



Taronga Zoo Wharf Upgrade

Review of Environmental Factors

Transport for NSW

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Review of Environmental Factors

Transport for NSW | March 2021

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



TfNSW: 21.043

ISBN: 978-1-922463-69-2

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Document controls

Approval and authorisation

| | |
|---|---|
| Title | Taronga Zoo Wharf Upgrade review of environmental factors |
| Accepted on behalf of Transport for NSW by: | Bob Rimac Senior Project Manager |
| Signed: |  |
| Dated: | 19/03/2021 |

Document status

| Document status | Date | Prepared by | Reviewed by |
|-------------------------|------------------|-----------------|------------------|
| Rev A – draft REF | 16 December 2020 | Kiera Plumridge | Belinda Crichton |
| Rev B – final draft REF | 12 February 2020 | Kiera Plumridge | Belinda Crichton |
| Rev C – final REF | 3 March 2021 | Kiera Plumridge | Belinda Crichton |
| Rev 0 – final REF | 15 March 2021 | Kiera Plumridge | Belinda Crichton |

Executive summary

The proposal

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

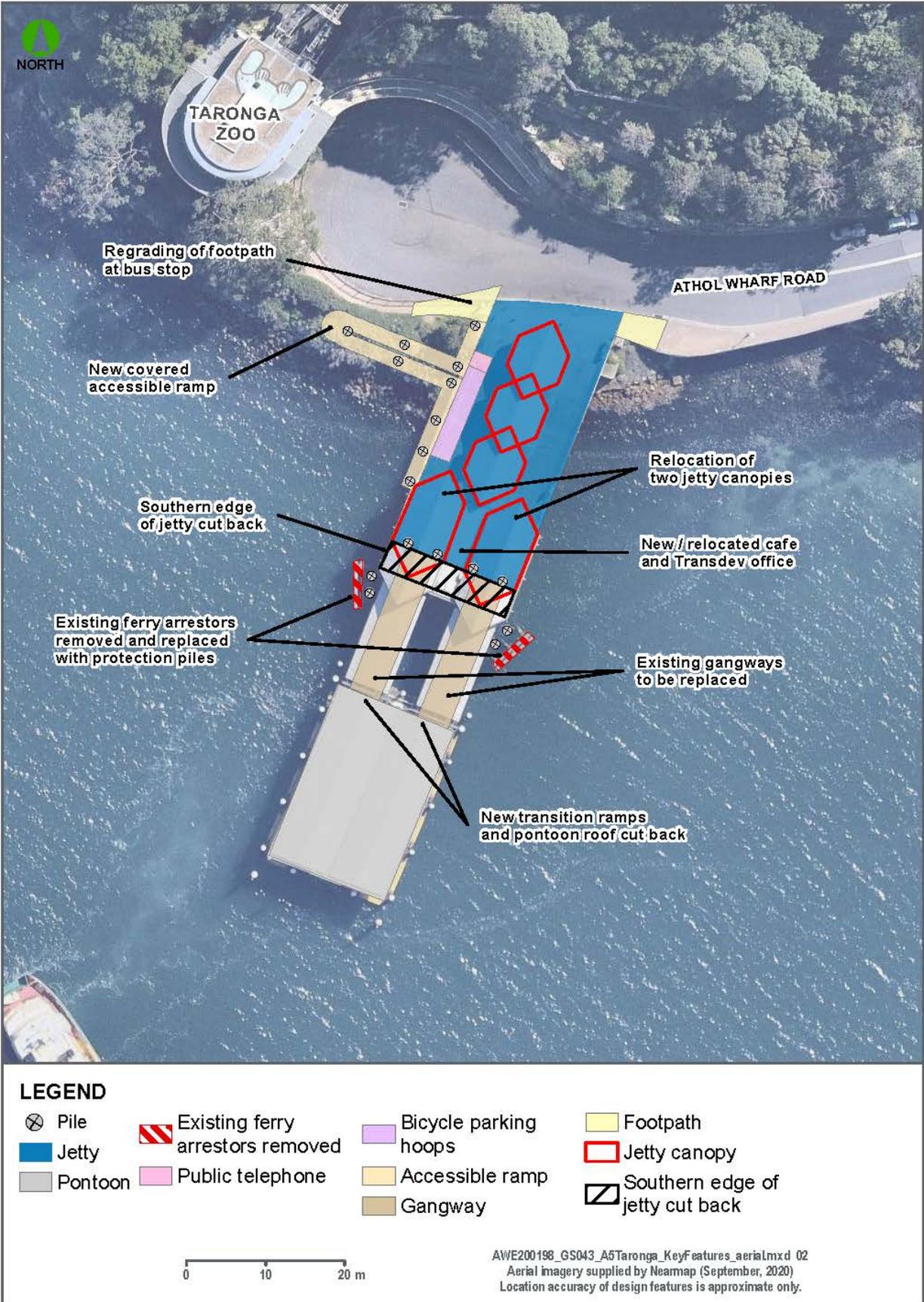
The water based features of the proposal would include:

- Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- Removal of existing gangways
- Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- Two new transition ramps on the existing pontoon to cater for the new gangways
- Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- Construction of a new covered *Disability Standards for Accessible Public Transport* (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- Removal and relocation of the Transdev office and café on the existing jetty
- Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- Relocation of existing Opal Card readers and Opal top-up machine
- Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the proposal would include:

- Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- Retention of the five existing bicycle parking hoops
- Retention of the public telephone booth
- Removal of foreshore vegetation to construct the new accessible ramp.

The proposal would be constructed over a duration of up to five months starting in late 2021. During construction the wharf would remain operational, however the adjacent café would be closed. Key features of the proposal are shown on Figure E-1.



E-1 Overview of 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 program is to achieve 100 per cent *Disability Standards for Accessible Public Transport* (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.

Therefore, Taronga Zoo wharf needs upgrading due to its lack of accessible pathway for passengers on and around the wharf.

Proposal objectives

The objectives of the proposal are:

- 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 improve accessibility, passenger safety and comfort for future patronage
- 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' option – no upgrade and not accessible, regular maintenance would continue
- Option 1 – accessible ramp off the existing jetty with upgrade to gangways and deferred upgrade of pontoon (preferred option)
- Option 2 – accessible ramp and lift on the existing jetty with upgrade to gangways and deferred upgrade of pontoon
- Option 3 – new separate wharf.

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

Although having the lowest initial capital cost and least 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.

Advantages and disadvantages of Options 1, 2 and 3 were presented to key stakeholders from Transport for NSW and Roads and Maritime Services (Roads and Maritime) at a

workshop on 31 January 2019 and their relative performance was assessed using a multi-criterion analysis (MCA) process. Following assessment of the options, including workshops with relevant stakeholders, Option 3 was discounted due to costs and consideration of the remaining life of the existing wharf structure.

While Option 2 was initially considered as the preferred option following the MCA process, upon refinement it was considered that a single lift would be insufficient to accommodate the expected users based on the peak patronage numbers, and the lift option was ultimately discounted. Based on patronage data collected in 2017, the Taronga Zoo wharf had almost 1500 passengers in the case of a special event, around 800 passengers in the busiest peak hour and around 120 passengers in commuter afternoon peak hour. Option 1 then progressed as the preferred concept design option given its ability to accommodate the larger patronage.

The concept design was developed to achieve compliance with DSAPT requirements which assumes that gangways and pontoons are located to be compliant for 80 per cent of tides (fully compliant).

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

Key stakeholders were invited to provide feedback on the proposal's concept design in November and December 2020.

Consultation with the Mosman Council, Department of Planning, Industry and Environment (DPIE) (formerly the Foreshores and Waterways Planning and Development Advisory Committee), Port Authority of NSW, Department of Primary Industries (DPI) Fisheries and Crown Lands 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. Figure E-2 shows the planning approval and consultation process for the proposal.



E-2 Planning approval and consultation process for the proposal

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 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.

There would be limited earthworks associated with the proposal. A small amount of seabed sediment would be disturbed during the piling work; however, no sediment would be removed. Earthworks during construction of the land based elements would include excavation for the construction of the new access ramp and regrading of the footpath at the bus stop on Athol Wharf Road.

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, 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 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 remove less than 0.01 hectares of native/exotic vegetation on the landside. This includes some native remnant trees and exotic understorey along the foreshore of the study area. The removal of habitat resources is unlikely to have a significant impact on native fauna however, as there is an abundance of similar or better conditioned habitat across the study locality of which the study area only forms a small proportion.

Less than 0.01 hectares of soft sediment habitat under the footprint of the piles that would be installed 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. In addition, the removal of the six ferry arrestor piles would allow for the colonisation of soft sediment assemblages into these areas when piles are permanently removed. Thus, the loss of these small areas of subtidal soft sediment due to the installation of new piles would not be a substantial loss and anchor areas in soft sediment would quickly recolonise following the removal of anchors.

