of the setting is to the proposed nature of change. For example, a pristine natural environment is likely to be more sensitive to a change of the nature of a four lane motorway than a built up industrial area. The design quality of the proposed development does not make the area less sensitive to change but instead affects the magnitude of the impact as described following.
- > **Magnitude** refers to the physical scale of the project, how distant it is and the contrast it presents to the existing condition. For example, a large interchange would have a very different impact on landscape character than a localised road widening in the same area. A more distant bridge would have a lesser magnitude than one nearer to residents. A vegetated embankment facing a parkland would have less contrast than a retaining wall in the same location. Magnitude will also need to consider cumulative impact, which is a consideration of the result of the incremental impact of the proposal when added to other past, current and known likely future activity.

The assessment intends to identify the overall impact of the proposed works/structures on each of the Landscape Character Zones (LCZ) through predicting the sensitivity of the LCZ to changes as a result of the proposed works/structures followed by identifying the anticipated magnitude change that would result from implementation of the proposed works/structures within each LCZ.

Based on the measures of sensitivity and magnitude, a rating of the landscape character impact for the South Mosman wharf can be formulated, as shown in **Table 5-1**.

Table 5-1 Landscape character rating matrix (Source: TfNSW, 2020b)

		Magnitude			
		High	Moderate	Low	Negligible
Sensitivity	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

For this assessment, the magnitude rating for the landscape character impact is categorised in **Table 5-2**.

Table 5-2 Landscape character impact description

Magnitude Rating	
High	The proposed works/structures would be the dominant feature in the landscape. It would significantly affect and alter the current character of the area.
Moderate	The proposed works/structures would be visible and constitute a new feature and alter the area's existing character.
Low	The proposed works/structures would constitute a minor feature, resulting in small changes to the existing landscape character.
Negligible	Only a small proportion of the proposed works/structures would be discernible, or the changes to the landscape character would be barely noticeable due to the separation distance.
None	The existing landscape character would not be altered as the proposed works/structures would not be noticeable.

### 5.3 Sub-precincts and character statements

Landscape character zones for the vicinity of the South Mosman wharf were determined by others as part of the preliminary LCVIA (Aurecon, 2019d) prepared during the Concept Design. Cardno has reviewed and adopted these zones for the purpose of this assessment.

To determine the South Mosman wharf impact, the study area has been divided into five LCZ as shown in Figure 5-1. The sensitivity of each LCZ was assessed and a summary of the impact is provided in Table 5-3.



Figure 5-1 Landscape character zones

## **5.4 Sensitivity – high**

The sensitivity of the existing landscape character is considered to be high. The locality is generally of high landscape quality incorporating the harbour and local bays, and narrow peninsulas with generally naturalistic foreshores and well vegetated high quality residential areas. The South Mosman wharf site is within a mapped Scenic Protection Area and is near local heritage items. Other components of the local landscape, including the Cremorne Point peninsula and Sydney Harbour are also of high landscape quality and would be highly sensitive to change.

Table 5-3 Landscape character assessment

Landscape Character Precinct	Description	Sensitivity	Magnitude	Landscape Character Impact
Zone 1 Residential Slopes - Mosman	<p>The Mosman Peninsula residential precinct is a mix of single dwellings and apartment buildings in a high quality, well treed setting.</p> <p>The precinct consists of a variety of architectural styles and building forms from large federation dwellings to 'tower' form residential flat buildings. The precinct includes a number of heritage items.</p> <p>The narrow peninsula that supports the residential precincts is moderately sloping resulting in many opportunities for high quality views to the harbour.</p> <p>Mature trees and vegetation are visible along the street frontage, which forms a significant part of the precinct's appearance.</p> <p>Yachts moored close to the shoreline form part of the visual character of the Mosman residential slopes.</p>	<p><b>High</b></p> <p>The Peninsula is a Scenic Protection Area mapped in the MLEP.</p> <p>Views to and from the Peninsula would be highly sensitive due to the overall scenic quality of the locality generated by the well vegetated foreshore and proximity to Sydney Harbour.</p>	<p><b>Moderate</b></p> <p>The proposed wharf and lift would have visual connections with private dwellings on Musgrave Street, on the Mosman Peninsula to the north and south of the site and from the Cremorne Point peninsula to the west.</p> <p>The proposal would include some removal of existing trees to facilitate construction of a new pedestrian lift. These land based works would have the highest potential for impact on landscape character.</p>	<p><b>Moderate - High</b></p> <p>Notwithstanding the high landscape sensitivity of the Precinct, the Mosman residential zone is capable of absorbing moderate change without altering its character for the following reasons:</p> <ul style="list-style-type: none"> <li>&gt; The proposal constitutes an upgrade of the existing wharf and stairs, which are in a relatively poor state of repair</li> <li>&gt; The design of the new wharf, lift and stairs responds to existing visual cues on the harbour, particularly the colour, materials, and vertical elements of nearby yachts</li> <li>&gt; The design of the wharf is consistent with other ferry wharves on the northern side of the harbour and is part of a program of wharf upgrades that will result in a visually consistent group of wharves in the locality.</li> <li>&gt; The wharf and lift complex would be recessive elements in local views and would not dominate views from any particular location.</li> </ul>
Zone 2 – Residential slopes – Cremorne Point Sydney Harbour	<p>The Cremorne Point peninsula supports a variety of residential forms, dominated by large single dwelling houses of Edwardian and Federation design interspersed with a small number of 4-8 storey residential apartment buildings.</p>	<p><b>High</b></p> <p>Similar to the Mosman Peninsula, views to and from the Cremorne Point Peninsula would be highly sensitive due to the overall scenic quality of the locality generated by the well vegetated</p>	<p><b>Moderate</b></p> <p>Construction of the new wharf and lift / stair complex would introduce a new built element on the foreshore to the east of the Cremorne Peninsula. The removal of some trees from the foreshore would increase the impact</p>	<p><b>Moderate</b></p> <p>Construction of the new wharf and lift / stair complex would introduce a new built element on the foreshore to the east of the Cremorne Peninsula. The removal of some trees from the foreshore would increase the impact of the new form. Distance from residences on the Cremorne peninsula would be a moderating factor and the wharf complex would form a</p>

Landscape Character Precinct	Description	Sensitivity	Magnitude	Landscape Character Impact
	Large scale trees are also dominant in the landscape in streets and within private properties.	foreshore and proximity to Sydney Harbour.	of the new form. Distance from residences on the Cremorne peninsula would be a moderating factor and the wharf complex would form a small component of broad views of the bay and foreshore.	small component of broad views of the bay and foreshore.
Zone 3 – Foreshore Reserves	The foreshore of Cremorne Point is a continuous public reserve including pathways, picnic areas, seating and conservation zones with views across the harbour to adjacent foreshores. The South Mosman wharf site is a part of the view from these recreational areas on the eastern foreshore of Cremorne Point.	<b>High</b> The Cremorne Point foreshore is largely public land with high quality views of Sydney Harbour and its foreshores. Visitors to the foreshore would be highly sensitive to changes that impact negatively on the quality of these views.	<b>Moderate</b> The changes that would occur as a result of the proposal would be substantial but they would constitute only a small component of the broad and expansive views available from the foreshore.	<b>Moderate</b> The new wharf complex would result in changes to these views from the loss of some foreshore trees and construction, principally, of the new lift and stairs. Again these views would be over moderate distances and the changed component of the view would be relatively small. In this regard, it is considered that the impact of the development on the Cremorne Point foreshore landscape character unit would be moderate.
Zone 4 – Taronga Zoo	The Taronga Zoo site reads as a generally natural element in the greater Sydney Harbour foreshore landscape.	<b>High</b> Protection of the visual integrity of the Taronga Zoo precinct is important to the overall character of the Harbour environs. Equally, views from the Zoo locality are highly sensitive to change.	<b>Negligible</b> The proposed redevelopment of the Wharf would not be visible from the Zoo.	<b>Negligible</b> The South Mosman wharf site is screened from view from Taronga Zoo by existing landforms. The proposed redevelopment of the wharf would not be visible from the Zoo.
Zone 5 –	Sydney Harbour is a large body of water.	<b>High</b>	<b>Moderate</b>	<b>Moderate</b>

Landscape Character Precinct	Description	Sensitivity	Magnitude	Landscape Character Impact
Sydney Harbour	<p>The landform around the harbour comprises peninsulas with steep slopes rising to ridgelines.</p> <p>Natural sandstone outcrops and manmade sandstone walls are visible from parts of the Harbour foreshore.</p> <p>The foreshore of Sydney Harbour mainly consists of vegetated public recreational areas and private dwellings. The harbour also includes moored yachts flanking the foreshores, and jetties and pontoons.</p> <p>The existing wharf is enclosed and protected by the escarpment to the east and Cremorne Point to the west.</p>	<p>The Sydney Harbour is an iconic scenic precinct that is highly sensitive to change in its character.</p>	<p>The proposal, incorporating the new wharf, tree planting and a new passenger lift would constitute a substantial change to views from the Harbour. However, the proposed mitigating measures in place, the proposed redevelopment with pontoon and lift structure would have a moderate impact on the landscape character of this portion of Sydney Harbour.</p>	<p>The proposed South Mosman wharf forms part of a group of wharves servicing Sydney Harbour. The waterside design would be in character with other existing wharves in the broader locality (e.g. Rose Bay, Cremorne Point Wharf, Neutral Bay Wharf, and Balmain Wharf).</p> <p>Tree removal and the proposed lift would impact substantially on views from the harbour waterway.</p> <p>It is considered, however, that with mitigating measures including new tree planting and the use of contemporary design forms and finishes the proposed redevelopment with pontoon and lift structure would have a moderate impact on the landscape character of this portion of Sydney Harbour.</p>

## **5.5 Magnitude - moderate to high**

The proposal, incorporating the refurbished wharf, new covered paths and stairway, passenger lift, accessible parking spaces and removal of some foreshore trees would significantly change the visual / landscape character of the Wharf site, particularly in views from the street and from nearby residences on and adjacent to Musgrave Street. Specifically, the residence at no. 2 Musgrave Street has direct views over the site of the new lift and stairs.

The changed site is, however, relatively small in area and is contained and protected from many close views by the local topography. Over greater distance, the magnitude of change would decrease and the newly constructed wharf site would become a small component of broader views from the harbour and the Cremorne Point peninsular foreshore.

The composite magnitude of change that would result from the development is considered to be moderate to high.

## **5.6 Overall landscape character impact - moderate to high**

It is considered that the proposed South Mosman wharf would have a moderate to high potential impact on the surrounding character zones.

The proposal would introduce a larger wharf structure and new associated access infrastructure into the local landscape and would also involve loss of some foreshore trees. In close views, these changes are considered to have the potential for high impact on the local landscape character. The impact would reduce with distance from the wharf site.

## 6 Visual impact assessment

### 6.1 Visual impact

The *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4* (TfNSW, 2020b) visual impact as follows:

- > **Visual impact** refers to impact on the views from residences, workplaces and public places.

### 6.2 Assessment methodology

To determine the potential visual impact of the South Mosman wharf, the assessment combines the viewers' sensitivity to the proposed works/structures with the magnitude of the proposed works/structure within the existing views.

#### 6.2.1 Visual sensitivity

According to the *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4* (TfNSW, 2020b) visual sensitivity is defined as follows:

- > **Visual sensitivity** refers to the quality of the existing view and how sensitive the view is to the proposed change.

To determine the visual sensitivity, the following factors should be taken into consideration:

- > Distance between the proposed works/structures and the viewer
- > The category of viewer (resident, worker and open space user)
- > The element of the proposal that would be visible
- > The importance of the view.

#### 6.2.2 Magnitude

Magnitude refers to the “*form – scale, size, character – of the project and its proximity to the viewer*” (TfNSW, 2020b). Magnitude assessment should also consider the distance of the proposed works/structures from the viewer. Other factors that should be considered include:

- > The scale of the change within the view as a result of the proposed works/structures
- > The integration of the proposed works/structures (i.e. form, scale and mass) within the landscape
- > The nature and extent of the view
- > The location of the proposed works/structure in relation to the region
- > The scale of the change within the view with respect to the addition (or loss) of elements taken up by the proposed development.

For this assessment, the magnitude rating is categorised in Table 6-1.

Table 6-1 Visual impact magnitude rating

Magnitude Rating	
High	The proposed works/structures would result in the total loss of key elements/features/characteristics of the existing landscape and/or introduction of elements inconsistent with the aspect of the current landscape character.
Moderate	The proposed works/structures would result in the partial loss or alteration to key elements/features/characteristics of the existing landscape.  The new elements would be prominent but not considered to be significantly uncharacteristic of the existing landscape.

Magnitude Rating	
Low	The proposed works/structures would result in a minor loss or alters the key elements/features/characteristics of the existing landscape. However, the new elements are generally consistent with the existing landscape.
Negligible	The proposed works/structures would result in a minor alteration to the essential elements/features/characteristics. The introduction of the new elements would have no to minimal impact on the existing landscape.

### 6.2.3 Visual impact assessment

Based on the measures of sensitivity and magnitude, a rating can be assigned to the South Mosman wharf's visual impact, as shown in Table 6-2.

Table 6-2 Visual impact rating matrix (Source: TfNSW, 2020b)

		Magnitude			
		High	Moderate	Low	Negligible
Sensitivity	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

For this assessment, the visual impact is categorised in Table 6-3.

Table 6-3 Visual impact description

Magnitude Rating	
High	The proposed works/structures would be highly visible and form a significant element within the current views, which would alter the overall character positively or negatively.
Moderate	The proposed works/structures would be visible and recognisable as a new element within the existing view and may be readily noticeable by a viewer.
Low	The proposed works/structures would result in minor changes to the existing view and unlikely to be recognisable by a casual observer. The new elements would not have much impact on the overall quality of the view and visual sensitivity is likely to be low.
Negligible	A small proportion of the proposed works/structures would be discernible and/or the new elements would be located at a significant distance from the viewpoint that it would hardly be visible.

### 6.2.1 Key View Points

In consultation with TfNSW, viewpoints within a reasonable distance and visual catchment of the South Mosman wharf have been identified (Figure 6-1). The diagram outlines the position and direction of the key viewpoints that are likely to be impacted by the proposed works/structures.



Figure 6-1 Visibility analysis and key viewpoints

### 6.2.2 Distance zones

The following distance zones have been established to assist in the assessment on key views within the vicinity of the site. The zones are categorised as follow:

- > Foreground zone (FZ): 0 – 250m from the viewer
- > Middle ground zone (MZ): 250 – 500m from the viewer
- > Background zone (BZ): 500m or greater from the viewer.

### 6.2.3 Photomontages

Photomontages have been developed to illustrate proposed changes and to determine the likely visual impact generated by the proposed South Mosman wharf. Photomontages in the broader study area have been prepared from the following five viewpoints.

- > Viewpoint A – Musgrave Street bus turning circle looking south west
- > Viewpoint B – Sydney Harbour looking south-east towards wharf
- > Viewpoint C – Sydney Harbour looking north-east towards wharf
- > Viewpoint D – Cremorne Point foreshore walkway looking south-east towards wharf.
- > Viewpoint E – Cremorne Point foreshore walkway looking east towards wharf.

The magnitude of visual impact of the proposed works from critical viewpoints in the proximity of the Study Area are assessed below with the aid of the photomontages.

## 6.2.4 Viewpoint assessment

### 6.2.4.1 Viewpoint A – Musgrave Street turning circle looking south west



Figure 6-2 Viewpoint A – existing view (source: TfNSW)



Figure 6-3 Viewpoint A – photomontage (source: TfNSW)

#### 6.2.4.1.2 Viewpoint A – view description

Viewpoint A is located on a terrace above the southern end of Musgrave Street adjacent to the existing bus stop. The viewpoint is elevated above the site of the existing wharf. The existing view incorporates views of the harbour through canopies of existing indigenous trees that are growing from the foreshore terrace that provides access to the existing wharf. The existing residence in the view is No.2 Musgrave Street.

6.2.4.1.3 Viewpoint A – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
<p>Lift accessway and canopy, lift and lift overrun, staircase to wharf level.</p> <p>Removed trees are also a significant element of the changed view.</p>	<p>High</p>	<p>High</p>	<p>FZ</p>	<p>High</p>	<p>Viewpoint A is representative of close views from Musgrave Street of the new access infrastructure associated with the wharf upgrade proposal.</p> <p>The viewpoint is considered to be of high sensitivity for the following reasons:</p> <ul style="list-style-type: none"> <li>&gt; This part of Musgrave Street is within the area indicated in the MLEP as the Musgrave Street Wharf local heritage item</li> <li>&gt; The area is also within a Scenic Protection Area mapped in the MLEP</li> </ul> <p>The magnitude of change to this view that would result from the proposal is considered high as it involves removal of existing indigenous trees and introduction of a substantial amount of new built form into available view towards the harbour.</p> <p>The impact on the view would be mitigated by the contemporary design form of the proposed infrastructure and the use of lightweight and relatively non-intrusive construction materials and finishes.</p>

6.2.4.2 Viewpoint B – foreshore adjacent to No. 2 Musgrave Street Mosman looking south



Figure 6-4 Viewpoint B – existing view (source: TfNSW)



Figure 6-5 Viewpoint B – photomontage (source: TfNSW)

6.2.4.2.2 Viewpoint B – view description

Viewpoint B is from the harbour waterway, approaching the wharf site from the north-west. The view includes the existing sea wall and vegetated foreshore against the backdrop of single dwelling houses and apartments on the southern end of the peninsula. The southern foreshore of Sydney Harbour forms the distant horizon.

6.2.4.2.3 Viewpoint B – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stair.	Moderate - High	Moderate - High	FZ	Moderate - High	<p>The sensitivity of Viewpoint B is moderate – high for the following reasons:</p> <ul style="list-style-type: none"> <li>&gt; Close proximity to the South Mosman wharf</li> <li>&gt; The relatively well vegetated foreshore</li> <li>&gt; Visibility of the Musgrave Street Wharf local heritage item</li> <li>&gt; Visibility of the Mosman peninsula Scenic Protection Area.</li> <li>&gt; The quality of the view is moderated by the presence of built form of variable visual quality (including the existing wharf, staircase and residences behind).</li> </ul> <p>The magnitude of impact on the view of the new wharf complex is also considered moderate to high as it involves substantial new built form and removal of some foreshore trees, offset by an improved quality of built form and finishes.</p>

6.2.4.3 Viewpoint C – Sydney Harbour looking north-east towards wharf



Figure 6-6 Viewpoint C – existing view (source: TfNSW)

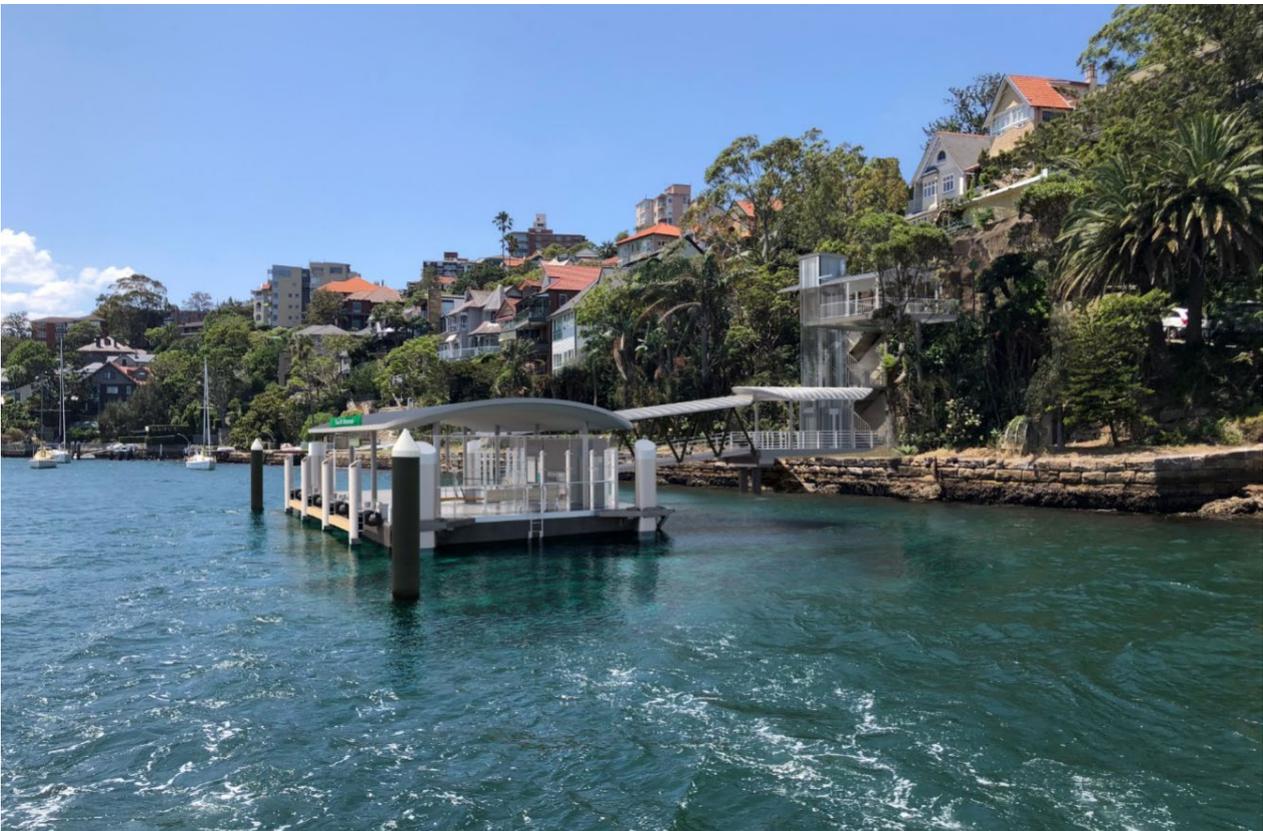


Figure 6-7 Viewpoint C - photomontage (source: TfNSW)

6.2.4.3.2 View C – view description

The existing view includes the current wharf against the backdrop of housing and vegetation on the mid to northern portion of the Mosman Point peninsula. The historically significant Musgrave Street wharf seawall is a significant component of the view as is the well vegetated foreshore. The existing wharf is somewhat dilapidated and is a detractor from the quality of the view. The visual quality of residential development is high and vegetation forms a significant portion of the view.

6.2.4.3.3 Viewpoint C – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stair.	Moderate - High	Moderate - High	FZ	Moderate - High	<p>The sensitivity of Viewpoint C is moderate – high for the following reasons:</p> <ul style="list-style-type: none"> <li>&gt; Close proximity to the South Mosman wharf</li> <li>&gt; The relatively well vegetated foreshore</li> <li>&gt; Visibility of the Musgrave Street Wharf local heritage item</li> <li>&gt; Visibility of the Mosman peninsula Scenic Protection Area.</li> <li>&gt; High quality residential backdrop including visually high quality homes and a substantial presence of vegetation.</li> <li>&gt; The quality of the view is moderated by the presence of built form of variable visual quality (including the existing wharf, staircase and residences behind).</li> </ul> <p>The magnitude of impact on the view of the new wharf complex is also considered moderate to high as it involves substantial new built form and removal of some foreshore trees, offset by an improved quality of built form and finishes.</p>

6.2.4.4 Viewpoint D – Cremorne Point foreshore walkway looking south-east towards wharf.



Figure 6-8 Viewpoint D – existing view (source: TfNSW)



Figure 6-9 Viewpoint D - photomontage (source: TfNSW)

6.2.4.4.2 Viewpoint D – view description

The view is from the pedestrian path immediately south-west of the Sydney Amateur Sailing Club. The view includes the sweep of Mosman Bay and the foreshores of Mosman Point and Cremorne Point. Horizon views include the Taronga Zoo peninsula and the southern foreshore of Sydney Harbour. The existing South Mosman wharf forms a small component of this broad view. It is recessive against the backdrop of Mosman Point.

6.2.4.4.3 Viewpoint D – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stair.	Low - Moderate	Low	MZ	Low - Moderate	<p>The sensitivity of Viewpoint D is low - moderate for the following reasons:</p> <ul style="list-style-type: none"> <li>&gt; Substantial distance of the wharf site from the viewpoint</li> <li>&gt; The wharf complex forming a small component of a high quality, broad and extensive view</li> <li>&gt; Visibility of the Mosman peninsula Scenic Protection Area</li> <li>&gt; The quality of the view is moderated by the presence of built form of variable visual quality (including the existing wharf, staircase and residences behind).</li> </ul> <p>The magnitude of impact on the view of the new wharf complex is also considered low to moderate as it occupies a small component of the broad, expansive view of the harbour and foreshores.</p>

6.2.4.5 Viewpoint E – Cremorne Point foreshore walkway looking east towards wharf



Figure 6-10 Viewpoint E – existing view (source: TfNSW)



Figure 6-11 Viewpoint E – photomontage (source: TfNSW)

6.2.4.5.2 Viewpoint E – view description

Viewpoint E is from open space on the Cremorne Point foreshore, directly south of the South Mosman wharf site. The view is dominated by the southern end of the Mosman Point peninsula. Other components include Mosman Bay with moored yachts and the residential precinct of Mosman Point which is the dominant backdrop. The wharf site is central in the middle ground of the view.

6.2.4.5.3 Viewpoint E – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Wharf platform and roof, gangway platform and roof, lift, elevated platform and access stair.	Moderate	Moderate	MZ	Moderate	<p>The sensitivity of Viewpoint E is considered to be moderate for the following reasons:</p> <ul style="list-style-type: none"> <li>&gt; The central location of the wharf complex in the view</li> <li>&gt; Visibility of the Mosman peninsula Scenic Protection Area</li> <li>&gt; The quality of the view is moderated by the presence of built form of variable visual quality (including the existing wharf, staircase and residences behind).</li> </ul> <p>The magnitude of impact on the view of the new wharf complex is also considered moderate. It would incorporate new built form including the passenger lift, platform and access stair and removal of some existing trees on the foreshore.</p>

### **6.3 Overall visual impact assessment - moderate**

The new South Mosman wharf would be a significant new built element within its locality. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site.

The South Mosman wharf and access infrastructure are located within the Mosman Point Scenic Protection Area and the Musgrave Street Wharf Item of Local Heritage Significance. A determining authority is required to take into account impacts on the scenic quality of the locality and the integrity of the heritage Item when undertaking an environmental assessment.

Visual impacts from houses on Musgrave Street adjacent to the new wharf complex are considered to be high due to close proximity to the development site and the significant level of change that would occur in these views as a result of the proposal.

Impacts on views from the water within Mosman Bay are considered to be moderate to high due largely to the loss of existing trees in the view and the construction of the new lift, access stair and street level platform. The impacts on these views would be moderated by the existence of the ferry wharf in the current view and the improvement in design quality and finishes that would result from the implementation of the proposal.

Impacts on views from the Cremorne Point foreshore are considered to be moderate from directly opposite the wharf site and declining with movement further to the north where the new wharf complex would be viewed over a greater distance and would be a relatively small component of very broad existing views.

Overall the impact is considered moderate within the context of the harbour and its foreshores.

## 7 Summary of urban design concept and mitigation strategy

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The proposed new South Mosman wharf has been designed in a form that is consistent with contemporary urban design practices. It incorporates use of lightweight materials and maximises transparency within the confines of the requirement to provide safety, weather protection and equitable access for ferry users. The approaches to and surrounds of the wharf have been designed to maximise amenity and are in keeping with the existing urban and landscape environment.

The main source of impact of the proposal on landscape character and visual quality would be the removal of existing trees and the construction of the lift, access stairs and street level platform. The following measures are recommended to mitigate these impacts:

- > Implementing of a considered landscape scheme which includes as a minimum the replanting of locally indigenous trees to replace the tree loss that would result from the proposal and appropriate ground plane treatment at the street and foreshore levels
- > Judicious use of materials and finishes to minimise reflectivity and maximise transparency of the new structures. Detailed design should include contemporary design practices, lightweight materials and muted, non-reflective finishes.

With these measures in place It is considered that the wharf design would constitute a high quality new built element in the local landscape that would be consistent with the values of its visual and landscape environment.

## 8 Conclusion

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The assessment of the impacts of the proposed new South Mosman wharf and associated access infrastructure on local landscape and visual quality has been carried out in accordance with the following TfNSW Guidelines:

- > *'Beyond the Pavement: urban design approach and procedures for road and maritime infrastructure planning, design and construction'* (TfNSW, 2020a)
- > *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4* (TfNSW, 2020b).

The assessment has found that the proposal would have an acceptable impact on landscape and visual quality when viewed from Sydney Harbour and from its foreshore. It is considered that with regard to visual and landscape impacts the proposal is worthy of support.

## 9 References

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Aurecon (2019d) *Preliminary Landscape Character and Visual Impact Assessment: Ferry Wharf Upgrade Program Package 3 South Mosman Wharf Interchange*. Prepared by Aurecon Australasia Pty Ltd on behalf of Roads and Maritime Services, July 2019.

TfNSW (2020a) *Beyond the Pavement: urban design approach and procedures for road and maritime infrastructure planning, design and construction*. Transport for NSW, 2020.

TfNSW (2020b) *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4 Centre for Urban Design*. Transport for NSW, August 2020.

# Appendix G

## Statement of heritage impact

# Ferry Wharf Upgrade Program 3, South Mosman Wharf

Statement of Heritage Impact

Report to Cardno

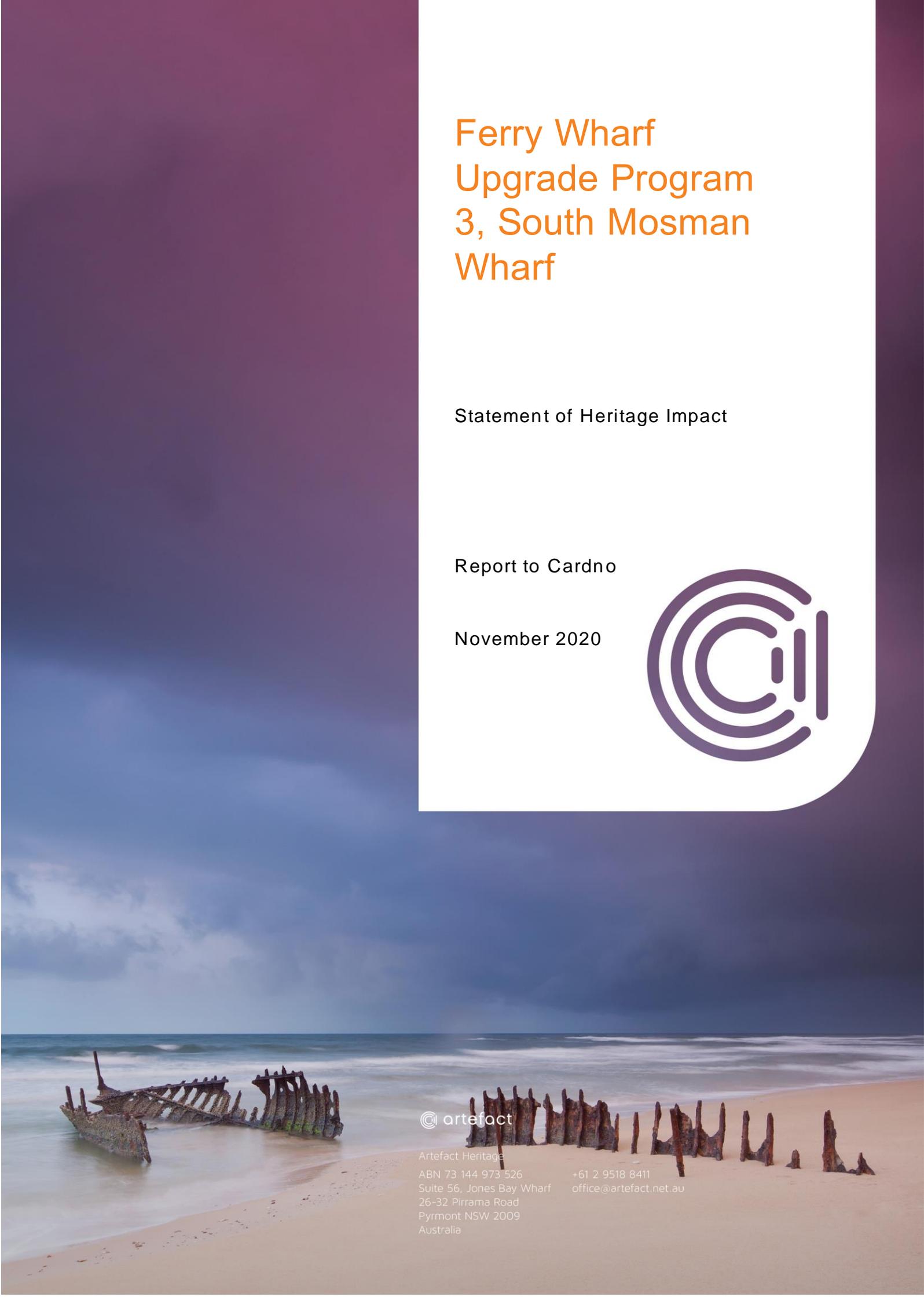
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## EXECUTIVE SUMMARY

Transport for New South Wales (Transport for NSW – formerly Roads and Maritime Services [Roads and Maritime]) is proposing to upgrade South Mosman Wharf as part of Ferry Wharf Upgrade Program 3 (FWUP3). FWUP3 is part of the Transport Access Program (TAP), aimed at providing a better experience for public transport customers by delivering accessible, modern, secure and integrated transport infrastructure. FWUP3 focusses on wharf interchanges within Sydney Harbour which do not currently provide equitable access to ferry services and as such do not meet the *Disability Standards for Accessible Public Transport 2002* (DSAPT) or *Disability Discrimination Act 1992* (DDA) requirements. Cardno, on behalf of Transport for NSW, is preparing a Review of Environmental Factors (REF) for each wharf upgrade.

Artefact Heritage have been engaged by Cardno, on behalf of Transport for NSW, to prepare a Statement of Heritage Impact (SoHI) to assess the potential impacts to listed heritage items and potential archaeological remains as a result of the proposed FWUP3 works at South Mosman Wharf. This report identified listed heritage items present within and in the vicinity of the proposal, provides a preliminary assessment of archaeological potential, assesses impacts to heritage items and potential archaeological remains, and provides recommendations, management strategies and mitigation measures.