The removal of some of the existing structure (six ferry arrestor piles) would also result in the removal of some marine vegetation, habitat and sessile/less mobile fauna on the piles and jetty structure. This constitutes a total vertical marine vegetation/habitat area of less than 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 new structures. The total vertical submerged area of the new structures available for colonisation (about 0.01 hectares) is about 1.4 times the vertical area to be removed. 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.

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 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 management levels for 'standard' and 'non-standard' hours of operation for all construction stages at the nearby residential receivers
- The most likely source of potential sleep disturbance (exceeding 60 dB(A)) from 'non-standard' hours of work would be from piling proposed as short duration and intermittent early morning works
- The proposed plant likely to generate the most vibration includes the bored piling rig and rock hammers/rock drill. This plant would only be required to operate for short periods of time and would not be constant for the duration of works.

It should be noted that the 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.

There is potential for vibration impacts to locally listed heritage structure within close proximity to the works including the former Taronga Zoo Wharf and the Athol Wharf Terminus due to works being undertaken within the theoretical safe working limits recommended for heritage structures. However, only a small number of piles are required and the potential impacts could also be largely mitigated through control measures such as vibration monitoring and regular inspections. As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

The works are located directly to the south of Taronga Zoo. Noise levels of approximately 65 dB(A) are predicted at the nearest animal enclosures to the works for all of the modelled scenarios based on a 'worst case' noise modelling, with all sources operating simultaneously within the worksite. Construction noise levels would generally be less than those predicted and intermittent in nature. Advice from Taronga Zoo would be sought prior to construction on impacts on resident Taronga Zoo fauna.

The carrying out works would occur within standard daytime hours, unless required for safety reasons when the water is calmer during the night time period or due to requirements to enable bus access. Should operations be required outside of standard hours, an Out of Hours procedure detailing works schedule, approval processes, communication requirements and management measures would be prepared.

Potentially affected receivers would be informed of night-time construction activities at least seven 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.

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.

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

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.

The landscape character impact of the proposed Taronga Zoo wharf upgrade is considered to be moderate to low on the surrounding character zones as the proposed design is essentially an extension to the existing wharf structure with an additional ramped structure proposed along the western side of the wharf. The design is not considered to have a significant contrast to the existing wharf area and is relatively distant from some sensitive LCZs.

The overall visual impact of the proposed concept design for Taronga Zoo wharf, is considered moderate following the assessment of the viewpoints. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site. The proposed design is seen as an extension to the existing wharf structure, which is of a notable large size in comparison to other ferry wharves within Sydney Harbour. Visually, the design is considered to be in context with the existing wharf structure.

Impacts on views from Little Sirius Point/Whiting Beach are considered low to moderate. Although the viewpoint has a high sensitivity due to views of a relatively natural foreshore, there is a low magnitude of change due to the existing wharf form.

Impacts on views from Cremorne Reserve Path are considered low as the design would introduce minimal change to the existing view.

Impacts on views from Athol Wharf Road, Sydney Harbour, and Taronga Zoo pathway at end of Athol Wharf Road are considered moderate to high due to the presence of a moderately substantial new built form of the accessible ramp and removal of some vegetation, however this would be offset by an improved quality of built form and finishes.

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 assessment concluded that there would be neutral direct and negligible potential direct impact to Taronga Zoo wharf (remains and seawall) and Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock; and negligible direct and potential direct impacts to Athol wharf Tram Terminus (including escarpment and retaining wall).

The proposed works would not impact the overall significance of the heritage items in the vicinity of the construction footprint, or within the visual buffer zone (areas where the proposal is visible within one kilometre of the proposal footprint). Based on the preliminary archaeological assessment, it is unlikely that the proposed works would result in impacts to significant archaeological 'relics'.

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

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, such as climate change adaptation measures and development of a sustainability management plan, would 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

This chapter introduces the proposal and 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 interchange at Taronga Zoo (the proposal) as part of the NSW Government's Transport Access Program (TAP, <https://www.transport.nsw.gov.au/projects/tap>, refer to section 2.1).

The proposal is located within the local government area (LGA) of Mosman Council. Taronga Zoo wharf is positioned near the cul-de-sac at the end of Athol Wharf Road on the northern shore of Sydney Harbour. The wharf is located in close proximity to the southern entry point of Taronga Zoo and Sydney Harbour National Park, and Bradleys Head is located to the east of 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 F2 ferry service that operates between Circular Quay and Taronga Zoo. The proposal is to improve access to the wharf via a new accessible ramp and the addition of other accessible elements, including longer gangways and modifications to the existing jetty and pontoon to allow for accessible and more efficient passenger services.

The water based features of the proposal would include:

- Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- Removal of existing gangways
- Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- Two new transition ramps on the existing pontoon to cater for the new gangways
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- Construction of a new covered *Disability Standards for Accessible Public Transport* (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- Removal and relocation of the Transdev office and café on the existing jetty
- Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- Relocation of existing Opal Card readers and Opal top-up machine

- Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the proposal would include:

- Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- Retention of the five existing bicycle parking hoops
- Retention of the public telephone booth
- Removal of foreshore vegetation to construct the new accessible ramp.

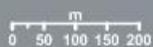
The key features of the proposal are shown in Figure 1-3. Chapter 3 describes the proposal in more detail.

The proposal would be constructed over a duration of up to five months starting in late 2021. During construction the wharf would remain operational, however the café would be closed.



FIGURE
1-1

1:12,000 Scale at A4



Regional setting

TARONGA ZOO

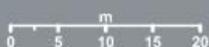


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Coordinate System: GDA 1994 MGA Zone 55
Map: AWE200198_03546_Taronga_RF_RegionalSetting.mxd 02
Aerial imagery supplied by Neatmap (Jan. 2021)



**FIGURE
1-2**

1:800 Scale at A4

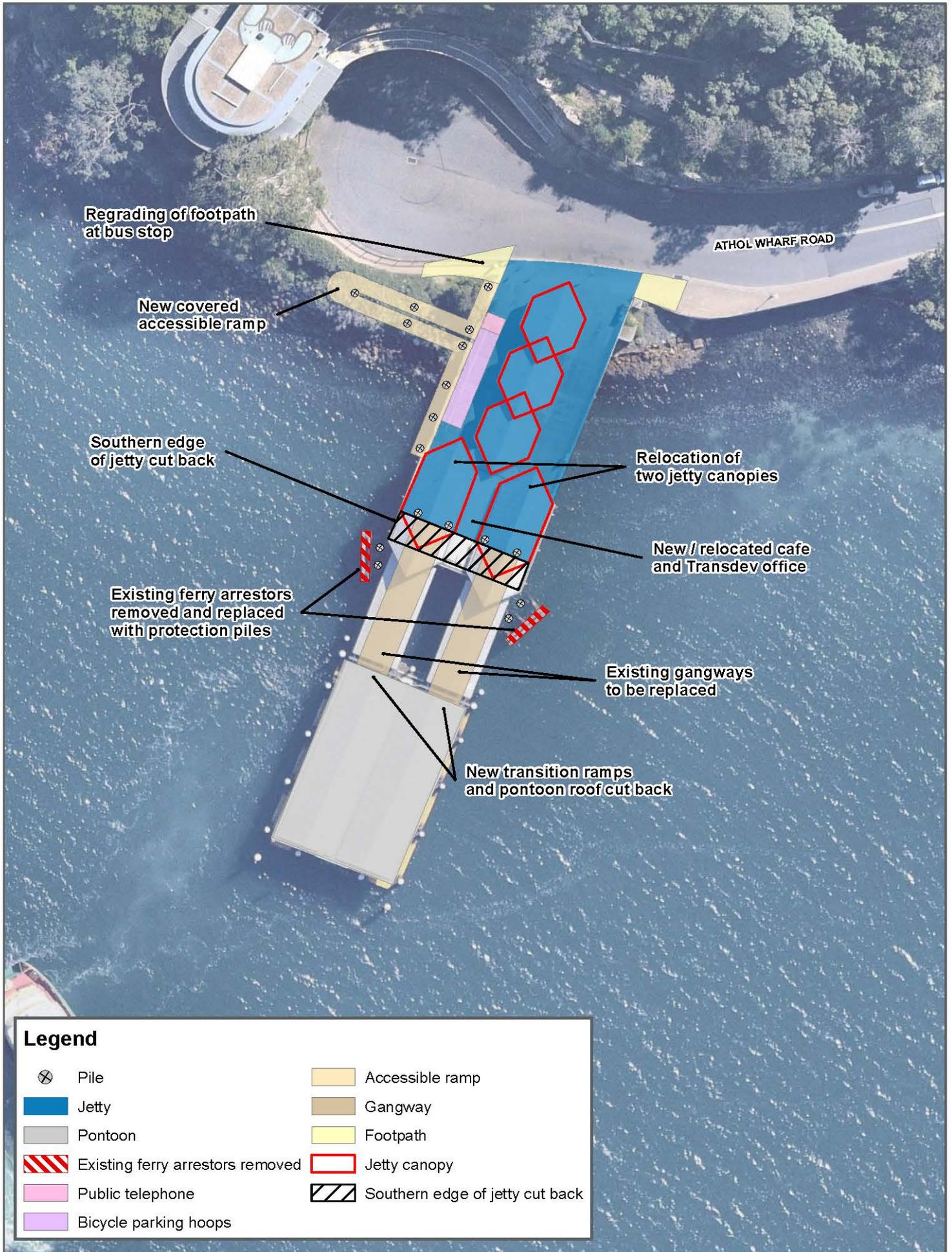


Local setting

TARONGA ZOO



Map Produced by Carond NSW/INACT Pty Ltd (ARDL)
 Date: 2021-02-12 | Project: AWE200198
 Coordinate System: GDA 1994 MGA Zone 58
 Map: AWE200198_OSON_T_Taronga_REF_LocalSetting.mxd 02
 Aerial imagery supplied by Neumao (Jan. 2021)



Legend

- | | | | |
|--|----------------------------------|--|---------------------------------|
| | Pile | | Accessible ramp |
| | Jetty | | Gangway |
| | Pontoon | | Footpath |
| | Existing ferry arrestors removed | | Jetty canopy |
| | Public telephone | | Southern edge of jetty cut back |
| | Bicycle parking hoops | | |

FIGURE 1-3

1:600 Scale at A4

Key features of the proposal

TARONGA ZOO



Map Produced by Cardno NS&I A CT Pty Ltd (WOL)
 Date: 2020-12-11 | Project: AWE200198
 Coordinate System: GDA 1984 MGA Zone 56
 Map: AWE200198_GS053_Taronga_KeyFeatures.mxd 01
 Aerial Imagery supplied by Nearmap (September, 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

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and 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 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 Taronga Zoo wharf needs upgrading 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 TAP aims to provide the following benefits:

- 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 Taronga Zoo.

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 upgrading and expanding the ferry wharf network, 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 greenhouse 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 |
|--|--|
| State Infrastructure Strategy 2018-2038 (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 Taronga Zoo. |
| Disability Inclusion Action Plan 2018-2022 (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 2002</i> (DSAPT) and <i>Disability (Access to Premises – Buildings) Standards 2010</i> 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"> • Improve the existing transport infrastructure, consistent with the building infrastructure priority • 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. |
| A Plan for Growing Sydney (DPE, 2014) | Focussed 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. |
| A Metropolis of Three Cities – The Greater Sydney Region Plan (Greater Sydney Commission, 2018a) | <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 <i>Future Transport Strategy 2056</i> and <i>State Infrastructure Strategy 2018-2038</i> 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"> • Infrastructure use is optimised • Infrastructure aligns with forecast growth • Services and infrastructure meet communities' changing needs • Integrated land use and transport creates walkable and 30-minute cities. <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</p> |

| Strategy / Policy | Description |
|--|---|
| | implementation. The North District Plan is the relevant district plan for Mosman LGA. |
| <i>North District Plan (Greater Sydney Commission, 2018b)</i> | <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 A Metropolis of Three Cities – The Greater Sydney Region Plan 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"> • Priority N1: Planning for a city supported by infrastructure (particularly prioritising infrastructure investment to support the vision of A Metropolis of Three Cities) • Priority N3: Providing services and social infrastructure to meet people’s changing needs (particularly in relation to accessibility, inclusion and safety). <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, and includes an accessible ramp to the pontoon.</p> |
| MOSPLAN Community Strategic Plan 2018-2028 (Mosman Council, 2018a) | <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"> • A culturally rich and vibrant community: the proposal would protect heritage items within the LGA • An attractive and sustainable environment: the proposal would maintain and protect the LGA’s natural areas and local biodiversity, and encourage sustainable practices • Well designed, liveable and accessible places: the proposal would provide high quality public infrastructure and improve accessibility. |

2.2 Existing infrastructure

The existing infrastructure at Taronga Zoo wharf includes the wharf and land-based infrastructure. The existing Taronga Zoo wharf does not currently meet the 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 Taronga Zoo.

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"> • A sheltered concrete jetty about 16.5 metres in width and 38 metres in length • A sheltered pontoon about 25 metres in width and 16 metres in length |

| Element | Description |
|--------------------|--|
| | <ul style="list-style-type: none"> Two 16 metre long sheltered gangways Land based infrastructure, including: <ul style="list-style-type: none"> Footpaths connecting the jetty to the foreshore Wayfinding signs and lighting Bus stop Five bicycle parking hoops 24 benches each seating three to four passengers. |
| Operation | <ul style="list-style-type: none"> Taronga Zoo operates as part of the F2 Taronga Zoo to Circular Quay ferry route Public ferry services typically operate 21 times a day on weekdays and 29 times on weekends and public holidays. |
| Ancillary services | <ul style="list-style-type: none"> Limited on-street parking further along Athol Wharf Road Bus stop located at the entrance of the wharf Milsons Point station and North Sydney station are located 5.7 kilometre and 5.4 kilometre (walking distance) away from the wharf, respectively. Both stations are part of the T1 North Shore, Northern and Western Line. |
| Land ownership | Public owned land and assets owned by Transport for NSW / Roads and Maritime: <ul style="list-style-type: none"> Bus stop Wayfinding signs Existing wharf. Public owned land and assets owned by Mosman Council: <ul style="list-style-type: none"> Roads Pavements Footpaths. |

2.2.1 Patronage

Based on patronage data collected in 2017, the Taronga Zoo wharf had 801 passengers in the busiest peak hour and 1473 passengers in the case of a special event.

Future patronage of Taronga Zoo wharf in 2036 was forecast to be 1028 in the busiest peak hour and 1891 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* (Mosman Council, 2016) outlines that land near Mosman's commuter ferry wharfs including Taronga Zoo 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.

Taronga Zoo wharf functions as a destination wharf, with most patrons travelling to visit Taronga Zoo and the Sydney Harbour National Park. There is a limited catchment for work commuters, with no residences within 500 metres of the wharf. The wharf connects to a bus stop which provides a local bus service (which also transfers zoo visitors from the wharf to the main zoo entrance).

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal are to:

- 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 improve accessibility, passenger safety and comfort for future patronage
- 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 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:

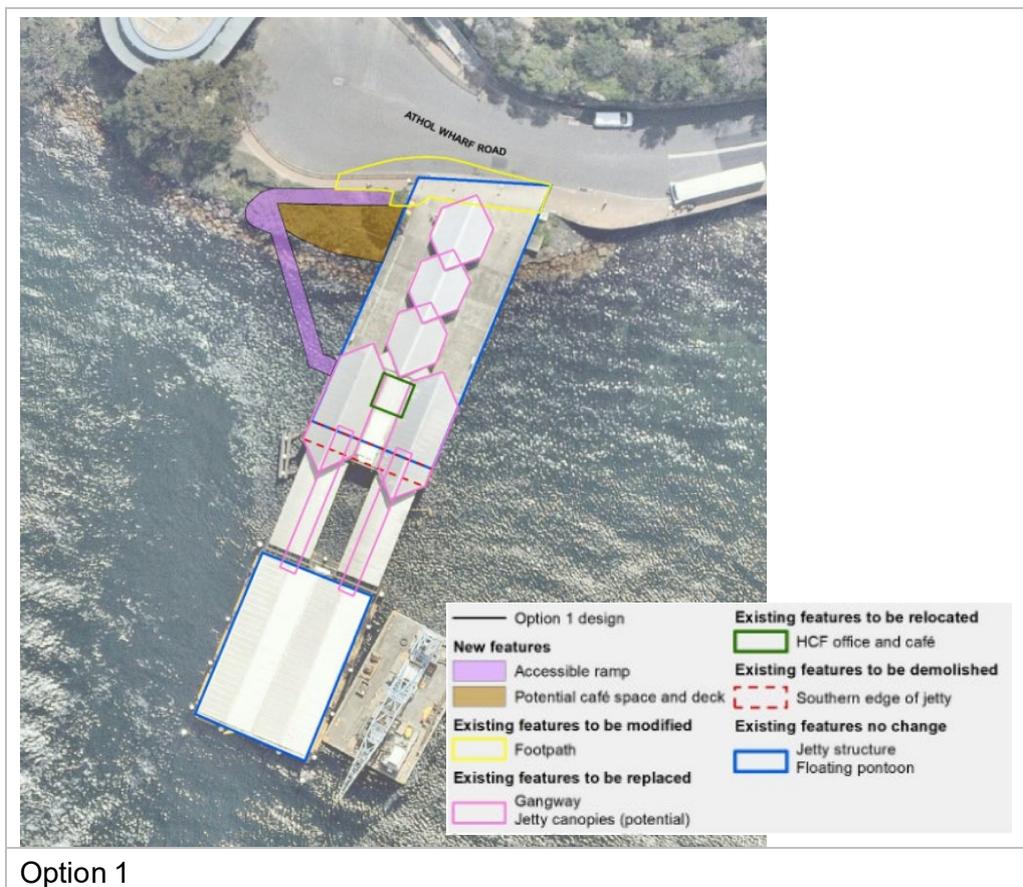
- Existing and future passenger use and service demand
- Engineering design requirements and current structural integrity
- Passenger safety
- Environmental and social constraints
- Build cost
- Accessibility offered
- Stakeholder feedback.