### Conclusions

This SoHI has determined the following:

- The impacts associated with the proposed works are necessary to make South Mosman Wharf compliant with the requirements of the DDA
- The construction footprint is located within the curtilage of one heritage item listed on the Roads and Maritime Section 170 (s170) Heritage and Conservation Register and two heritage items listed on the Mosman Local Environmental Plan (LEP) 2012:
  - Musgrave Street Wharf site (State Heritage Inventory [SHI] no. 4920109 & LEP no. A491)
  - Divided road (LEP no. I411)
- The construction footprint is located adjacent to the curtilages of two heritage items listed on the Mosman LEP 2012:
  - Group of 2 houses, divided into 3 dwellings (LEP no. I183)
  - Herron Walk Steps (LEP no. I412)
- The visual buffer zone for the construction footprint also includes eight items listed on the North Sydney LEP 2013 and Mosman LEP 2012:
  - Chinese boatshed (Mosman LEP no. I182)
  - Sydney Amateur Sailing Club Building (North Sydney LEP no. I0103)
  - Site of Cremorne Smelter (North Sydney LEP no. I0102)
  - Old Cremorne Wharf (North Sydney LEP no. I0110)
  - Cremorne Reserve (including Robertson's Point) (North Sydney LEP no. I0136)
  - Balangowan (North Sydney LEP no. I0086)
  - Cremorne Point Conservation Area (North Sydney LEP no. CA06)
  - Lower Boyle St Conservation Area (Mosman LEP no. C13)

- A preliminary archaeological assessment has determined that the construction footprint has nil to low potential to contain locally significant archaeological remains associated with Phase 1 (1788-1873 Informal use and whaling allotments), and low to high potential to contain locally significant archaeological remains associated with Phase 2 (1873-1905 Richard Hayes Harnett development), including extant evidence of the original Musgrave Street Wharf seawall (high potential) and evidence of the earlier establishment of Musgrave Street (low potential). The extant archaeological remains of the original Musgrave Street Wharf seawall would not be directly impacted, however. The construction footprint also has moderate to high potential to contain non-significant reclamation fills associated with Phase 2, and low to high potential to contain non-significant evidence of the second Musgrave Street Wharf associated with Phase 3 (1905-1968 Second Musgrave Street Wharf). The archaeological remains would likely be limited to evidence of former 'works' and the construction footprint is unlikely to contain significant 'relics' as defined by the *NSW Heritage Act 1977* (Heritage Act)
- Based on the preliminary archaeological assessment, excavations associated with the proposal would result in negligible impacts to potential archaeological remains of local significance. The proposed excavations are unlikely to impact significant 'relics'
- The proposed works would not impact the overall significance of the heritage items within and adjacent to the construction footprint, or the heritage items within the visual buffer zone
- The impacts on the identified heritage items resulting from the proposed works are summarised in the table below.

Heritage item	Direct	Indirect (visual)	Potential direct	Archaeological
<b>Musgrave Street Wharf site</b>	Neutral	Negligible	Negligible	Negligible
<b>Divided road</b>	Negligible	Negligible	Negligible	Negligible
<b>Group of 2 houses, divided into 3 dwellings</b>	Neutral	Negligible	Negligible	Neutral
<b>Herron Walk Steps</b>	Neutral	Negligible	Negligible	Neutral
<b>Chinese boatshed</b>	Neutral	Neutral	Negligible	Neutral
<b>Cremorne Reserve (including Robertsons Point)</b>	Neutral	Negligible	Neutral	Neutral
<b>Sydney Amateur Sailing Club building</b>	Neutral	Negligible	Neutral	Neutral
<b>Cremorne Point Conservation Area</b>	Neutral	Negligible	Neutral	Neutral
<b>Site of Cremorne Smelter</b>	Neutral	Negligible	Neutral	Neutral
<b>Old Cremorne Wharf</b>	Neutral	Negligible	Neutral	Neutral
<b>Balangowan</b>	Neutral	Neutral	Neutral	Neutral

Heritage item	Direct	Indirect (visual)	Potential direct	Archaeological
Lower Boyle St Conservation Area	Neutral	Neutral	Neutral	Neutral

## Management and mitigation measures

The following mitigation measures should be enacted to minimise heritage impacts:

- The proposed works would not result in greater than minor impacts to any locally listed heritage item. As a result, the proposal is consistent with the general requirements for exempt development under Section 20 of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP). Therefore, consultation is not required with Mosman Municipal Council prior to any impacts occurring. However, a copy of this report should be submitted to Mosman Municipal Council for their reports
- A copy of this report would be submitted to Transport for NSW to inform them of the negligible impacts to Musgrave Street Wharf site which is listed on the Roads and Maritime s170 Heritage and Conservation Register (SHI no. 4920109)
- This SoHI has identified that there is currently no mapped curtilage available for Musgrave Street Wharf site (SHI no. 4920109). It is recommended that the s170 heritage curtilage be updated to be consistent with the current Mosman LEP 2012 curtilage for the heritage item (LEP no. A491), which was previously reassessed by Austral Archaeology (Austral) in 2015<sup>1</sup>
- In accordance with the sustainability requirements for the project, opportunities for implementation of heritage interpretation should be investigated during detailed design. It is recommended that a Heritage Interpretation Strategy be prepared for the proposal. This report would discuss various media for heritage interpretation appropriate to the location and heritage significance of the South Mosman Wharf. This would be consistent with the recommended management for Musgrave Street Wharf site (SHI no. 4920109) that is outlined in the SHI sheet for the Roads and Maritime s170 Heritage and Conservation listed item, which states that 'The wharf waiting shelter provides opportunities for interpretation of the history and significance of the wharf, the ferry system and other heritage elements within their visual catchment which should be explored and developed.'<sup>2</sup>
- As part of the preparation of the Heritage Interpretation Strategy the area around South Mosman Wharf, Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) and Divided road (LEP no. I411) should be photographed to help document the changes to the area and the development of the South Mosman Wharf

<sup>1</sup> Austral Archaeology, 2015. 'Assessment of Archaeological Sites, Mosman Local Environmental Plan Historical Archaeological Site Assessment'. Report prepared for Mosman Municipal Council.

<sup>2</sup> Heritage NSW, DPC, 2017. 'Musgrave Street Wharf Site.' SHI. Accessed online 15/10/2020 at: <https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=2060325>

- If feasible, the extant timber beams that are visible in the seawall and are associated with the second Musgrave Street Wharf and waiting room should be retained and re-use can be incorporated into the Heritage Interpretation Strategy
- The preliminary archaeological assessment has identified that there is low to high potential for archaeological remains of local significance associated with Phase 2 to be present within the construction footprint. However, as the area of high archaeological potential (extant remains of the Phase 2 original Musgrave Street Wharf seawall) is located outside of the proposal footprint and would not be directly impacted, it is unlikely significant archaeology would be impacted. The preliminary archaeological assessment has found that the potential archaeological remains would likely be limited to 'works'. As a result, an exception under Section 139 (4) of the Heritage Act would not be required for the proposed works and they would be managed under the Roads and Maritime Unexpected Heritage Item Procedure 2015
- If design changes result in additional excavations and impacts to significant archaeological remains associated with Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), further archaeological assessment and management would be required
- If unexpected 'relics' are encountered during excavation, a s146 relics notification would be forwarded to Heritage NSW, DPC. 'Relics' cannot be impacted without appropriate approvals under the Heritage Act
- If significant archaeological remains are encountered during excavation, design options for avoiding impacts to the significant archaeological remains should be considered where practicable and opportunities should be investigated for the implementation of heritage interpretation
- If archaeological 'works' such as evidence of earlier road constructions are encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts
- A heritage induction would be provided to workers prior to construction, informing them of the location and significance of known heritage items and the implementation of the Unexpected Heritage Item Procedure 2015 if unanticipated heritage items or deposits are located during construction. The heritage induction would include management of expected non-significant archaeological remains, such as minor artefactual material associated with Phase 2 reclamation fills
- It is unlikely that the vibrations associated with the proposed works would result in direct impacts to the original seawall and the retaining wall within the Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), the rock face of Divided road (LEP no. I411), the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183) or the Chinese boatshed (LEP no. I182). However, a structural engineer should assess this to confirm if there are potential risks of vibration impacts
- During the construction works, regular inspections of the construction activities and work areas should be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology and confirm the integrity of the seawall and retaining wall in Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), the rock face in Divided road

(LEP no. I411), the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183) and the Chinese boatshed (LEP no. I182). Assessment and monitoring of vibration impacts should adhere to:

- British Standard BS 7385: *Part 2: Evaluation and Measurement for Vibrations in Buildings – Part 2 Guide to Damage Levels from Ground-Borne Vibration*
- German Standard DIN 4150, *Part 3: Structural Vibration in Buildings: Effects on Structures*
- If vibration monitors are attached to the retaining wall in Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), the rock face in Divided road (LEP no. I411), the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183) or the Chinese boatshed (LEP no. I182), they must not be attached with permanent fixings. They should be removable without causing damage. Bees wax may be a suitable attachment method
- If it is identified that levels of vibration are causing damage to heritage fabric, works must cease, and the construction methodology reviewed by the project engineers in consultation with a Heritage Consultant in order to mitigate further impacts. A temporary protection plan to outline protection measures required for significant fabric during activities causing potential vibration impacts would be prepared prior to commencement of works
- All impacted areas and ground surfaces, including grassed surfaces adjacent to the wharf and the road surface of Musgrave Street, must be reinstated as near as possible to their original state following the completion of works
- It has been assessed that the proposed works would avoid archaeological remains of the original Musgrave Street Wharf and that potential maritime archaeological remains of the Phase 3 second Musgrave Street Wharf would not reach the threshold of local significance. As a result, a maritime archaeological assessment would not be required to assess the potential for impacts to maritime archaeological remains of the former wharves
- Any proposal redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to this SoHI.

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## 1.0 INTRODUCTION

### 1.1 Project Background

#### 1.1.1. Transport Access Program

The Transport Access Program (TAP) is a Transport for NSW initiative to provide a better experience for public transport customers by delivering accessible, modern, secure and integrated transport infrastructure.

#### 1.1.2. Ferry Wharf Upgrade Program

Transport for NSW (formerly Roads and Maritime Services [Roads and Maritime]) is the delivery agency for the upgrade of the Sydney ferry wharves within the TAP program (known as FWUP3). FWUP3 involves upgrades to seven wharves in Sydney Harbour, with South Mosman Wharf being one of those proposed to be upgraded.

The objectives of FWUP3 are:

- Achieve one hundred per cent compliance with the DSAPT for all assets, access paths and transport services within the wharf interchange
- Increase the rate at which passengers embark and disembark
- Make the wharf safer for passengers to embark and disembark
- Meet the current demand and enable future growth
- Enhance the efficiency of the interchange
- Improve passenger amenities and waiting areas
- Minimise construction impacts to customers and wharf operations
- Minimise the cost of ownership and maintenance
- Develop a functional, distinctive and iconic design theme that will unify and identify Sydney Harbour ferry wharves
- Discourage inappropriate activities at the wharves.

FWUP3 focusses on wharf interchanges which do not currently provide equitable access to ferry services, such as South Mosman Wharf, and as such do not meet the DSAPT or DDA requirements. Cardno, on behalf of Transport for NSW, is preparing a REF for each wharf upgrade.

Artefact Heritage have been engaged by Cardno, on behalf of Transport for NSW, to prepare a SoHI to assess the potential impacts to listed heritage items and potential archaeological remains as a result of the proposed works at South Mosman Wharf (the proposal). This report is aimed at identifying what listed heritage items are present within and in the vicinity of the proposal, providing a preliminary assessment of potential archaeological remains which could be present, identifying potential impacts to the heritage items and potential archaeological remains, and providing recommendations, management strategies and mitigation measures.

### 1.2 Project location

For the purposes of the REF, and this SoHI, the construction footprint of the South Mosman Wharf has been defined as the construction area around the project footprint which includes the site

compound and barge locations in the water around the existing wharf. The project footprint has been defined as the physical footprint of the proposed works.

The construction footprint includes South Mosman Wharf, located at the south end of Musgrave Street, within the suburb of Mosman. Part of Musgrave Street is also within the construction footprint. The construction footprint is located on the south-east side of Curraghbeena Point and within Lot 1100 of DP 752067 and Lot 1 of DP 725239. The construction footprint is situated within Mosman Bay and is surrounded by nineteenth and twentieth century residential development. The construction footprint is located within the Mosman Municipal Council Local Government Area (Mosman LGA), within the Country of Cumberland and the Parish of Willoughby.

In addition to the construction footprint, a visual buffer zone including the surrounding area between Mosman Bay, Sirius Cove, and part of Sydney Harbour has been assessed for visual impacts associated with the proposed FWUP3 works at South Mosman Wharf. The extent of the visual buffer zone has been based on a visibility analysis prepared by Cardno for the proposal (refer to Section 1.4.3).

The location of the project footprint is illustrated in Figure 1 and Figure 2, and the visual buffer zone assessed in this SoHI is illustrated in Figure 3.

### 1.3 The proposal

The proposal is to upgrade the South Mosman Wharf as part of the TAP.

The water-based features of the proposal would include:

- Installation of a new covered 18.9m gangway, located to the north of the existing wharf to provide access to the new pontoon
- Installation of a new covered steel 9m by 22.5m pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- Removal of the existing gangway and pontoon including existing piles
- Remediation of the seawall following removal of the existing wharf, if required.

The land-based features of the proposal would include:

- Installation of a new 16m high lift and new covered stairs
- Installation of a new covered street level waiting area
- Installation of a covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- Installation of three bicycle parking hoops
- Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

The construction footprint and key features of the proposal are illustrated in Figure 2.

## 1.4 Report methodology and limitations

This SoHI has been prepared in accordance with the guidelines outlined by the Heritage Office, now Heritage NSW, Department of Premier and Cabinet (Heritage NSW, DPC), and Department of Urban Affairs & Planning in the document *Statements of Heritage Impact* as part of the *NSW Heritage Manual*.<sup>3</sup> This SoHI has been prepared in accordance with the principles contained in the most recent edition of *The Burra Charter: The Australian ICOMOS Charter for Places of Cultural Significance*.

### 1.4.1 NSW heritage significance assessment

Determining the significance of heritage items or a potential archaeological resource is undertaken by utilising a system of assessment centred on the *Burra Charter* of Australia International Council on Monuments and Sites (ICOMOS).

The principles of the charter are relevant to the assessment, conservation and management of sites and relics. The assessment of heritage significance is outlined through legislation in the Heritage Act and implemented through the *NSW Heritage Manual* and the *Archaeological Assessment Guidelines*.<sup>4</sup> The criteria specified by the guidelines encompass the four values identified in the *Burra Charter*, historical significance, aesthetic significance, scientific significance and social significance, and also consider representativeness and rarity values.

If an item meets one of the seven heritage criteria, and retains the integrity of its key attributes, it can be considered to have heritage significance. The significance of an item or potential archaeological site can then be assessed as being of local or state significance. If a potential archaeological resource does not reach the local or state significance threshold, then it is not classified under the Heritage Act.

*'State heritage significance'* in relation to a place, building, work, relic, moveable object or precinct, means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.

*'Local heritage significance'* in relation to a place, building, work, relic, moveable object or precinct, means significance to an area in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.<sup>5</sup>

The overall aim of assessing archaeological significance is to identify whether an archaeological resource, deposit, site or feature is of cultural value. The assessment will result in a succinct statement of heritage significance that summarises the values of the place, site, resource, deposit or feature. The heritage significance assessment criteria are described in Table 1 below.

<sup>3</sup> Heritage Office (now Heritage NSW, DPC) and Department of Urban Affairs & Planning, 1996 revised 2002. *Statements of Heritage Impact. NSW Heritage Manual*. Accessed online 4/5/2020 at: <https://www.environment.nsw.gov.au/Heritage/publications/index.htm>.

<sup>4</sup> NSW Heritage Council, "Archaeological Assessment Guidelines," in *NSW Heritage Manual* (New South Wales: Heritage Office, 1996).

<sup>5</sup> This section is an extract based on the Heritage Office *Assessing Significance for Historical Archaeological Sites and Relics* 2009, 6.



 **artefact** **Construction footprint**  
20035 Seven Wharves Upgrade - South Mosman  
LGA: Mosman

Scale: 1:1000  
Size: A4  
Date: 12-09-2020

0 20 40 m



Figure 1: Location of the construction footprint



Figure 2: Proposal footprint and construction footprint



Source: C:\Users\SHawkins\Documents\20035 Seven Wharves\South Mosman Wharf\Seven Wharves South Mosman Mapping.ggz

 **Construction footprint and visual buffer zone** Scale: 1:9000  
20035 Seven Wharves Upgrade - South Mosman Size: A4  
LGA: Mosman Date: 12-09-2020

0 180 360 m 

Figure 3: Location of the construction footprint and the wider visual buffer zone

**Table 1: NSW heritage significance assessment criteria**

Criterion	Explanation
<b>A – Historical Significance</b>	An item is important in the course, or pattern, of NSW’s cultural or natural history (or the cultural or natural history of the local area)
<b>B – Associative Significance</b>	An item has a strong or special association with the life or works of a person, or group of persons, of importance in NSW’s cultural or natural history (or the cultural or natural history of the local area)
<b>C – Aesthetic Significance</b>	An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or in the local area)
<b>D – Social Significance</b>	An item has a strong or special association with a particular community or cultural group in NSW (or local area) for social, cultural or spiritual reasons
<b>E – Research Potential</b>	An item has the potential to yield information that will contribute to an understanding of NSW’s cultural or natural history (or cultural or natural history of the local area)
<b>F – Rarity</b>	An item possesses uncommon, rare or endangered aspects of NSW’s cultural or natural history (or the cultural or natural history of the local area)
<b>G – Representative</b>	An item is important in demonstrating the principal characteristics of a class of NSW’s cultural or natural places; or cultural or natural environments (or a class of the local area’s cultural or natural places; or cultural or natural environments)

#### 1.4.2 Assessment of heritage impact

This SoHI has been prepared using the document *Statement of Heritage Impact 2002*, contained within the *NSW Heritage Manual*, as a guideline.

Impacts on heritage are identified as either:

- Direct impacts, resulting in the demolition or alteration of fabric of heritage significance
- Potential direct impact, resulting in impacts from vibration and demolition of adjoining structures
- Indirect impacts, resulting in changes to the setting or curtilage of heritage items or places, historic streetscapes or views.

Specific terminology and corresponding definitions are used in this assessment to consistently identify the magnitude of the proposal’s direct, indirect or potentially direct impacts on heritage items or archaeological remains. The terminology and definitions are based on those contained in guidelines produced by ICOMOS and are shown in Table 2.<sup>6</sup> It is assumed that all direct and potential direct impacts are a result of construction. Indirect impacts are assumed to be operational unless specified as temporary in which case they are related to construction.

<sup>6</sup> Including the document *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties*, ICOMOS, January 2011.

**Table 2: Terminology for assessing the magnitude of heritage impact**

Magnitude	Definition
<b>Major</b>	<p>Actions that would have a long-term and substantial impact on the significance of a heritage item. Actions that would remove key historic building elements, key historic landscape features, or significant archaeological materials, thereby resulting in a change of historic character, or altering of a historical resource.</p> <p>These actions cannot be fully mitigated</p>
<b>Moderate</b>	<p>This would include actions involving the modification of a heritage, including altering the setting of a heritage item or landscape, partially removing archaeological resources, or the alteration of significant elements of fabric from historic structures.</p> <p>The impacts arising from such actions may be able to be partially mitigated</p>
<b>Minor</b>	<p>Actions that would results in the slight alteration of heritage buildings, archaeological resources, or the setting of an historical item.</p> <p>The impacts arising from such actions can usually be mitigated</p>
<b>Negligible</b>	<p>Actions that would results in very minor changes to heritage items</p>
<b>Neutral</b>	<p>Actions that would have no heritage impact</p>

### 1.4.3 Assessment of visual and potential direct impacts

Heritage items that are located within one kilometre of the construction footprint have been assessed for potential visual impacts. Cardno have prepared a *Landscape Character and Visual Impact Assessment (LCVIA)* for the proposal as part of the REF.<sup>7</sup> As part of this, a visibility analysis has been undertaken and sightlines to and from the construction footprint have been established in order to assess the visual impacts associated with the proposal. This SoHI utilises the visibility analysis prepared by Cardno to assess visual impact on heritage items within the one-kilometre visual buffer zone. Both the views *towards* heritage items (whether the proposal would impair views of the item's significant visual characteristics) and views *away* from the items (whether the proposal would impair views of the heritage-significant surroundings or character of the items) have been assessed.

The visual buffer zone assessed in this SoHI is illustrated in Figure 2, and the visibility analysis undertaken by Cardno that the buffer zone is based on is illustrated in Figure 4.

The following grading, which has been informed by the LCVIA, has been used in this SoHI for identifying the location of heritage items in relation to the visual buffer zone:<sup>8</sup>

- Foreground zone (FZ): Heritage items within 200m of the construction footprint
- Middle ground zone (MZ): Heritage items within 200 – 500m of the construction footprint
- Background zone (BZ): Heritage items more than 500m from the construction footprint.

<sup>7</sup> Cardno, 'Landscape Character and Visual Impact Assessment: South Mosman Wharf Upgrade'. Draft. Report to Transport for NSW, 2020.

<sup>8</sup> Cardno, 'Landscape Character and Visual Impact Assessment: South Mosman Wharf Upgrade.'



Figure 4: Visibility analysis prepared by Cardno. Source: Cardno 2020

In order to assess potential direct impacts, the guidelines provided in the 2016 Roads and Maritime *Construction Noise and Vibration Guideline* are followed.<sup>9</sup> The strategy provides recommendations on the minimum safe working distances from heritage items when utilising vibration intensive plant in order to avoid cosmetic damage. These recommended minimum working distances are provided in Table 3 below.

**Table 3: Recommended minimum working distances from vibration intensive plant<sup>10</sup>**

Plant item	Rating / Description	Minimum working distance		
		Cosmetic damage (BS 7385) Light-framed structures	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human response (EPA's Vibration guideline)
Vibratory Roller	< 50kN (Typically 1-2 tonnes)	5m	14m	15m to 20m
	< 100kN (Typically 2-4 tonnes)	6m	16m	20m
	< 200kN (Typically 4-6 tonnes)	12m	33m	40m
	< 300kN (Typically 7-13 tonnes)	15m	41m	100m
	> 300kN (Typically 13-18 tonnes)	20m	54m	100m
	> 300kN (> 18 tonnes)	25m	68m	100m
Small Hydraulic Hammer	(300kg - 5 to 12t excavator)	2m	5m	7m
Medium Hydraulic Hammer	(900kg – 12 to 18t excavator)	7m	19m	23m
Large Hydraulic Hammer	(1600kg – 18 to 34t excavator)	22m	60m	73m
Vibratory Pile Driver	Sheet piles	20m	50m	100m
Pile Boring	≤ 800mm	2m (nominal)	40m	4m
Jackhammer	Hand held	1m (nominal)	2m	2m

For the purposes of this SoHI a conservative approach to vibration levels is followed based on the use of the largest plant items causing the most amount of vibration: >18t vibratory rollers. An indicative minimum working distance of 68m is recommended for >18t vibratory rollers. As a result, it is assumed that any heritage item within at least 68m of the construction footprint, would potentially be subject to vibrational impacts as a result of the proposal. It is assumed that any heritage items located more than 75m from the edge of the construction footprint would likely be located at a sufficient distance that vibrations resulting from the proposed works would not cause structural damage.

<sup>9</sup> Roads and Maritime, 'Construction Noise and Vibration Guideline'. Roads and Maritime, 2016. 71.

<sup>10</sup> Roads and Maritime, 'Construction Noise and Vibration Guideline'.

#### 1.4.4 Non-Aboriginal archaeological assessment

A preliminary archaeological assessment has been undertaken for this SoHI. Non-Aboriginal archaeological potential is defined as the potential of a site to contain significant archaeological remains, including works or relics as identified in the Heritage Act. The assessment of non-Aboriginal archaeological potential is based on the identification of former land uses and evaluating whether subsequent actions (either natural or human) may have impacted on archaeological evidence for these former land uses. Knowledge of previous archaeological investigations, understanding of the types of archaeological remains likely to be associated with various land uses, and the results of site inspection are also taken into consideration when evaluating the potential of an area to contain archaeological remains.

The potential for the survival of archaeological remains in a particular place is significantly affected by activities which may have caused ground disturbance. These processes include the physical development of the site (for example, phases of building construction) and the activities that occurred there. The likelihood for the survival of these remains (i.e. their archaeological potential) is distinct from the 'archaeological significance' and 'archaeological research potential of these remains', should any exist. These designations refer to the cultural value of potential archaeological remains and are the primary basis of the recommended management actions included in this document. For example, there may be 'low potential' for certain remains to survive, but if they do, they may be assessed as being of State significance.

The *NSW Heritage Manual* provides the framework used for the significance assessment of the potential archaeological remains within the construction footprint. These guidelines incorporate the aspects of cultural heritage value identified in the *Burra Charter*. The Heritage Council also issued the 1996 *Archaeological Assessment Guidelines*<sup>11</sup> and the Heritage Branch (now Heritage NSW, DPC) issued the 2009 *Assessing Significance for Historical Archaeological Sites and 'Relics'*.<sup>12</sup> The assessment of historical archaeological sites requires a specialised framework in order to consider the range of values of an archaeological site.

The grades of archaeological potential used in this report are outlined in Table 4 below.

**Table 4: Grades of archaeological potential**

Grading	Justification
<b>Nil</b>	No evidence of historical development or use, or where previous impacts such as deep basement structures would have removed all archaeological potential
<b>Low</b>	Research indicates little or low intensity historical development, or where there have been substantial previous impacts, disturbance and truncation in locations where some archaeological remains such as deep subsurface features may survive
<b>Moderate</b>	Analysis demonstrates known historical development and some previous impacts, but it is likely that archaeological remains survive with some localised truncation and disturbance
<b>High</b>	Evidence of multiple phases of historical development and structures with minimal or localised twentieth century development impacts, and it is likely the archaeological resource would be largely intact.

<sup>11</sup> NSW Heritage Council, "Archaeological Assessment Guidelines".

<sup>12</sup> NSW Heritage Branch, *Assessing Significance for Historical Archaeological Sites and 'Relics'*.

#### 1.4.5 Limitations

This SoHI provides a preliminary assessment of potential non-Aboriginal archaeology only. This SoHI does not provide an assessment for Aboriginal heritage.

This SoHI includes an assessment of the visual impacts on heritage items within one kilometre of the construction footprint which have views to and from the construction footprint. While it is possible that additional heritage items outside of the visual assessment area illustrated in Figure 4 would potentially be within sightlines of the new development, it is expected that these items are located at a sufficient distance from the construction footprint that the proposal would not result in visual impacts to these heritage items under normal circumstances. As a result, heritage items located outside of the one-kilometre visual assessment area have not been included in this SoHI.

#### 1.5 Authorship

This report was prepared by Sarah Hawkins (Heritage Consultant) and Jayden van Beek (Senior Heritage Consultant) with management input and review by Josh Symons (Technical Director) and Sandra Wallace (Managing Director).

## 2.0 STATUTORY CONTEXT

### 2.1 Introduction

There are several items of State and Commonwealth legislation that are relevant to the current study. A summary of these Acts and the potential legislative implications follow.

Heritage listed items within and directly adjacent to the construction footprint were identified through a search of the relevant state and federal statutory and non-statutory heritage registers discussed below including:

- World Heritage List (WHL)
- Commonwealth Heritage List (CHL)
- National Heritage List (NHL)
- Australasian Underwater Cultural Heritage Database (AUCHD)
- State Heritage Register (SHR)
- Section 170 Heritage and Conservation Registers
- Shipwreck Register
- Mosman Local Environmental Plan (LEP) 2012
- North Sydney LEP 2013
- NSW State Heritage Inventory (SHI) Database
- Register of the National Estate (RNE)
- Register of the National Trust of Australia (NSW) (RNTA).

Items listed on these registers have been previously assessed against the NSW heritage assessment guidelines. Statements of heritage significance, based on the NSW Heritage Assessment guidelines, as they appear in relevant heritage inventory sheets and documents, are provided in this assessment.

### 2.2 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legislative framework for the protection and management of matters of national environmental significance, that is, flora, fauna, ecological communities and heritage places of national and international importance. Heritage items are protected through their inscription on the WHL, NHL, or the CHL.

The EPBC Act stipulates that a person who has proposed an action that will or is likely to have; a significant impact on a World, National or Commonwealth heritage site must refer the action to the Minister for the Environment (hereafter the Minister). The Minister would then determine if the action requires approval under the EPBC Act. If approval is required, an environmental assessment would need to be prepared. The Minister would approve or decline the action based on this assessment.

**There are no items within or in the immediate vicinity of the construction footprint listed on the WHL, NHL, or CHL. There are no items within the visual buffer zone listed on the WHL, NHL, or CHL.**

## 2.3 Underwater Cultural Heritage Act 2018

The *Underwater Cultural Heritage Act 2018* (UCH Act) provides for the protection of Australia's underwater cultural heritage. The objects of the UCH Act include:

- To provide for the identification, protection and conservation of Australia's underwater cultural heritage
- To enable the cooperative implementation of national and international maritime heritage responsibilities
- To promote awareness, understanding, appreciation and appropriate use of Australia's underwater cultural heritage.

It is aligned with the UNESCO 2001 *Convention on the Protection of the Underwater Cultural Heritage* and identifies a standard for the assessment and management of underwater cultural heritage in Australia.

Under the UCH Act, different articles of underwater cultural heritage are, or can be, protected, depending on the nature of the article, its significance and location. The remains of vessels situated in Australian waters for at least 75 years are afforded automatic protection under the UCH Act. Australian waters extend from State waters to the outer limit of Australia's continental shelf.

The remains of aircraft and certain associated articles that have been in Commonwealth waters for at least 75 years are also afforded automatic protection under the UCH Act. Commonwealth waters extend:

- a. From the waters three nautical miles seaward of the baseline of the territorial seas that are adjacent to the States and Northern Territory
- b. To the outer limit of Australia's continental shelf.

Other articles of underwater cultural heritage can be protected if the Minister is satisfied that the articles are significant. Such articles may be in Commonwealth waters, Australian waters or in waters beyond Australian waters, depending on the kind of article concerned. Some articles are, or can be protected, even if they have been removed from those waters. If an article is removed from waters after it becomes protected, that protection applies to the article regardless of its location.

Certain conduct is prohibited under the UCH Act without a permit, including:

- Conduct that would or is likely to adversely impact the site
- Possessing the article
- Supplying, or offering to supply, the article
- Importing or exporting the article.

Further, the Minister can declare an area containing protected underwater cultural heritage to be a protected zone, if the area is within Australian waters and the declaration would be consistent with the objects of the UCH Act. The declaration may regulate or prohibit the kinds of activities that can be carried out in the protected zone.

### 2.3.1 Australasian Underwater Cultural Heritage Database

The UCH Act requires the Minister to maintain a register in relation to underwater cultural heritage. The AUCHD contains information about the shipwrecks, submerged aircraft and other underwater cultural heritage in the Oceania and Southeast Asian regions. It also includes information about artefacts or articles associated with specific entries.

**There are no items within or in the immediate vicinity of the construction footprint listed on the UCH. There are no items within the visual buffer zone listed on the UCH.**

## 2.4 NSW Heritage Act 1977

The NSW *Heritage Act 1977* (Heritage Act) is the primary piece of legislation affording protection to heritage items (natural and cultural) in NSW. Under the Heritage Act, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant. Significance is based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items can be listed on the NSW SHR and are given automatic protection under the Heritage Act against any activities that may damage an item or affect its heritage significance. The Heritage Act also protects 'relics', which can include archaeological material, features and deposits.

Under the Heritage Act, all government agencies are required to identify, conserve and management heritage items in their ownership or control. Section 170 of the Act requires all government agencies to maintain a Heritage and Conservation Register that lists all heritage assets and an assessment of the significance of each asset. They must also ensure that all items inscribed on its list are maintained with due diligence in accordance with State Owned Management Principles approved by the Government on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of items and are based on NSW heritage legislation and guidelines.

### 2.4.1 Relics Provisions

The Heritage Act also provides protection for 'relics', which includes archaeological material or deposits. According to Section 139 (Division 9: Section 139, 140-146):

- (1) A person must not disturb or excavate any land knowingly or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, damaged or destroyed unless the disturbance is carried out in accordance with an excavation permit.
- (2) A person must not disturb or excavate any land on which the person has discovered or exposed a relic except in accordance with an excavation permit.
- (3) This section does not apply to a relic that is subject to an interim heritage order made by the Minister or a listing on the State Heritage Register.
- (4) The Heritage Council may by order published in the Gazette create exceptions to this section, either unconditionally or subject to conditions, in respect of any of the following:
  - (a) Any relic of a specified kind or description
  - (b) Any disturbance of excavation of a specified kind or description
  - (c) Any disturbance or excavation of land in a specified location or having specified features or attributes,

- (d) Any disturbance or excavation of land in respect of which an archaeological assessment approved by the Heritage Council indicates that there is little likelihood of there being any relics in the land.

Section 4(1) of the Heritage Act (as amended in 2009) defines a relic as:

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*...Any deposit, artefact, object or material evidence that relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and is of State or local heritage significance.*

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A relic has been further defined as:

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*Relevant case law and the general principles of statutory interpretation strongly indicate that a 'relic' is properly regarded as an object or chattel. A relic can, in some circumstances, become part of the land be regarded as a fixture (a chattel that becomes permanently affixed to land).<sup>13</sup>*

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Excavation permits are issued by the Heritage Council of NSW, or its delegate, under Section 140 of the Heritage Act for relics outside SHR curtilages or under Section 60 for significant archaeology within SHR curtilages. An application for an excavation permit must be supported by an Archaeological Research Design and Archaeological Assessment prepared in accordance with the NSW Heritage Division archaeological guidelines. Minor works that will have a minimal impact on archaeological relics may be granted an exception under Section 139 (4) or an exemption under Section 57 (2) of the Heritage Act.

## 2.4.2 Works

The Heritage Act defines 'works' as being in a separate category to archaeological 'relics'. 'Works' refer to remnants of historical structures which are not associated with artefactual material that may possess research value. 'Works' may be buried, and therefore archaeological in nature, however, exposure of a 'work' does not require approved archaeological excavation permits under the Act.

The following examples of remnant structures have been considered to be 'works' by the NSW Heritage Council:

- Former road surfaces or pavement and kerbing
- Evidence of former drainage infrastructure, where there are no historical artefacts in association with the item.
- Building footings associated with former infrastructure facilities, where there are no historical artefacts in association with the item.
- Evidence of former rail track, sleepers or ballast
- Evidence of former rail platforms and former platform copings

Where buried remnants of historical structures are located in association with historical artefacts in controlled stratigraphic contexts (such as intact historic glass, ceramic or bone artefacts), which have

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<sup>13</sup> Heritage Branch and Department of Planning 2009. *Assessing Significance for Archaeological Sites and 'Relics'*, p. 7.

the potential to inform research questions regarding the history of a site, the above items may not be characterised as 'works' and may be considered to be 'relics'. The classification of archaeological remains as a 'work' therefore is contingent on the predicted remains being associated with historical structures as well as there being no prediction of the recovery of intact artefactual deposits which may be of research interest.

### 2.4.3 The State Heritage Register

The SHR was established under Section 22 of the Heritage Act and is a list of places and objects of particular importance to the people of NSW, including archaeological sites. The SHR is administered by the Heritage NSW, DPC and includes a diverse range of over 1,500 items, in both private and public ownership. To be listed, an item must be deemed to be of heritage significance for the whole of NSW.

To carry out activities within the curtilage of an item listed on the SHR, approval must be gained from the Heritage Council by securing a Section 60 permit. In some circumstances, under Section 57(2) of the Heritage Act, a Section 60 permit may not be required if works are undertaken in accordance with the Heritage Council document *Standard Exemptions for Works Requiring Heritage Council Approval*<sup>14</sup> or in accordance with agency specific exemptions.<sup>15</sup> This includes works that are only minor in nature and will have minimal impact on the heritage significance of the place.

**There are no items within or in the vicinity of the construction footprint listed on the SHR. There are no items within the visual buffer zone listed on the SHR.**

### 2.4.1 Shipwrecks and the Register for Shipwrecks

Part 3C of the Heritage Act relates to the protection of shipwrecks within State waters. In NSW, a shipwreck situated within the State waters for 75 years or more, or the subject of a protection order, is identified on the NSW Register for Shipwrecks and is protected under the Heritage Act. The protection afforded under the Act also extends to articles associated with a shipwreck including articles that formed part of, or had been installed on, or carried in, the ship, or constructed or used by a person associated with the ship.

Part 3C of the Heritage Act applies to shipwrecks and associated articles within State waters that are not the subject of an Interim Heritage Order or included, or within an area included, on the SHR. Under the Heritage Act, it is an offence to 'move, damage or destroy' a shipwreck in NSW unless in accordance with a permit.

The Shipwreck Register now forms part of the NSW Maritime Heritage Database (a register of a diverse range of over 2800 shipwrecks, relics and other underwater and maritime cultural heritage).

**There are no items within or in the immediate vicinity of the construction footprint listed on the Shipwreck Register. There are no items within the visual buffer zone listed on the Shipwreck Register.**

### 2.4.2 Section 170 Registers

Under the Heritage Act all government agencies are required to identify, conserve and manage heritage items in their ownership or control. Section 170 (s170) requires all government agencies to maintain a Heritage and Conservation Register that lists all heritage assets and an assessment of the

<sup>14</sup> Heritage Council of New South Wales, 2009. *Standard Exemptions for Works Requiring Heritage Council Approval*.

<sup>15</sup> Heritage Council, 2009. *Standard Exemptions for Works Requiring Heritage Council Approval*,

significance of each asset. They must also ensure that all items inscribed on its list are maintained with due diligence in accordance with State Owned Heritage Management Principles approved by the Government on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of items and are based on NSW heritage legislation and guidelines.

**There is one item within the construction footprint and visual buffer zone listed on s170 heritage and conservation registers:**

- Musgrave Street Wharf site (Roads and Maritime s170 Heritage and Conservation Register SHI no. 4920109).

It is the understanding of Artefact Heritage that a mapped heritage curtilage is not available for the Roads and Maritime s170 listed Musgrave Street Wharf site (SHI no. 4920109). As a result, a curtilage for the site is not included in Figure 5. Further details on the listing are discussed in Section 5.2.3.

## 2.5 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A) establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that environmental impacts are considered prior to land development; this includes impacts on cultural heritage items and places as well as archaeological sites and deposits. The Proposal is subject to assessment under Part 5 of the EP&A Act.

The EP&A Act also requires that local governments prepare planning instruments (such as LEPs and Development Control Plans [DCPs]) in accordance with the EP&A Act to provide guidance on the level of environmental assessment required. The construction footprint falls within the boundaries of the Mosman LGA. Schedule 5 of the Mosman LEP 2012 includes a list of items/sites of heritage significance within the Mosman LGA.

### 2.5.1 Mosman Local Environmental Plan 2012

Heritage items listed on the Mosman LEP 2012 are managed in accordance with the provisions of Section 5.10 Heritage Conservation of this LEP. Under Clause 5 of this section of Mosman LEP 2012:

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1) **Objectives** *The objectives of this clause are as follows—*

(a) *to conserve the environmental heritage of Mosman,*

(b) *to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views,*

(c) *to conserve archaeological sites,*

(d) *to conserve Aboriginal objects and Aboriginal places of heritage significance.*

2) **Requirement for consent** *Development consent is required for any of the following—*

(a) *demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance)—*

*(i) a heritage item,*

*(ii) an Aboriginal object,*

*(iii) a building, work, relic or tree within a heritage conservation area,*

*(c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed,*

*(e) erecting a building on land—*

*(i) on which a heritage item is located or that is within a heritage conservation area*

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**There are four heritage items and heritage conservation areas listed on the Mosman LEP 2012 that are located within or in the immediate vicinity of the construction footprint:**

- Musgrave Street Wharf (remains and sea wall) (LEP no. A491)
- Divided road (LEP no. I411)
- Herron Walk Steps (LEP no. I412)
- Group of 2 houses, divided into 3 dwelling (LEP no. I183)

There is one heritage conservation area listed on the Mosman LEP 2012 within the visual buffer zone and seven heritage items and heritage conservation areas listed on the North Sydney LEP 2013 (Table 4).

### 2.5.2 Development Control Plan

The Mosman DCP 2012 is a supporting document that compliments the provisions contained within the Mosman LEP 2012 and provides specific design detail in regard to sympathetic development on, or in the vicinity of, items listed on Schedule 5 of the Mosman LEP 2012.

Part D of the DCP 2012 provides sympathetic considerations for development in the vicinity of a heritage listed item. These considerations include ensuring that the character, bulk, scale and height of new development does not unreasonably overshadow a nearby heritage item, that colouring and texture of new materials of a new development is sympathetic to a heritage item, and that views of a heritage item should not be obscured from the point of view of areas of public domain.

## 2.6 State Environmental Planning Policy (Infrastructure) 2007

In 2007, the ISEPP was introduced to streamline the development of infrastructure projects delivered by state agencies, including Transport for NSW. Generally, where there is conflict between the provisions of the ISEPP and other environmental planning instruments, the ISEPP prevails. Under the ISEPP, development for the purpose of wharves or wharf infrastructure facilities may be carried out by a public authority without consent on any land. The ISEPP overrides the controls included in the LEPs and DCPs, and Transport for NSW is required to consult with the relevant local councils only when development:

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*is likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage item, in a way that is more than minor or inconsequential.<sup>16</sup>*

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When this is the case, the proponent must not carry out such development until it has:

- Had an assessment of the impact prepared
- Given written notice of the intention to carry out the development, with a copy of the assessment, to the council for the area in which the heritage item or heritage conservation area (or the relevant part of such an area) is located
- Taken into consideration any response to the notice that is received from the council within 21 days after the notice is given.

## 2.7 Non-statutory heritage registers

In addition to the heritage registers established by State and Commonwealth legislation, there are a number of relevant non-statutory registers which should be considered. The following registers were searched:

- Register of the National Trust of Australia (NSW) (RNTA)
- Register of the National Estate (RNE).

The RNE lists historic, Aboriginal and natural heritage places throughout Australia. Originally established under the *Australian Heritage Commission Act 1975*, the RNE entered more than 13,000 places into the register. The RNE was frozen on 19 February 2007 following amendments to the *Australian Heritage Council Act 2003*. It ceased to be a statutory register in February 2012. The RNE is now maintained on a non-statutory basis as an archive and education resource.

**There are no non-statutory items within or in the immediate vicinity of the construction footprint listed on the RNTA or RNE.**

## 2.8 Heritage registers search

A search of all relevant registers was undertaken on 15 September 2020. The results are displayed below in Table 5. A map of the curtilages of the relevant heritage items is provided in Figure 5 and Figure 6.

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<sup>16</sup> ISEPP Clause 14. Accessed 12 May 2020. [http://www7.austlii.edu.au/cgi-bin/viewdoc/au/legis/nsw/consol\\_reg/sepp2007541/s14.html](http://www7.austlii.edu.au/cgi-bin/viewdoc/au/legis/nsw/consol_reg/sepp2007541/s14.html).

**Table 5: Heritage listed items within the construction footprint and the visual buffer zone**

Item	Address	Significance	Listing	Distance from construction footprint
Musgrave Street Wharf site	Musgrave Street	Local	Roads and Maritime s170 Heritage and Conservation Register (SHI no. 4920109) Mosman LEP 2012 no. A491	Within
Divided road	Musgrave Street	Local	Mosman LEP 2012 no. I411	Within
Group of 2 houses, divided into 3 dwellings	9A-11 Musgrave Street	Local	Mosman LEP 2012 no. I183	Adjacent
Herron Walk Steps	Musgrave Street and Raglan Street	Local	Mosman LEP 2012 no. I412	Adjacent
Chinese boatshed	3 Musgrave Street	Local	Mosman LEP 2012 no. I182	Visual buffer zone (50m south-east)
Cremorne Reserve (including Robertsons Point)	N/A	Local	North Sydney LEP no. I0136	Visual buffer zone (200m west)
Sydney Amateur Sailing Club building	Green Street	Local	North Sydney LEP no. I0103	Visual buffer zone (200m north-west)
Cremorne Point Conservation Area	N/A	Local	North Sydney LEP no. CA06	Visual buffer zone (200m west)
Site of Cremorne Smelter	East of 5 Green Street	Local	North Sydney LEP no. I0102	Visual buffer zone (220m south-west)
Old Cremorne Wharf	Kareela Road, foreshore of Mosman Bay	Local	North Sydney LEP no. I0110	Visual buffer zone (300m north-west)
Balangowan	5 Bromley Avenue	Local	North Sydney LEP no. I0086	Visual buffer zone (620m north-west)
Lower Boyle St Conservation Area	Lower Boyle Street	Local	Mosman LEP no. C13	Visual buffer zone (620m north-west)



Document Path: D:\GIS\GIS\_Mapping\20035\_Seven\_Wharves\_Upgrades\South Mosman\MXD\20035\_Heritage\_Items\_20200921.mxd

Figure 5: Heritage listings within and in close proximity to the construction footprint



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Figure 6: Heritage items within the visual buffer zone

## 3.0 HISTORICAL CONTEXT

### 3.1 Early European settlement in Mosman

#### 3.1.1 Early settlement in Mosman

Shortly after settlement at Port Jackson, exploration of Sydney's North Shore began with early expeditions to Manly, through Middle Harbour, and to North Sydney. Farming had been attempted at nearby Balmoral throughout the 1820s and early 1830s, however, government services, transportation and communication were all limited.

The first major land grant in the area was given to Archibald Mosman, a Scottish free-migrant who became a businessman upon arriving to Sydney.<sup>17</sup> He established a warehouse on George Street and received a land grant in Sirius Cove in 1831. Mosman built 'The Nest' at Sirius Cove in 1832, and he planned to turn Sirius Cove into a centre for the whaling industry in Sydney. He established a firm and by 1835 was in the ownership of two whaling ships, the 'Jane' and the 'Tigress'.<sup>18</sup> In 1838 Mosman purchased an additional 100 acres in the area. The Nest, his own home, also included an orchard and vineyard. Simultaneously Mosman's whaling business was run by Hughes & Hosking who paid annual sums to Mosman. In 1844 however, the company, and Mosman, had gone bankrupt.

Additional land grants in the area were granted as a whaling allotment scheme, while other grants were purchased by relatively well to do colonists who constructed bush retreat villas.<sup>19</sup> The area gradually became popular for recreational excursions, particularly around Mosman Falls at the northern point of Mosman Bay. Semi-permanent camping grounds also developed around the area, including at Curlew Camp on the eastern side of Little Sirius Cove.

The defence of Sydney Harbour was considered a priority of the colonial government from the mid-nineteenth century, and several gun batteries were established at Bradleys Head, Middle Head, and Georges Head throughout the 1870s.<sup>20</sup> The military development and subsequent employment around Mosman encouraged the growth of the suburb. In the late nineteenth century a town grew around the former whaling station location as several services were opened, including a post office, schools, churches, retail stores and commercial premises.<sup>21</sup>

##### 3.1.1.1 Whaling

In the early-nineteenth century the whaling industry employed thousands in Sydney, with hundreds of colonial ships operating in the trade around Australia.<sup>22</sup> Prior to 1800 about one third of convict transportation and store ships sent from Britain to Sydney were repurposed whaling ships, many of which arrived in the colony and commenced whaling from Sydney.<sup>23</sup> The industry was prominent across much of the Southern Hemisphere, with earlier ports in Peru frequently used by the British. Following the outbreak of the British War with Spain in 1797, Sydney became an increasingly popular whaling base. The new maritime industry was heavily encouraged by Governor Phillip, who had

<sup>17</sup> Stephen, M.D., 1967. 'Mosman, Archibald (1799-1863)'. *Australian Dictionary of Biography*. Accessed online 14/9/2020 at: <http://adb.anu.edu.au/biography/mosman-archibald-2485>.

<sup>18</sup> Stephen, M.D., 1967. 'Mosman, Archibald (1799-1863)'. *Australian Dictionary of Biography*.

<sup>19</sup> Mosman Municipal Council, n.d. 'A Brief History of Mosman.' *Mosman Council*. Accessed online 14/9/2020 at: <https://mosman.nsw.gov.au/mosman/history/a-brief-history-of-mosman>.

<sup>20</sup> Mosman Municipal Council, n.d. 'A Brief History of Mosman.' *Mosman Council*.

<sup>21</sup> Mosman Municipal Council, n.d. 'A Brief History of Mosman.' *Mosman Council*.

<sup>22</sup> Howard, M., 2011. 'Sydney's whaling fleet.' *Dictionary of Sydney*. Accessed online 1/4/2020 at: [https://dictionaryofsydney.org/entry/sydneys\\_whaling\\_fleet](https://dictionaryofsydney.org/entry/sydneys_whaling_fleet).

<sup>23</sup> Howard, M., 2011. 'Sydney's whaling fleet.' *Dictionary of Sydney*. Accessed online 1/4/2020 at: [https://dictionaryofsydney.org/entry/sydneys\\_whaling\\_fleet](https://dictionaryofsydney.org/entry/sydneys_whaling_fleet).

begun his maritime career on a whaling ship and saw the immediate financial benefit to the new colony.<sup>24</sup>

From 1832 Mosman developed a whaling station in Mosman Bay using convict labour.<sup>25</sup> A 180m long wharf was constructed, in addition to two storerooms and dwellings for ship crews and officers. The station served as a location for ships to bring back oil for transportation, and the bay also became a shipyard for repairing ships following months at sea.<sup>26</sup>

Additional land grants were allotted for free in Mosman in exchange for the construction of stores and wharves, many of which were granted along Curraghbeena Point in the 1840s. Originally, the peninsula was surveyed into eleven whaling allotments which were sold. The construction footprint formed part of Allotment 11, which was a one-acre parcel which was purchased by Francis Mitchell in 1842. Mitchell was a merchant and ship owner. There is no evidence to suggest Mitchell built on the land.

### 3.1.1.2 Richard Hayes Harnett and subdivision of South Mosman

Richard Harnett was an Irish settler from Cork, who arrived in Melbourne in May 1840.<sup>27</sup> He then travelled to Sydney and after struggling to find employment, worked in Maitland as a cattle trader until 1845. Upon arriving back in Sydney, he lived at Blues Point working for the Row and McNab & Company importers.<sup>28</sup> In 1859 Harnett purchased much of Archibald Mosman's land, including his home 'The Nest'. Harnett accumulated ownership of much of the land between Mosman Bay and Sirius Cove and sought to subdivide the land in the mid-nineteenth century. He was also influential in the subdivision of several other North Shore estates in the Chatswood, Neutral Bay and Willoughby areas.<sup>29</sup> Prior to Harnett's involvement in real estate and speculation in the area, the region was primarily owned and dominated by Mosman, Henry Stuart Russell and James King, who owned much of the land around Mosman Bay, including waterfront lots.<sup>30</sup> Throughout the mid-nineteenth century the Mosman area became recognised in Sydney as a picturesque recreation spot, particularly around Balmoral Gardens, and the town developed a civic centre with schools, churches, library and other municipal and commercial buildings.<sup>31</sup> Harnett himself attempted to capitalise on the growing popularity of the area as 'pleasure gardens' by creating a picnic resort near the Mosman waterfalls, however this never eventuated due to insolvencies.<sup>32</sup>

Harnett engaged the surveyor W. M. Brownrigg to survey his Mosman land holdings (Figure 7 and Figure 8). Many roads in Mosman were developed at this time, including Musgrave Street in the mid-1870s. This was occurring as Military Road, the primary arterial road in the area from North Sydney to Manly, was being formalised. While Harnett organised a ferry service to the point to encourage land sales, much of his subdivision remained unsold. At the same time as he was arranging for the subdivision of his land, Harnett provided public support for the construction of a tram line and the rail line in the North Shore, largely to promote the successful sale of his land.<sup>33</sup> The lots which were sold at the time saw the construction of large Victorian houses, such as 'Duncraggin' on McLeod Street, which was built by W. E. Wilson in 1877 (Figure 9). However, the lack of transport saw the land sales progress slowly. By the end of the 1880s however, where the newfound presence of the ferry network

<sup>24</sup> Howard, M., 2011. 'Sydney's whaling fleet.' *Dictionary of Sydney*. Accessed online 1/4/2020 at: [https://dictionaryofsydney.org/entry/sydneys\\_whaling\\_fleet](https://dictionaryofsydney.org/entry/sydneys_whaling_fleet).

<sup>25</sup> Newton, J., 2012. *A Savage History: Whaling in the Pacific and Southern Oceans*, 87.

<sup>26</sup> Newton, J., 2012. *A Savage History: Whaling in the Pacific and Southern Oceans*, 87.

<sup>27</sup> Willoughby District Historical Society and Museum, n.d. 'Harnett, Richard Hayes Snr (1819-1902).' *Historical Willoughby*. Accessed online 14/9/2020 at: <https://abc17603.wordpress.com/history/people/harnett/>.

<sup>28</sup> Willoughby District Historical Society and Museum, n.d. 'Harnett, Richard Hays Snr (1819-1902).' *Historical Willoughby*.

<sup>29</sup> Willoughby District Historical Society and Museum, n.d.

<sup>30</sup> Otto Cserhalmi and Partners, 2008. *Boronia & surrounds, Mosman, Conservation Management Plan*, 17.

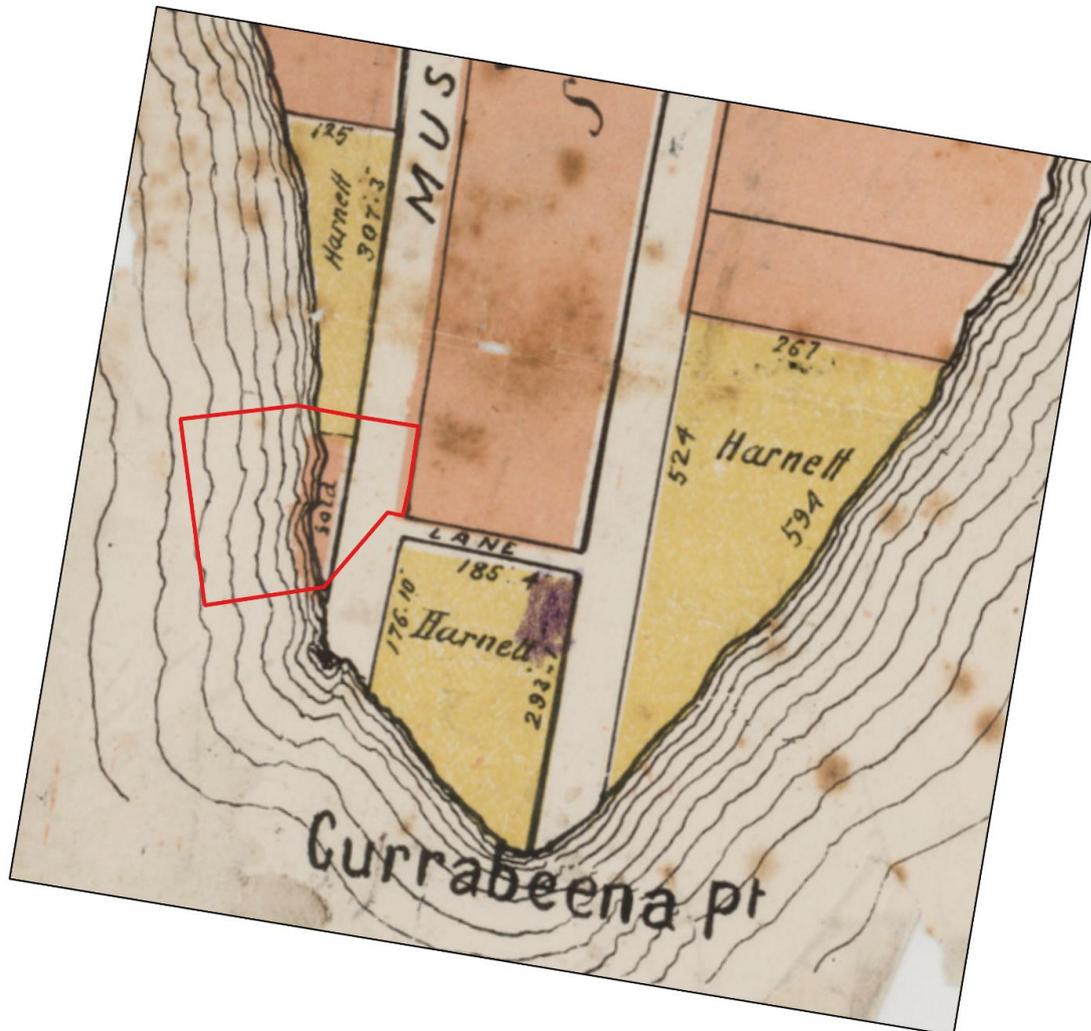
<sup>31</sup> Otto Cserhalmi and Partners, 2008. *Boronia & surrounds, Mosman, Conservation Management Plan*, 17.

<sup>32</sup> Otto Cserhalmi and Partners, 2008. *Boronia & surrounds, Mosman, Conservation Management Plan*, 17.

<sup>33</sup> Willoughby District Historical Society and Museum, n.d.

and the North Shore rail line provided a more substantial and reliable public transport network, the land had been successfully sold.<sup>34</sup>

At the south-eastern corner of Musgrave Street, the Harnett family constructed 'Clifford', their own estate which was still owned by the Harnett family in 1905. Part of the land may have been quarried to create a level site for building.



**Figure 7: South Mosman Subdivision Plan, dated 1894, with the location of the construction footprint marked in red Source: State Library of NSW (SLNSW)<sup>35</sup>**

<sup>34</sup> Otto Cserhalmi and Partners, 2008, 20.

<sup>35</sup> Creator Unknown, 1894. *Mosman Heights no. 2. – Great Military Road, Rangers Rd, Harrison St, Bennett St, Bertha St, Claude Ave, Powel St, Murdock St, Florence St, Reed St, Shadler St, Spofforth St, Bannerman St, Boyle St, Orlando Ave, Royalist Rd, Reginald St, Briarly St, Norris St, Lower Avenue Rd, Musgrave St, Mosman Ave, Raglan St, Illawarra St, Lennox St, Simpson St, Mulner St, Cowles Rd, Price Albert St, Shadforth St, Somerset St, Sverge St, Violet St, Clanalpine St, Mistral St, Magic St, Calypso Ave, Queen St.* State Library of New South Wales. Call No. Z/SP/M26 IE9038580 FL9038586. Accessed online 4/9/2020 at: [http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?dps\\_pid=IE9038580&change\\_lng=](http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?dps_pid=IE9038580&change_lng=)

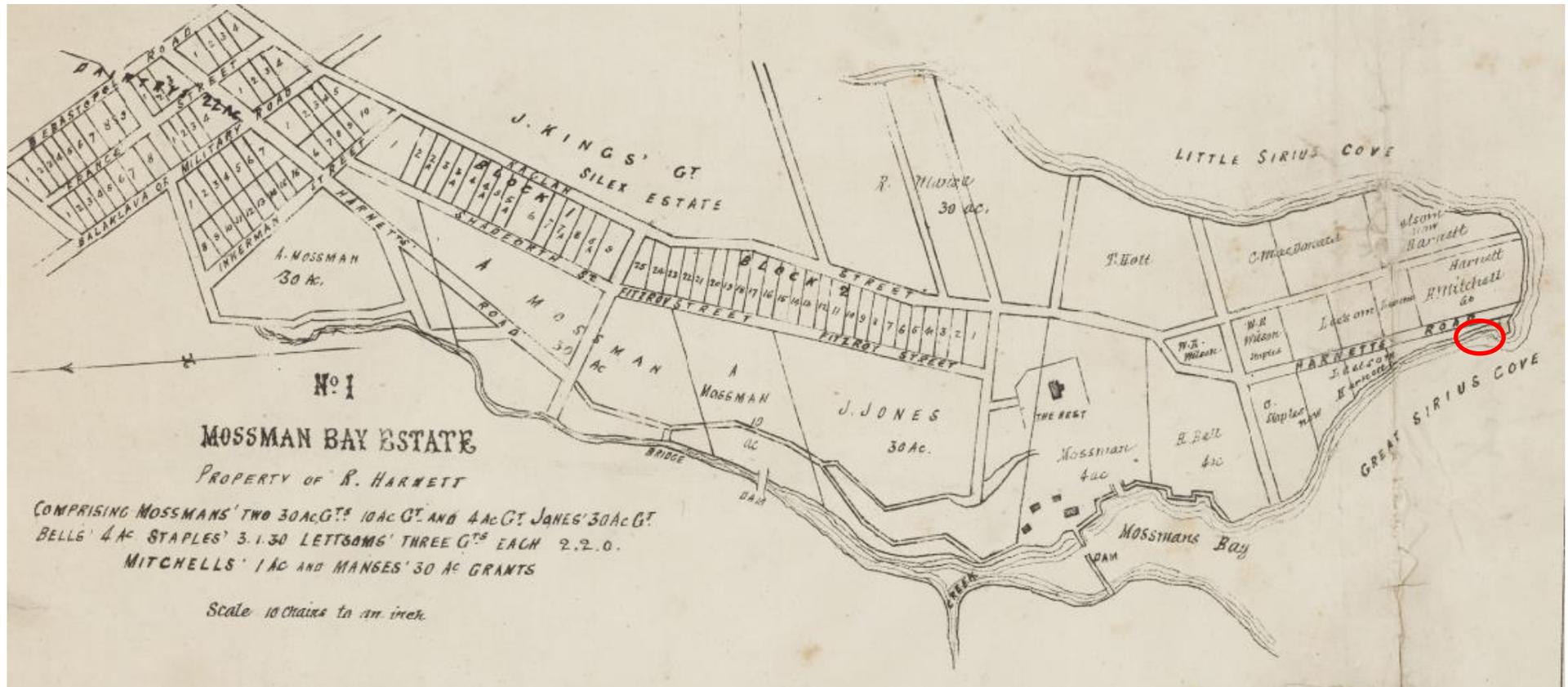


Figure 8: Subdivision plan of Mossman Bay Estate, dated c.1859, but is likely later on account of formation of Musgrave Street/Harnett Road. The indicative location of the construction footprint is marked in red. Source: SLNSW<sup>36</sup>

<sup>36</sup> Subdivision Plans of the North Shore, Sydney, Approximately 1859, 1859, 1859, IE3764469 FL3764478, State Library of New South Wales, [http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps\\_pid=IE3764469&\\_ga=2.255715272.1906594067.1585549174-706910494.1581896604](http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE3764469&_ga=2.255715272.1906594067.1585549174-706910494.1581896604).



**Figure 9: Subdivision of the area around South Mosman wharf, showing early housing estates, with the indicative location of the construction footprint marked in red**

### 3.1.1.3 Musgrave Street

Musgrave Street was formed by Richard Hayes Harnett in 1876 during subdivision of his Mosman land holdings. Originally referred to as Harnett's Road, as seen on early subdivision plans such as Figure 8, the road was constructed as a connection from Raglan Street (now Curraghbeena Road) and likely followed the original topography initially. While this is not indicated on any available plans, early photographs and aerial images attest to the road originally being constructed in a divided form to match the existing topography. In 1884 it was gazetted as a public road, finished with red iron stone gravel.<sup>37</sup> At this time the road did not feature footpaths, kerbs, or gutters, according to a 1920 description of Mosman local Arthur Marshall. Musgrave Street continued to the shoreline of the peninsula, adjacent to the Clifford homestead, until the 1970s. In 1976 the end of Musgrave Street was dedicated as a public highway, purchased by the Maritime Services Board.

<sup>37</sup> Austral Archaeology, 2008. *Former Musgrave Street Wharf, Mosman NSW Archaeological Assessment & Statement of Heritage Impact*. Report prepared for Mosman Municipal Council.

## 3.2 The North Shore ferries

### 3.2.1 Sydney ferries

The harbour has been a crucial part of Sydney's lifestyle, transportation and industry for much of its non-Aboriginal history. Prior to non-Aboriginal colonisation, the Eora people of various groups around Sydney Harbour and the Parramatta River utilised the harbour for transportation and food supply. From the arrival of the First Fleet at Port Jackson/Sydney Cove (now Circular Quay) in 1788, non-Aboriginal exploration occurred via ships through the Harbour, which was a major influence in location of new settlements. As early as 1789 the convict built ship the 'Rose Hill Packet' provided a ferry service along the Parramatta River between the major settlements at Sydney Cove and Parramatta (Rose Hill at the time).<sup>38</sup> As early as the 1820s both the North and South Heads of the Harbour were recognised as important military locations, with the original Macquarie Lighthouse and associated barracks established at South Head by 1818. Early industry was concentrated around the Harbour and dominated by maritime trades. The need for workers to be in close proximity to the harbour led to the development of major historic suburbs near dockyards at Millers Point, Pyrmont and Balmain. It is estimated that until the 1880s, approximately 80% of Sydney's population lived within walking distance of the harbour.<sup>39</sup>

In 1861 the North Shore Ferry Company was established and operated the first commuter-style ferry across the harbour.<sup>40</sup> At the time there were less than 1000 people living in the North Sydney area, however ferry was the only available transportation method at the time. As the Harbour Bridge had not been constructed, rail or vehicular transportation was not available. The establishment of the ferry service contributed to the growth of the North Shore suburbs including Manly, which grew from a population of 500 in 1871 to 8000 by 1901.<sup>41</sup> Early ferries on the harbour were purpose built steam paddlers (Figure 10), many of which were constructed at Morts Dock in Balmain in the early twentieth century.<sup>42</sup>

The popularity of the route and the growth of the North Shore region resulted in several competitors starting business, including Sydney Ferries Limited and the Port Jackson and Manly Steamship Company. The busiest route was Circular Quay to Milsons Point, where at either end passengers could change onto trams or trains.<sup>43</sup>

Following the construction of the Sydney Harbour Bridge, which opened in 1932, ferry patronage dropped significantly (Figure 11). The bridge and the train network allowed faster travel and prevented the need for multiple modes of transport. Ferry services were overall halved.<sup>44</sup> Vehicular ferries had also been common throughout the early twentieth century, however, these services were entirely eradicated following the opening of the harbour Bridge.<sup>45</sup> In the late nineteenth and early twentieth centuries ferries had been constructed locally, however as the costs of local construction increased and were no longer financially viable, subsequent ferries were constructed in Scotland.<sup>46</sup>

<sup>38</sup> Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*. Accessed online 31/3/2020 at: <https://dictionaryofsydney.org/entry/ferries>.

<sup>39</sup> Karskens, G., 2014. 'Harbour life: tracing early Sydney's watery history.' *The Conversation*. Accessed online 31/3/2020 at: <http://theconversation.com/harbour-life-tracing-early-sydneys-watery-history-21892>.

<sup>40</sup> Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

<sup>41</sup> Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

<sup>42</sup> Australian National Maritime Museum, 2018. 'The Manly Ferry.' Accessed online 1/4/2020 at: <http://arhv.anmm.gov.au/en/collections/details/34289/the-manly-ferry>.

<sup>43</sup> Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

<sup>44</sup> Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

<sup>45</sup> Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

<sup>46</sup> Australian National Maritime Museum, 2018. 'The Manly Ferry.'

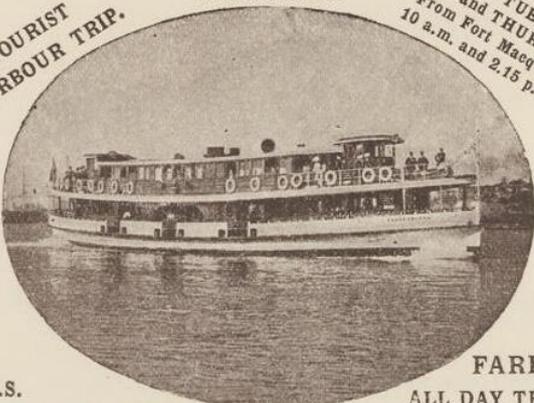
Following financial hardship among private ferry operators in the mid-twentieth century, many of the ferry services were acquired by the State Government in 1951. In the 1980s several new ferries were constructed at Newcastle, reopening the local shipbuilding industry. The 1980s ferries – many of which remain a frequent sight on the Harbour – included the Freshwater, Narrabeen, Queenscliff and Collaroy, double storey designs which reflected the design of the ‘golden era’ ferries.

**SYDNEY FERRIES (LIMITED).**

**Regular Service of High-class Steamers from Nos. 1, 4, 5, & 6 Jetties,**

[See also page 42.]

Every **TUESDAY**  
and **THURSDAY**  
From Fort Macquarie  
10 a.m. and 2.15 p.m.



**FARES :**

**ALL DAY TRIP—**  
Adults, 2/- ; Children, 1/-

**AFTERNOON TRIP—**  
Adults, 1/- ; Children, -/6

**LUNCHEON EXTRA—**  
Adults, 1/6 ; Children, 1/-

**CIRCULAR QUAY, SYDNEY,**  
FOR  
**PARRAMATTA RIVER,**  
**NORTH SYDNEY,**  
**LAVENDER BAY,**  
**NEUTRAL BAY,**  
**CREMORNE,**  
**MOSMAN'S BAY,**  
**ATHOL GARDENS,**  
**CLIFTON GARDENS,**  
**BALMORAL BEACH,**  
**THE SPIT,**  
**MIDDLE HARBOUR.**

Unequaled  
Picturesque Scenery  
and Holiday Resorts.

FOR PARTICULARS, SEE TIME-TABLES.  
TELEPHONE 98 & 794 CENTRAL.

**TOURIST  
HARBOUR TRIP.**

**S.S.**  
Kookooburra covering about  
60 miles of Harbour Scenery.  
Do not MISS this trip when  
in Sydney!

12

Figure 10: Sydney Ferries advertisement, c.1890s, including travel to Mosman's Bay. Source: National Library of Australia<sup>47</sup>

<sup>47</sup> The Bureau, "Sydney Ferries (Limited) Regular Service of High-Class Steamers from Nos. 1, 4, 5 & 6 Jetties," *Trips around Sydney, New South Wales*, 1909, National Library of Australia.



Figure 11: Ferry on Sydney Harbour during construction of the Sydney Harbour Bridge, 1928.  
Source: City of Sydney Archives

### 3.2.2 South Mosman Wharf

#### 3.2.2.1 The first wharf

In 1873 Richard Harnett Senior, a local landowner and property developer, constructed the first ferry wharf at the end of Musgrave Street. Harnett owned 490 acres of land in Mosman, which we had purchased in the 1860s and 1870s to subdivide. As Mosman was isolated from Sydney at the time without a ferry, major roads, or train line, Harnett petitioned for the construction of a ferry (as well as providing public support for tram and rail networks), largely to enable the sale of his land.<sup>48</sup> Eventually Harnett took it upon himself to construct the wharf and arranged the ferry service, which served as a second stop for the Mosman Bay wharf. The Mosman Bay wharf was operated by the North Shore Ferry Company, with a rival company and wharf operated nearby by Charles Jeanerette.<sup>49</sup> As Jeanerette's wharf was located close to land and roads owned by Harnett, Harnett established a fence and gate across Lower Avenue Road (a private road owned by Harnett), and charged Jeanerette's ferry passengers a shilling to cross. This resulted in Jeanerette's wharf suffering financially and being purchased by the North Shore Ferry Company.<sup>50</sup>

The first Musgrave Street wharf was constructed at the southern end of Musgrave Street and built of piles with timber planking (Figure 12). A sandstone seawall was also constructed, and the wharf was accessed via a stairway from Raglan Street.<sup>51</sup> While there are no detailed plans of the first wharf, one subdivision plan illustrates the wharf coming out to the west from the very southern point of Musgrave Street. Musgrave Street originally stopped short of the wharf site, however, it was extended to reach the wharf in 1876.<sup>52</sup> The original structure of the wharf and its access from Raglan Street was painted by the influential Australian impressionist painter Arthur Streeton. Streeton created two paintings of the Musgrave Street Wharf in the 1890s, one which illustrates the wharf accessed by the narrow staircase from Raglan Street (Figure 13), and the second accessed from Musgrave Street (Figure 14).