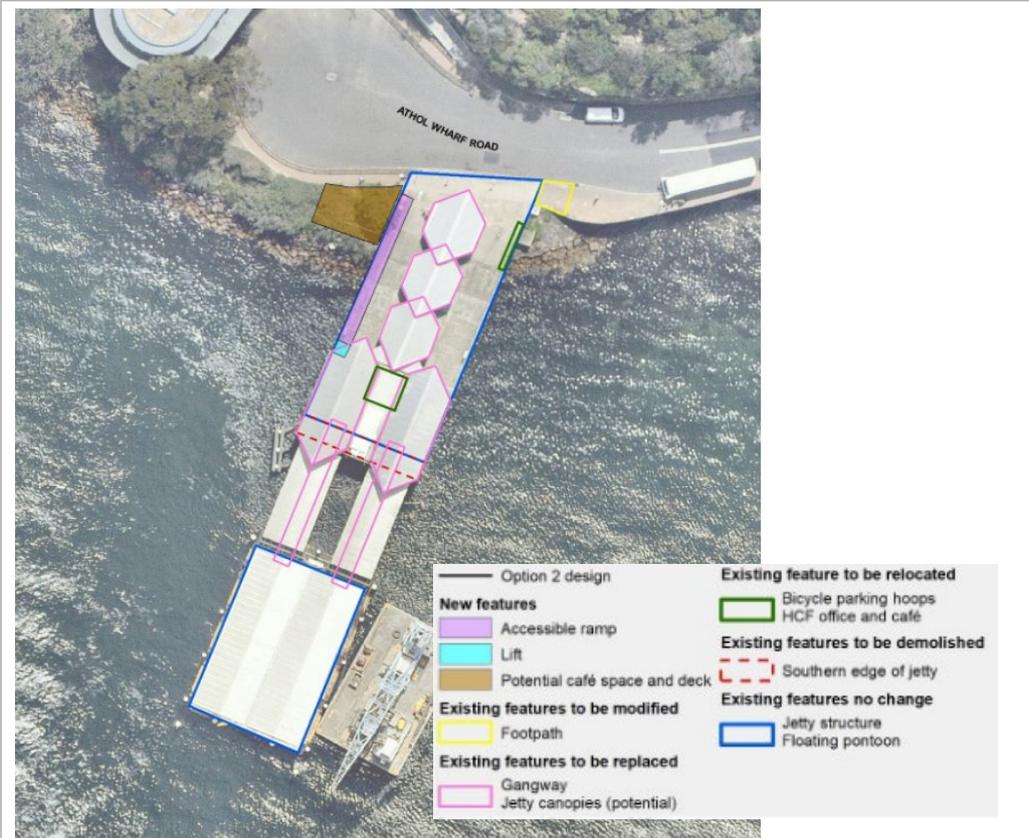
2.4.2 Identified options

Three concept design options (refer Figure 2-1) in addition to the 'Do nothing' option were considered for the Taronga Zoo wharf. These options were based on the strategic design, future needs analysis and the site-specific requirements.

The following options were considered:

- 'Do-nothing' – no upgrade and not accessible, regular maintenance would continue
- Option 1 – accessible ramp off the existing jetty with upgrade to gangways and deferred upgrade of pontoon (preferred option)
- Option 2 – accessible ramp and lift on the existing jetty with upgrade to gangways and deferred upgrade of pontoon
- Option 3 – new separate wharf.





Option 2



Option 3

Source: Aurecon, 2019a

Figure 2-1: Identified options

2.4.3 Analysis of options

Do nothing

The option of 'do nothing' would limit the scope of work to carrying out activities required to maintain operation of the existing wharf, including undertaking regular maintenance. The structure is currently in poor condition, and is not DDA compliant. Undertaking regular maintenance would not correct these issues, and the wharf is not currently suitable for long-term operation.

Although it would present the lowest initial capital cost and least 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 (refer Table 2-3) were presented to key stakeholders (Transport for NSW, Roads and Maritime and Harbour City Ferries (now TransDev)) at a workshop on 31 January 2019 and their relative performance was assessed using a multi-criterion analysis (MCA) 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"> • Accessible connection to bus stop (mandatory). • Wider kerb at the bus stop would alleviate some congestion. • Demolition of the canopy provides a design opportunity to create a more distinctive destination wharf. • Wharf can continue to operate during construction. | <ul style="list-style-type: none"> • Does not achieve the 50-year design life due to the use of the existing wharf. • Wayfinding to the transition ramp may be difficult when the wharf is crowded. • Visual impact of transition ramp from land and water. • Users of transition ramp forced to follow different and longer route to other customers. • Increases the footprint of the wharf. • Transition ramp requires developing a new structure over water. • Requires works to the seawall • Narrowing of Athol Wharf Road makes passing stopped buses more difficult. |

| Option | Advantages | Disadvantages |
|----------|---|---|
| Option 2 | <ul style="list-style-type: none"> • Accessible connection to bus stop (mandatory). • Minimal visual impact from land and water. • Users of the transition ramp follow a similar route (direction and length) to other customers. • Footprint of the wharf unchanged. • Demolition of the canopy provides a design opportunity to create a more distinctive destination wharf. • Wharf can continue to operate during construction. | <ul style="list-style-type: none"> • Does not achieve the 50-year design life due to the use of the existing wharf. • Wayfinding to the transition ramp may be difficult when the wharf is crowded. • Lift requires specialist maintenance. |
| Option 3 | <ul style="list-style-type: none"> • Accessible connection to bus stop (mandatory). • Achieves the 50-year design life. • Wayfinding is simple. • Users of the transition ramp follow the same route as all other customers. • New wharf provides a design opportunity to develop a covered boardwalk with a waiting area and café. • Wharf can continue to operate during construction. | <ul style="list-style-type: none"> • Greater visual impacts than existing and options 1 and 2. • Substantially grows the footprint of wharf infrastructure. • Requires works to the seawall. • Impacts the seabed in an area not currently impacted by ferry operations and infrastructure. |

Preferred option and design refinement

Following the MCA assessment of the options at the workshop with Transport for NSW, the former Roads and Maritime project team and other relevant stakeholders Option 2 was selected as the preferred option based on a cost and non-cost evaluation. Option 2 included an accessible ramp from the wharf entrance along the jetty to a lift to connect to the gangways.

Option 3 was discounted due to costs and consideration of the remaining life of the existing wharf structure.

While Option 2 was initially considered as the preferred option following the MCA process, upon refinement it was considered that a single lift would be insufficient to accommodate the expected users based on the peak patronage numbers, and the lift option was ultimately discounted.

Option 1 then progressed as the preferred concept design option given its ability to accommodate the larger patronage.

The concept design was developed to achieve compliance with DSAPT requirements which assumes that gangways and pontoons are located to be compliant for 80 per cent of tides (fully compliant).

The final concept design is described in detail in Chapter 3 and shown in Figure 3-1.

3 Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, 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 Taronga Zoo wharf as part of the TAP.

The water based features of the proposal would include:

- Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- Removal of existing gangways
- Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- Two new transition ramps on the existing pontoon to cater for the new gangways
- Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- Construction of a new covered *Disability Standards for Accessible Public Transport* (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- Removal and relocation of the Transdev office and café on the existing jetty
- Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- Relocation of existing Opal Card readers and Opal top-up machine
- Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the proposal would include:

- Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- Retention of the five existing bicycle parking hoops
- Retention of the public telephone booth
- Removal of foreshore vegetation to construct the new accessible ramp.

The proposal would be constructed over a duration of up to five months starting in late 2021. During construction the wharf would remain operational, however the adjacent café would be closed.

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 footprint, construction footprint and compound area have been defined as follows:

- Proposal footprint – the area directly impacted by proposed works, including the installation and removal of structures (refer Figure 3-2)
- Construction footprint – the area around the proposal footprint required for construction including the compound areas (refer Figure 3-2)
- Compound area – the temporary facilities required for construction, including for example an office and amenities compound, construction compound and materials storage compound. A small compound area would be located landside (refer Figure 3-2) and a floating construction barge would be located adjacent to the wharf structure.