In 1880 a small timber waiting room was constructed on the wharf, which is pictured in one photograph dated to c.1890 (Figure 15) but may be earlier, as the surrounding land is uncleared. The photograph shows the timber waiting shed as a small weatherboard structure with cladded horizontal baseboards at the lower half of the shed, and a corrugated iron roof and awning. The wharf itself is timber and three-tiered, with the central level accessed off the early dirt and gravel surface of Musgrave Street. Musgrave Street also features what appears to be a formal footpath along the western edge with a timber fence, and a drain channel along the east side of the road. The surrounding area has been uncleared of vegetation and few houses are evident in the background of the photograph. Figure 15 and Figure 16 show that the first wharf was located within the (approximate) 45-degree angle return within the stone seawall at the southern end of Musgrave Street.

It appears that this first wharf was used intermittently at first, however, by 1893 it was part of the regular ferry service between Mosman and Circular Quay.<sup>53</sup> These early services may have been associated with recreational weekend trips to the nearby picnic and camping grounds around Mosman waterfall and Curlew Camp, however, they had become more regular and served commuters by the turn of the century.<sup>54</sup> The photograph of the first wharf perpetuates the idea that the wharf was used for recreational trips, as the people within the photograph are dressed in what would likely be considered their best clothing for the time. In 1892 the first wharf was closed and ceased operations entirely in 1905, however, it likely was not demolished for some time after. Portions of the

<sup>48</sup> Willoughby District Historical Society & Museum, n.d.

<sup>49</sup> Otto Cserhalmi & Partners 2008, 19.

<sup>50</sup> Otto Cserhalmi & Partners 2008, 19.

<sup>51</sup> Heritage NSW, DPC, 2017. 'Musgrave Street Wharf Site'.

<sup>52</sup> Heritage NSW, DPC, 2017. 'Musgrave Street Wharf Site'.

<sup>53</sup> Heritage NSW, DPC, 2017. 'Musgrave Street Wharf Site'.

<sup>54</sup> Otto Cserhalmi & Partners 2008, 19; Heritage NSW, DPC 2017.

first wharf remain partially visible today (particularly at low tide), including the surrounding seawall and some timber piling fragments. By the time the wharf was closed it had become highly dilapidated, with the waiting room declared as a “disgrace to Mosman”.<sup>55</sup>

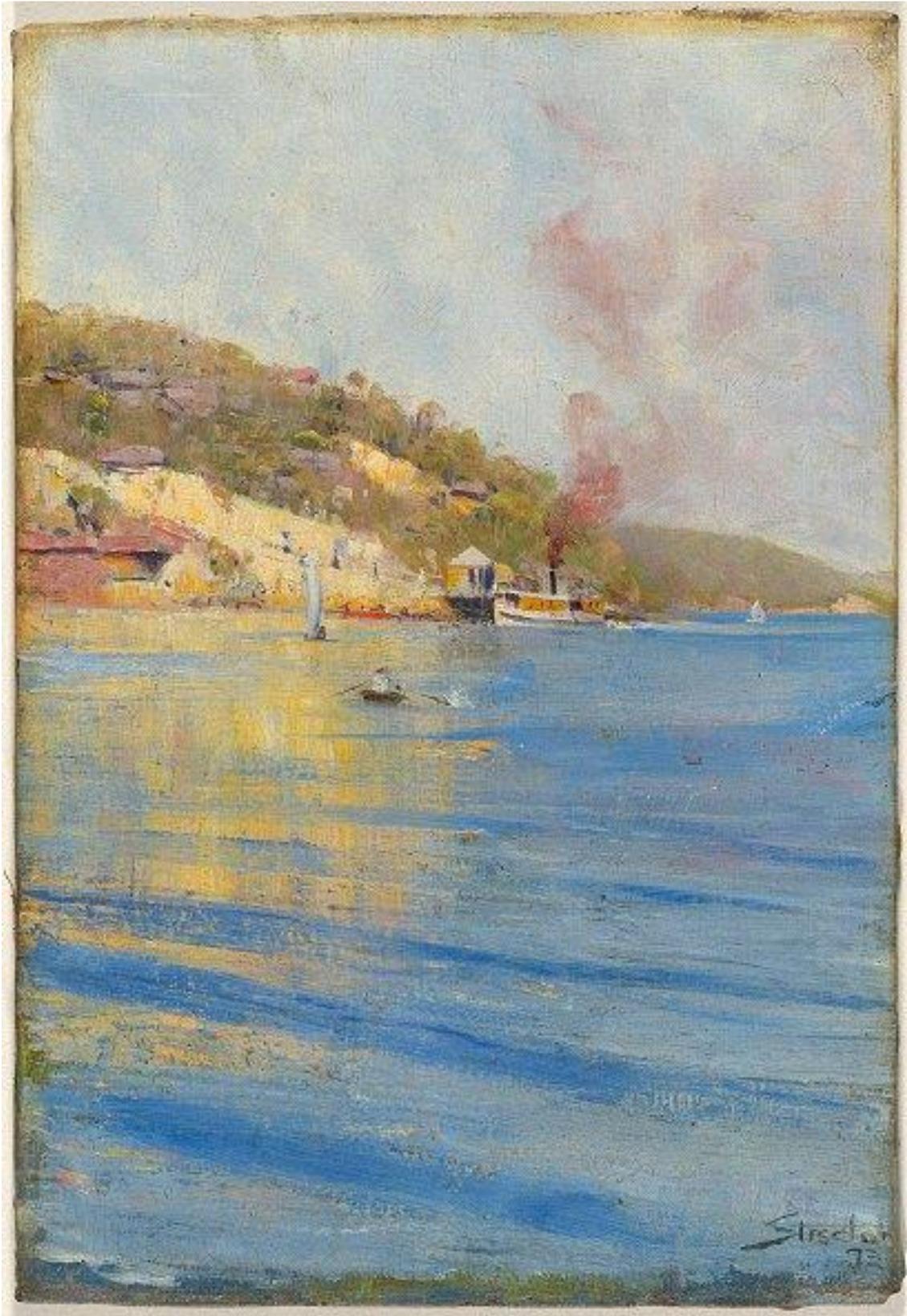


Figure 12: Location of the first wharf on subdivision plan of South Mosman, dated c.1859 but likely later. Source: SLNSW<sup>56</sup>

<sup>55</sup> *Evening News*, 14 Sep 1898. ‘Brevities.’ Accessed online 14/9/2020 at:

<https://trove.nla.gov.au/newspaper/article/113256464?searchTerm=%22musgrave%20street%20wharf%22>

<sup>56</sup> Subdivision Plans of the North Shore, Sydney, Approximately 1859, IE3764469 FL3764478, SLNSW, [http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps\\_pid=IE3764469&\\_ga=2.255715272.1906594067.1585549174-706910494.1581896604](http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE3764469&_ga=2.255715272.1906594067.1585549174-706910494.1581896604).



**Figure 13: The Point Wharf, Mosman's Bay, by Arthur Streeton, 1893. Source: National Gallery of Australia<sup>57</sup>**

<sup>57</sup> Streeton, A., 1893. *The Point Wharf, Mosman's Bay*. National Gallery of Australia. NGA 2017.210. Accessed online 14/9/2020 at: <https://artsearch.nga.gov.au/detail.cfm?irn=309484>



**Figure 14: Musgrave Street Wharf, painted by Arthur Streeton, 1895. Source: New England Regional Art Museum<sup>58</sup>**

<sup>58</sup> Streeton, A., 1895. *Musgrave Street Wharf*. New England Regional Art Museum. 1933\_27. Accessed online 14/9/2020 at: <https://ehive.com/collections/5568/objects/484467/musgrave-street-wharf>



Figure 15: Musgrave Street Wharf, Mosman, c.1890. Source: NSW State Archives<sup>59</sup>



Figure 16: Remains of the first Musgrave Street Wharf and wall, n.d. Source: Heritage NSW, DPC<sup>60</sup>

<sup>59</sup> Creator Unknown, c.1900. *Musgrave St wharf, Mosman*. NSW State Archives and Records. NRS-9856-2 [Glass Neg Box1410]-Glass Neg Box 1410-2. Accessed online 14/9/2020 at: [https://records-primo.hosted.exlibrisgroup.com/primo-explore/fulldisplay?docid=ADLIB\\_RNSW113581193&context=L&vid=61SRA&lang=en\\_US&search\\_scope=Everything&adaptor=Local%20Search%20Engine&tab=default\\_tab&query=any,contains,9856\\_a017\\_A017000173&offset=0](https://records-primo.hosted.exlibrisgroup.com/primo-explore/fulldisplay?docid=ADLIB_RNSW113581193&context=L&vid=61SRA&lang=en_US&search_scope=Everything&adaptor=Local%20Search%20Engine&tab=default_tab&query=any,contains,9856_a017_A017000173&offset=0)

<sup>60</sup> Creator Unknown, n.d. *Site of original 1870's Musgrave Street Wharf remains, Musgrave Street, Mosman*. Heritage NSW. Accessed online 14/9/2020 at: <https://apps.environment.nsw.gov.au/dpcheritageapp/HeritageItemImage.aspx?ID=2060325#ad-image-0>

### 3.2.2.2 The second wharf

A new wharf was constructed about 100m north of the first Musgrave Street Wharf, located on reclaimed land. The reclamation had been carried out by the North Shore Steam Ferry Co. in 1894 and appears to have involved expansion to the west from the natural sandstone escarpment/cliff face along Musgrave Street. The second wharf was opened in 1905 and comprised a wharf that was larger and more formalised than the first. The construction of the wharf involved a large retaining wall,<sup>61</sup> a new pontoon and waiting room, and increased services through Mosman to accommodate the passengers at the new Musgrave Street Wharf.<sup>62</sup> Additional beautification works occurred, including the planting of climbing vegetation along the sandstone escarpment.<sup>63</sup> By 1907 however, it was reported that Sydney Ferries were vacating the Musgrave Street Wharf for operation by another company.<sup>64</sup>

Early photographs also show a weatherboard waiting room with a (potentially Marseille tile) tiled roof, situated on the reclaimed land constructed adjacent to the sandstone escarpment of Musgrave Street. This building appears in photographs dating to c.1910 (Figure 18) and c.1912 (Figure 19) and it appears that the waiting room was a small, enclosed timber shelter (Figure 20). A newspaper article from 1911 lamented the 'inadequate' shelter of the current awning, which was not large enough to provide shelter to the large numbers of passengers that used the wharf.<sup>65</sup> Newspaper advertisements from 1914 included requests for tenders for the waiting room at the Musgrave Street Wharf, likely for the expansion and improvements of the early structure.<sup>66</sup>

The early stairs to the wharf from Musgrave Street were constructed of timber and aligned directly west to the wharf. The 1910 photograph also shows iron gas lamps on the wharf (Figure 18). Additional photographs from the 1910s show the reclaimed land area surrounded by white timber fencing, and that the staircase down from Musgrave Street was constructed on a retaining wall. The area to the north of the waiting room appears to still retain the natural slope of the sandstone topography. The wharf is clearly constructed on a series of timber piles, including some in close proximity to the sandstone seawall.

The timber staircase leading from Musgrave Street was reported as 'winding and narrow', resulting in many problems for passengers attempting to board the ferries.<sup>67</sup> The end of Musgrave Street, which formed part of a local bus network, often became congested and the traffic combined with the narrow staircase resulted in large numbers of passengers missing the ferry or causing delays throughout the network.<sup>68</sup> To resolve the issue of congestion from terminating buses, Mosman Council embarked on the widening of Musgrave Street, which included the excavation and removal of over 2000 cubic yards of natural stone.<sup>69</sup>

The waiting room building may have been modified in the 1920s, with a 1929 photograph showing the building with what appears to be windows and a new roof (Figure 20). This photograph clearly shows

<sup>61</sup> *The Australian Star*, 28 Jun 1905. 'Mosman Council.' Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/231844244>.

<sup>62</sup> *Evening News*, 2 Feb 1906. 'Shipping.' Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/114231855>.

<sup>63</sup> *The Mosman Mail*, 17 Jun 1905. 'Mosman Ferry Service.' Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/247010619>.

<sup>64</sup> *Mosman, Neutral and Middle Harbour Resident*, 13 July 1907. 'Mosman Council.' Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/252193586>.

<sup>65</sup> *The Sun*, 8 November 1911. 'Musgrave-Street Wharf.' Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/221533555>.

<sup>66</sup> *The Sydney Morning Herald*, 4 August 1914. 'Tenders'. Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/15527363>.

<sup>67</sup> *The Sun*, 23 January 1924. 'Musgrave Street Wharf.' Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/224566690>.

<sup>68</sup> *The Sun*, 23 January 1924. 'Musgrave Street Wharf'.

<sup>69</sup> *The Sun*, 8 Dec 1923. 'Musgrave Street – Widening the Road.' Accessed online 14/9/2020 at: <https://trove.nla.gov.au/newspaper/article/222672828>.

the sandstone seawall, which does not appear to have been modified over time and is still in its original form today. The waiting room was certainly modified and enlarged by the mid-twentieth century, now constructed to the edge of the sandstone seawall. The building is constructed in weatherboard form and the roof has been replaced, with what appears to be slate tiles and a central gable over the entrance to the wharf itself. It is undetermined whether the former building was demolished or incorporated into the larger built structure. The upgraded waiting room structure featured a smaller vestibule room at the base of the stairs from Musgrave Street. This photograph also shows horizontal timber beams attaching the wharf to the sandstone seawall and waiting room (Figure 20).

The stairs from Musgrave Street also appear to have been modified over time. In the early 1910s the stairs are clearly shown on a stone retaining wall for support (Figure 19, Figure 21), however, by the 1960s photographs show that the sandstone supports had been removed and the staircase was constructed on timber support posts, including two within the Bay itself (Figure 25). The alignment and balustrades of the staircase are of similar design to the original staircase and aerial imagery from the 1960s show the second staircase in roughly the same location (Figure 23, Figure 24, Figure 27). As the first staircase structure did not include supports within the water, the second staircase was potentially an entirely new structure or was widened.

In addition to forming part of the infrastructure and transport network of the area, the South Mosman Wharf also appears to have been a busy recreational place, with residents known to have enjoyed fishing from the area.<sup>70</sup> The wharf also featured a general store within the waiting room building,<sup>71</sup> in addition to a bootmakers/shoe repairs shop.<sup>72</sup>

The structure was demolished by the 1970s, as evidenced by the aerial imagery (Figure 27), and the SHI states that a new pontoon was constructed in 1967.<sup>73</sup> The pontoon featured an enclosed design with half-walls and a corrugated metal roof (Figure 28). These works also involved the construction of the current ramp/gangway. The extant stairs from Musgrave Street were added in 1983.<sup>74</sup> The wharf appears to have had limited upgrades since the late-twentieth century, except for replacement of the enclosed walls and potentially the roof (Figure 29).

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<sup>70</sup> *Evening News*, Sat 11 Feb 1911. 'Fishing Notes.' Accessed online 15/9/2020 at: <https://trove.nla.gov.au/newspaper/article/113930656>.

<sup>71</sup> Graeme Andrews, 1962. *General shop with staff, on Musgrave Street Wharf*. City of Sydney Archives. Graeme Andrews Working Harbour Collection. Accessed online 14/9/2020 at: <https://archives.cityofsydney.nsw.gov.au/nodes/view/710681>.

<sup>72</sup> Graeme Andrews, 1962. *Musgrave Street ferry wharf from ferry*. City of Sydney Archives. Graeme Andrews Working Harbour Collection. Accessed online 14/9/2020 at: <https://archives.cityofsydney.nsw.gov.au/nodes/view/710697>.

<sup>73</sup> Heritage NSW, DPC 2017. 'Musgrave Street Wharf site'.

<sup>74</sup> Heritage NSW, DPC 2017. 'Musgrave Street Wharf site'.



**Figure 17: Ferries near Musgrave Street Wharf at Mosman, c.1900. Source: Stanton Library<sup>75</sup>**

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<sup>75</sup> Creator Unknown, c.1900. *Ferries near Musgrave Street Wharf, Mosman*. Stanton Library. Call No. LH REF PF790. Accessed online 9/9/2020 at: <https://www.aurorashore.com.au/montage/stanton/Gallery.aspx?keyword=south+mosman+wharf&method=0&sort=1003&showall=true&fname=&bibid=R0000740242&#prettyPhoto>



Figure 18: Ferry at the Musgrave Street Wharf, c.1910. Source: Wikimedia Commons<sup>76</sup>



Figure 19: Musgrave Street ferry wharf, c.1912. Source: City of Sydney Archives<sup>77</sup>

<sup>76</sup> Creator Unknown, c.1910. *Sydney ferry Kareela at Musgrave Street Wharf in Mosman's Bay*. Wikimedia Commons. Accessed online 14/9/2020 at: [https://commons.wikimedia.org/wiki/File:Sydney\\_ferry\\_KAREELA\\_at\\_Musgrave\\_Street\\_Wharf\\_in\\_Mosman\\_Bay\\_circa\\_1910.jpg](https://commons.wikimedia.org/wiki/File:Sydney_ferry_KAREELA_at_Musgrave_Street_Wharf_in_Mosman_Bay_circa_1910.jpg).

<sup>77</sup> Graeme Andrews, 1912. *Musgrave St. ferry Wharf, Mosman postcard*. City of Sydney Archives. Graeme Andrews Working Harbour Collection. Accessed online 14/9/2020 at: <https://archives.cityofsydney.nsw.gov.au/nodes/view/703289>.



Figure 20: Musgrave Street Wharf from the north, showing detail of the sandstone seawall and waiting room facade, 1929. Source: City of Sydney Archives<sup>78</sup>



Figure 21: Musgrave Street Ferry Wharf, c. 1925. Source: Australian National Maritime Museum

<sup>78</sup> Graeme Andrews, 1929. *Ferry Wharf. Musgrave St. Mosman.*



Figure 22: Musgrave Street Wharf with modified waiting room, 1962. Source: City of Sydney Archives



Figure 23: 1940s aerial imagery. Source: Historical Aerial Image Viewer

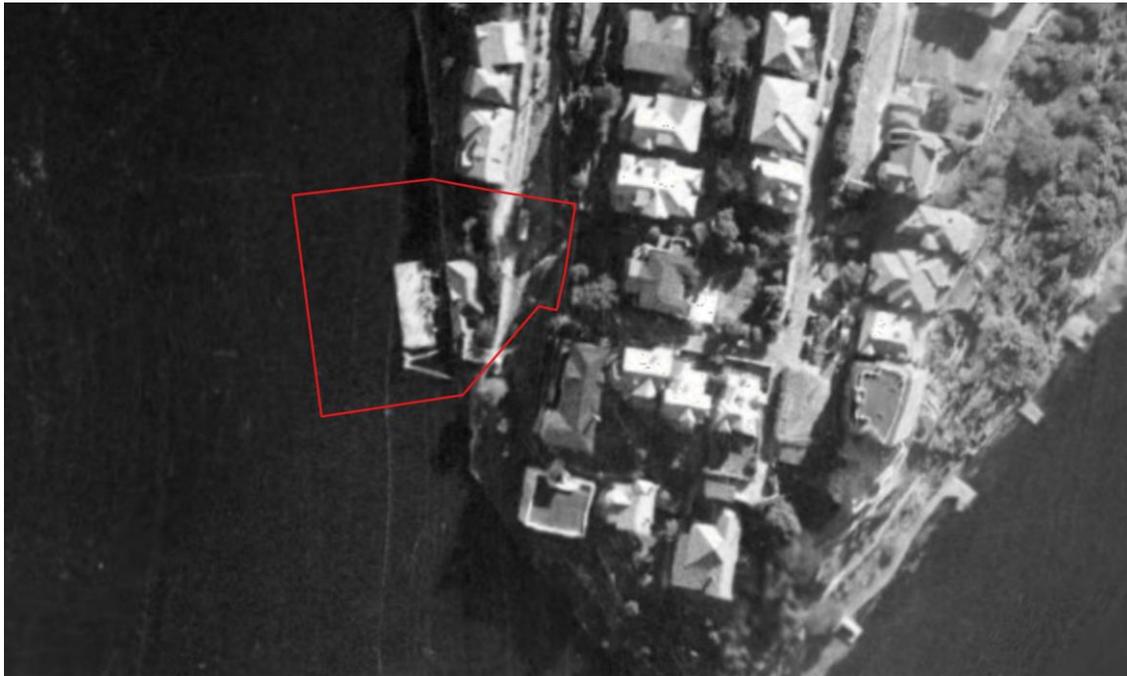


Figure 24: 1950s aerial imagery. Source: Historical Aerial Imagery Viewer



Figure 25: The Musgrave Street Wharf from the south, 1962. Source: City of Sydney Archives<sup>79</sup>

<sup>79</sup> Graeme Andrews, 1962. *Musgrave St ferry wharf from ferry*. Accessed online 14/9/2020 at: <https://archives.cityofsydney.nsw.gov.au/nodes/view/710697>.



Figure 26: Musgrave Street Wharf, 1962. Source: City of Sydney Archives<sup>80</sup>



Figure 27: Overlay of 1970s aerial imagery, showing demolition of the former waiting room and new wharf. Source: Historic Aerial Imagery Viewer

<sup>80</sup> Graeme Andrews, 1962. *Musgrave Street ferry wharf from ferry*. Accessed online 14/9/2020 at: <https://archives.cityofsydney.nsw.gov.au/nodes/view/710700>.



**Figure 28: Musgrave Street Wharf (third iteration), following construction of potential new pontoon and stairs, 1985. Source: City of Sydney Archives<sup>81</sup>**



**Figure 29: Musgrave Street Wharf, following replacement of exterior walls and windows, 2020. Source: Artefact Heritage**

<sup>81</sup> Graeme Andrews, 1985. *Ferry Wharf, Musgrave Street*. City of Sydney Archives. Graeme Andrews Working Harbour Collection. Accessed online 15/9/2020 at: <https://archives.cityofsydney.nsw.gov.au/nodes/view/698117>.

## 4.0 SITE INSPECTION

### 4.1 Introduction

A site inspection was conducted on 26 March 2020 by Jayden van Beek from Artefact Heritage and the FWUP3 South Mosman Wharf project team. The aim of the site inspection was to inspect the area of proposed impacts, inform a preliminary assessment of archaeological potential, and to identify heritage items and heritage significant fabric at the wharf and in the vicinity that may be affected by the Proposal. The inspection was undertaken on foot and a photographic record was made.

### 4.2 Site context and setting

South Mosman Wharf is located on the south-west side of Curraghbeena Point at the end of Musgrave Street in the suburb of Mosman. Musgrave Street slopes downwards towards the end of the peninsula and terminates in a cul-de-sac (Figure 30). Musgrave Street is a divided road with a sandstone retaining wall on the eastern side of the street, surrounded by residential development (Figure 31).

Access to the existing South Mosman Wharf is provided by a concrete pathway and staircase that leads west and north from Musgrave Street, dated to the late-twentieth century (Figure 32). From there, the timber gangway with diagonal cross-bracing extends west out to the pontoon in the water (Figure 33). The pontoon is on a north-south alignment and is a concrete structure covered with a corrugated metal roof (Figure 34, Figure 35). The pontoon features several columns throughout, in addition to stairs, furniture and bins (Figure 36). There are a series of timber piles within the water bracing the wharf structure, and adjacent to the wharf, the sandstone seawall is present and comprised of large sandstone blocks (Figure 37). Remnant timber beams associated with the former waiting room are set into the sandstone seawall.

Directly south of the wharf and Musgrave Street is the archaeological site of the former Musgrave Street Wharf, which includes a steep descent at the southern end of Musgrave Street (Figure 38) and adjoins the northern portion of the seawall adjacent to the extant wharf (Figure 39). At the time of the site inspection the historic seawall associated with the first wharf was underwater and could not be seen (Figure 16, Figure 38). Adjacent to the north of the wharf is a small grassy reserve area which features dense vegetation (Figure 39).

The proposed location of the new wharf has clear views across Mosman Bay to Cremorne (Figure 40), and south to Sydney Harbour (Figure 41). Views north to Mosman are partially obstructed by the topography of the land, as are views from the wharf to the nearby heritage structures such as Herron Walk Steps and the Chinese Boatshed.



Figure 30: Cul-de-sac at the end of Musgrave Street



Figure 31: Musgrave Street Divided road



Figure 32: Overview of South Mosman Wharf from Musgrave Street



Figure 33: Gangway to South Mosman Wharf



Figure 34: South Mosman Wharf (south end)



Figure 35: Overview of South Mosman Wharf



Figure 36: South Mosman Wharf interior



Figure 37: Sandstone seawall with remnant timber beams from the earlier wharf construction



Figure 38: Sandstone retaining wall at the end of Musgrave Street (original seawall in this area is underwater)



Figure 39: Sandstone seawall and garden area to the north of the stairs



Figure 40: View across Mosman Bay to Cremorne



Figure 41: South view from South Mosman Wharf to Sydney Harbour

## 5.0 ASSESSMENT OF SIGNIFICANCE

### 5.1 Introduction

This section outlines the significance assessments and statements of significance for the listed heritage items within the construction footprint. The significance of the heritage items has been assessed against the NSW heritage significance criteria outlined in Table 1. Statements of significance have also been provided for the heritage items which have been identified in Table 5 as being adjacent to the construction footprint.

### 5.2 Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491)

#### 5.2.1 Assessment of Significance

The SHI entry for Musgrave Street Wharf site (SHI no. 4920109) does not contain a complete significance assessment for the heritage item.<sup>82</sup> As a result, the significance assessment in Table 6 extracted from the s170 listing for the Musgrave Street Wharf site has been supplemented by further assessment undertaken by Artefact Heritage. The significance assessments extracted from the SHI are identified below in italics.

**Table 6: Significance assessment for Musgrave Street Wharf site (SHI 4920109 & LEP no. A491)<sup>83</sup>**

Criterion	Explanation
<b>A – Historical Significance</b>	<p><i>Musgrave Street Wharf site is of historical significance as an early passenger ferry wharf on the northern side of the harbour which has been in continuous use for over a century. It is representative of the first generation of European land/water transport interchanges in Sydney Harbour, where the wharf existed prior to extensive suburban development in the vicinity and its operation has consequently influenced the evolution of the surrounding urban form, including roads, general traffic routes, commercial centres and building forms. Its origins as an investment by the local land speculator are representative of a range of historical trends in the development of Sydney and have direct parallels with the development of the Manly ferry service and the Suspension Bridge at Northbridge.</i></p> <p><b>Musgrave Street Wharf site has local significance under this criterion</b></p>
<b>B – Associative Significance</b>	<p><i>The site of the first Musgrave Street Wharf is associated with Richard Hayes Harnett Senior, an early promoter and land speculator of Mosman, whose son, Richard Hayes Harnett Junior, was also prominent in the development of Neutral Bay and Cremorne.</i></p> <p><b>Musgrave Street Wharf site has local significance under this criterion</b></p>
<b>C – Aesthetic or Technical Significance</b>	<p><i>The sandstone seawall and stone wharf-support structure adjacent to the present Musgrave Street Wharf expresses the long period of use of this wharf and is aesthetically consistent with the surrounding character of Mosman.</i></p> <p><b>Musgrave Street Wharf site has local significance under this criterion</b></p>

<sup>82</sup> Heritage NSW, DPC 2017. 'Musgrave Street Wharf site'.

<sup>83</sup> Heritage NSW, DPC 2017. 'Musgrave Street Wharf site'.

Criterion	Explanation
<b>D – Social Significance</b>	<p>The Musgrave Street Wharf site may be of interest to local residents and history groups in Mosman and the North Shore. The former passenger wharf served as an important transportation route for residents of the area and facilitated frequent recreational trips, and Curraghbeena Point has continued to provide ferry services for over 100 years. Remains of the former wharf may contribute to residents understanding of place and Mosman's interaction with Sydney Harbour.</p> <p><b>Musgrave Street Wharf site has local significance under this criterion</b></p>
<b>E – Research Potential</b>	<p>Archaeological remains of the Musgrave Street Wharf site may be able to demonstrate the construction style and layout of the former wharf structure. However, the location and style of the structure are relatively well known from the available historic evidence and therefore the archaeological remains are unlikely to provide unique information. As a result, the archaeological remains of the former wharf have little research potential.</p> <p><b>Musgrave Street Wharf site does not reach the threshold of local significance under this criterion</b></p>
<b>F – Rarity</b>	<p>The Musgrave Street Wharf site is not considered to be a rare heritage item within the local area. A search of the Mosman LEP 2012 identifies a total of eight listed wharf sites, including remnant wharfs and archaeological sites of former wharves. In addition, there are other unlisted wharves in the Mosman LGA and numerous wharves within the surrounding suburbs. This indicates that the wharves are a common type of heritage item within the Mosman LGA and surrounding area.</p> <p><b>Musgrave Street Wharf site does not reach the threshold of local significance under this criterion</b></p>
<b>G – Representativeness</b>	<p>Photographs of the former wharf indicate that it was representative of 19th century wharves in the Mosman LGA and surrounding area, which played an important role in transportation for local residents. Although the seawall appears to be largely intact however, it is unclear if substantial and intact evidence of the former wharf structure survives. Without intact remains of the wharf structure the site has lost the ability to demonstrate the principal characteristics of its type.</p> <p><b>Musgrave Street Wharf site does not reach the threshold of local significance under this criterion</b></p>

## 5.2.2 Statement of Significance

Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI database entry for the Musgrave Street Wharf site (SHI no. 4920109):

*Musgrave Street Wharf site is of historical significance as an early passenger ferry wharf on the northern side of the harbour which has been in continuous use for over a century. It is representative of the first generation of European land/water transport interchanges in Sydney Harbour, where the wharf existed prior to extensive suburban development in the vicinity and its operation has consequently influenced the evolution of the surrounding urban form, such as roads, general traffic routes, commercial centres and building forms. Its origins as an investment by the local land speculator are representative of a range of historical trends in the*

*development of Sydney and have direct parallels with the development of the Manly ferry service and the Suspension Bridge at Northbridge.<sup>84</sup>*

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### 5.2.3 Listing details

It is noted that there are two heritage listings for the Musgrave Street Wharf, the s170 listed Musgrave Street Wharf site (SHI no. 4920109) and the Mosman LEP 2012 listed Musgrave Street Wharf (remains and sea wall) [LEP no. A491]. There is currently a discrepancy however between the physical description in the SHI sheets for the heritage items and their heritage curtilages.

While it is the understanding of Artefact Heritage that a mapped heritage curtilage is not available for the s170 listed Musgrave Street Wharf site (SHI no. 4920109), the curtilage for the LEP listing of the heritage item is mapped as being located to the south-east of the existing South Mosman Wharf, as illustrated in Figure 5. The current LEP heritage curtilage for Musgrave Street Wharf (remains and sea wall) [LEP no. A491] was developed following an archaeological assessment of the LEP listed historical archaeological sites on the Mosman LEP 2012 by Austral Archaeology (Austral) in 2015.<sup>85</sup> Austral was commissioned by Mosman Municipal Council to assess 16 sites on the Mosman LEP 2012 which only consisted of an indicative site location, including Musgrave Street Wharf (remains and sea wall) [LEP no. A491]. At the time, the curtilage of Musgrave Street Wharf (remains and sea wall) [LEP no. A491] was indicatively mapped as being located where the existing South Mosman Wharf is. Following further historical research and assessment Austral identified that the original wharf was located to the south-east of the existing wharf and recommended that the LEP curtilage be moved to its present location. The previously recorded location of Musgrave Street Wharf (remains and sea wall) [LEP no. A491] in relation to the location identified by Austral is illustrated in Figure 42.

Although the LEP curtilage has been relocated as a result of the assessment undertaken by Austral, the physical descriptions of the heritage items contained in the s170 and LEP SHI sheets have not been updated to match this. Both SHI sheets include the modern ferry wharf pontoon, steps and ramp as part of the physical description of the wharf site, thereby causing a discrepancy between the mapped curtilage and the physical description of the items:

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*A modern ferry wharf pontoon accessed by new steps and ramp, an older path and steps, grassed foreshores plus sandstone seawalls and wharf abutments are all contained within the road reservation at the southern end of Musgrave Street.*

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It is the recommendation of Artefact Heritage that the physical descriptions of the heritage items are outdated and inaccurate and that the current LEP curtilage should also be used for the assessment of the s170 listed Musgrave Street Wharf site (SHI no. 4920109). This recommendation is made as the significance of the heritage listings is primarily associated with the original c.1870s Musgrave Street Wharf and not the two later wharves (with the existing wharf having replaced the second earlier wharf in the same location). The first wharf and associated seawall draw their significance from being one of the original ferry stopping places for Mosman, their association with Harnett, and their association with the early development of Mosman. While the later seawall and existing wharf are also associated with historical transportation in Mosman and contribute to the visual character of the area, they are part of the later development of the area and are not associated with Harnett and therefore have reduced significance. This is reflected in the statements of significance and alternative names for the heritage items, which both specifically reference the original 1870s wharf.

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<sup>84</sup> Heritage NSW, DPC, 2017. 'Musgrave Street Wharf site'.

<sup>85</sup> Austral Archaeology, 2015. 'Assessment of Archaeological Sites, Mosman Local Environmental Plan Historical Archaeological Site Assessment'.

As a result, this SoHI uses the current LEP curtilage for Musgrave Street Wharf site to assess impacts for both the s170 and LEP listings (SHI no. 4920109 & LEP no. A491).



**Figure 42: Archaeological features associated with the original Musgrave Wharf in relation to the previously recorded indicative location of Musgrave Street Wharf (remains and sea wall) [LEP no. A491]<sup>86</sup>**

<sup>86</sup> Austral Archaeology, 2015. 'Assessment of Archaeological Sites, Mosman Local Environmental Plan Historical Archaeological Site Assessment', p. 81.

## 5.3 Divided road (LEP no. I411)

### 5.3.1 Significance assessment

The SHI entry for Divided road (LEP no. I411) does not contain a detailed significance assessment for the heritage item.<sup>87</sup> As a result, a significance assessment has been prepared as part of this SoHI and is detailed in Table 7.

**Table 7: Significance assessment for Divided road (LEP I411)**

Criterion	Explanation
<b>A – Historical Significance</b>	<p>Musgrave Street reflects the historic road type present in the Mosman district, which followed and were shaped by the natural land contour. Musgrave Street is associated with the expansion of residential subdivision in Mosman, which required new roadways to accommodate new development, including in areas with most irregular terrain.</p> <p><b>Divided road has local significance under this criterion</b></p>
<b>B – Associative Significance</b>	<p>Musgrave Street was originally named Harnett’s Road for its association with Richard Hayes Harnett and providing access to his property. Harnett was a leading landowner and an influential member of the local area, and was responsible for the establishment of several divided roads in the Mosman LGA as well as the originally ferry wharf at the end of Musgrave Street.</p> <p><b>Divided road has local significance under this criterion</b></p>
<b>C – Aesthetic or Technical Significance</b>	<p>Musgrave Street is an interesting example of a roadway within Mosman that has been shaped by the natural topography in the area. The divided road reflects the creative ways in which residents and councils constructed roads to utilise the terrain, which may have been influenced by several historic factors such as the cost and feasibility of earthworks in the area. The numerous divided roads in Mosman, including Musgrave Street, are an integral component of the visual character of the local area and are instantly and uniquely recognisable.</p> <p><b>Divided road has local significance under this criterion</b></p>
<b>D – Social Significance</b>	<p>Musgrave Street Divided road likely contributes to the understanding and sense of place felt by residents in Mosman, particularly as divided roads are an integral and uniquely recognisable aspect of the visual character of the local area.</p> <p><b>Divided road has local significance under this criterion</b></p>
<b>E – Research Potential</b>	<p>The Musgrave Street Divided road is unlikely to have research potential, as archaeological remains are unlikely to reveal information that cannot be ascertained from historic or pictographic sources.</p> <p><b>Divided road does not reach the threshold of local significance under this criterion</b></p>
<b>F – Rarity</b>	<p>The Musgrave Street Divided road is not considered to be a rare heritage item within the local area. A search of the Mosman LEP 2012 identifies a total of 52 listed divided roads, indicating that they are a common type of heritage item within the Mosman LGA.</p> <p><b>Divided road does not reach the threshold of local significance under this criterion</b></p>

<sup>87</sup> Heritage NSW, DPC, 2011. 'Musgrave Street, Divided Road'. SHI. Accessed online 9/10/2020 at: <https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=2060322>.

Criterion	Explanation
<b>G – Representativeness</b>	The Musgrave Street Divided road is a good and intact example of the divided road type within the Mosman LGA. The road alignment and stone retaining walls appear to be unmodified and hold high integrity, although the roads have been resurfaced.  <b>Divided road has local significance under this criterion</b>

### 5.3.2 Statement of significance

Musgrave Street Divided Road (LEP I411) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI database entry for the Musgrave Street Divided Road (LEP I411):

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*Mosman's divided roads are integral to the municipality's visual character and sense of place. Built as a utilitarian response to the steep harbourside topography, they reflect, in their fabric and construction technology, the development of Mosman's suburban structure. The large collection of these features makes Mosman instantly and uniquely recognisable.<sup>88</sup>*

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## 5.4 Group of 2 houses, divided into 3 dwellings (LEP no. I183)

### 5.4.1 Statement of Significance

Group of 2 houses, divided into 3 dwellings (LEP no. I183) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI database entry for Group of 2 houses, divided into 3 dwellings (LEP no. I183):

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*These are two large, intricately-finished and decorated Arts-and-Crafts houses typical of those on Cremorne Point and Curraghbeena Point that were built in the early years of the Twentieth Century to capitalise on the ferry service and the magnificent setting.<sup>89</sup>*

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## 5.5 Herron Walk Steps (LEP no. I412)

### 5.5.1 Statement of Significance

Herron Walk Steps (LEP no. I412) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI database entry for Herron Walk Steps (LEP no. I412):

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*The pedestrian steps of Mosman are integral to the visual character and sense of the place. Built as a utilitarian response to the steep harbourside topography the*

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<sup>88</sup> Heritage NSW, DPC, 2011. 'Musgrave Street, Divided Road'.

<sup>89</sup> Heritage NSW, DPC, 2011. 'Group of 2 houses (3 dwellings)'. SHI. Accessed online 6/10/2020 at: <https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=2060326>.

*large collection of steps and associated paths reflect, in their fabric and construction, the development of Mosman's suburban structure. In general they are pleasing visual features in the streetscape. They are among the features that make the suburb instantly recognisable as Mosman.<sup>90</sup>*

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<sup>90</sup> Heritage NSW, DPC, 2011. 'Herron Walk Steps'. SHI. Accessed online 6/10/2020 at: <https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=2060323>.

## 6.0 PRELIMINARY ARCHAEOLOGICAL ASSESSMENT

### 6.1 Introduction

This section provides a preliminary discussion of the construction footprint's potential to contain historical archaeological remains. The potential for the survival of archaeological remains is significantly affected by previous activities which may have caused ground disturbance. This assessment is therefore based on consideration of current ground conditions and analysis of the historical development around the construction footprint.

Areas of archaeological potential are illustrated in Figure 43.

### 6.2 Land use summary

Non-Aboriginal occupation and development around the construction footprint has been divided into four general phases of historical activity, which are summarised below.

#### 6.2.1 Phase 1 (1788-1873): Informal land use and whaling allotments

In the early 1840s the area around the construction footprint was purchased by Francis Mitchell as 'Allotment 11', a one-acre land parcel made available as part of the whaling allotment scheme. There is no historical documentation to suggest that Mitchell built upon the land grant, however land clearance and modification may have occurred, and undocumented structures may have been present. The whaling allotments were often granted in exchange for the construction of a store and/or wharf on the land grant.

Prior to the purchase of the land by Mitchell, there is no documentation of activity within the construction footprint, however informal land use may have occurred.

#### 6.2.2 Phase 2 (1873-1905): Richard Hayes Harnett development

In the early 1870s much of the construction footprint and surrounding land on Curraghbeena Point was purchased by Richard Hayes Harnett, an Irish land proprietor. Harnett had the land on the peninsula surveyed for subdivision and established Musgrave Street at the point of the peninsula. At the end of Musgrave Street, Harnett constructed the first wharf (no longer extant) in the area from timber planks on piling and established a ferry service. This wharf was accessed by stairs from Raglan Street, while the end of Musgrave Street was partially expanded later. A stone seawall was also constructed at this time. Musgrave Street was first established with red-gravelled surface and no kerbing, gutters or footpaths, though a footpath and drain look to have been added later on (Figure 15).

Minor land reclamation occurred during this phase by the North Shore Ferry Company following their purchase of the wharf, which subsequently may have preserved remains such as the former seawalls and structure of the wharf.

#### 6.2.3 Phase 3 (1905-1968): Second Musgrave Street Wharf

In 1905 the first wharf was decommissioned and closed, with a second wharf constructed about 100m north and within the construction footprint. The second wharf was larger than the first and a weatherboard waiting shed with tiled roof was constructed. During this phase Musgrave Street would have been upgraded and sealed, with more formal gutters and kerbing added.

#### 6.2.4 Phase 4 (1968-present): Current South Mosman Wharf

In 1968 the current wharf was constructed as part of renovation works to the second wharf, including a pontoon structure. This also included the removal of the waiting room. Musgrave Street has been further upgraded, and additional landscaping works have been undertaken.

### 6.3 Preliminary assessment of archaeological potential

#### 6.3.1 Phase 1 (1788-1873): Informal land use and whaling allotments

Archaeological remains associated with Phase 1 may include evidence of land clearance, including tree boles. Following the establishment of formal land grants in 1830 as part of the whaling allotment scheme, archaeological evidence related to the formalisation of boundaries may be present, including timber fencing and post holes. Evidence of undocumented structures within the construction footprint, associated with Francis Mitchell may be present, including earthen, timber, or stone floor surfaces or foundations of former structures. Archaeological evidence associated with Phase 1 may also include camp remains and rubbish pits located near any undocumented structures, which may include artefacts. However, there is no documentation of activity within the construction footprint during this period and as the land had likely not been reclaimed there would have been limited space to build on. As a result, it is unlikely that buildings would have been constructed within the construction footprint during this time.

Overall, there is **nil to low** potential that archaeological remains associated with Phase 1 may be present within the construction footprint.

#### 6.3.2 Phase 2 (1873-1905): Richard Hayes Harnett development

Potential archaeological remains associated with Phase 2 may include evidence of the former wharf and seawall constructed by Richard Hayes Harnett. Potential remains may include timber planking, timber piles, or remnant postholes. Remains associated with the original Musgrave Street Wharf are known to be present in the area and have been previously identified by Austal during surveys undertaken in 2008 and 2015. As a result, there is **high** potential for archaeological remains associated with the original wharf to be present in the area. However, the original wharf and associated infrastructure was primarily located to the south-east of the existing South Mosman Wharf, and only a small portion of it extends into the south end of the construction footprint. The portion of the seawall that extends into the south end of the construction footprint is visible at low tide and does not appear to continue north of the angled return of the later seawall, which is where the proposed works would primarily be undertaken.

Earlier road surfaces of Musgrave Street may be present and associated with Phase 2. These remains may include red-gravelled road surfaces and associated elements such as and stone kerbing, footpaths, and drains. Evidence of former road surfaces may have been partially truncated or completely removed in areas by subsequent modern road upgrades and utilities, however, evidence of the former road surfaces may have survived in localised pockets. There is **low** archaeological potential for evidence of former road surfaces and associated elements.

Archaeological remains from Phase 2 would likely primarily consist of evidence of land reclamation fills from the late nineteenth and early twentieth centuries. Reclamation fill may include late nineteenth century backfill deposits which likely includes rubbish deposits from the time of filling. However, these deposits would be highly mixed and would not represent *in situ* deposits, and the provenance of any artefacts would not be identifiable. There is **moderate to high** archaeological potential for evidence of reclamation fill.

### 6.3.3 Phase 3 (1905-1968): Second Musgrave Street Wharf

Potential archaeological remains associated with Phase 3 may include evidence of the second wharf and additional portions of the seawall constructed in 1905 by the North Shore Ferry Company. The second wharf was built in the same location as the existing South Mosman Wharf. Potential remains may include timber planking, timber support piers, remnant postholes, or timber demolition material. This could include maritime archaeological remains. Additional remains may also include excavation cuts or fills from the construction of the wharf and seawall. There is **low to moderate** potential for intact archaeological remains associated with the establishment of the second wharf and the existing seawall to be present.

Structural remains or demolition fills associated with the former weatherboard waiting room adjacent to the wharf may also be present, including archaeological evidence of footings or foundations. Any foundations or footings present would likely be truncated in localised areas by the extant staircase. The historical photos also indicate that the walls of the waiting room were at least partially founded on the extant seawall, and therefore may not have featured deep footings and are more likely to have been removed during the demolition of the building. A retaining wall and earlier timber support posts associated with the early staircase from Musgrave Street to the wharf may be present, however, this has likely been disturbed by more recent late twentieth century works in the area, including the construction of the extant stairs. Remains of the former stairs are likely to be limited to remnant posts or postholes. There is generally **low** potential for intact evidence of the former wharf and stairs to be present. However, there is **high** potential for evidence of the former waiting room, namely the horizontal timber beams that attached the former pontoon to the seawall and were underneath the waiting room. Remnant timber beams can currently be seen extending out from the seawall (Figure 37). There is **low** potential however for other remains of the waiting room such as sandstone or brick footings to be present.

Additional land reclamation may have been undertaken by North Shore Ferry Company during Phase 3 as they established the former wharf. Again, the reclamation fills may include late nineteenth and early twentieth century backfill deposits which likely includes rubbish deposits from the time of filling. However, these deposits would be highly mixed and would not represent *in situ* deposits, and the provenance of any artefacts would not be identifiable. There is **moderate to high** archaeological potential for evidence of reclamation fill.

Early twentieth century stone or cement kerbing, footpaths, or utilities associated with upgrades to Musgrave Street may also be present, including drainage. Additionally, early road surfaces may be evident. Evidence of the earlier road surfaces from this phase however may have been truncated by later upgrades. There is **low to moderate** archaeological potential for former surfaces and material associated with Musgrave Street.

### 6.3.4 Phase 4 (1968-present): Current Musgrave Street Wharf

Elements from Phase 4 are largely extant and as such, would not be considered archaeological. Therefore, there is nil archaeological potential associated with this phase.



Figure 43: Areas of archaeological potential

## 6.4 Assessment of archaeological significance

This section assesses the significance of the potential archaeological remains outlined in the previous section. As with other types of heritage items, archaeological remains should be managed in accordance with their significance. Assessing the heritage value of archaeological remains is complicated by the fact that their extent and nature is often unknown. Judgement must therefore be based on expected or potential attributes.

Archaeological significance assessments have only been prepared for those historical phases which potential archaeological remains have been identified.

### 6.4.1 Archaeological significance assessment

Potential archaeological remains from Phase 1 are associated with whaling allotments from the 1840s. There is no documentary evidence to suggest that the construction footprint was developed during this period and therefore there is nil to low potential for substantial and intact archaeological remains to be present. However, if archaeological remains survive which are associated with the former whaling allotments, they may hold historical significance for their association with the development of Mosman and early industries in the area. These remains may also hold research potential for their ability to provide material evidence and information relating to the whaling allotments and associated activities, for which little documentation is available. Therefore, substantial and intact archaeological remains from Phase 1 would reach the threshold of local significance.

Potential archaeological remains from Phase 2 may include evidence of the original Musgrave Street wharf and associated infrastructure such as the original seawall. These remains would be directly associated with the locally significant Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491). Remains of the original wharf and seawall would therefore be significant for their historical, associative and social heritage values; however, the remains are likely to have little to no research value. Evidence of the earlier construction of Harnett Road/Musgrave Street, such as former road surfaces, kerbing and drainage would be significant for their association with Harnett and the development of divided roads in Mosman.

Archaeological remains from Phase 2 and Phase 3 may include evidence of nineteenth and twentieth century reclamation events. Evidence of reclamation fill is unlikely to be significant on its own however as the deposits would be highly mixed and the provenance of any artefactual material would not be identifiable. As a result, artefact bearing reclamation fill would have little to no research potential.

Phase 3 is associated with the development of the second Musgrave Street Wharf and the waiting room. These features have some historical and social value for their association with the provision of public transportation in Mosman and North Shore throughout a large portion of the twentieth century, and there are likely still local residents who would remember using the former wharf. However, as the second wharf was associated with the later development of transportation in Mosman it would have reduced significance compared to remains of the original Musgrave Street Wharf. Furthermore, the second wharf was not associated with Harnett and therefore the archaeological remains would no longer have associative significance. There is also a range of photographs and aerial imagery available which show the size, design, and location of the former wharf, waiting room and staircase, and therefore there would not be research potential associated with these remains. As a result, it is assessed that Phase 3 archaeological remains associated with the second wharf and former waiting room and stairs would not reach the threshold of local significance.

Overall, the preliminary archaeological assessment has identified that the construction footprint has potential to contain archaeological remains of local significance, largely associated with the development of the original Musgrave Street Wharf and earlier road construction during Phase 2. However, only a small area of the construction footprint is associated with the original Musgrave Street Wharf, and these remains are still extant and visible today. These archaeological remains are generally unlikely to be found in association with *in situ* artefact bearing deposits, such as intact occupation deposits. Artefactual material would primarily be associated with reclamation fills, which would not be considered *in situ* deposits. As a result, the potential archaeological remains within the construction footprint would likely be classified as 'works'. The preliminary archaeological assessment has found that there is generally nil to low potential for 'relics' as defined by the Heritage Act.

#### 6.4.2 Summary of archaeological potential and significance

A summary of the preliminary assessment of archaeological potential and significance is provided in Table 8. Areas of archaeological significance are illustrated in Figure 44.

**Table 8: Summary of archaeological potential and significance**

Phase	Potential remains	Potential	Significance
Phase 1 (1788-1873)	Evidence of informal land use, land clearance and evidence of whaling allotments	Nil to low	Local
	Evidence of earlier road constructions, such as earlier (gravelled and stone) road surfaces, kerbing and drainage	Low	Local (works)
Phase 2 (1873-1905)	Structural evidence of the original Musgrave Street Wharf and seawall, including extant remains at the south end of the construction footprint	High	Local (works)
	Evidence of land reclamation events	Moderate to high	Would not reach the threshold of local significance
Phase 3 (1905-c.1968)	Maritime and terrestrial evidence of the second Musgrave Street Wharf and former stairs	Low	Would not reach the threshold of local significance
	Evidence of the former Musgrave Street waiting room, including extant remains of the horizontal timber beams	High (low potential for other remains such as sandstone or brick footings)	Would not reach the threshold of local significance
	Evidence of early twentieth century road upgrades and formalisation of road surfaces, kerbing and drainage	Low	Would not reach the threshold of local significance
	Evidence of land reclamation events	Moderate to high	Reclamation fill would not reach the threshold of local significance
Phase 4 (c.1968-present)	Not considered archaeological	Nil	N/a



Figure 44: Areas of significant potential archaeological remains

## 7.0 PROPOSED WORKS

### 7.1 Introduction

This section describes the main design features of the proposal and outlines the associated construction activities at South Mosman Wharf.

### 7.2 Proposed works

#### 7.2.1 Major water-based features

##### 7.2.1.1 Jetty

A new jetty would be constructed behind the seawall. The new jetty would consist of a short concrete deck slab supported by concrete headstock on steel piles. The new jetty length and width would be about 4m and the deck level would be a minimum of +1.975m AHD to account for future sea level rise. The seaward side of the abutment would provide the support to the gangway to provide access to the pontoon.

##### 7.2.1.2 Gangway

A covered aluminium gangway would be constructed to connect the jetty with the pontoon. It would be 18.9m long and 2.5m wide. A transition plate would be installed over the join between the landside connection and the gangway. The gradient of the gangway would vary according to the tides to be almost horizontal at high tide and maximum 1 in 14 for a minimum 80 per cent of the tide levels.

##### 7.2.1.3 Pontoon

The pontoon would be a rectangular shaped steel floating structure 22.5m long and nine metres wide. The pontoon would be used as both ferry boarding and waiting area and would be held in place by four steel 760mm diameter guide piles.

The pontoon would have a curved zinc roof (canopy) supported by steel columns that provides the shelter structure. The covered waiting area would contain stainless steel handrails, glass screens arranged in a curve on the northern and southern ends, providing weather protection for the centrally located seating. On the north-eastern end, part of the edge would be protected by glass screen and the remainder would be a service pod.

The services pod would contain items such as a life buoy, help point, repeat last message button, waste bins, information screens and data/electrical cabinets.

A range of associated safety and security facilities would also be installed, including lighting, CCTV, ladders to the water, life buoy on the pontoon, glass weather protective screens and tactile floor treatments.

The pontoon is made up of a number of independent cells which would be ballasted to provide a freeboard of around one metre to match the ferry still level.

The pontoon cells are independent and not interconnected to ensure redundancy within structure, such that if one cell is punctured or damaged, that the pontoon is not compromised for stability. The pontoon is orientated parallel to the shoreline, to match the dominate wave direction for both wind waves and vessel wash to match the navigation channel. This alignment enables the seaward side of the pontoon to be used as a sweep berth. To assist with ferry movements at the wharf, 457mm diameter pivot piles are provided at each end of the pontoon berth face (two in total).

Four fenders are provided along the berth face of the pontoon. The fender units would comprise 500mm outer diameter cylindrical fenders with steel fender panels that are 2000mm above the pontoon deck level. Timber whalers would connect vertical steel fender beams, slightly below the pontoon deck level to prevent vessels nosing in and impacting the pontoon or fender units. Pontoon mounted 20t bollards are provided for ferry mooring lines. The berthing and mooring loads are ultimately resisted by the four pontoon guide piles, which also act to restrain the pontoon.

#### **7.2.1.4 Optional recreational berthing**

The wharf design currently considers the use of the wharf for Transdev vessels. The concept design has nominally identified that recreational berthing could be accommodated on the back of the pontoon, with some rearrangement of the furniture on the pontoon. Any desirable requirements for recreational berthing would be developed by Transport for NSW during detailed design in consultation with stakeholders and community groups.

### **7.2.2 Major land-based features**

#### **7.2.2.1 Pedestrian access**

The concept design requires the development of a new pedestrian interface between street level and the pontoon. A new lift and covered staircase would be constructed to provide access to the proposed wharf.

The lift would be of steel framed construction. The lift walls and car would be likely be made of glass and the overall height of the lift (seen from water) would be around 15m. Around 7.5m of this structure would be seen from street level. The staircase would be of concrete construction and would contain five flights of 1.5m wide stairs between Musgrave Street and the wharf.

Metal balustrades and handrails would be installed on the staircases and lift platform. A pier would be constructed to support the staircase structure and would be located on the foreshore near the wharf entry. The pier would be around nine metres tall.

#### **7.2.2.2 Cyclist facilities**

South Mosman wharf upgrade would include three new bicycle hoops. The proposed location of the bicycle hoops adjoins Musgrave Street and is located to the north of the existing staircase.

#### **7.2.2.3 Parking**

Parking would not be provided at the wharf due to constraints on Musgrave Street such as access for bus services.

### **7.2.3 Supporting infrastructure**

While the specifics of the supporting infrastructure, lighting, signage, and furniture would be confirmed during the detailed design, they would be consistent with the provisions included on the other wharves on the network. It would therefore include:

- Opal Fixed Location Readers (tap on/off machines) to be relocated at the entrance to the wharf
- Safety and security lighting in the waiting shelter and on the pontoon wharf
- Passenger information boards, notices, and (electronic and display board) timetables
- Safety ladders around the walkway and wharf pontoon
- Strung cabling and ducting to provide power and communications
- CCTV
- Passenger facilities

- Tactile flooring
- New signage to assist with information and navigating (wayfinding).

The above would be developed in accordance with Transport for NSW design specifications.

#### 7.2.4 Construction activities

The appointed contractor would confirm the final construction activities in discussion with Transport for NSW. As such, this section only indicates a likely method and work plan as it may vary due to the identification of additional constraints before work starts, detailed design refinements, community and stakeholder consultation feedback, and contractor requirements/limitations. Should the work method differ from what is proposed in this REF, the contractor would consult Transport for NSW to determine if additional assessment is needed. Some additional land would be needed temporarily to support construction.

#### 7.2.5 Work methodology

The proposal would likely comprise a sequence of work activities similar to that summarised in Table 9.

**Table 9: Planned construction activities**

Activity	Associated work
Site establishment	<ul style="list-style-type: none"> <li>• The existing wharf would be closed</li> <li>• Given that there is little space available on land it is likely that the majority of the site compound (materials storage, laydown, site sheds, ablutions, etc.) would need to be established on a construction barge moored adjacent to the existing wharf. It may be possible to use the existing wharf for site offices and ablutions once the wharf is closed to the public</li> <li>• Traffic control measures (including for vehicles, watercraft, pedestrians and cyclists) would be established in accordance with the traffic management plan. Appropriate wayfinding signage would be installed advising of alternative transport options where necessary</li> <li>• Environmental controls would be established in accordance with the Construction Environmental Management Plan (CEMP).</li> <li>• A small excavator (about eight tonnes) would be installed at water's edge by crane barge, to undertake clearing and grubbing of water's edge and rock face areas. Spoil would be removed by barge.</li> </ul>
Construction of works on the water's edge	<ul style="list-style-type: none"> <li>• Install a medium sized excavator (about 13t) with rock hammer at water's edge by crane barge</li> <li>• Excavate stair well and lift slot. The excavation may require rock bolting and/or shotcrete to support the face. This would require specialised equipment to be lifted into position and removed by a large crane barge. Spoil would be removed by barge</li> <li>• Install a small excavator-mounted piling rig at water's edge by barge crane</li> <li>• Install piles for platform, lift shaft and gantry abutment foundations. It is assumed piles will be five to ten metres in depth and 600-750mm in diameter. Concrete and reinforcement can be delivered from Musgrave Street. Spoil would be removed by barge.</li> <li>• Remove piling rig by barge crane</li> <li>• Break down piles. Spoil would be removed by barge.</li> </ul>

Activity	Associated work
Construction of superstructure works	<ul style="list-style-type: none"> <li>• Construct base slab and pile caps for stairs, lift platform and lift tower. Form work, concrete and reinforcement would be delivered from Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked</li> <li>• Construct piers and headstocks for stairs and lift platform. Form work, concrete and reinforcement would be delivered from Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked</li> <li>• Lift precast column capping beams (for platform) using large mobile crane on Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked</li> <li>• Install precast concrete stairs units by large mobile crane installed in Musgrave Street</li> <li>• Saw cut Musgrave Street concrete pavement and excavate to abutment foundation level (assuming rock is within one metre of pavement level, otherwise piles will also be required). Musgrave Street would be closed to buses at this time as there would be no provision for turning around. Steel road plates would be required to allow cul-de-sac to be opened to buses between works</li> <li>• Construct platform abutment in Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around. Steel road plates would be required to allow cul-de-sac to be opened for buses between works</li> <li>• Demolish existing Musgrave Street pavement below platform. Musgrave Street would be closed to buses at this time as there would be no provision for turning around</li> <li>• Install precast planks between abutment and columns using large mobile crane on Musgrave Street. A detailed lift study would be required to confirm that planks can be delivered to site (probably by reversing trucks) and lifted into position by crane within the limited footprint. Musgrave Street would be closed to buses at this time as there would be no provision for turning around</li> <li>• Construct concrete deck slab on platform. Form work, concrete and reinforcement would be delivered from Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around</li> <li>• Construct tie-in pavement between platform and Musgrave Street. Musgrave Street would be closed to buses at this time as there would be no provision for turning around</li> <li>• Install lift tower and lift car using large mobile crane on Musgrave Street. This would need to be done out of peak hours as bus access to Musgrave Street would be blocked</li> <li>• Demolition of the existing stairs. Spoil would be removed by barge</li> <li>• Finishing works (landscaping, paving, handrails, etc.) and demobilisation</li> <li>• It is likely that a new electricity supply would need to be installed to power the lifts. This may require the installation of a new electrical cable (either underground or overhead) along streets accessing the site. This could require extensive works.</li> </ul>
Demolition of the existing wharf	<ul style="list-style-type: none"> <li>• The construction work area would be delineated using floating booms. This would make allowance for the outward reach of the construction barge's four anchorage points, over which marine vessels may not cross for safety reasons. The anticipated size of the barges is up to about 20m by 30m in size</li> <li>• Up to three barges would travel to the site from the off-site facility. One barge would be fitted with a crane. When on-site, it would be anchored by four points but would reposition around the site during the work, as required</li> <li>• The existing shelter, wharf furniture and gantry would be cut away from the piles and loaded onto a barge by crane to be transported to an appropriately approved and licensed facility for reuse and/or disposal</li> <li>• The existing pontoon would be floated away for disposal</li> <li>• The existing steel piles would be removed by vibratory methods. If a pile is unable to be extracted by vibratory methods, it would be cut off level with the harbour bed. Divers would cut the pile at seabed level using appropriate underwater equipment. Piles would be transported by barge to an appropriately approved and licensed facility for reuse and/or disposal</li> <li>• Remediation of the seawall following removal of the existing wharf, if required.</li> </ul>

Activity	Associated work
Installation of steel piles within the waterway	<ul style="list-style-type: none"> <li>• Steel locator piles for the pontoon and foundation piles for the jetty would be installed into bedrock. These piles would be transported by barge to the site from the off-site facility</li> <li>• The installation of the piles for the jetty would likely be undertaken by a barge mounted piling rig. The jetty would be an independent structure to the seawall</li> <li>• Construct pile foundation systems in bedrock as follows:               <ul style="list-style-type: none"> <li>○ Pre-drilling into rock</li> <li>○ Positioning steel pile casing with crane mounted driving unit and piling guide</li> <li>○ Driving or screwing the steel pile casings into position</li> <li>○ Cutting the steel pile casings to length and backfilling with concrete.</li> </ul> </li> </ul>
Installation of the pontoon and gangway	<ul style="list-style-type: none"> <li>• Lifting and placement of components for the new wharf would be carried out using a barge mounted crane</li> <li>• The new pontoon structure would be fabricated at an off-site facility and floated back to site. The pontoon would be secured to the locator piles and packing plates used to trim the plan position. The roof structure may be installed in a separate lift</li> <li>• The new gangway would be fabricated at an off-site facility and floated to site by barge. The gangway would be lifted into position a large barge mounted crane</li> <li>• Finishing works completed (architectural, services, handrails, etc.)</li> </ul>
Installation of new or improved facilities	<ul style="list-style-type: none"> <li>• Installation of way-finding signage</li> <li>• Re-landscaping of the construction areas.</li> </ul>
Site clean up	<ul style="list-style-type: none"> <li>• The site would be cleaned up and restored to its previous state</li> <li>• Sedimentation controls and temporary structures would be removed</li> </ul>

Key features of the proposal are illustrated in Figure 45 and virtual renders of the design are illustrated in Figure 46 to Figure 47.

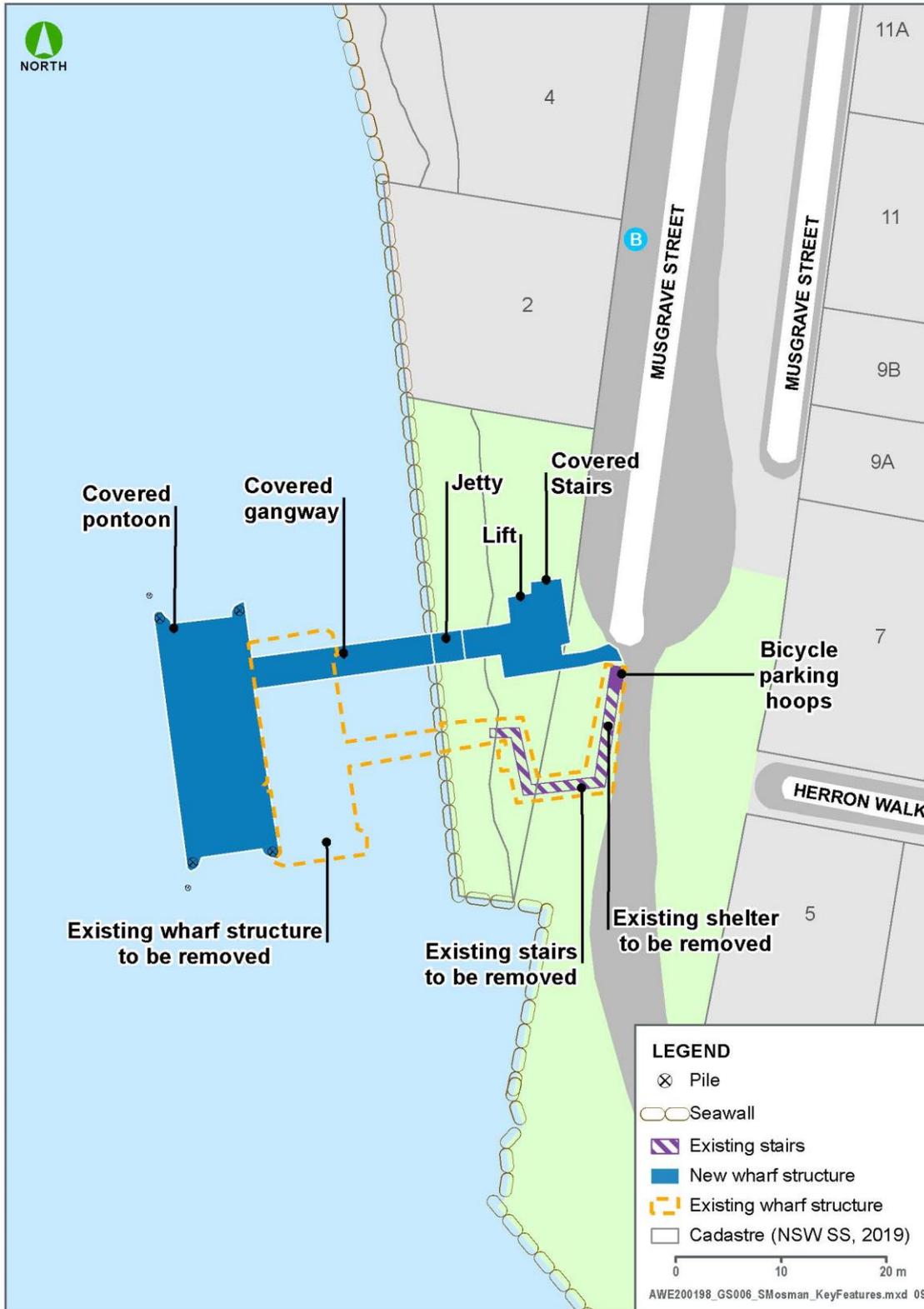


Figure 45. Key features of the proposal (provided by Cardno)



Figure 46. Render of the proposed wharf structure from water side perspective (provided by Transport for NSW)



Figure 47. Render of the proposed wharf from landside perspective at Musgrave Street (provided by Transport for NSW)



Figure 48. Render of the proposed wharf from landside perspective (waterfront) [provided by Transport for NSW]

## 8.0 HERITAGE IMPACT ASSESSMENT

### 8.1 Introduction

This section provides a heritage impact assessment for the heritage items located within and adjacent to the construction footprint, and within the wider visual buffer zone. An assessment of impacts to potential archaeological remains has also been included based on the preliminary archaeological assessment.

Individual visual impact assessments have been prepared for the heritage items within the FZ due to their closer proximity to the proposed works. Heritage items within the MZ and BZ have been assessed as a group as impacts to these items would generally be limited to the same visual impacts. Only visual impacts have been assessed for the heritage items within the MZ and BZ due to their distance from the construction footprint.

### 8.2 Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491)

#### 8.2.1 Direct and potential direct (physical) heritage impacts

Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) is a listed archaeological item and therefore impacts to potential archaeological remains associated with the item would equate to direct impacts to the heritage item. Potential impacts to archaeological remains of the heritage item are discussed in Section 8.9, although an assessment of potential direct impacts to archaeological remains resulting from vibrations are discussed below.

As outlined in Section 5.2.3, the curtilage of Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) is largely located to the south-east of the construction footprint and only a small portion of the proposal footprint extends into it (Figure 44). The proposed works would involve the removal of the existing stairs and path which are partially within the curtilage of the heritage item, however, these are not considered to be contributing elements to the significance of the item. The existing wharf and gangway also are not considered to be significant elements of the heritage item and therefore their removal would not result in heritage impacts. As a result, there are little to no built elements associated with the heritage item within the construction footprint except for a small portion of the sandstone retaining wall at the end of Musgrave Street (Figure 38). However, this was constructed as part of the second Musgrave Street Wharf and therefore does not provide a strong contribution to the heritage significance of Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491). The portion of the retaining wall within the curtilage of Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) would not be directly modified by the proposed works. As a result, the proposed works would not result in direct impacts to Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491).

The proposed works would involve piling and the use of a rock hammer and other vibration intensive plant. These works would be located within the minimum safe working distance for cosmetic damage, which is identified in the 2016 Roads and Maritime *Construction Noise and Vibration Guideline* as being within 68m of vibration intensive plant (Table 3).<sup>91</sup> Therefore, due to the close proximity of the works the vibrations associated with the piling, hammering and additional plant have the potential to cause impacts to the archaeological remains in the area, including the extant remains of the original Musgrave Street Wharf seawall and the later retaining wall at the south end of the construction footprint. However, only a small number of piles are required, the rock hammering would primarily be located on the opposite side of the construction footprint, the extant remains of the original seawall

<sup>91</sup> Roads and Maritime Services, 'Construction Noise and Vibration Guideline'. Roads and Maritime Services, 2016. 71.

are already subject to some movement as a result of being within the water, and as stated above the later retaining wall contributes little to the significance of Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491). The potential impacts could also be largely mitigated through control measures (see mitigation measures and recommendations in Section 9.2). As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, there would be a **neutral** direct and **negligible** potential direct impacts to Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491).

### 8.2.2 Indirect (visual) heritage impacts

The proposed works would involve the demolition of the existing wharf structure and stairs, and the construction of a new wharf and elevator structure. As outlined previously the existing wharf structure and stairs are not considered to be contributing elements to the significance of Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) and therefore their removal would not result in a visual impact. The new wharf and elevator structure would be located outside of the curtilage of Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), however it would be located directly adjacent to it. This would introduce new intrusive visual elements within sight of the heritage item, particularly the new lift which would not be consistent with the current views.