Study areas for specialist disciplines are defined in Chapter 6.



Legend

- | | | | |
|---|----------------------------------|---|---------------------------------|
|  | Pile |  | Accessible ramp |
|  | Jetty |  | Gangway |
|  | Pontoon |  | Footpath |
|  | Existing ferry arrestors removed |  | Jetty canopy |
|  | Public telephone |  | Southern edge of jetty cut back |
|  | Bicycle parking hoops | | |

**FIGURE
3-1**

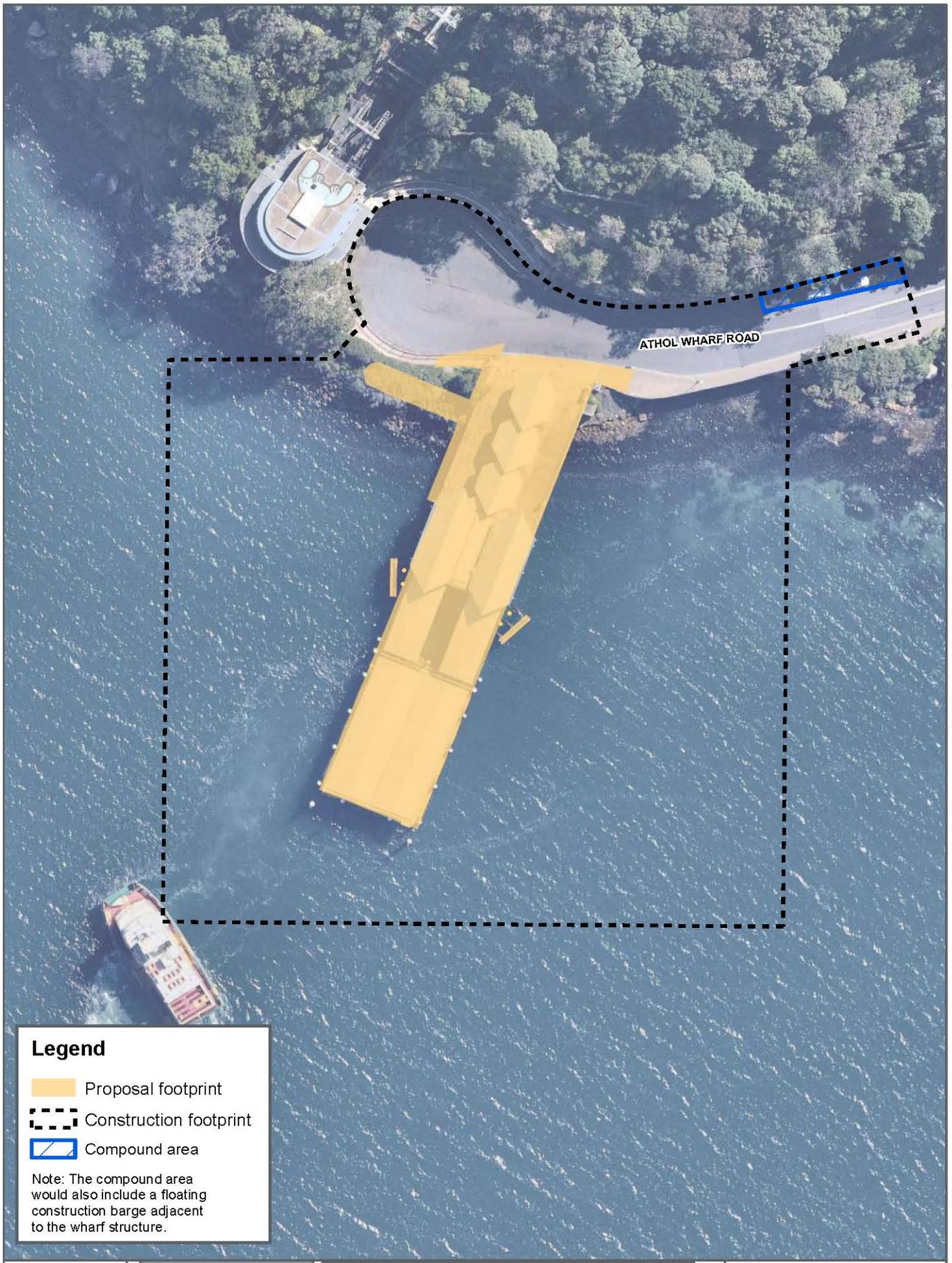
1:600 Scale at A4
m
0 3 6 9 12

Key features of the proposal

TARONGA ZOO



Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2020-12-11 | Project: AWE200198
Coordinate System: GDA 1984 MGA Zone 56
Map: AWE200198_GS053_Taronga_KeyFeatures.mxd 01
Aerial Imagery supplied by Neamap (September, 2020)

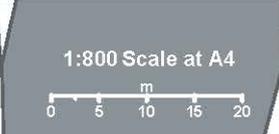


Legend

- Proposal footprint
- Construction footprint
- Compound area

Note: The compound area would also include a floating construction barge adjacent to the wharf structure.

FIGURE
3-2



Construction and proposal footprint
TARONGA ZOO

Map Produced by Carbro NSW/ACT Pty Ltd (WOL)
 Date: 2020-12-15 | Project: A/WE200198
 Coordinate System: GDA 1994 MGA Zone 56
 Map: A/WE200198_CS054_Taronga_ConstructionProposal.mxd 02
 Aerial Imagery supplied by Nearmap (September, 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
- DDA
- *National Construction Code (NCC) 2019 Volumes 1, 2 and 3 (Formerly Building Code of Australia)*
- 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 a 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 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.



Figure 3-3: View of proposal from landside perspective looking south-east



Figure 3-4: View of proposal from waterside perspective looking south-west



Figure 3-5: View of proposal from waterside perspective looking north-east

3.2.2 Engineering and development constraints

Table 3-1 lists the main constraints to the 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: Athol Wharf Tram Terminus (including escarpment and retaining wall) and Taronga Zoo wharf (remains and sea wall) | Various design options were considered. Impact to the adjacent heritage items would be minimised and consultation with Mosman Council heritage advisors will be undertaken. |
| 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 accessible to people with a disability and meet the standards of the DDA, DSAP and current legislative standards for disabled access. |
| High patronage of the wharf and importance to Taronga Zoo | Construction would be staged to maintain operation of the wharf with only localised disruption. |

3.2.3 Major design features

Major water based features

Fixed accessible ramp

A new fixed accessible ramp would be built on the western side of the existing wharf structure. The ramp would provide a path of DSAPT compliant grade to connect the existing footpath to southern end of the jetty before the gangways. The ramp would consist of a concrete deck slab supported by concrete headstocks on steel piles. Metal handrails would be provided either side of the ramp. The ramp would be about 60 metres long and 2.2 metres wide. The ramp would be covered with a steel framed canopy with composite cladding and metal roofing supported on steel columns. The style of the roof would complement the angular appearance of the existing jetty canopies to be retained.

Gangways

The two existing 16 metre long dual gangways would be replaced with two 18 metre long and 3.5 metre wide, dual-lane aluminium gangways which would connect the fixed jetty structure to the pontoon. The gangway gradient would vary according to the tides to be almost horizontal at high tide, and a maximum grade of one in 14 for 80 per cent of the tide levels.

The new gangways would be installed at the same location as the existing, with the connection points at the pontoon unchanged.

To accommodate the additional gangway length, the existing fixed jetty structure would be cut back about 3.5 metres. To support each gangway, two piles and headstock would be installed, this would be connected to the existing wharf through a new concrete deck about 1.4 metres wide.

Modification to existing jetty

The existing jetty would also be modified to comply with DSAPT requirements and provide an accessible pathway from the accessible ramp to the gangways and around the wharf facilities including the TransDev office/ toilet and café.

The existing TransDev office and toilet and Taronga Zoo Kiosk would be demolished and relocated in the jetty. The existing kerb in front of the current position of the café would be removed to allow a level two metre circulation zone.

The TransDev office and toilet would be replaced in a similar location to its current position on the jetty between the two gangways. The office would be around 2.5 metres by two metres with a one metre by two metre toilet. The café space would be around five metres by three metres, with a separate café store. The existing distribution board would also be rehoused as part of this building structure.

Two of the jetty canopies would be replaced to accommodate the change in size of the jetty.

Modifications to the existing pontoon

Minor modifications to the existing pontoon are proposed at each gangway connection point to accommodate the new gangway and its landings. This includes relocation of glass partitions, the cutting back of the pontoon roof and installation of transition ramps at the end of the gangways. The transition ramps would be 1:14 ramps (about four metres long) and would be the same width as the gangways. A central balustrade would be constructed in the middle of the ramp that would align with the centre posts of the gangway.