The proposed wharf, elevator and associated elements have been designed however to reduce the visual imprint of the new features. The wharf structure has been designed to be small in size and feature a low height and would be a similar size to the existing wharf. The wharf and elevator have also been designed to respond to existing visual cues on the harbour by using lightweight materials, simple lines, and muted colours, and the lift would be partially obscured by the existing vegetation. The introduction of a new wharf would be consistent with the historical use of the area, and the design of the wharf is consistent with other wharves in Sydney. Although the new features would be visible from Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), views to and from the heritage item would not be more obstructed than they currently are, and it would still retain views to Sydney Harbour. The proposed works would also retain the later seawall adjacent to the wharf. Although the later seawall is not part of the fabric of Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), it does contribute to the visual setting of the area and therefore retaining it would help to maintain the visual setting of the site.

Overall, the proposed works would result in a **negligible** visual impact to Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491).

## 8.3 Divided road (LEP no. I411)

### 8.3.1 Direct and potential direct (physical) heritage impacts

The proposed works would include impacts within the Musgrave Street Divided road (LEP no. I411), including saw cutting and excavating in the roadway, resurfacing, and impacts to pavements and kerbing, in addition to temporary construction impacts. The significance of the Musgrave Street Divided road however is largely associated with the structure and form of the road as a divided road, rather than the fabric of the road surface. Although the works would result in impacts within the roadway, they would only affect a small, localised area at the south end of the larger heritage item, and they would not alter the overall layout or form of the road. Therefore, any impacts to the heritage listed roadway would be minimal.

The proposed works would be located within the curtilage of Divided road (LEP no. I411) and therefore the vibrations associated with the proposed works could result in potential direct impacts. In particular, the proposed works are located within 10m of the rock face which divides the two halves of

the road and vibrations resulting from the proposed works could potentially cause cracking of the significant rock face. However, the rock face is a robust feature and it is therefore unlikely that the relatively minor works in the roadway would cause substantial structural issues. Furthermore, the portion of the divided road within the construction footprint is only a small part of the overall heritage item. As a result, any potential direct vibration impacts would cause minimal impacts to Divided road (LEP no. I411) overall.

Overall, there would be a **negligible** direct and potential direct impact to Divided road (LEP no. I411).

### 8.3.2 Indirect (visual) heritage impacts

Visual impacts to the Musgrave Street Divided road (LEP no. I411) would primarily be associated with the construction of the new wharf structure with elevator and stairs adjoining Musgrave Street. The proposed superstructure would be in a more prominent position when viewed from Musgrave Street than the extant wharf structure and would be visible from much of the southern end of Musgrave Street. This would introduce new intrusive visual elements within the portion of the heritage item that sees the most pedestrian foot traffic, and as a result would detract from the visual setting of Divided road (LEP no. I411), which derives part of its significance from its aesthetical heritage values.

The superstructure however has been designed to be cohesive with the surrounding area and the sandstone retaining wall of the divided road. Therefore, because of the recessive design of the Musgrave Street-facing structure any impacts to the setting of the divided road would be minimal. Furthermore, as the new features would only be visible from the south end of Musgrave Street, they would only be visible from a small portion of the overall heritage item.

Overall, the proposed works would result in a **negligible** visual impact to Divided road (LEP no. I411).

## 8.4 Group of 2 houses, divided into 3 dwellings (LEP no. I183)

### 8.4.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of Group of 2 houses, divided into 3 dwellings (LEP no. I183). As a result, there would be no direct impacts to the heritage item. Group of 2 houses, divided into 3 dwellings (LEP no. I183) is located 20m east from the nearest proposed work (works on Musgrave Street). As a result, the heritage item would be located within the minimum safe working distance for cosmetic damage and the vibrations associated with the proposed works could result in potential direct impacts. However, as the structure is located further away from the main works it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposed works would result in **neutral** direct and **negligible** potential direct impact to Group of 2 houses, divided into 3 dwellings (LEP no. I183).

### 8.4.2 Indirect (visual) heritage impacts

Group of 2 houses, divided into 3 dwellings (LEP no. I183) was not accessed during the site inspection, however, given the location of the buildings on the upper level of Musgrave Street, it is anticipated that the houses would have views of the construction footprint. The construction of the new wharf and associated features would therefore introduce new visually intrusive elements within sight of the heritage item. While the new wharf would be largely obscured by the terrain, the new elevator and stair superstructure would be more visible (Figure 47). However, the structure has been designed to be less obtrusive through the use of lightweight and consistent materials, simple lines, and muted colours. The new superstructure would not obstruct views from the houses across

Mosman Bay to Cremorne or views towards the heritage item. As a result, the visual impact associated with the proposed works would be minimal.

Overall, the proposed works would result in a **negligible** visual impact to Group of 2 houses, divided into 3 dwellings (LEP no. I183).

## 8.5 Herron Walk Steps (LEP no. I412)

### 8.5.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of Herron Walk Steps (LEP no. I412). As a result, there would be no direct impacts to Herron Walk Steps (LEP no. I412). The heritage item is located 20m east from the nearest proposed work (removal of the existing stairs). As a result, the heritage item would be located within the minimum safe working distance for cosmetic damage and the vibrations associated with the proposed works could result in potential direct impacts. However, as the structure is located further away from the main works and is on higher ground it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposed works would result in **neutral** direct and **negligible** potential direct impact to Herron Walk Steps (LEP no. I412).

### 8.5.2 Indirect (visual) heritage impacts

Herron Walk Steps (LEP no. I412) was not accessed during the site inspection, however, given the location of the item on the upper level of Musgrave Street, it is anticipated that the steps would have at least a partial view of the construction footprint. However, views to the construction footprint would be largely obscured by the terrain and the existing vegetation. Furthermore, the small part of the proposed superstructure that would be visible would only be visible from the western edge of the heritage item, as views from the remainder of the item would be blocked by the adjacent buildings. Therefore, only a small portion of the heritage item would be visually impacted, and the visual impact associated with the proposed works would be minimal.

Overall, the proposed works would result in a **negligible** visual impact to Herron Walk Steps (LEP no. I412).

## 8.6 Chinese boatshed (LEP no. I182)

### 8.6.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of Chinese boatshed (LEP no. I182). As a result, there would be no direct impacts to the heritage item. Chinese boatshed (LEP no. I182) is located 50m south-east of the nearest proposed work (removal of the existing stairs).

As a result, there would be no direct impacts to Chinese boatshed (LEP no. I182), and the works would be far enough away that there would be no risk of potential direct impacts resulting from vibrations. As a result, the heritage item would be located within the minimum safe working distance for cosmetic damage and the vibrations associated with the proposed works could result in potential direct impacts. However, as the structure is located further away from the main works and is closer to the minimum safe working distance, it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposed works would result in **neutral** direct and **negligible** potential direct impact to Chinese boatshed (LEP no. I182).

### 8.6.2 Indirect (visual) heritage impacts

Chinese boatshed (LEP no. I182) is located about 50m south-east of the construction footprint. However, there are no direct sightlines between Chinese boatshed (LEP no. I182) and the construction footprint due to the natural landforms in the area and the alignment of Musgrave Street. The new wharf would not be visible from Chinese boatshed (LEP no. I182).

Overall, the proposed works would result in **neutral** visual impacts to Chinese boatshed (LEP no. I182).

## 8.7 Visual impacts to heritage items in the MZ

This section provides a visual impact assessment for the heritage items located within the MZ of the visual buffer zone (located 200 – 500m from the construction footprint). The items within the MZ are listed in Table 10.

**Table 10. Heritage items within the MZ of the visual buffer zone**

Item	Address	Significance	Listing	Distance from construction footprint
Cremorne Reserve (including Robertsons Point)	N/A	Local	North Sydney LEP no. I0136	Visual buffer zone (200m west)
Sydney Amateur Sailing Club building	Green Street	Local	North Sydney LEP no. I0103	Visual buffer zone (200m north-west)
Cremorne Point Conservation Area	N/A	Local	North Sydney LEP no. CA06	Visual buffer zone (200m west)
Site of Cremorne Smelter	East of 5 Green Street	Local	North Sydney LEP no. I0102	Visual buffer zone (220m south-west)
Old Cremorne Wharf	Kareela Road, foreshore of Mosman Bay	Local	North Sydney LEP no. I0110	Visual buffer zone (300m north-west)

The proposed construction of the wharf and associated superstructure would introduce new intrusive elements within sight of the heritage items listed above, which have views to and from the construction footprint. However, while direct sightlines are present to and from each of these heritage items, they are located at a sufficient distance that the wharf and associated elements would not interrupt prominent views and would generally only be partially visible in the background. The wharf and associated elements have been designed to be less obtrusive through the use of lightweight and consistent materials, simple lines, and muted colours. Renders of the proposed design show that the low height of the proposed wharf would enable the retention of views between heritage items along Musgrave Street across Mosman Bay to Cremorne, and into Sydney Harbour. The new wharf would be consistent with the historical use of the area and views to the wharf would be mostly comparable to the views to the existing wharf. Other elements of the proposed works such as new paving and bicycle parking spaces would either be low to the ground or small in size and therefore would not be visible at that distance.

There may be some temporary visual impacts resulting from the site compound within the grassy area adjacent to the wharf, however this would be relatively minimal and would be fully removed following completion of the works.

Overall, the proposed works would have a **negligible** visual impact to most of the heritage items listed in Table 10, but this impact would not affect the overall significance of the heritage items.

## 8.8 Visual impacts to heritage items in the BZ

This section provides a visual impact assessment for the heritage items located within the BZ of the visual buffer zone (located 500m or more from the construction footprint). The items within the BZ are listed in Table 11.

**Table 11. Summary of impacts to listed heritage items in the area**

Item	Address	Significance	Listing	Distance from construction footprint
Balangowan	5 Bromley Avenue	Local	North Sydney LEP no. I0086	Visual buffer zone (620m north-west)
Lower Boyle St Conservation Area	Lower Boyle Street	Local	Mosman LEP no. C13	Visual buffer zone (620m north-west)

The proposed construction of the wharf and superstructure would introduce new intrusive elements within sight of Balangowan (LEP no. I0086) and the Lower Boyle St Conservation Area (LEP no. C13), which would have some views to the construction footprint. Although the heritage items would have views towards the construction footprint, the distance to the construction footprint would be sufficient enough that the new structures would not introduce adverse visual impacts to the area or obstruct any significant viewlines to from the heritage items.

Overall, the proposed works would result in a **neutral** visual impact to Balangowan (LEP no. I0086) and the Lower Boyle St Conservation Area (LEP no. C13).

## 8.9 Impacts to archaeological resources

The proposed works within the construction footprint would require excavations up to 5-10m deep for the elevator piles and up to 1m deep on Musgrave Street, with the remainder of the works typically being shallower than this. However, the preliminary archaeological assessment has identified that there is relatively low potential for significant archaeological remains to be within the impact footprint of the works.

The construction footprint contains extant archaeological remains of the Phase 1 sandstone seawall of the original Musgrave Street Wharf. However, the remains of the seawall are located to the south of the angled return of the later seawall, and the proposal footprint is located to the north of the angled return of the seawall, therefore the extant archaeological remains of the original seawall would not be directly impacted. Furthermore, the main structure of the original wharf was located further south-east outside the construction footprint, and there are no known Phase 2 remains associated with the original wharf within the grass and pavement area of the proposal footprint next to the existing wharf, where excavations for landscaping and construction of the elevator would be undertaken. As a result, the known and potential archaeological remains associated with the original wharf structure and seawall would not be impacted by excavations. The proposed excavations in Musgrave Street would also be located within a small portion of the northern end of the archaeological site and could impact potential Phase 2 archaeological remains of earlier road construction that may survive in that location. This would result in a direct impact to locally significant archaeological remains within the heritage item. However, only a very small portion of the proposal

footprint extends into this area. Overall, the potential archaeological impacts to Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) would be negligible.

On Musgrave Street there is also low potential for locally significant archaeological remains of Phase 2 road constructions to be present within the curtilage of Divided road (LEP no. I411). Evidence of the former road constructions, including earlier road surfaces and associated kerbing and drainage, would be directly associated with the establishment of Divided road (LEP no. I411). Therefore, impacts to the potential archaeological remains would result in an archaeological impact to the heritage item. The proposed works would only be undertaken within a relatively small portion of the heritage item, however. Overall, the potential archaeological impacts to Divided road (LEP no. I411) would be negligible.

The bulk of the proposed excavations would be undertaken around the base of the elevator for the piles and landscaping. However, the preliminary archaeological assessment has identified that there are unlikely to be significant archaeological remains present in that location. There is generally nil to low potential for locally significant archaeological remains from the Phase 1 whaling allotment. The construction footprint was primarily associated with the Phase 3 establishment of the second Musgrave Street Wharf and waiting room, however, it has been assessed that archaeological remains associated with these would not reach the threshold of local significance. This would include potential maritime remains associated with the former pontoon, such as timber piles, as well as non-significant Phase 2 reclamation fills including minor artefactual material contained within the fill layers. As a result, there is limited risk of impacts to significant archaeological remains within the proposal footprint.

Overall, the proposed works would potentially result in **negligible** impacts to archaeological remains of local significance. As a result, it is unlikely that detailed archaeological management and investigation would be required.

The preliminary archaeological assessment has identified that the potential archaeological remains within the construction footprint would likely be limited to 'works'. As a result, based on the preliminary archaeological assessment it is unlikely that the proposed works would result in impacts to significant archaeological 'relics'.

## 8.10 Summary of impacts to heritage items

A summary of impacts to relevant heritage items is provided in Table 12.

**Table 12: Summary of impacts to heritage items**

Heritage item	Direct	Indirect (visual)	Potential direct	Archaeological
Musgrave Street Wharf site	Neutral	Negligible	Negligible	Negligible
Divided road	Negligible	Negligible	Negligible	Negligible
Group of 2 houses, divided into 3 dwellings	Neutral	Negligible	Negligible	Neutral
Herron Walk Steps	Neutral	Negligible	Negligible	Neutral
Chinese boatshed	Neutral	Neutral	Negligible	Neutral
Cremorne Reserve (including Robertsons Point)	Neutral	Negligible	Neutral	Neutral

Heritage item	Direct	Indirect (visual)	Potential direct	Archaeological
Sydney Amateur Sailing Club building	Neutral	Negligible	Neutral	Neutral
Cremorne Point Conservation Area	Neutral	Negligible	Neutral	Neutral
Site of Cremorne Smelter	Neutral	Negligible	Neutral	Neutral
Old Cremorne Wharf	Neutral	Negligible	Neutral	Neutral
Balangowan	Neutral	Neutral	Neutral	Neutral
Lower Boyle St Conservation Area	Neutral	Neutral	Neutral	Neutral

### 8.11 Statement of heritage impact

A statement of heritage impact has been prepared according to the NSW Heritage Office guidelines in Table 13 below.

**Table 13: Statement of Heritage Impact for the proposal**

Development	Discussion
What aspects of the Proposal respect or enhance the heritage significance of the study area?	<p>The proposed works are largely located outside of listed heritage items, with only small portions of the proposal footprint extending into Musgrave Street Wharf site (SHI no. 4920109 &amp; LEP no. A491) and Divided road (LEP no. I411). The proposed works would avoid impacts to the extant locally significant archaeological remains of the original seawall of Musgrave Street Wharf site (SHI no. 4920109 &amp; LEP no. A491).</p> <p>The proposed wharf and associated superstructure would introduce new intrusive visual elements in the area. However, the new wharf is consistent with the historical use of the area, and the wharf and associated elements have been designed with appropriate materials and colours to reduce the visual impact on the context and setting of the area, or on views to and from heritage items in the area. The proposal would allow greater accessibility and appreciation of the area by providing DDA compliant access.</p>
What aspects of the Proposal could have a detrimental impact on the heritage significance of the study area?	<p>The proposed works would introduce new intrusive visual elements in the vicinity of listed heritage items. However, the introduction of a new wharf is consistent with the historical use of the area and the structures have been designed to reduce visual impacts. The proposed excavations could potentially impact evidence of earlier road constructions within the curtilages of Musgrave Street Wharf site (SHI no. 4920109 &amp; LEP no. A491) and Divided road (LEP no. I411). However, because of the relatively small impact area within the curtilages, impacts to potential archaeological remains would be negligible and the archaeological remains are unlikely to include significant archaeological 'relics'.</p>

Development	Discussion
	<p>Vibrations associated with the proposed works have the potential to result in structural impacts to the original seawall in Musgrave Street Wharf site (SHI no. 4920109 &amp; LEP no. A491), the rock face of Divided road (LEP no. I411), Group of 2 houses, divided into 3 dwellings (LEP no. I183), Herron Walk Steps (LEP no. I412) and Chinese boatshed (LEP no. I182). However, the risk of potential indirect impacts could be largely mitigated through control measures.</p> <p>The proposal would also introduce new intrusive visual elements which would be visible from most heritage items in the area. However, the generally negligible visual impacts to the heritage items within the visual buffer zone would have minimal impact to the overall setting and character of these items and would not impact their overall heritage significance. The proposed works are necessary to make South Mosman Wharf DDA compliant</p>
Have more sympathetic options been considered and discounted?	<p>Three options were assessed as part of the concept design. Option 2 and Option 3 both proposed larger switchback ramps to connect Musgrave Street to the new wharf. Both of these options would have resulted in a greater visual impact and would have provided a less direct route for passengers to the wharf. Both designs also would have extended further into the curtilage of Musgrave Street Wharf site (SHI no. 4920109 &amp; LEP no. A491). These options were discounted in favour of Option 1 (the current design), which proposed the more direct lift and stairs instead of a switchback ramp. This has helped to reduce impacts to Musgrave Street Wharf site (SHI no. 4920109 &amp; LEP no. A491).</p>

## 9.0 MANAGEMENT AND MITIGATION MEASURES

### 9.1 Conclusions

This SoHI has determined the following:

- The impacts associated with the proposed works are necessary to make South Mosman Wharf compliant with the requirements of the DDA
- The construction footprint is located within the curtilage of one heritage item listed on the Roads and Maritime s170 Heritage and Conservation Register and two heritage items listed on the Mosman LEP 2012:
  - Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491)
  - Divided road (LEP no. I411)
- The construction footprint is located adjacent to the curtilages of two heritage items listed on the Mosman LEP 2012:
  - Group of 2 houses, divided into 3 dwellings (LEP no. I183)
  - Herron Walk Steps (LEP no. I412)
- The visual buffer zone for the construction footprint also includes eight items listed on the North Sydney LEP 2013 and Mosman LEP 2012:
  - Chinese boatshed (Mosman LEP no. I182)
  - Sydney Amateur Sailing Club Building (North Sydney LEP no. I0103)
  - Site of Cremorne Smelter (North Sydney LEP no. I0102)
  - Old Cremorne Wharf (North Sydney LEP no. I0110)
  - Cremorne Reserve (including Robertson's Point) (North Sydney LEP no. I0136)
  - Balangowan (North Sydney LEP no. I0086)
  - Cremorne Point Conservation Area (North Sydney LEP no. CA06)
  - Lower Boyle St Conservation Area (Mosman LEP no. C13)
- A preliminary archaeological assessment has determined that the construction footprint has nil to low potential to contain locally significant archaeological remains associated with Phase 1 (1788-1873 Informal use and whaling allotments), and low to high potential to contain locally significant archaeological remains associated with Phase 2 (1873-1905 Richard Hayes Harnett development), including extant evidence of the original Musgrave Street Wharf seawall (high potential) and evidence of the earlier establishment of Musgrave Street (low potential). The extant archaeological remains of the original Musgrave Street Wharf seawall would not be directly impacted, however. The construction footprint also has moderate to high potential to contain non-significant reclamation fills associated with Phase 2, and low to high potential to contain non-significant evidence of the second Musgrave Street Wharf associated with Phase 3 (1905-1968 Second Musgrave Street Wharf). The archaeological remains would likely be limited to evidence of former 'works' and the construction footprint is unlikely to contain significant 'relics' as defined by the Heritage Act

- Based on the preliminary archaeological assessment, excavations associated with the proposal would result in negligible impacts to potential archaeological remains of local significance. The proposed excavations are unlikely to impact significant 'relics'
- The proposed works would not impact the overall significance of the heritage items within and adjacent to the construction footprint, or the heritage items within the visual buffer zone
- The impacts on the identified heritage items resulting from the proposed works are summarised in the table below.

Heritage item	Direct	Indirect (visual)	Potential direct	Archaeological
<b>Musgrave Street Wharf site</b>	Neutral	Negligible	Negligible	Negligible
<b>Divided road</b>	Negligible	Negligible	Negligible	Negligible
<b>Group of 2 houses, divided into 3 dwellings</b>	Neutral	Negligible	Negligible	Neutral
<b>Herron Walk Steps</b>	Neutral	Negligible	Negligible	Neutral
<b>Chinese boatshed</b>	Neutral	Neutral	Negligible	Neutral
<b>Cremorne Reserve (including Robertsons Point)</b>	Neutral	Negligible	Neutral	Neutral
<b>Sydney Amateur Sailing Club building</b>	Neutral	Negligible	Neutral	Neutral
<b>Cremorne Point Conservation Area</b>	Neutral	Negligible	Neutral	Neutral
<b>Site of Cremorne Smelter</b>	Neutral	Negligible	Neutral	Neutral
<b>Old Cremorne Wharf</b>	Neutral	Negligible	Neutral	Neutral
<b>Balangowan</b>	Neutral	Neutral	Neutral	Neutral
<b>Lower Boyle St Conservation Area</b>	Neutral	Neutral	Neutral	Neutral

## 9.2 Management and mitigation measures

The following mitigation measures should be enacted to minimise heritage impacts:

- The proposed works would not result in greater than minor impacts to any locally listed heritage item. As a result, the proposal is consistent with the general requirements for exempt development under Section 20 of ISEPP. Therefore, consultation is not required with Mosman Municipal Council prior to any impacts occurring. However, a copy of this report should be submitted to Mosman Municipal Council for their reports
- A copy of this report would be submitted to Transport for NSW to inform them of the negligible impacts to Musgrave Street Wharf site which is listed on the Roads and Maritime s170 Heritage and Conservation Register (SHI no. 4920109)

- This SoHI has identified that there is currently no mapped curtilage available for Musgrave Street Wharf site (SHI no. 4920109). It is recommended that the s170 heritage curtilage be updated to be consistent with the current Mosman LEP 2012 curtilage for the heritage item (LEP no. A491), which was previously reassessed by Austral in 2015<sup>92</sup>
- In accordance with the sustainability requirements for the project, opportunities for implementation of heritage interpretation should be investigated during detailed design. It is recommended that a Heritage Interpretation Strategy be prepared for the proposal. This report would discuss various media for heritage interpretation appropriate to the location and heritage significance of the South Mosman Wharf. This would be consistent with the recommended management for Musgrave Street Wharf site (SHI no. 4920109) that is outlined in the SHI sheet for the Roads and Maritime s170 Heritage and Conservation listed item, which states that 'The wharf waiting shelter provides opportunities for interpretation of the history and significance of the wharf, the ferry system and other heritage elements within their visual catchment which should be explored and developed.'<sup>93</sup>
- As part of the preparation of the Heritage Interpretation Strategy the area around South Mosman Wharf, Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491) and Divided road (LEP no. I411) should be photographed to help document the changes to the area and the development of the South Mosman Wharf
- If feasible, the extant timber beams that are visible in the seawall and are associated with the second Musgrave Street Wharf and waiting room should be retained and re-use can be incorporated into the Heritage Interpretation Strategy
- The preliminary archaeological assessment has identified that there is low to high potential for archaeological remains of local significance associated with Phase 2 to be present within the construction footprint. However, as the area of high archaeological potential (extant remains of the Phase 2 original Musgrave Street Wharf seawall) is located outside of the proposal footprint and would not be directly impacted, it is unlikely significant archaeology would be impacted. The preliminary archaeological assessment has found that the potential archaeological remains would likely be limited to 'works'. As a result, an exception under Section 139 (4) of the Heritage Act would not be required for the proposed works and they would be managed under the Roads and Maritime Unexpected Heritage Item Procedure 2015
- If design changes result in additional excavations and impacts to significant archaeological remains associated with Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), further archaeological assessment and management would be required
- If unexpected 'relics' are encountered during excavation, a s146 relics notification would be forwarded to Heritage NSW, DPC. 'Relics' cannot be impacted without appropriate approvals under the Heritage Act

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<sup>92</sup> Austral Archaeology, 2015. 'Assessment of Archaeological Sites, Mosman Local Environmental Plan Historical Archaeological Site Assessment'.

<sup>93</sup> Heritage NSW, DPC, 2017. 'Musgrave Street Wharf Site'.

- If significant archaeological remains are encountered during excavation, design options for avoiding impacts to the significant archaeological remains should be considered where practicable and opportunities should be investigated for the implementation of heritage interpretation
- If archaeological 'works' such as evidence of earlier road constructions are encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts
- A heritage induction would be provided to workers prior to construction, informing them of the location and significance of known heritage items and the implementation of the Unexpected Heritage Item Procedure 2015 if unanticipated heritage items or deposits are located during construction. The heritage induction would include management of expected non-significant archaeological remains, such as minor artefactual material associated with Phase 2 reclamation fills
- It is unlikely that the vibrations associated with the proposed works would result in direct impacts to the original seawall and the retaining wall within the Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), the rock face of Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183). However, a structural engineer should assess this to confirm if there are potential risks of vibration impacts
- During the construction works, regular inspections of the construction activities and work areas should be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology and confirm the integrity of the seawall and retaining wall in Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), the rock face in Divided road (LEP no. I411), and the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183). Assessment and monitoring of vibration impacts should adhere to:
  - British Standard BS 7385: *Part 2: Evaluation and Measurement for Vibrations in Buildings – Part 2 Guide to Damage Levels from Ground-Borne Vibration*
  - German Standard DIN 4150, *Part 3: Structural Vibration in Buildings: Effects on Structures*
- If vibration monitors are attached to the retaining wall in Musgrave Street Wharf site (SHI no. 4920109 & LEP no. A491), the rock face in Divided road (LEP no. I411), or the buildings in Group of 2 houses, divided into 3 dwellings (LEP no. I183), they must not be attached with permanent fixings. They should be removable without causing damage. Bees wax may be a suitable attachment method
- If it is identified that levels of vibration are causing damage to heritage fabric, works must cease, and the construction methodology reviewed by the project engineers in consultation with a Heritage Consultant in order to mitigate further impacts. A temporary protection plan to outline protection measures required for significant fabric during activities causing potential vibration impacts would be prepared prior to commencement of works
- All impacted areas and ground surfaces, including grassed surfaces adjacent to the wharf and the road surface of Musgrave Street, must be reinstated as near as possible to their original state following the completion of works

- It has been assessed that the proposed works would avoid archaeological remains of the original Musgrave Street Wharf and that potential maritime archaeological remains of the Phase 3 second Musgrave Street Wharf would not reach the threshold of local significance. As a result, a maritime archaeological assessment would not be required to assess the potential for impacts to maritime archaeological remains of the former wharves
- Any proposal redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to this SoHI.

## 10.0 REFERENCES

- Austral Archaeology, 2008. *Former Musgrave Street Wharf, Mosman NSW Archaeological Assessment & Statement of Heritage Impact*. Report prepared for Mosman Municipal Council.
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## Appendix H

### Procedure for Aboriginal cultural heritage consultation and investigation clearance letter

30/10/2020

Rebecca Murray  
Environment Officer  
Environment Officer I Greater Sydney Project Office

Dear Rebecca

**Re: Preliminary assessment results for the South Mosman Wharf Project *proposal area* proposal based on Stage 1 of the *Procedure for Aboriginal cultural heritage consultation and investigation* (the procedure).**

The project, as described in the Stage 1 assessment checklist, was assessed as being unlikely to have an impact on Aboriginal cultural heritage. The assessment is based on the following due diligence considerations:

- The project is unlikely to harm known Aboriginal objects or places.
- The AHIMS search did not indicate any known Aboriginal objects or places in the immediate study area.
- The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the Roads and Maritime Services' procedure.
- The Aboriginal cultural heritage potential of the study area appears to be severely reduced due to past disturbance.

Your project may proceed in accordance with the environmental impact assessment process, as relevant, and all other relevant approvals.

If the scope of your project changes, you must contact me and your regional environmental staff to reassess any potential impacts on Aboriginal cultural heritage.

If any potential Aboriginal objects (including skeletal remains) are discovered during the course of the project, all works in the vicinity of the find must cease. Follow the steps outlined in the Roads and Maritime Services' *Unexpected Archaeological Finds Procedure*.

For further assistance in this matter and do not hesitate to contact me.

Yours sincerely



Mark Lester  
Aboriginal Cultural Heritage Officer – Sydney Region  
27-31 Argyle St Parramatta NSW 2150

**Roads and Maritime Services**

# Appendix I

## Socio-economic impact assessment

# Socio-economic Impact Assessment

## South Mosman Wharf Upgrade

AWE200198

Prepared for  
Transport for NSW

19 November 2020



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Our report is based on information made available by the client. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Cardno is both complete and accurate. Whilst, to the best of our knowledge, the information contained in this report is accurate at the date of issue, changes may occur to the site conditions, the site context or the applicable planning framework. This report should not be used after any such changes without consulting the provider of the report or a suitably qualified person.

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# 1 Introduction

---

## 1.1 Overview

Transport for NSW proposes to construct a new wharf at South Mosman (the proposal) as part of the NSW Government's Transport Access Program (TAP). TAP is an initiative to deliver modern, safe and accessible transport infrastructure across NSW.

This socio-economic impact assessment (SEIA) has been prepared by Cardno (NSW/ACT) Pty Ltd on behalf of Transport for NSW. For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979*.

The SEIA has been prepared to inform the Review of Environmental Factors (REF) for the proposal. The SEIA is required by Transport for NSW to ensure potential socio-economic impacts have been considered in the proposal's planning phase.

## 1.2 Proposal description

The proposal is located in the Mosman Local Government Area (LGA) and about six kilometres from the Sydney Central Business District (CBD).

South Mosman wharf is located in Mosman Bay, on the western side of Curraghbeena Point on Sydney's Lower North Shore. The wharf is accessed from Musgrave Street which runs along the western side of the peninsula and terminates at the wharf interchange.

Figure 1-1 and Figure 1-2 show the regional and local setting respectively. South Mosman Wharf is a stop on the F6 Ferry Service that operates between Circular Quay and Mosman Bay. The proposal is to improve access to the wharf, and upgrade and install a new gangway and floating pontoon to allow for more efficient passenger services. The proposed wharf would include a new lift and stairs, providing a safer accessible route from street-level to the wharf.

The key features of the proposal are shown in Figure 1-3 and Figure 1-4, and detailed description of the water-based and land-based works are provided below.

The water based features of the proposal would include:

- > Installation of a new covered 18.9 metre gangway, located to the north of the existing wharf to provide access to the new pontoon
- > Installation of a new covered steel 9 metre by 22.5 metre pontoon containing a curved zinc roof, steel columns, glass weather screens, stainless steel balustrades, seating and information boards. The pontoon would be held in place by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- > Installation of safety and security features on the pontoon including lighting, closed circuit television (CCTV) cameras, ladders to the water and a life buoy on the pontoon, glass weather screen and tactile ground surface indicators
- > Removal of the existing gangway and pontoon including existing piles
- > Remediation of the seawall following removal of the existing wharf, if required.

The land based features of the proposal would include:

- > Installation of a new 16 metre high lift and new covered stairs
- > Installation of a new covered street level waiting area
- > Installation of a covered footpath and jetty structure from the proposed lift and stairs to the proposed gangway
- > Installation of three bicycle parking hoops
- > Removal of existing shelter and stairs from Musgrave Street to the existing wharf
- > Removal of trees and vegetation to construct the lift, stairs and ramp to the jetty.

The proposal would be constructed over a duration of up to six months starting in late 2021.



Figure 1-1 Regional setting of the South Mosman wharf



Figure 1-2 South Mosman wharf location and local setting

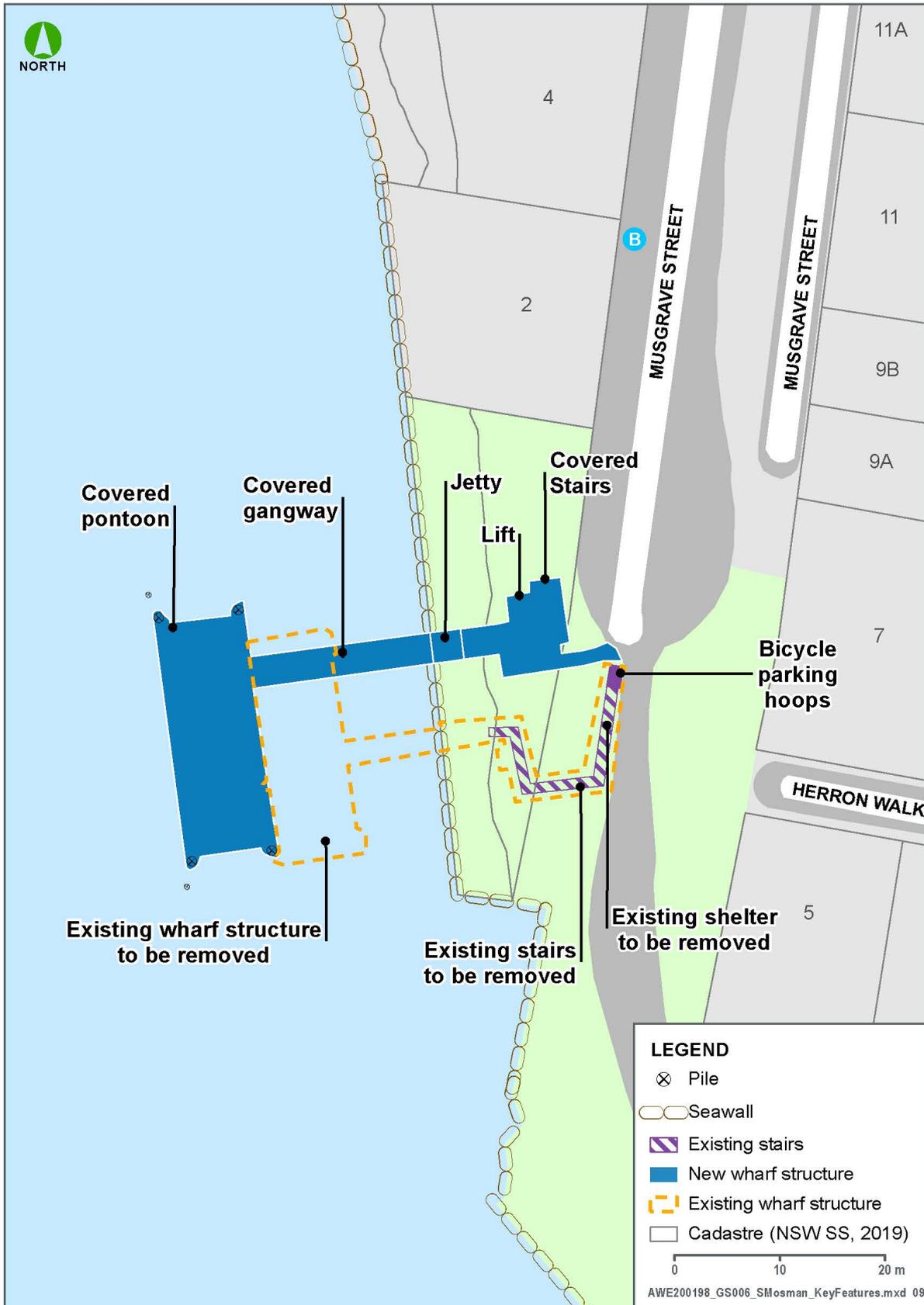


Figure 1-3 Key features of the proposal



Figure 1-4 South Mosman wharf visualisation of proposed changes, source TfNSW 2020.