Tactile Ground Surface Indicators (TGSIs) would be installed at appropriate locations on the pontoon to comply with DSAPT requirements.

Major land based features

Pedestrian access

There would be two methods of access to the wharf from street level as part of the proposed upgrade:

- New accessible ramp
- Through the existing jetty.

The accessible ramp would be constructed on the west side of the existing jetty, connecting the jetty to the footpath at the bus stop. A small part of the existing fence would need to be removed to connect the existing footpath to the accessible ramp. The entry to the new ramp would be flat to allow people to wait undercover for the bus. The existing footpath at the entry to the wharf would be widened to provide DSAPT-compliant grades suitable for wheelchairs accessing the new ramp from the bus stop or Athol Wharf Road cul-de-sac.

Bus facilities

There is an existing bus interchange at the wharf entrance on Athol Wharf Road. It is proposed to re-grade and extend the Council footpath to provide an accessible connection to the bus stop for DSAPT compliance.

The covered jetty is located a few metres away from the bus stop, where patrons can wait for buses. The jetty would remain a covered structure to continue provide shelter to patrons.

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
- 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 for land side works | <ul style="list-style-type: none">• Establishment of a temporary site compound (site offices, amenities and plant/material storage areas, etc). There is limited space available for these facilities on land, other than parking spaces along the northern side of Athol Wharf Road (with a narrowing of existing traffic lanes and installation of temporary traffic barriers) or on the existing jetty structure. As such, the main compound area would be installed on a construction barge adjacent to the wharf structure. |

| Activity | Associated work |
|--|---|
| | <ul style="list-style-type: none"> • Temporary pedestrian paths may need to be installed to maintain safe access past the works. This may require traffic controllers to control pedestrian, vehicle and bus movements. • 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. • Environmental controls would be established in accordance with the CEMP. |
| Site establishment for water side works | <ul style="list-style-type: none"> • Establishment of a construction work area using floating booms to delineate this area. 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. • Environmental controls would be established in accordance with the CEMP. |
| Construction of a new access ramp | <ul style="list-style-type: none"> • Install temporary footpath diversion to allow construction access. • Clear and excavate for ramp using medium sized excavator (+20 tonne). Note that rock armour has been placed along the water's edge. • Install land side piles (if required) using small excavator mounted piling rig. • Install water side piles using a piling barge. • Install two protection piles (to replace removed ferry arresters). • Install precast concrete headstocks, precast ramps and prefabricated. • Install roof structure by mobile crane located in Athol Wharf Road cul-de-sac. The works may require the closure of Athol Wharf Road cul-de-sac so may need to be undertaken at night to avoid impacting on bus services. Alternatively, the components could be delivered to site by barge and installed by barge mounted crane. • Connect ramp to existing jetty structure and make good. • Finalisation works (pavements, architectural, finishes, hand rails, etc). |
| Installation of new gangways and jetty fit out | <ul style="list-style-type: none"> • Close the café offices and western gangway. • Demolish the existing café, office, glazing, roof structures and fitments to the extent required. • Demolition of the existing wharf would need to be staged to ensure that one of the western and eastern gantries remains in service at all times. • Demolition of the existing timber ferry arresters would be staged similar to demolition of the existing wharf. • Establishment of a construction work area using floating booms to delineate this area. 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. • Up to three barges (about 20 metres by 30 metres in size) 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. • The western side gantry would be closed. • Remove/demolish existing western timber ferry arresters. • Remove the existing western gantry using barge mounted crane and dispose off-site using a barge. • Demolish the western side of the existing jetty to the extent required and make good. • Modify the western side of the existing pontoon to suit new gantry. |

| Activity | Associated work |
|---------------|---|
| | <ul style="list-style-type: none"> • The new western gangway would be fabricated off-site and floated to site by barge. The gangway would be lifted into position a large barge mounted crane. • Install new steel protection piles approximately at the location of demolished timber ferry arresters. • The existing western side roof structure would be modified to suit the final arrangement. • Finishing works on the western side would be completed (handrails, finishes, architectural, etc) and the gantry opened. • The eastern side gantry would be closed. • Remove/demolish existing eastern timber ferry arresters. • Remove the existing eastern gantry using barge mounted crane and dispose off-site using a barge. • Demolish the eastern side of the existing jetty to the extent required and make good. • Modify the western side of the existing pontoon to suit new gantry. • The new eastern gangway would be fabricated off-site and floated to site by barge. The gangway would be lifted into position a large barge mounted crane. • Install new steel protection piles approximately at the location of demolished timber ferry arresters. • The existing eastern side roof structure would be modified to suit the final arrangement. • Finishing works on the eastern side would be completed (handrails, finishes, architectural, etc) and the gantry opened. • New café, office, glazing, roof modifications and other finishing works would be completed. |
| Site clean-up | <ul style="list-style-type: none"> • The site would be cleaned up and restored to its previous state. • Sedimentation controls and temporary structures would be removed. |

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 constructed over a duration of up to five months starting in late 2021. Construction is proposed over the winter months when patronage is lower to minimise impacts to commuters. 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 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. Approximately 20 night shifts would be required to complete the piling works.

Due to the requirement for calm water conditions, the new gangways would be lifted into position by a barge-mounted crane over a two to three-day period between approximately between 11pm and 7am when the water is calmer.

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 and land based construction | <ul style="list-style-type: none"> • Barge • Barge crane • Floating boom (crane) • Crane • Day-maker • Road truck <ul style="list-style-type: none"> • Pile hammer • Work boat • Pneumatic drill • Franna crane • Hand tools • Bobcat |

| Activity | Equipment |
|----------|--|
| | <ul style="list-style-type: none"> <li>• Truck <li>• Truck (medium rigid) <li>• Generator <li>• Elevated work platform <li>• Rock drill or bored piling <li>• Pile hammer |

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; however, no sediment would be removed. Earthworks during construction of the land based elements would include earthworks for the construction of the new access ramp and regrading of the footpath at the bus stop. 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 licensed 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 (gangway, canopy and barriers), substructure (piles) and land side work (accessible ramp)
- 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

Due to the importance of the Taronga Zoo wharf to the adjoining Taronga Zoo and other recreational facilities, the wharf must remain operational during construction. 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 construction footprint for the water-side construction works to prevent both commercial and recreational traffic entering the area
- Restrictions on work sites on the Taronga Zoo wharf (e.g. restriction to use of one gangway)
- Potential changes to Taronga Zoo wharf ferry timetable during construction

- Potential temporary partial closure of the Athol Wharf Road cul-de-sac
- Introduction of construction traffic along Athol Wharf Road and Bradleys Head Road.

No private property access would be impacted during construction.

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 Athol Wharf Road 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, making use of an offshore storage barge. The primary compound area would be a construction barge located adjacent to the wharf structure. While the specific requirements for this area would be confirmed by the contractor, it would most likely comprise a shipping container with a supporting site office and toilet, construction compound and materials storage compound.

A small compound area would be located in the parking spaces along the northern side of Athol Wharf Road (with a narrowing of existing traffic lanes and installation of temporary traffic barriers) as shown on Figure 3-2.

The marshalling and storage of most 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). During detail design, further assessment of impacts to local utilities would be undertaken including on-site services locating. The preliminary assessment identified that the following services are present around the Taronga Zoo wharf:

- Electrical low voltage (LV) cables (Ausgrid)
- Sewer services (Sydney Water)
- Communications services (Telstra).

There would be no impact to these services.

The DBYD searches did not identify any water infrastructure in vicinity of the wharf. The nearest water hydrant to the wharf and the feasibility of its use for wharf maintenance or emergency events should be further investigated during detail 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 Mosman Council.

4 Statutory planning framework

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 Mosman 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 SRD 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 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 falls within land identified as coastal environment area under Clause 13 of the Coastal Management SEPP, however Clause 13 (3) details that land that falls within the

Foreshores and Waterway Area in the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*, the Coastal Management SEPP does not apply. 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 and management measures to protect and maintain the areas natural and heritage values. 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 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 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 Taronga Zoo 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 remain operational during the construction of the proposal. Existing nearby bus transport would also remain available. Land transport is discussed further in section 6.8.</p> |
| <p>(e) To encourage a culturally rich and vibrant place for people.</p> | <p>The proposal would continue to provide local residents and visitors with access to the ferry network and interchange with other public transport provisions. This would sustain the area as a vibrant place to visit.</p> |
| <p>(f) To ensure accessibility to and along Sydney Harbour and its foreshores.</p> | <p>The upgrade would ensure that visitors are provided with ongoing access to Sydney Harbour and its foreshore</p> |

| Aim | Comment |
|---|---|
| | <p>areas over the next 50 years. It would also improve access for low mobility passengers.</p> <p>The existing wharf would be operational during the construction of the proposal.</p> |
| (g) To ensure the protection, maintenance and rehabilitation of watercourses, wetlands, riparian lands, remnant vegetation and ecological connectivity. | <p>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, sediment disturbance, mobilisation and smothering.</p> |
| (h) To provide a consolidated, simplified and updated legislative framework for future planning. | <p>The proposal is being delivered under the relevant planning provisions covering waterfront and marine development set at a State and Commonwealth level.</p> |

The proposal has been considered in respect of the objectives from Clause 17 of the SREP Sydney Harbour zones for W1 Maritime Waters and W2 Environment Protection in Table 4-2 and Table 4-3 respectively.

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 the Taronga Zoo wharf, and no impact is anticipated. Water transport is discussed further in section 6.8.</p> <p>The Port Authority of NSW as the Harbour Master would be consulted prior to and during the works. Where required, 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 wharf would still be operational during staged construction work so as not to interrupt public transportation services between Taronga Zoo and Circular Quay.</p> <p>The Port Authority of NSW as the Harbour Master 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 upgrade of the existing Taronga Zoo wharf, including introducing an accessible ramp. The new wharf would allow for more effective and efficient public water transport for its 50-year design life.</p> |

Table 4-3: Zone W2 Environment Protection objectives

| Objective | Comment |
|--|--|
| (a) To protect the natural and cultural values of waters in this zone | Providing the safeguard measures are implemented, the proposal would not have a significant impact on biological diversity and ecological integrity within the proposal footprint or surrounds. |
| (b) To prevent damage or the possibility of longer term detrimental impacts to the natural and cultural values of waters in this zone and adjoining foreshores | The identified mitigation measures would mitigate any potential impacts of the proposal on Aboriginal and non-Aboriginal heritage items. |
| (c) To give preference to enhancing and rehabilitating the natural and cultural values of waters in this zone and adjoining foreshores | 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 aquatic ecology would be caused by the proposal. Minor terrestrial vegetation removal, of less than 0.01 hectares, is expected to occur as a result of the proposal. |
| (d) To provide for the long-term management of the natural and cultural values of waters in this zone and adjoining foreshores. | 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 Chapter 3). Both factors provide for a sustainable urban environment over its 50-year design life. |

Under clause 18 of the Sydney Harbour SREP, the proposal is permissible as a public water transport facility with consent in the W1 and W2 zones. 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 (refer 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 | Chapter 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. |
| Clause 22 Public access to, and use of, foreshores and waterways | The wharf would continue operation during the construction period. Access to the foreshore would not be impeded during construction works including the foreshore footpath as the works would be staged to ensure continued operation of the wharf. The local community, park users and ferry passengers would be notified ahead of the commencement of work. |

| Division 2 matter | Comment |
|--|---|
| Clause 23 Maintenance of a working harbour | The upgrade would ensure that visitors to the area would be provided with access to a ferry service (and public transport) over the next 50 years. |
| Clause 24 Interrelationship of waterway and foreshore uses | 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. |
| Clause 25 Foreshores and waterways scenic quality | <p>Upgrading the wharf in the same 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>The design is not considered to have a significant contrast to the existing wharf area and is relatively distant from some sensitive landscape character zones, as discussed in section 6.5.</p> |
| Clause 26 Maintenance, protection and enhancement of views | <p>Section 6.5 describes the landscape character and visual impacts associated with the proposal. The new wharf would have an overall moderate visual impact on surroundings views.</p> <p>Impacts on views from Sydney Harbour specifically are considered moderate to high and moderate due to the presence of a moderately substantial new built form of the path and removal of some trees, however this would be offset by an improved quality of built form and finishes.</p> |
| Clause 27 Boat storage facilities | There is no boat storage works associated with, or impacted by, the proposal. |

Clause 31 of the Sydney Harbour SREP requires consultation for certain development proposals not requiring development consent. Consultation, including under the Sydney Harbour SREP, 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. The nearest Sydney Harbour SREP listed heritage item is the Stone Wharf (Item no. 25) in National Park, Bradleys Head which is outside the construction footprint. Notwithstanding, a number of locally listed heritage items are in proximity to the works including:

- Athol Wharf Tram Terminus (including escarpment and retaining wall) (Item no. A482)
- Taronga Zoo Wharf (remains and sea wall) (Item no. A483)
- Taronga Zoo - Upper and Lower Entrance Gates, Elephant house, Aviary, Floral Clock (Item no. I34).

Heritage items are discussed further in section 6.6 and section 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 a direct or potential direct impact on three local heritage items, however these impacts would not affect the overall significance of the items and are classified as negligible or neutral (refer 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. | Based on the preliminary archaeological assessment it is unlikely that the proposed works would result in impacts to significant archaeological 'relics'. |
| 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. The proposal would have only minor to moderate impacts to some heritage items and the overall significance of the items would not be affected. 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 SREP identifies 'wetlands protection areas' to conserve and protect any wetland habitats. In Sydney Harbour these include mangroves, seagrasses, saltmarshes, sedgeland, wet meadows and mudflats and the wetlands protection areas cover a 40 metre buffer around these to account for movement, growth and seasonal variation.

The construction footprint is identified as being located within a Wetland Protection Area under the SREP. However, the vegetation and habitat in the study area does not include any of the features defined as 'wetland habitat' in the SREP. The proposal would include the clearing of landscape plantings which do not constitute remnant vegetation.

Although the foreshore is highly modified and no mangroves, seagrasses or saltmarshes occur in the study area or the area mapped as a wetlands protection area, the entire Parramatta Estuary is considered an estuarine wetland (estuarine waterbody) by Kingsford et al. (2004). A precautionary approach has been adopted to address the objectives in relation the estuarine habitat in the wetlands protection area within the study area. The wetlands objectives from the Sydney Harbour SREP in clause 61 are considered in Table 4-6.

Table 4-6: Wetland objectives

| Objective | Comment |
|---|---|
| <p>(a) To preserve, protect and encourage the restoration and rehabilitation of wetlands.</p> | <p>Potential impacts of the proposal to the wetland include (refer section 6.3):</p> <ul style="list-style-type: none"> • Loss of habitat under the footprint of the piles to be installed • Mobilisation of fine and coarse debris (e.g. sediments) and mobilisation of contaminants known to persist in the sediments • Scour from vessel and barge movements during construction • Shading of less than 0.01 hectares of subtidal rocky reef habitat. <p>These were not considered to substantially impact the estuarine habitat as the majority of habitat lost would be reinstated by the new piles, providing similar or better habitat than that removed.</p> <p>Mitigation measures would be implemented to avoid or minimise the mobilisation of fine and coarse debris and the habitat in the area are currently exposed to substantial scouring from an ambient level of vessel traffic at the wharf. Thus, the proposal is unlikely to interfere with the preservation and protection of the wetland and the reinstatement of any lost habitat features may promote restoration and rehabilitation.</p> <p>During detailed design, consideration to promoting colonisation of habitat-forming species would be considered by the installation of structures which provide habitat complexity.</p> <p>Refer to section 6.3 for more information.</p> |
| <p>(b) To maintain and restore the health and viability of wetlands.</p> | <p>Refer (a). The reinstatement of the majority of lost habitat features would likely maintain the habitat condition, availability and viability in the estuarine wetland. Also, providing relevant standard controls are implemented and monitored as set out in Transport for NSW guidelines and quality assurance specifications (refer section 7.2), the proposal's environmental impacts during construction are expected to be safeguarded and minimised thus affording protection of the wetlands in the local area.</p> |
| <p>(c) To prevent the fragmentation of wetlands.</p> | <p>The proposal would not impact on the connectivity of the broader Parramatta Estuary hence, would not fragment any wetland habitat.</p> |
| <p>(d) To preserve the scenic qualities of wetlands.</p> | <p>The location and construction of the wharf has been selected to minimise impacts upon wetlands, and the</p> |

| Objective | Comment |
|--|--|
| | overall visual impact of the proposal is considered moderate (refer section 6.5). |
| (e) To ensure that wetlands continue to perform their natural ecological functions (such as the provision of wetland habitat, the preservation of water quality, the control of flooding and erosion). | As described above, the proposal's design in combination with the proposed safeguards described in Chapter 7 are aimed at protecting the ecological marine environment to ensure the wetland's ecological function is preserved. Safeguards are being implemented as a matter of precaution to avoid and minimise impacts as described in section 7.2. |

The matters to be considered for works within a wetland protection area from clause 63(2) of the Sydney Harbour SREP are considered in Table 4-7.