### 1.3 Purpose of the report

The purpose of this SEIA is to identify and assess the socioeconomic impact of the proposal and recommend management and mitigation measures to address the identified impacts. The SEIA has been prepared to inform the REF for the proposal.

This SEIA has been prepared in accordance with the *Roads and Maritime Services Assessment Practice Note: Socio-economic assessment EIA-N05 (2013)*. The aims of this report are to:

- > Establish the baseline socio-economic conditions in the proposal area, including identifying potentially affected groups or communities, to provide a basis for predicting likely changes and future monitoring of impact management strategies
- > Identify and assess potential socio-economic benefits or impacts arising from the proposal, including the magnitude, duration and likelihood of identified benefits and impacts
- > Identify mitigation and monitoring measures, including measures to enhance the proposal's benefits and avoid, manage or mitigate its potential impacts.

### 1.4 Structure of this report

The structure of the report is outlined below:

- > Section 1: Introduction – introduces the proposal and scope of this report
- > Section 2: Methodology – provides a description of the study area specific to the socio-economic assessment, an overview of the socio-economic assessment methodology, and data sources used
- > Section 3: Policy setting – provides an overview of the strategic policy framework relevant to the socio-economic environment of the proposal
- > Section 4: Existing environment – provides an overview of the existing socio-economic conditions of the study area
- > Section 4: Potential impacts – provides an assessment of the potential socio-economic benefits and impacts of the proposal
- > Section 5: Safeguards and management measures – outlines the safeguards and management measures for potential socioeconomic impacts resulting from the proposal
- > Section 6: Conclusion – provides a conclusion of the findings in the socio-economic assessment
- > Section 7: References.

## 2 Methodology

---

This SEIA assesses the socio-economic impact of the proposal in accordance with Roads and Maritime Service's Environmental Impact Assessment Practice Note – Socio-economic assessment (EIA-N05) (Practice Note) (Roads and Maritime, 2013). This section provides an overview of the study area and methodology applied.

### 2.1 Study area

The extent of the Study Area for this assessment (shown in Figure 1-1) comprises the communities that have potential to experience changes due to the construction and operation of the proposal.

The local Study Area was defined using Australian Bureau of Statistics (ABS) geographic boundaries, for which statistical data is readily available. The Mosman Statistical Area Level 2/Mosman LGA, hereafter "Study Area", has been selected to represent the Study Area for this assessment.

In practice it is clear that there are several scales of potential impact, ranging from the immediate impact to communities living close to the South Mosman wharf, users of the wharf and Musgrave Street, Mosman LGA, or to the broader North Sydney-Mosman Statistical Area – Level 3 (SA3) or Greater Sydney region.

### 2.2 Data sources

The following data sources were used to define the socio-economic baseline:

- > Data on population and demography, income and employment, and business and industry were sourced from the ABS Census 2016, and Commonwealth, State and local government agencies
- > Existing socio-economic policies and strategies in the North Sydney-Mosman area, including local government policies and strategies:
  - Mosman Council 2018-2019 Annual Report (Mosman Council, 2019)
  - MOSPLAN: Community Strategic Plan 2018-2028 (Mosman Council, 2018a)
  - MOSPLAN: Revised Delivery Program 2018-2021 and Operational Plan 2020-2021 (Mosman Council, 2020a)
  - Mosman Disability Inclusion Action Plan 2017-2021 (Mosman Council, 2017a)
  - Mapping Mosman's Community Services and Programs (Mosman Council, 2018b)
  - Greater Sydney Harbour Estuary Coastal Management Program Scoping Study (BMT, 2018)
- > South Mosman Wharf Upgrade Concept Design Community Consultation Report – July 2020 (NSW Government, 2020) details the outcomes of community consultation on the concept design of the proposal
- > NSW Department of Planning, Industry and Environment (DPIE) population projections (DPIE, 2019)
- > Analysis of social infrastructure based on a review of publicly available information, including Council's webpage
- > Available mapping and imagery from Google maps and from government agencies.

This assessment is informed by the following studies commissioned as part of the concept design and REF:

- > South Mosman Wharf Upgrade: Landscape character and visual impacts (Cardno, 2020a)
- > South Mosman Wharf Upgrade: Noise and vibration study (Cardno, 2020b)
- > South Mosman Wharf – Ferry Wharf Upgrade Program TAP 3 – Communications and Stakeholder Engagement Plan 2020 (Cardno, 2020c)
- > Preliminary Landscape Character and Visual Impact Assessment: Ferry Wharf Upgrade Program Package 3 South Mosman Wharf Interchange (Aurecon, 2020).

## 2.3 Scope

Scoping for the proposal was undertaken in accordance with the Practice Note (EIA-N05) to identify the appropriate level of SEIA required for the proposal. After the scoping process was completed, it was concluded that a basic level of assessment would be prepared.

## 2.4 Consultation

The SEIA has been informed by stakeholder and community consultation undertaken for the proposal during the concept design. A summary of the consultation activities undertaken is detailed in Chapter 5 (Consultation) of the REF.

The community and key stakeholders were invited to provide feedback on the project's concept design from Monday 4 May to Friday 29 May 2020. Community members and stakeholders were encouraged to provide feedback, leave comments and make submissions via phone, email, or via the online project portal and survey.

As part of the community consultation program, a four-page community update and a 'reminder to have your say' postcards were distributed to around 400 residents and businesses in the wharf area. Addressed letters were delivered to directly affected residents in lieu of doorknocking due to COVID-19 social distancing measures. Public meetings were not held to safeguard the health and safety of both the community and staff due to COVID-19 restrictions.

There were 119 individual submissions received, including: 14 emails, three phone calls, 47 survey responses, one letter and 54 comments on social media. The responses have been detailed in the South Mosman Wharf Upgrade Concept Design Community Consultation Report – July 2020 (NSW Government, 2020).

The responses have been analysed, along with local council plans, to gain insights into community identity, values and goals, and the community's perception about the potential impacts associated with the proposal.

### 3 Legislative and policy framework

This section provides an overview of the strategic policy framework relevant to the proposal, including State, regional and local government legislation, policies and strategies relevant to the socio-economic environment of the Study Area.

#### 3.1 NSW legislation and policies

##### 3.1.1 Greater Sydney Region Plan: A Metropolis of Three Cities

The *Greater Sydney Region Plan, A Metropolis of Three Cities* (Greater Sydney Commission, 2018a) is built on a vision of three cities where most residents live within 30 minutes of their jobs, education and health facilities, services and great places. The Greater Sydney Regional Plan consists of directions, objectives and strategies to meet the needs of a growing and changing population over the next 40 years.

To meet the needs of a growing and changing population the Greater Sydney Region Plan seeks to transform Greater Sydney into a metropolis of three cities, where the Study Area is located in the proposed Eastern Harbour City. The Harbour CBD is identified as the metropolitan centre of Eastern Harbour City, where South Mosman wharf is part of. The Plan states that the Harbour CBD, “will focus on innovation and global competitiveness to underpin its continued growth. It will extend its capabilities with an emerging Innovation Corridor on its western edge comprising universities, a major teaching hospital, international innovation companies and fast-growing start-ups.”

Directions, objectives and strategies which are of particular importance to this proposal are discussed below in Table 3-1.

Table 3-1 Directions, objectives and strategies relevant to the proposal (Greater Sydney Commission, 2018a)

Direction 1 A city supported by infrastructure: Infrastructure and collaboration	
Objectives	Objective 1: Infrastructure supports the three cities
Strategy	Strategy 1.1: Prioritise infrastructure investments to support the vision of A Metropolis of Three Cities.
Extracts from the Plan	<p>“Providing adequate infrastructure to support population growth is essential to creating strong communities. One mechanism to better align growth with infrastructure is the growth infrastructure compact which would assess the nature, level and timing of infrastructure required for an area in light of its forecast housing and employment growth, including analysis of growth scenarios. This approach would demonstrate the correlation between growth and infrastructure, such as public transport, schools and open space, to allow for timely integration and more effective expenditure on infrastructure by location. The sequencing, optimising and adaptability of infrastructure are also considered as part of managing infrastructure delivery with growth.”</p> <p>“Planning decisions need to support new infrastructure in each city – including cultural, education, health, community and water infrastructure – to fairly balance population growth with infrastructure investment. Decisions are required to equitably enhance local opportunities, inclusion and connection to services. In this way infrastructure provision can move from a focus on network-based services to a place-based service approach.”</p>
Direction 3 A city for people: Celebrating diversity and putting people at the heart of planning	
Objectives	Objective 7: Communities are healthy, resilient and socially connected
Strategy	<p>Strategy 7.1: Deliver healthy, safe and inclusive places for people of all ages and abilities that support active, resilient and socially connected communities by:</p> <ul style="list-style-type: none"> <li>▪ providing walkable places at a human scale with active street life</li> <li>▪ prioritising opportunities for people to walk, cycle and use public transport.</li> </ul>
Extracts from the Plan	<p>“Mixed-use neighbourhoods close to centres and public transport improve the opportunity for people to walk and cycle to schools, local shops and services.”</p> <p>“Physical, social and spatial accessibility is important across all ages and abilities and is a key part of planning for a female-friendly region. A region that is female-friendly applies the principles of Crime Prevention Through Environmental Design and is safer and more accessible for all people. Places and transport designed to be accessible by all people, and homes that can be easily adapted to house older people and people with a disability, are increasingly required as the population grows and demographics change.”</p>

Direction 6 A well-connected city: Developing a more accessible and walkable city	
Objectives	Objective 14: A Metropolis of Three Cities – integrated land use and transport creates walkable and 30-minute cities
Strategy	Strategy 14.1: Integrate land use and transport plans to deliver the 30-minute city. Strategy 14.3 Support innovative approaches to the operation of business, educational and institutional establishments to improve the performance of the transport network.
Extracts from the Plan	“Establish a metropolitan transport network which reinforces the metropolis of three cities, particularly the delivery of a 30-minute city where most residents in each city can access their metropolitan centre or cluster within 30 minutes by public transport.” “Greater Sydney transport survey outcomes: fully accessible transport for all customers”

The proposal supports the objectives and strategies of the Greater Sydney Region Plan by:

- > Planning for the future when the population around the South Mosman wharf is increasing and the demand for the ferry services are higher, necessitating the upgrade of the wharf infrastructure
- > Upgrading South Mosman wharf infrastructure to accessible platforms where the ferry services can be comfortably accessed by all customers.

### 3.1.2 Disability Inclusion Action Plan 2018-2022

The *Disability Inclusion Action Plan 2018–2022* is Transport for NSW’s plan for delivering high quality services to all customers including those with disability, including compliance with the Federal disability standards. The *Disability Standards for Accessible Public Transport (DSAPT, 2002)* and *Disability (Access to Premises – Buildings) Standards (2010)* form part of the Commonwealth *Disability Discrimination Act 1992 (DDA)*. Each prescribe the minimum accessibility standards for disabled access to public transport services and infrastructure, including a timetable for implementation. The proposal meets the above requirements within the timeframes specified in both standards by providing suitable access for people with a disability.

### 3.1.3 Transport Access Program (TAP)

The TAP is an ongoing ‘initiative to deliver modern, safe and accessible transport infrastructure’ in NSW (Transport for NSW, 2015). The focus of the program is improving access to the transport network for less mobile passengers. As a result, Roads and Maritime (now Transport for NSW) assessed the condition of all ferry wharves across the transport network in 2009 in terms of: safety and structural integrity, access for less mobile and disabled passengers, and existing and predicted future patronage and use.

The aims behind the objective of the TAP are to:

- > Improve the accessibility for passengers who use wheelchairs and prams by removing stairs and supplying ramps
- > Build facilities for all transport modes to meet the needs of a growing population
- > Provide an effective and seamless interchange that supports an integrated transport network
- > Deliver safety and signage improvements to help with the customer user experience
- > Provide other aesthetic improvements.

The Ferry Wharf Upgrade Program forms part of the TAP and its objectives are to:

- > Improve access for less mobile people
- > Improve passenger amenity
- > Improve passenger embarking/disembarking times
- > Develop an iconic design across the commuting wharf network
- > Cater for current and future passenger numbers
- > Minimise customer and wharf operator impact during any refurbishment and upgrade work
- > Minimise ownership and maintenance costs
- > Ensure the design complies with current safety laws
- > Discourage inappropriate activities on public wharves
- > Aim to comply with the DDA by 2022.

The proposal meets the TAP objectives within the timeframes specified above by providing suitable access for people with a disability.

### 3.1.4 Our Greater Sydney 2056: North District Plan

The *North District Plan* (Greater Sydney Commission, 2018b) sets out the NSW Government's strategy for accommodating Sydney's future population growth in the northern part of Sydney over the next 20 to 40 years.

The North District forms a large part of the Eastern Harbour City, and its economy leans to the Harbour CBD, which is the North District's metropolitan centre. The Harbour CBD includes Mosman and contains half a million jobs, making it the largest office market in the region. The North District Plan addresses issues influencing Greater Sydney to 2056 with one of the overarching priorities for a productive North District including improved access to local jobs, goods and services within a 30-minute commute via public transport.

Planning Priority N3 includes providing services and social infrastructure, which mainly focus on people's changing needs and accessibility. The North District has over 27,500 people with disability. Therefore, public places such as streets, parks, shopping precincts and community facilities should be designed so that people of all ages and abilities can participate in community life.

The Plan focusses on accessibility, inclusion and safety when designing and building neighbourhoods, public transport and transport interchanges, places and homes, to encourage a greater cross-section of people to lead physically active and socially connected lives. This is especially important to the health of people ageing in community and also benefits people with a disability and families.

The proposal supports the priorities and actions of the North District Plan by improving and modernising South Mosman wharf infrastructure, and by making the ramps accessible to people with limited mobility.

### 3.1.5 Sydney's Ferry Future: Modernising Sydney's Ferries 2013

Published in 2013, the Sydney's Ferry Future plan acknowledges, and builds on, the TAP and the ferry wharf upgrade program by outlining the short and long-term initiatives for getting the most out of the "ferry network today while investing in the infrastructure and services to attract more passengers in the future" (Transport for NSW, 2013). The plan:

- > Focuses on short-term timetable, service and infrastructure improvements and the long-term expansion of the network
- > Reinforces the need to upgrade wharf infrastructure and make it more accessible in accordance with the TAP.

This proposal responds to this plan by improving and modernising infrastructure, responding to efficiencies by creating accessible pathways, and increasing the available car parking spaces.

### 3.1.6 NSW Long Term Transport Master Plan (2012)

The Long-Term Transport Master Plan (NSW Government, 2012) provides the framework for delivering an integrated, modern transport system across NSW over the next 20 years. It identifies transport actions and investment priorities over the short, medium and long-term that have emerged in response to six identified transport challenges. The master plan is clear in identifying the need to:

- > Cater for a 31 per cent increase in people travelling into and out of Sydney city centre during peak periods by 2031 from 2021
- > Provide improvements in public transport services and accessibility across the network to cater for the expected increase in the commuting population.

Upgrading and expanding the ferry wharf network are two recognised ways that support meeting the above objectives. As such, the proposal directly responds to the master plan by providing improved and safer access for ferry passengers at South Mosman wharf, and improving the capacity of the ferry network.

## 3.2 Mosman Council

Mosman Council strategic plans relevant to the proposal are discussed below in Table 3-2.

Table 3-2 The Mosman Council strategic plans relevant to the proposal

Plan name	Description
MOSPLAN 2018-2028 Community Strategic Plan (Mosman Council, 2018a)	<p>The MOSPLAN 2018-2028 Community Strategic Plan sets the future direction for the community of Mosman Council. For enforcing Community Strategic Plan into practice, Council has prepared MOSPLAN 2018-2028 Revised Delivery Program and 2020-2021 Operational Plan. Together, they articulate a long-term vision for Mosman's future</p> <p>Under the Delivery Program, the Strategic Direction 1 is building a caring and inclusive community. Mosman Council highlights that there are a wide range of services available that support, connect and care for members of the Mosman community including those with a disability.</p> <p>The Strategic Direction 6 is well designed, liveable and accessible places, where the Council highlights that the accessibility of public space and infrastructure is a key consideration. The council is guided by accessibility audits and strategy and by other plans including the Disability Inclusion Action Plan and Pedestrian Access Mobility Plan.</p>
Disability Inclusion Action Plan 2017-2021 (Mosman Council, 2017a)	<p>The Plan will build on and complement the work already being done to improve access and inclusion by Council's Access and Mobility Community Consultative Committee and Council's Access Strategy 2014 and Pedestrian Access and Mobility Plan 2012.</p> <p>This Plan is aligned with some of the strategies identified in the MOSPLAN 2018-2028 Delivery and Operational Plans. This Plan will progressively implement improved access in the local community and in Council facilities in consultation with Access and Mobility Community Consultative Committee. This plan will be reviewed by the Community Services Manager</p>
Mapping Mosman's Community Services and Programs (Mosman Council, 2018b)	<p>A social planning analysis was undertaken in late 2017 and provides strategic advice based on demographic data, identification of existing local community services, programs and facilities, and the results of the most recent consultation and planning undertaken by various government and non-government agencies. This serves as an information resource to guide planning for and delivery of community services by Council, non-government and government agencies.</p>
Asset Management Marine Structures (Mosman Council, 2012)	<p>Council has adopted an Asset Management Strategy and Policy, as well as a series of Asset Management Plans to assist in planning and implementing asset renewal and maintenance. This documentation forms part of Council's Resourcing Strategy and provides a link between the Community Strategic Plan and Delivery Program.</p> <p>This Asset Management: Marine Structures 2012 outlines the broad approach that Council will adopt to manage the condition of and use of marine structures assets over the next 12 years providing future directions for marine structure use, safety, and maintenance. All the assets considered are held to provide services oriented to the customer rather than the Council's provider of the services.</p>

The proposal supports the priorities and actions sets out in Mosman Council's strategic plans by improving and modernising South Mosman wharf infrastructure and making the ramps accessible to people with limited mobility.

## 4 Existing socio-economic environment

The section provides an overview of the socio-economic characteristics of the Study Area. This background study was informed by the Australian Census of Housing and Population (ABS) Census 2016 and the NSW Government's Transport and Performance Analytics (TPA) data.

For the purpose of defining a boundary for assessing social and economic characteristics, ABS geographic boundaries referred to as Mosman LGA have been used (identified in section 4.1.2), and the North Sydney–Mosman SA3 was used as a comparison.

### 4.1 Overview of the regional and local socio-economic context

#### 4.1.1 Regional context

The proposal is located within the North Sydney–Mosman SA3 region. The North Sydney–Mosman SA3 is about 1897 hectares. In the 2016 Census, there were 94,139 people in the region. Of these, 47 per cent were male and 53 per cent were female. Aboriginal and/or Torres Strait Islander people made up 0.3 per cent of the population. The median age of people in the North Sydney–Mosman SA3 was 38 years. Children aged 0 - 14 years made up 14.2 per cent of the population and people aged 65 years and over made up 16.1 per cent of the population. The North Sydney–Mosman SA3 is predominantly a residential area, but has substantial commercial and mixed-use areas along the arterial roads. Over 60 per cent of housing is low-medium density flats, townhouses, separate houses and terrace houses. There were 55,125 people who reported being in the labour force and of these 69.1 per cent were employed full time, 23.2 per cent were employed part-time and 3.8 per cent were unemployed.

#### 4.1.2 Study Area

The proposal is situated in the Mosman LGA (Figure 1-1). It is an area of 865 hectares within the North Sydney–Mosman SA3. The Mosman LGA (the Study Area) includes the suburbs of Mosman Bay, Middle Head - Georges Heights - Clifton Gardens, Mosman Junction, Mosman Central, Balmoral, Middle Harbour and Beauty Point – The Spit. The proposal is located in the suburb of Mosman Bay. The Study Area is bounded by the Middle Harbour in the north and north-east, Port Jackson in the east and south, and the North Sydney LGA in the west.

### 4.2 Population and demography

A demographic profile for the Study Area and North Sydney–Mosman SA3 (Table 4-1) was developed based on a review of ABS Census Data (2016).

Table 4-1 Demographic and social characteristics of the Mosman LGA (ABS 2016 Census)

Sub-category	Indicator	Mosman LGA	North Sydney – Mosman SA3
Population size	Population Total	28,475	94,139
	Male	13,189 (46.3%)	44,137 (46.9%)
	Female	15,290 (53.7%)	49,999 (53.1%)
Age	Babies and pre-schoolers (0-4)	5%	6%
	Primary and secondary schoolers (5-19)	18%	12%
	Tertiary education and independence (20 to 24)	4%	5%
	Young workforce (25 to 34)	12%	20%
	Parents and homebuilders (35 to 54)	29%	30%
	Older workers and pre-retirees (55 to 64)	12%	11%
	Empty nesters and retirees (65 to 74)	11%	9%
	Seniors (75 to 84)	5%	4%
	Elderly aged (85 and over)	3%	2%
	Median age of persons	42	38

Sub-category	Indicator	Mosman LGA	North Sydney – Mosman SA3
Average household size		2.4	2.1
Cultural Diversity	Aboriginal and Torres Strait Islander population	0.2%	0.3%
	Proportion of people who speak a language other than English at home	18.6%	22.5%
	Top three languages other than English spoken in the home	Mandarin, Spanish and French	Mandarin, Cantonese and Japanese
People with disability	People with need for assistance (percentage of the total population)	3%	2%
Dwelling Structures	Separate house	35%	18%
	Semi-detached, row or terrace house, townhouse etc	12%	14%
	Flat or apartment	52%	68%
	Other dwelling	0.4%	0.3%
Tenure Type	Median mortgage repayment (per monthly)	\$3,000	\$2,700
	Median rent (per weekly)	\$560	\$570
	Home owners (outright)	36%	29%
	Home owners (with a mortgage)	27%	23%
	Renters	34%	46%
Primary methods of travel to work	People who travelled to work by public transport	32%	38%
	People who travelled to work by car as driver or passenger	43%	36%
	Walked only	5%	9%
	Worked at home	9%	7%
	Ferry as the primary method of travel to work	3%	2%
	Train as the primary method of travel to work	1%	12%
	Bus as the primary method of travel to work	21%	17%
People who use multiple methods to travel to work	Combination of train and ferry as method of travel to work	1%	1%
	Combination of bus and ferry as method of travel to work	1%	1%

#### 4.2.2 Population and growth

At the time of the 2016 Census, the Study Area had an estimated residential population of about 28,475 people, of these 46 per cent were male and 54 per cent were female. Aboriginal and/or Torres Strait Islander people made up 0.2 per cent of the population.

About 587 people live in the neighbourhoods closest to South Mosman wharf (Figure 4-2) in Statistical Area 1 – Code 1141541.



Figure 4-1 Level 1 Statistical Area (SA1) – Code 1141541  
 Source: Australian Bureau of Statistics 2016

The Study Area experienced a four per cent population growth between 2011 and 2016. This is lower than the rate of population growth in the North Sydney–Mosman SA3 (6.5 per cent) and Greater Sydney (10 per cent) for the same period.

In 2018, Mosman LGA recorded population was 30,877 (Mosman Council, 2019). By 2041, the population of Mosman LGA is forecast to grow by 2.44 per cent, which is 31,630 people (DPIE, 2019).

### 4.2.3 Age

In 2016 the median age of the Study Area population was 42 years. In 2016, the ‘parents and homebuilders’ group represented the highest proportion of people (29 per cent) in the Study Area, that is consistent with the Study Area median age. The data showed a similar trend for North Sydney–Mosman SA3 and State. However, in 2016 the Study Area had the smallest ‘young workforce’ population (12 per cent) when compared with North Sydney–Mosman SA3 and State. The Study Area had a considerably high proportion of ‘primary and secondary schoolers’ (18 per cent) compared with North Sydney–Mosman SA3 (12 per cent) in 2016.

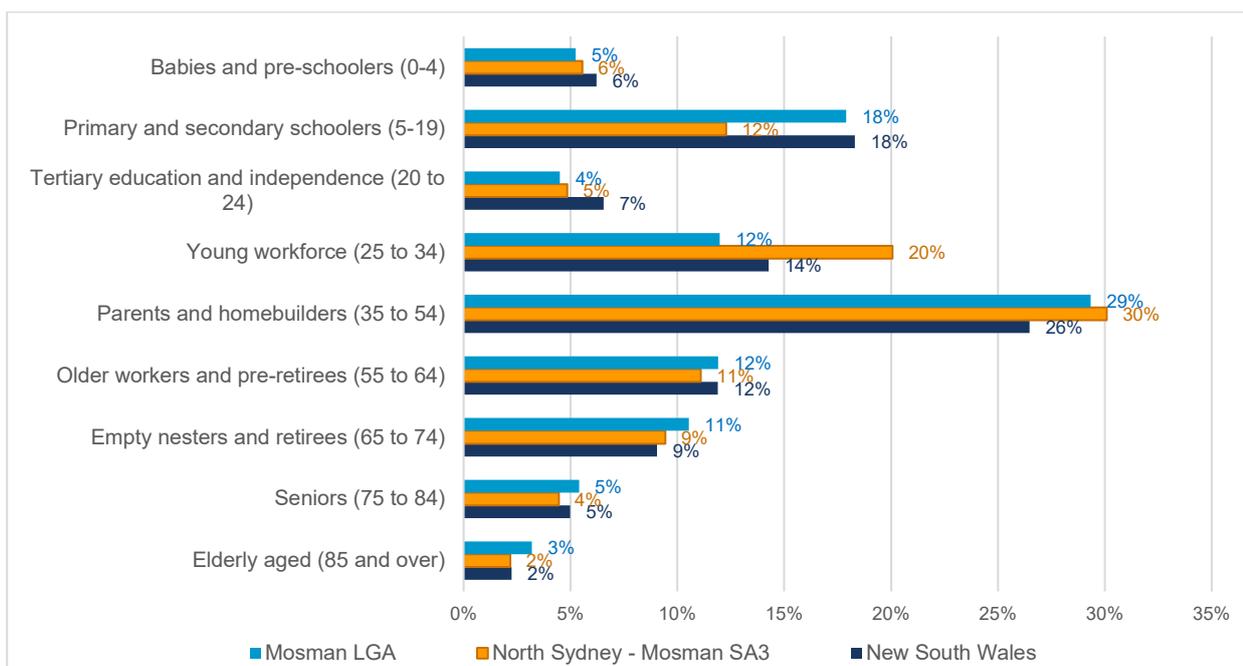


Figure 4-2 Age distribution of population in the Study Area (Mosman LGA), compared with North Sydney-Mosman SA3 and NSW in 2016

Source: Australian Bureau of Statistics 2016

#### 4.2.4 Cultural diversity

Most of the Study Area's residents were born in Australia (60 per cent) with majority of the remaining population were born in England, New Zealand, United States of America, China (excludes Hong Kong, Macau and Taiwan) and South Africa. The Study Area is culturally diverse with descendants from various countries. The most common ancestries in the Study Area were English (29 per cent), Australian (18 per cent), Irish (11 per cent), Scottish (8 per cent) and Chinese (4 per cent). About 19 per cent of residents speak another language other than English at home, with other languages including Mandarin, Spanish and French. Comparatively there is a low proportion of Aboriginal residents (0.2 per cent) in the Study Area, when compared to North Sydney-Mosman SA3 (0.3 per cent) and Greater Sydney (1 per cent).

#### 4.2.5 Families and households

When compared to the North Sydney-Mosman SA3, the Study Area had a considerably high proportion of couple families with children, at about 47 per cent of families compared to about 38 per cent in North Sydney-Mosman SA3. In 2016 41 per cent of families in the Study Area were couple families without children and 11 per cent were one parent families. There was a lower proportion of step families as well as a lower proportion of blended families in Study Area when compared with North Sydney-Mosman SA3.

#### 4.2.6 Housing

In 2016, the majority of residents of the Study Area lived in flats or apartments (52 per cent) and 35 per cent lived in separate houses. Of the occupied private dwellings, the majority of them consists of two bedrooms (31 per cent). About 36 per cent of dwellings in the Study Area were owned outright, 27 per cent were owned with a mortgage and 34 per cent were rented. In 2016, the Study Area had a much higher rate of home ownership when compared to the North Sydney-Mosman SA3, and this reflects in the low number of renters in the Study Area. When compared to North Sydney-Mosman SA3 (at 61 per cent), the Study Area had a high percentage of family households (at 68 per cent).

#### 4.2.7 Socio-economic Indices for Areas (SEIFA)

Socio-Economic Indexes for Areas (SEIFA) is developed by the ABS to rank areas in Australia according to relative socio-economic advantage and disadvantage based on Census data. SEIFA can help governments, communities and businesses determine areas needing additional funding and improved services, identify potential business opportunities, and research the relationship between health and education outcomes and the socio-economic conditions of an area.

SEIFA 2016 has been created from Census 2016 data and consists of four indices: the Index of Relative Socio-economic Disadvantage (IRSD); the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD); the Index of Economic Resources (IER) and; the Index of Education and Occupation (IEO).

Table 4-2 shows the SEIFA indices for the Study Area in 2016. The Study Area has IRSAD score of 1,165, indicating a relative low incidence of disadvantage and greater advantage in general. The SEIFA scores of the Study Area indicate there are many households with high incomes, or many people in skilled occupations, and few households with low incomes, or few people in unskilled occupations.

Table 4-2 SEIFA scores for the Study Area\*

2016 Statistical Area Level 2 (SA2) Name	Index of Relative Socio-economic Disadvantage (IRSD)		Index of Relative Socio-economic Advantage and Disadvantage (IRSAD)		Index of Economic Resources (IER)		Index of Education and Occupation (IEO)		Usual Resident Population
	Score	Decile	Score	Decile	Score	Decile	Score	Decile	
Mosman	1115	10	1165	10	1076	9	1188	10	28,475

\* SEIFA 2016 scores created from 2016 Census (ABS, 2018)

#### 4.2.8 Transport and access

The majority of the employed residents (43 per cent) of the Study Area travelled to work by car (either as driver or as passenger) while 32 per cent used public transport (train, bus, ferry, tram/light rail) as at least one of their methods of travel to work. About 21 per cent travelled by bus and three per cent travelled by ferry as the primary method of travel to work. When compared to Greater Sydney (20 per cent), a high proportion of residents rely on public transport to reach work in the Study Area (32 per cent). This reflects the Study Area’s high level of access to bus, rail and ferry services.

As shown in Figure 4-4, the majority of residents who use public transport are located along the arterial routes and near the main ferry wharves within the Study Area. The figure shows that residents in Mosman Bay area use a higher percentage of public transport.

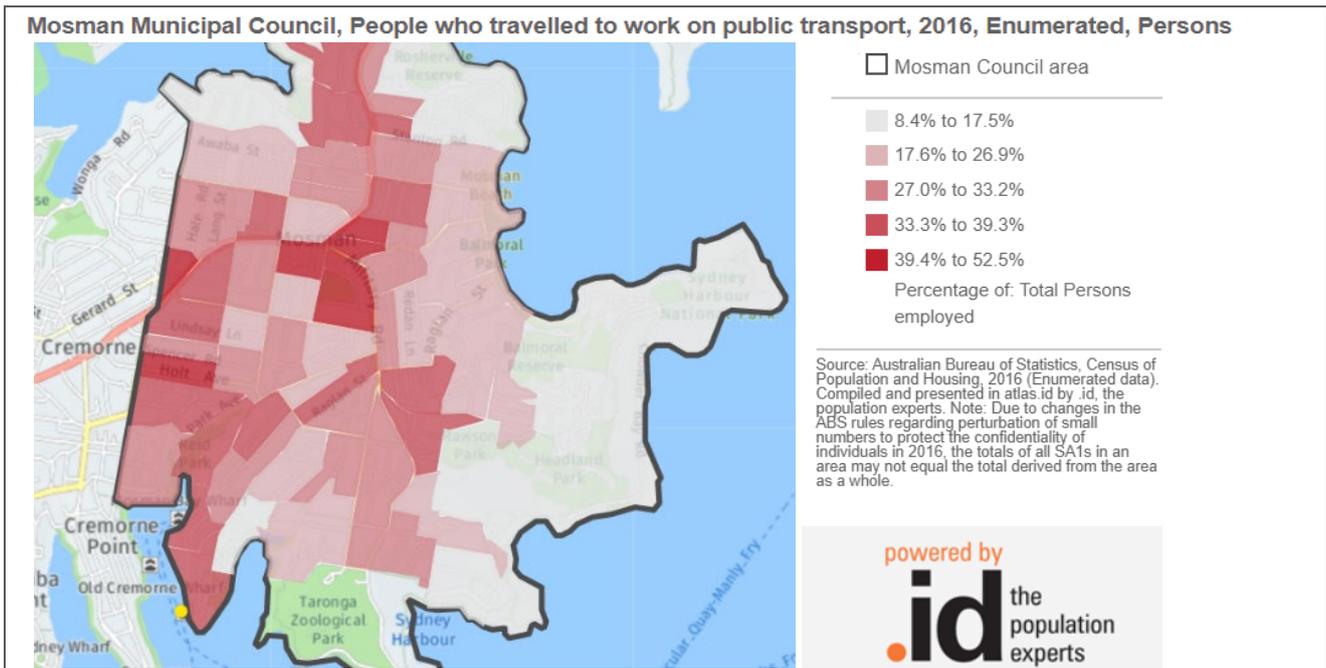


Figure 4-3 Statistical Area Level 1 data showing the percentage of people travel to work on public transport in 2016 within the Mosman LGA

Source: Mosman Municipal Council Social Atlas, accessed via <https://atlas.id.com.au/mosman/maps/>

#### Road network

South Mosman wharf is located to the east of the Warringah Freeway and can be accessed via Musgrave Street, which runs through the peninsula and terminates at the wharf. The road network in the vicinity of the wharf is characterised by residential streets with on-street and off-street parking.

#### Bus network

There are two bus routes that service the wharf: route 230 and route 236.

Route 236 (refer to Figure 4-4) services the wharf exclusively, traveling between Spit Junction and South Mosman wharf. The entire journey takes about 10 minutes. The bus stop is located 50 metres from the wharf entrance. The route 236 caters to public transport users who live in residential areas away from the Military Road arterial corridor. On weekdays, the 236 bus operates from Spit Junction between 06:14 to 20:05 and the last bus leaves the wharf at 20:18 to Spit Junction. On Saturdays the 236 bus operates from Spit Junction between 07:14 to 20:09 and the last bus from the wharf leaves at 20:20. On Sundays and public holidays the 236 bus operates from Spit Junction between 09:09 and 20:09 and the last bus leaves the wharf at 20:20.

There are services every 30 minutes from Monday to Friday, as well as on weekends. There are various bus routes between the Spit Junction and Military Road that travel to the Sydney CBD.

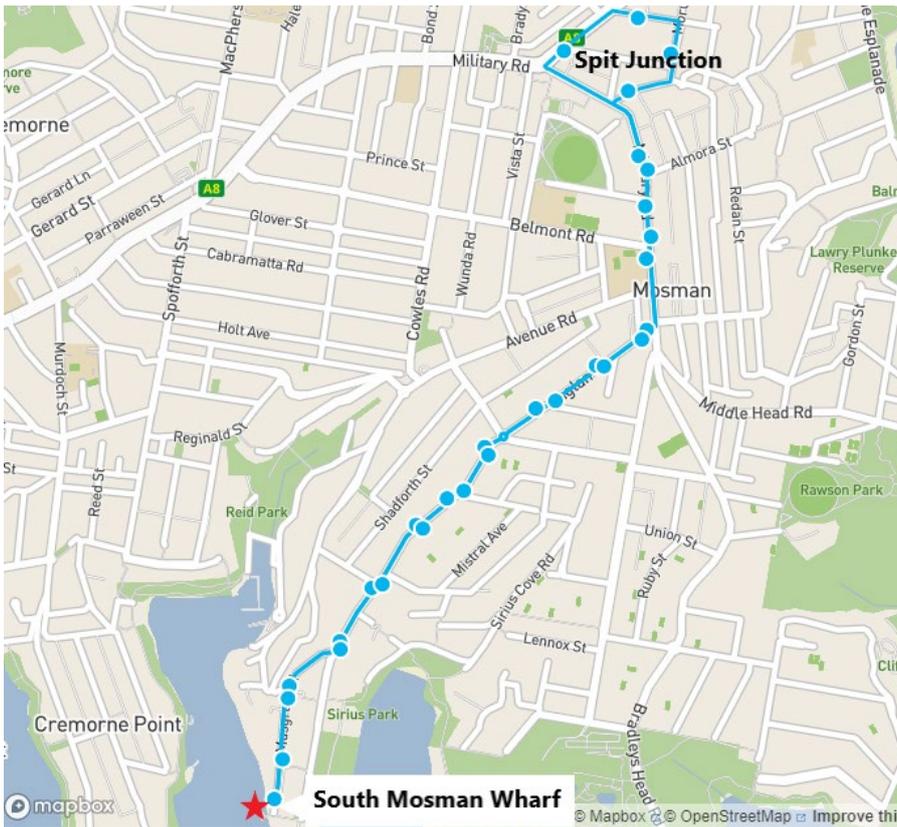


Figure 4-4 Sydney Buses Network – Route 236 (Transport for NSW website <https://transportnsw.info/routes/details/sydney-buses-network/236/28236>)

Route 230 (refer to Figure 4-5) travels between Milsons Point wharf and Mosman Bay wharf passing through the suburbs of Mosman, Cremorne, Neutral Bay and North Sydney. This route service the residents in Mosman connecting Milsons Point wharf, Milsons Point Station, North Sydney Station and Mosman Bay wharf. On average, entire journey takes about 35 minutes. The South Mosman wharf is within 10 minutes walk from Mosman Bay wharf along the Avenue Road. On weekdays, the 230 bus operates from Milsons Point wharf between 06:56 and 23:49 and the last bus leaves Mosman Bay wharf at 23:25 to Milsons Point. On Saturdays the 230 bus operates from Milsons Point wharf between 07:54 and 23:53 and the last bus from the Mosman Bay wharf leaves at 23:23 to Milsons Point. On Sundays and Public holidays, the 230 bus operates from Milsons Point wharf between 08:23 and 21:49 from Milsons Point wharf and the last bus leaves the Mosman Bay wharf at 22:23 to Milsons Point.

The frequency of bus services on Route 230 range between 15 minutes and 30 minutes during peak periods, and 30 minutes and 60 minutes during off-peak, weekends and public holidays.

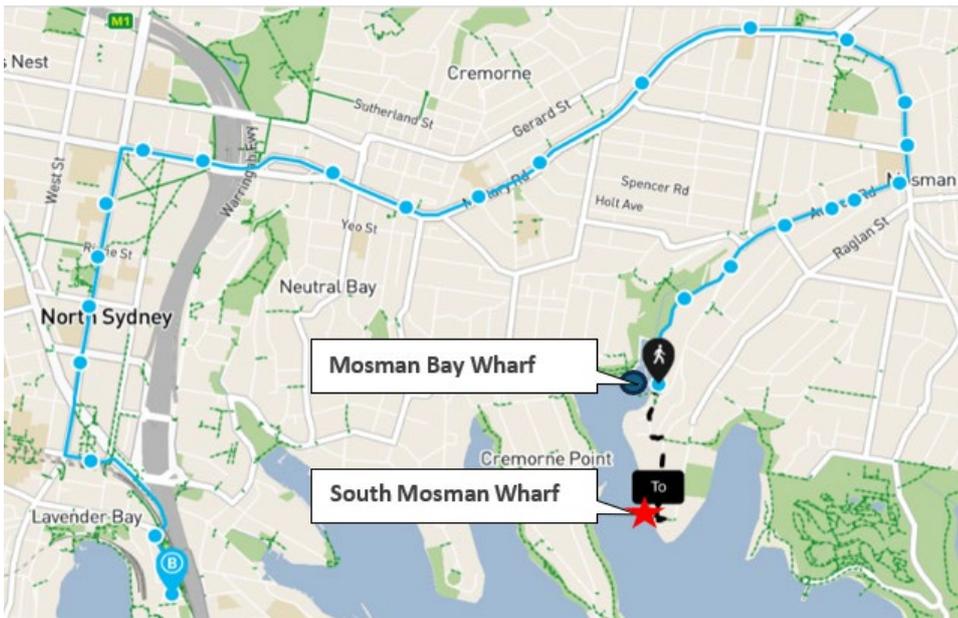


Figure 4-5 Sydney Buses Network – Route 230 (Transport for NSW website <https://transportnsw.info/routes/details/sydney-buses-network/230/28230>)

*Train network*

Milsons Point Station and North Sydney Station are located 4.1 kilometres and 4.3 kilometres (walking distance) away from the wharf, respectively. Both stations are on the T1 North Shore, Northern and Western Line, providing connectivity to Hornsby, Epping, Penrith and Richmond. The frequency of services along this line ranges from three minutes between trains during the peak period and 10 minutes during off-peak periods.

*Bicycle network*

Marked bicycle routes established by Mosman Council are present along Raglan Street, Avenue Road, and the Rangers Avenue. These bicycle routes provide connectivity to Military Road in the north and towards the Pacific Highway, Milsons Point Station and North Sydney Station. Access for cyclists travelling to and from the wharf requires connectivity to the local bicycle network via Musgrave Street. Musgrave Street is also identified as a suggested, unmarked cycling route in the Northern Sydney Cycling Map, with the identified route running along both Musgrave Street and Raglan Street providing connectivity to Mosman Town Centre. No bicycle parking hoops or secure lockers are currently provided at the wharf.

*Pedestrian access*

Pedestrian access to the wharf is mainly via Musgrave Street and alternatively via Raglan Street, the two-main north-south roadways through the peninsula.

Provision for pedestrians walking towards the wharf comprises a 1.2-metre-wide concrete footpath along the western side of Musgrave Street, which has an average slope of 9.8 per cent along a 100-metre section starting from the wharf entrance. This may cause issues for passengers with limited mobility. Access from Raglan Street to the wharf requires pedestrians to traverse a steep stairway and elevated walkway accessible via Herron Walk. This route is not wheelchair accessible.

*Ferry network*

South Mosman wharf forms part of Sydney’s extensive ferry network which consists of 28 vessels serving eight routes and 39 wharves around the Sydney harbour and along the Parramatta River (TfNSW, 2013). Mosman Bay ferry service operates from Cremorne Point, South Mosman, Old Cremorne and Mosman Bay wharves to Circular Quay in the city (Figure 4-6). It takes about 15 minutes for the ferry to travel from South Mosman wharf to Circular Quay.

According to the Household, Income and Labour Dynamics in Australia (HILDA) survey, Sydney has the longest average daily commutes, calculated at around 71 minutes in 2017 (Wilkin et al, 2019). The ferry

network in Sydney provides important cross harbour links, extra capacity and often provide much faster access to the City than buses.

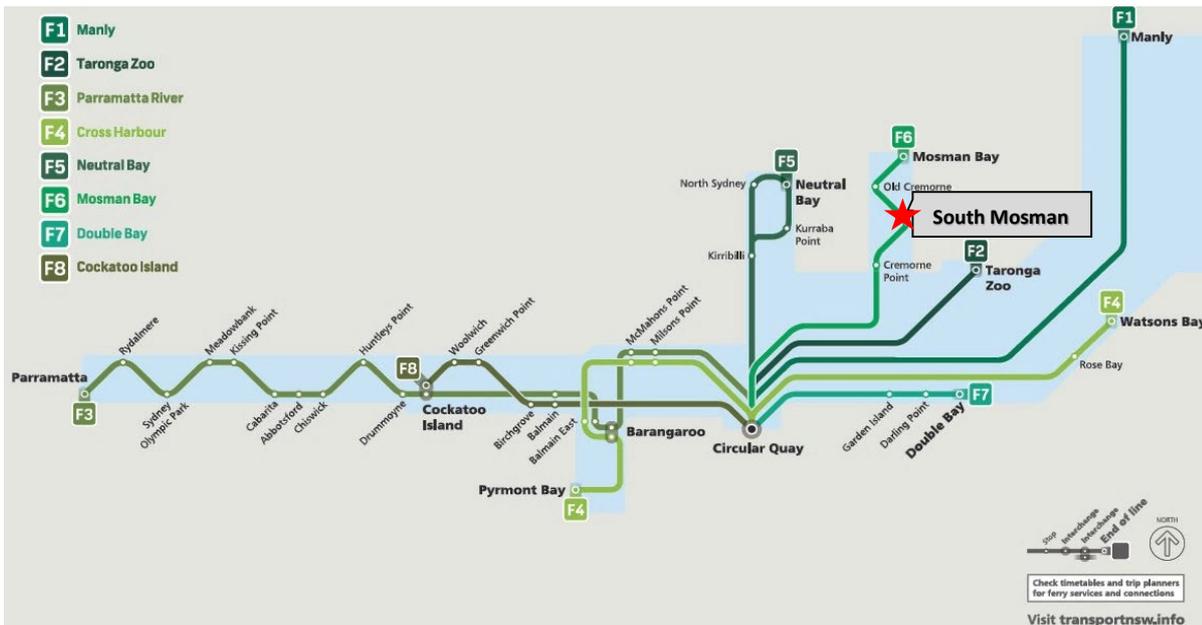


Figure 4-6 Sydney Ferries Network map with South Mosman wharf highlighted  
Source: TfNSW 2017.

Around 16 million trips were made on the Sydney ferries network in 2019 (calculated using Opal Ferry Trips) and both Manly (F1) and Cross Harbour (F4) are the most popular routes. In 2019, passengers made about 753,000 trips on Mosman Bay line (F6), which represents about five per cent of the total trips made on the ferry network (TfNSW, 2020).

Using 2017 Opal card data, the maximum number of boarding and alighting passengers in an hour over a 10-month period in 2017 was 81 (Aurecon, 2019).

Table 4-3 Peak hour patronage at South Mosman wharf in 2017 (Aurecon, 2019)

Peak hour of week (day and hour)	2017 patronage/hour			Special events maximum patronage (total boarding and alighting)
	Boarding	Alighting	Total	
Thursday, 07:00-08:00	79	2	81	109

Future patronage forecasts for the wharf are shown in Table 4-4. The future patronage was calculated using the information on population and employment forecasts for areas surrounding the wharf and adding a further 15 per cent to the highest average forecasted for 2036 (Aurecon, 2019).

Table 4-4 Future patronage forecasted for the South Mosman wharf (Aurecon, 2019)

Peak hour of week	2036 + 15% patronage/hour			Special events maximum patronage
	Forecast Opal activity in highest average one hour period in year			Maximum patronage/hour 2036 +15%
Day and hour	Boarding	Alighting	Total	Total boarding + alighting
Thursday 7am – 8am	102	2	104	140

During weekdays the F6 Mosman Bay to Circular Quay ferry service stops at South Mosman wharf from 6:29 to 00:27 with the exception of 17:00 to 19:00 when the ferry service runs express from Mosman Bay to Cremorne Point. On Saturdays, the ferry service stops at the wharf from 7:30 to 00:27. During Sundays and public holidays the ferry service stops at the wharf from 9:30 to 21:27.

During weekdays the F6 Circular Quay to Mosman Bay ferry service stops at South Mosman wharf from 9:15 to 00:15. On Saturdays, the ferry service stops at the wharf from 7:15 to 00:15. During Sundays and public holidays the ferry service stops at the wharf from 9:15 to 21:15.

During weekdays the F6 ferry service usually operates every 30 minutes from the wharf and during weekends and public holidays the ferry service operates every hour from the wharf.

Currently, the wharf functions simply as a local commuter wharf with connection to a bus service that co-ordinates with the ferry schedule.

The *Draft Mosman Local Housing Strategy 2020* (Mosman Council, 2020b) highlights that land near Mosman's commuter ferry wharves is zoned as medium density residential areas suitable as a focus for housing growth - this includes South Mosman wharf. However, due to its proximity to strategic corridors and hubs, and noting also the predominantly residential character of surrounding land use combined with the steep topography, the wharf's patronage potential is constrained.

### 4.3 Economic profile

Table 4-5 summarises the employment profile of the Study Area.

Table 4-5 Economic profile of the Mosman LGA (ABS 2016 Census)

Sub-category	Indicator	2016 census
Income	Median total household income (\$/weekly)	2,522
	Median total personal income (\$/weekly)	1,295
Employment	Worked full-time	40%
	Worked part-time	18%
	Employed, away from work	2%
	Unemployed	2%
	Top three industries of employment	Professional, Scientific and Technical Services - 19% Financial and Insurance Services - 14% Health Care and Social Assistance - 10%
	Top three professions	Professionals - 40% Managers – 24% Clerical and administrative workers – 12%

#### 4.3.2 Income and employment

In 2016 the median weekly household income in the Study Area was \$2,522. This was higher than that of the North Sydney-Mosman SA3 (\$2,393).

About 40 per cent of the Study Area's labour force was employed full time and about 18 per cent were employed part time. Labour force participation (62 per cent) in the Study Area is lower than the North Sydney-Mosman SA3, which is 68 per cent. This correlates with the low percent of the young workforce group in the Study Area. The most common occupations in the Study Area include professionals (40 per cent), managers (24 per cent) and clerical and administrative workers (12 per cent). People in the Study Area mainly worked for the professional, scientific and technical services, and financial and insurance industry sectors.

### 4.3.3 Local business and services

The Study Area is comprised of large (4,273; ABS, 2016) number of local businesses due to the close proximity to the Sydney CBD. The largest employing industries are: Professional, Scientific and Technical Services.

The only local business in close proximity to the wharf is Elegant Waterfront Mosman Bay guest house. The entrance to the Elegant Waterfront Apartment is via Raglan Street.

Local businesses and service providers within 500 metres of the proposal are shown in Figure 4-7. The main types of local businesses and service providers within 500 metres include:

- > Elegant Waterfront Mosman Bay – guest house
- > Absolute Removals – professional furniture removal business
- > Rochelhill Consulting Pty Ltd – professional services company
- > The Sydney Amateur Sailing Club
- > Cremorne Point Manor – hotel
- > Various cafés and restaurants.

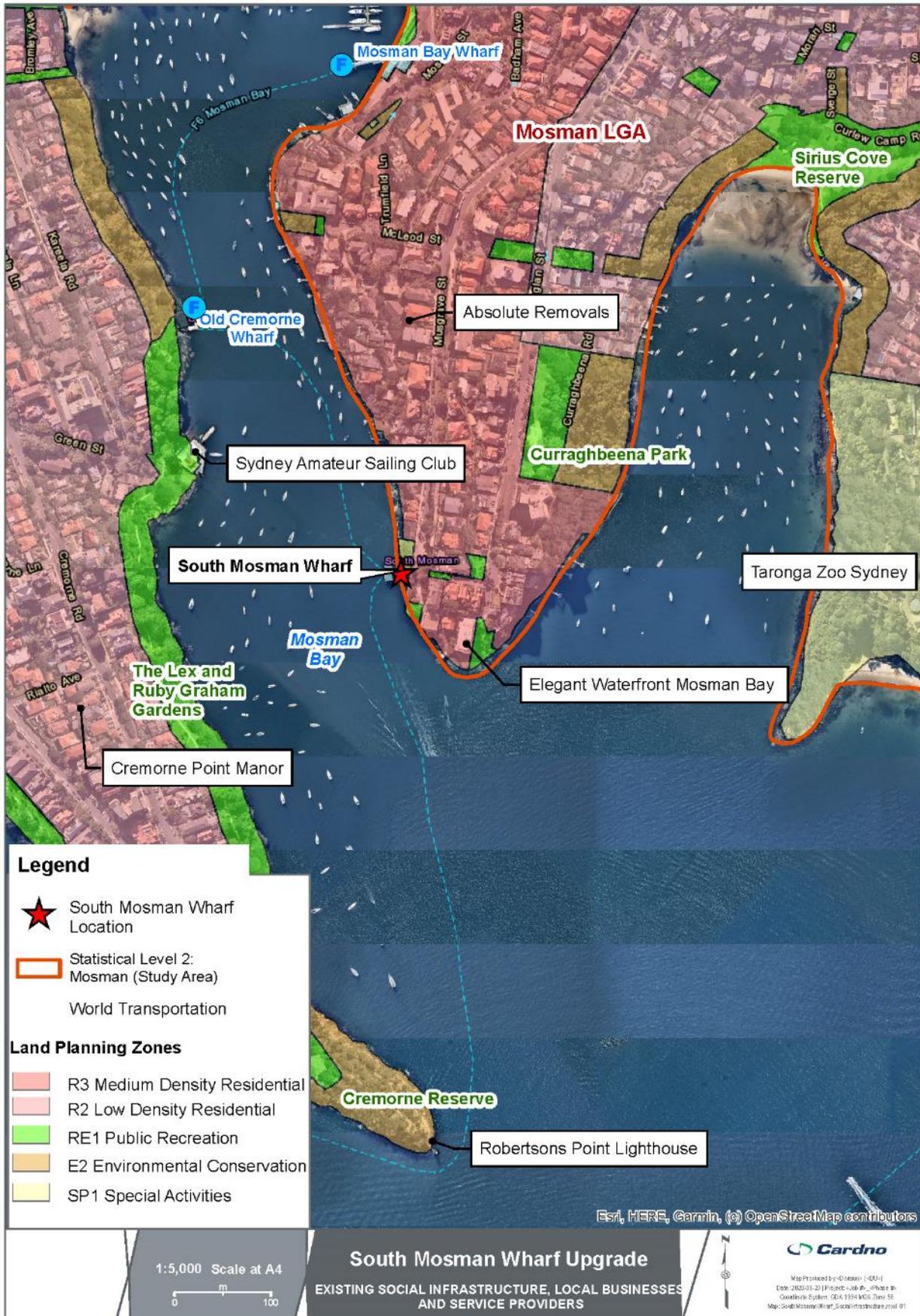


Figure 4-7 Existing social infrastructure, local businesses and service providers within the Study Area

## 4.4 Social infrastructure

Social infrastructure refers to community facilities, services and networks which help individuals, families, groups and communities meet their social needs, maximise their potential for development and enhance community well-being.

Social infrastructure located within the Study Area (Figure 4-7), close to the proposal includes:

- > Local parks including:
  - Curraghbeena Park
  - The Lex and Ruby Graham Gardens
  - Cremorne Reserve
  - Cremorne Point Circuit walking track
  - Hunts Lookout
  - Sirius Cove Reserve
- > Taronga Zoo Sydney
- > Robertsons Point Lighthouse
- > Public transport facilities such as bus stops operating in the Musgrave street and Raglan Street.

## 4.5 Community values

Community values are those socio-economic aspects considered to be important to quality of life and well-being. They include social factors such as a sense of safety, well-being, belonging and community diversity, as well as physical assets, such as parks and recreational areas.

Community values associated with the Study Area have been informed by the review of South Mosman Wharf Upgrade Concept Design Community Consultation Report – July 2020 (NSW Government, 2020) and social policies and strategies relevant to the Mosman Council.

A community satisfaction survey conducted in 2017 (Mosman Council, 2017b) reveals that the most cherished aspects of living in Mosman are:

- > Opportunities for a healthy lifestyle
- > Location/proximity to amenities
- > Natural environment including provision and maintenance of parklands
- > Lifestyle/ambience within Mosman
- > Friendly neighbourhood
- > Sense of community
- > Beaches and harbour foreshore.

The *South Mosman Wharf Upgrade Concept Design Community Consultation Report* (NSW Government, 2020) reports that the community surrounding the wharf value:

- > Increased accessibility in the new wharf design
- > Maintaining landscape character and visual amenity in the area
- > Protection from the weather and safety for the commuters
- > Controlled fishing activities at the with consideration of nearby residents.

## 4.6 Landscape character and visual amenity

The proposal site is characterised by single dwelling residential houses and vegetated areas comprising some native tree species and palm trees set into a rock/sandstone cliff face. Vegetation at the terrace level includes some indigenous trees and exotic weed species. North of the terrace, existing private residential properties extend almost to the foreshore of the bay. Local community fishing activity is conducted from the wharf as well.

Mosman Bay is approximately 250 metres wide and is flanked by a mix of residential properties and public open space. The Cremorne Reserve pedestrian walkway extends along the western shoreline of the Bay and provides views of the harbour which often include the South Mosman wharf.

The Sydney Amateur Sailing Club is on the opposite foreshore, north-west of the wharf. Two other ferry wharves are within Mosman Bay, the Old Cremorne wharf on the western foreshore and the Mosman Bay wharf close to the top of the Bay.

The Figure 4-8 shows the land and water uses surrounding South Mosman wharf.



Figure 4-8 Location of South Mosman wharf and surrounding land and water uses (Source: TfNSW)

Views from Sydney Harbour looking north-east towards the wharf, before and after the upgrade of the South Mosman wharf, are provided in Figure 4-9 and Figure 4-10.



Figure 4-9 Existing views from Sydney Harbour looking north-east towards the wharf (Source: TfNSW)



Figure 4-10 Post-upgrade views from Sydney Harbour looking north-east towards the wharf (Source: TfNSW)

Views from Sydney Harbour looking south west towards the wharf, before and after the upgrade of the South Mosman wharf, are provided in Figure 4-11 and Figure 4-12.



Figure 4-11 Existing views from Sydney Harbour looking south-west towards the wharf (Source: TfNSW)



Figure 4-12 Post-upgrade views from Sydney Harbour south-west towards the wharf (Source: TfNSW)

The wharf is located in an area surrounded by local non-Indigenous heritage sites (Table 4-6) listed under the *Mosman Local Environmental Plan 2012* (Mosman LEP). These include Musgrave Street wharf remains and sea wall, Divided road (adjacent to 7–25, 35–41 and 43–49 Musgrave Street) and Herron Walk steps in between Musgrave Street and Raglan Street.

There are no known Aboriginal heritage sites within or near the wharf upgrade area, and impacts to Aboriginal cultural heritage are unlikely.

These potential heritage impacts are further assessed in the Section 6.10 and Section 6.11 of the REF.

Table 4-6 Non-Aboriginal heritage sites within the proposal vicinity

Item number	Site	Address	Approximate distance from project boundary (metres)
A491	Musgrave Street wharf (remains and sea wall)	Musgrave Street	Within project boundary
I411	Divided Road	Musgrave Street	Adjacent to project boundary
I412	Herron Walk steps	Between Musgrave Street and Raglan Street	Adjacent to project boundary
I183	Group of two houses, divided into three dwellings	9A-11 Musgrave Street	10
I231	Flats	10 Raglan Street	39
I182	Chinese boatshed	3 Musgrave Street	53
I435	Divided Road	Raglan Street	56
I229	'The Castle', flats	3 Raglan Street	63
I437	Pedestrian steps and walkway	Raglan Street	68
I230	Group of four houses	5-11 Raglan Street	77
I184	'Rutledge Lodge', house	16 Musgrave Street	80
I232	'Ythanbank, house, formerly known as 'Boxmoor Flats'	15 Raglan Street	80
I233	'Bareena', house	22 Raglan Street	94
I234	'Abingtonn', house	"24 Raglan Street	104

## 5 Potential impacts

The proposal has the potential for both wider regional and local benefits in the medium to long-term through reduced traffic congestion and improved access and connectivity for users of the ferry service. However, the proposal would also result in some negative impacts and changes to the existing socio-economic environment for communities and businesses in Mosman and the wider region.

This section describes the potential benefits and impacts of the proposal's design, construction and operation for local and regional communities.

### 5.1 Construction impacts

The proposal would be constructed over a duration of up to six months starting in mid-2021. South Mosman wharf would be closed throughout the construction period. Ferry passengers would be notified ahead of construction and updated whilst the proposal is built. Local bus services, North Sydney train station, Milsons Point train station and Mosman Bay wharf are possible alternatives for some public transport customers in the catchment area of South Mosman wharf.

Existing bus services would be used to support access to Sydney CBD as bus transport would remain operational with the exception of when construction activities are occurring near the bus stop at the wharf. Ferry users travelling to or from the city could catch the existing 236 bus service along Musgrave Street to Spit Junction and then use a connecting bus service to the Sydney CBD. Alternatively, customers can catch the route 230 from Mosman Bay wharf along the Avenue Road to Milsons Point Station.

The existing bus service (route 236) has reduced operating hours compared with the ferry service. The bus services from the wharf to Spit Junction stops at 20:18 during the weekdays and 20:20 during weekends and public holidays. However, the Circular Quay to Mosman Bay ferry service to the wharf stops at 00:15 during weekdays and Saturdays and 21:15 during Sundays and public holidays. As such consideration should be given to extending the bus operating hours to reduce travel impacts.

A maritime exclusion zone may be required around the proposal footprint during construction to prevent commercial and recreational traffic entering the works area. This would also include changes to the F6 Mosman Bay ferry route to avoid the construction site. The closure of the South Mosman wharf would cause disruption to approximately 81 passengers during peak hour (based on 2017 Opal data) due to the requirement to switch transport modes. Disruptions could potentially involve increased travel times by using bus services, or a combination of bus and train, when compared to travelling by ferry. Some commuters may also use private vehicles during the construction period, which may result in additional commuter traffic and increased travel times during peak hours. Any disruption would be minimised through notification ahead of construction, and consequent updates. In addition, the short-term impacts during construction described above would be offset by the benefits of the upgraded wharf and interchange during operation (refer Section 5.2).

The NSW Government leased private vessel moorings, as well as water-based activities and fishing conducted from the wharf, would be impacted by restricting access and the marine exclusion zone.

There would be a number of heavy vehicles accessing the proposal site via Musgrave Street during the earthworks, installation of the lift, ramp construction and demolition of the existing shelter and stairs from Musgrave Street. It is anticipated that most materials and equipment required for land-based elements of the proposal would be delivered by road. Temporary traffic lights or stop-go provisions on Musgrave Street may be required if major deliveries take place by road. The additional construction traffic expected within the area is considered minor in the context of existing levels of traffic and would be unlikely to affect the capacity of the road network. Any potential impact associated with construction vehicles accessing the site would be minimised through the preparation and implementation of a traffic management plan.

Noise, air quality and visual impacts from construction activities would disrupt the amenity of the area. This would directly impact residents surrounding the wharf. There would be temporary loss of amenity in the area surrounding the wharf due to the construction works and the presence and use of barge mounted cranes and other plant and equipment. Lift installation and associated construction activities would result in removal of trees and native vegetation and a loss of amenity near the wharf. The loss of amenity, along with restrictions on pedestrian access, may discourage the use of these areas in the vicinity of the wharf during construction.

Some construction activities may require work to be carried out during early mornings when the water is calm and the harbour is least busy, a time of day where residents may be more likely to be at home and therefore disrupted by the activities. Construction activities conducted at night-time, and the high voltage lighting used

during construction, may also disrupt nearby residents. The management measures described in Chapter 6 would aim to minimise these impacts on local amenity.

Indirect impact to local businesses in the broader area may occur due to noise, air quality and visual impacts, as well as the decline in patronage of the wharf and general, short term decline in local amenity. Further consultation with the community would be undertaken to determine sensitive periods for surrounding businesses and other receivers. This may include consultations with the surrounding businesses to understand their peak hours. The management measures described in Chapter 6 aim to minimise these impacts.

The proposal would also generate some opportunities for employment of local people, and the construction Contractor/personnel may also buy resources, potentially from businesses in the region.

## 5.2 Operational impacts

The proposal would provide a range of long-term socio-economic benefits for the community of the Study Area, as well as communities and businesses in the wider region.

Currently, customers with mobility needs are unable to access Musgrave Street from the wharf. The proposed wharf design would improve the efficiency and safety for customers getting on and off ferries that stop at the wharf. The new lift would provide access to street-level from the wharf. This also would improve access to customers with prams.

The existing wharf at South Mosman is a pontoon with a connecting gangway and stairs leading up to the cul-de-sac at the end of Musgrave Street. A new pontoon would have a waiting area with a curved roof, seating and glass weather protection panels to provide passengers with a comfortable place to wait for their ferry. New bicycle hoops would be installed.

Ferry services would recommence once the new wharf is operational. The proposal would result in the improvement of efficiency and an improved customer experience of ferry services from the wharf. This may result in an increase to patronage of the ferry service and additional commuter traffic travelling to and from the wharf. However, this is not considered to be significant in the context of the existing patronage of the wharf.

The proposal would potentially increase access to goods, services, and economic opportunities for locals by upgrading and improving accessibility to the wharf.

Recreational fishing would continue to be allowed at the new wharf.

The overall visual impact of the proposal once operational is moderate. The wharf design aims to unify and identify the harbour wharves and the ferry commuter transport system. The design would minimise the removal of vegetation and incorporate surrounding elements to tie-in to the area; for example, the landside upgrades have been designed to fit in with the urban landscape of the surrounding area. It incorporates use of lightweight materials and maximises transparency while at the same time providing for safety, weather protection and equitable access for ferry users. More detailed assessment of the visual impacts during operation are described in the South Mosman wharf Upgrade: Landscape Character and Visual Impact Assessment (Cardno, 2020a).

During operation, the extra lighting and security cameras at the wharf would deter antisocial behaviour from occurring and provide a safer night-time environment for ferry users. Generally, the design of the ferry wharf creates a clear hierarchy of space, enables safe access/egress, and enables formal and passive surveillance. There would be an emergency button on the pontoon for the security of waiting passengers.

## 6 Safeguards and management measures

The management and mitigation measures recommended in the SEIA focus on avoiding or reducing negative social impacts, and enhancing potential benefits. Stakeholder and community involvement in program planning and ongoing environmental management would be key to avoiding, minimising and mitigating the social impact of the proposal.

Strategies to manage potential socio-economic impacts during the construction and operational phases are outlined in Table 6-1. Strategies to manage amenity impacts (such as noise, air quality and visual impacts) are outlined in chapter 7 of the REF.

Table 6-1 Socio-economic safeguards and management measures

Impact	ID	Environmental safeguards	Responsibility	Timing
General Socio-economic impacts	SE1	<p>A Communications and Stakeholder Engagement Plan will be developed prior to the commencement of construction and will be implemented during construction to provide timely and accurate information to stakeholders. It would include (as a minimum):</p> <ul style="list-style-type: none"> <li>▪ Mechanisms to provide details and timing of proposed activities to affected residents and local businesses, including changes to traffic, public transport services and access</li> <li>▪ A contact name and telephone number for complaints.</li> </ul>	Transport for NSW	Pre-construction/ Construction
General Socio-economic impacts	SE2	<ul style="list-style-type: none"> <li>▪ A webpage and free-call number will be established for enquiries regarding the proposal, and will remain active for the duration of construction.</li> <li>▪ Contact details will be clearly displayed at the entrance to the site.</li> <li>▪ All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received.</li> </ul>	Contractor	Pre-construction/ Construction
Socio-economic benefits	SE3	Investigate opportunities to improve priorities group employment participation in line with Transport for NSW's Social Procurement Policy.	Contractor	Pre-construction/ Construction
Socio-economic benefits	SE4	Investigate opportunities to encourage the construction Contractor to purchase goods and services locally.	Transport for NSW	Construction/ Construction
Socio-economic benefits	SE5	Investigate opportunities to incorporate community health and well-being initiatives in the design and construction of the proposal.	Transport for NSW	Design/ Construction
Land transport and parking	T2	Where possible, the preferred means of transporting equipment and materials to the site will be via boat and barge over land transport so as to limit impacts to the local road network.	Contractor	Construction
Land transport and parking	T3	Public transport passengers will be notified of any impacts to services and alternative transport arrangements prior to the commencement of construction. This will include updates to the timetable (online and Opal app) indicating the temporary closure of the South Mosman wharf.	Transport for NSW	Pre-construction/ construction
Land transport and parking	T4	Consider the need to provide extended operating hours for the existing bus service that services the wharf (bus service 236) for those hours during which the ferry service is currently running.	Transport for NSW	Pre-construction
Maritime transport	T5	<ul style="list-style-type: none"> <li>▪ A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area.</li> <li>▪ This zone will be clearly defined to communicate access for other water users.</li> </ul>	Contractor	Construction

## 7 Conclusion

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The NSW Government is progressively upgrading ferry wharves across Sydney Harbour to improve Sydney's ferry service for customers. Upgraded commuter wharves are being delivered as part of the NSW Government's TAP. TAP is an initiative to deliver modern, safe and accessible transport infrastructure across NSW.

Customers with mobility needs are currently unable to access ferry services from South Mosman wharf. The existing wharf at South Mosman is a pontoon with a connecting gangway and stairs leading up to the cul-de-sac at the end of Musgrave Street. Transport for NSW are planning to upgrade the wharf at South Mosman to improve accessibility. The proposed wharf design includes a new floating pontoon to improve the efficiency and safety of wharves for ferries to pick-up and drop-off passengers. The pontoon would have a waiting area with a curved roof, seating and glass weather protection panels to provide passengers with a comfortable place to wait for their ferry. The pontoon would be connected to land by an uncovered gangway and jetty. The proposal would include a new lift and stairs providing a safer accessible route from street-level to the wharf.

This SEIA has assessed the potential socio-economic impacts associated with the design, construction and operation of the proposal. The assessment has had regard to the existing context of the proposal, the contribution of other specialist studies prepared for the REF, the outcomes of community consultation and the adoption of appropriate mitigation measures.

In the long-term, the proposal is expected to provide a range of socio-economic benefits for both the local and broader community including:

- > Improved access for customers with assisted and unassisted mobility needs and customers with prams
- > Improved protection from the weather
- > Improved seating and waiting areas
- > Improved safety for customers and staff
- > Quicker and more efficient ferry pick-ups and drop-offs
- > Improved pedestrian access around the wharf interchange.

While the concept design has sought to minimise the impact of proposal to the extent possible, the proposal is expected to have some negative impacts. During construction, a degree of disruption and negative impact on the socio-economic environment would be expected. These would include noise, vibration and dust intrusions, disruption to recreational activities conducted at the wharf, and some reduction in visual amenity. These impacts on the amenity of the locality would need to be carefully and proactively managed with businesses, social infrastructure providers and local residents being notified and effectively engaged with throughout the process. This would be managed and mitigated through mitigation measures, and the implementation of the Communications and Stakeholder Engagement Plan would manage the ongoing consultation and notification activities during construction.

It is considered that the negative impacts of the proposal can be effectively managed with the implementation of mitigation measures identified in this report. It is anticipated that the proposal would have an overall beneficial impact on the Study Area and the wider Greater Sydney region in terms of socio-economic outcomes.

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