Table 4-7: Clause 63(2) matters

| Objective | Comment |
|---|--|
| (a) The development should have a neutral or beneficial effect on the quality of water entering the waterways. | The proposal would have a neutral effect if relevant standard safeguards in Transport for NSW guidelines, quality assurance specifications and this REF are implemented and monitored. The proposal is expected to have minimal environmental impact and protect the marine environment and water quality (refer to section 6.2). |
| (b) The environmental effects of the development, including effects on: <ul style="list-style-type: none"> (i) the growth of native plant communities, (ii) the survival of native wildlife populations, (iii) the provision and quality of habitats for both indigenous and migratory species, (iv) the surface and groundwater characteristics of the site on which the development is proposed to be carried out and of the surrounding areas, including salinity and water quality and whether the wetland ecosystems are groundwater dependent | <p>Proposed impacts on vegetation and terrestrial habitat are minimal and would not fragment or isolate existing habitat.</p> <p>The proposal is unlikely to impact threatened species. 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.</p> <p>The removal of six ferry arrestor piles would result in minor removal of marine vegetation, habitat and sessile/less mobile fauna currently colonising the piles and concrete steps. However, the majority of these species are common in subtidal rocky reefs and would quickly colonise the piles of the new wharf and pontoon. In addition, the installation of new piles would create habitat for aquatic vegetation to establish, however it is noted this location is not ideal habitat.</p> <p>Sediment mobilisation from piling and other water-based construction activities and vessel wash and scour were also identified as potential proposal impacts. However, the study area is likely to be frequently exposed to elevated levels of sediment, associated with rainfall, sea conditions and vessel traffic at the wharf. Thus, with the appropriate controls, a slight, temporary increase in these impacts is not expected to substantially impact marine biodiversity. Vessel traffic to the new wharf during operation would be similar to current conditions.</p> <p>There are no aquatic or terrestrial groundwater dependent ecosystems in or next to the study area.</p> |

| Objective | Comment |
|--|--|
| | <p>Providing the relevant safeguards described in Chapter 7 are implemented and monitored, the proposal's environmental impacts on the area's surface and groundwater quality are expected to be safeguarded and minimised.</p> |
| <p>(c) Whether adequate safeguards and rehabilitation measures have been, or will be, made to protect the environment.</p> | <p>Chapter 7 sets out the safeguards and management measures to protect the local environment. The chapter also includes post-construction measures, and corrective actions needed during an accident or emergency to manage any impacts.</p> |
| <p>(d) Whether carrying out the development would be consistent with the principles set out in The NSW Wetlands Management Policy (as published in March 1996 by the then Department of Land and Water Conservation).</p> | <p>The Policy lists five principles for wetland protection (clauses 61a-e). The proposal is located in the same position as the existing wharf and changes to ferry wash impacts to the near-shore habitat would be minimal. A CEMP would be implemented during construction to minimise impact to shallow habitat (e.g. use of floating mooring lines). As such, the proposal aims meets the Policy's principles by:</p> <ul style="list-style-type: none"> • Avoid and minimise impacts first • Mitigate impacts where avoidance is not possible • Offset where residual impacts cannot be avoided. |
| <p>(e) Whether the development adequately preserves and enhances local native vegetation.</p> | <p>The proposal would not affect aquatic vegetation. Submerged structures, such as piles, would provide habitat availability for aquatic vegetation to establish. The proposal has also been designed to minimise impacts to vegetation. Refer to section 6.3 for further detail.</p> |
| <p>(f) Whether the development adequately demonstrates:</p> <p>(i) how the direct and indirect impacts of the development will preserve and enhance wetlands,</p> <p>(ii) how the development will preserve and enhance the continuity and integrity of the wetlands,</p> <p>(iii) how soil erosion and siltation will be minimised both while the development is being carried out and after it is completed,</p> <p>(iv) how appropriate on-site measures are to be implemented to ensure that the intertidal zone is kept free from pollutants arising from the development</p> <p>(v) that the nutrient levels in the wetlands do not increase as a consequence of the development,</p> <p>(vi) that stands of vegetation (both terrestrial and aquatic) are protected or rehabilitated,</p> | <p>(i) Section 6.1 and Table 4-6 describe how the proposal has been designed and environmental safeguards have been proposed to protect the area in which the proposal would be built.</p> <p>(ii) Refer Table 4-6</p> <p>(iii) The proposed new piles described in Chapter 3 should be designed to minimise scour, erosion or any sediment transport, hydrodynamic and/or physical impact on the marine environment. During construction work, a silt boom and curtain may be used to prevent any sediment dispersion and siltation, while additional erosion management controls have been identified in the safeguards and management measures in Chapter 7.</p> <p>(iv) Chapter 7 includes a range of standard pollution management controls that would be implemented and monitored during construction as set out in Transport for NSW guidelines and quality assurance specifications (refer to Chapter 7). If implemented, then the proposal's environmental impact on the intertidal zone are expected to be safeguarded and minimised. As such, safeguards identified in section 6.1.4 would be implemented to prevent potential contamination of the waterway.</p> <p>(v) The proposed standard pollutant management and sediment disturbance controls included in Chapter 7 help prevent any nutrient loading into the marine environment.</p> |

| Objective | Comment |
|---|--|
| <p>(vii) that the development minimises physical damage to aquatic ecological communities,</p> <p>(viii) that the development does not cause physical damage to aquatic ecological communities.</p> | <p>(vi) Refer to Clause 63 (2b).</p> <p>(vii) The proposal's direct impact to aquatic ecological communities would be limited to the removal and installation of piles, as described in section 6.3. This would be insufficient to have any material physical impact on marine ecological communities and their supporting habitat. Also, as described in section 6.1, the operational wharf would not alter the hydrodynamic or physical environment, to the extent to indirectly impact on aquatic ecological values.</p> <p>(viii) As above</p> |
| <p>(g) Whether conditions should be imposed on the carrying out of the development requiring the carrying out of works to preserve or enhance the value of any surrounding wetlands.</p> | <p>Chapter 7 includes safeguards and mitigation measures that Transport for NSW, and its contractor(s), would commit to implementing and monitoring during construction to prevent any impact on the surrounding wetland values. Table 4-6 describes this in more detail.</p> |

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 4-8.

Table 4-8: Relevant LEP land use zoning policies

| Objective | Proposal consistency |
|--|---|
| SP2 Infrastructure (Infrastructure) | |
| <ul style="list-style-type: none"> To provide for infrastructure and related uses. To prevent development that is not compatible with or that may detract from the provision of infrastructure | <ul style="list-style-type: none"> Provides improvement as use as a ferry wharf Short-term impacts to Athol Wharf Road during construction. |

4.2 Other relevant NSW legislation

Table 4-9 lists the NSW legislation relevant to the proposal or the land on which the proposal would be built.

Table 4-9: 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 PACHCI assessment confirmed that the proposal would avoid impacts to known Aboriginal heritage items (Appendix I). An Aboriginal heritage impact permit (AHIP) is not required for the proposal. 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>The proposal includes primarily neutral or negligible direct or potential direct impacts to local heritage items Taronga Zoo wharf, Athol Wharf Tram Terminus and Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock. There would also be negligible visual impact to these items.</p> <p>Based on the preliminary archaeological assessment it is unlikely that the proposed works would result in impacts to significant archaeological ‘relics’.</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 would include impacts to Athol Wharf Road, a local road managed by Mosman Council.</p> <p>Consultation with Mosman Council is required for works on Athol Wharf Road.</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 section 6.3) carried out to support the REF, noted the proposal is expected to impact less than 0.01 hectares of intertidal rocky reef, less than 0.01 hectares of vertical submerged marine vegetation/habitat (intertidal and subtidal), less than 0.01 hectares of low - medium relief subtidal rocky reef (Type 2 – moderately sensitive Key Fish Habitat, KFH), and less than 0.01 hectares of soft sediment (Type 3 – Minimally sensitive KFH).</p> <p>The assessment concluded that the proposal would trigger the need for a permit to harm marine vegetation under Section 205, however, consultation with DPI Fisheries has confirmed that no permit is required (refer to Table 5-2).</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 species impact statement is not required.</p> |

| Legislation and application | Relevance to proposal and further requirements |
|--|---|
| | <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 was provided.</p> <p>A Section 37 permit under the FM Act to relocate Syngnathids collected during the targeted pre-clearance survey would be required as part of the White's Seahorse relocation. The requirement for this permit will be considered in consultation with DPI Fisheries.</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 section 6.3), carried out to support the REF, identified that 14 terrestrial 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 less than 0.01 hectares of native/exotic landscaping. Proposed impacts on vegetation and terrestrial habitat would not substantially fragment or isolate existing 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 harm, 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</p> |

| Legislation and application | Relevance to proposal and further requirements |
|---|--|
| | required. Chapter 5 details the consultation that has taken place. |
| <p><i>Marine Safety Act 1998</i> and Marine Safety Regulation 2016: 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, 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>DPIE Crown Land has indicated that works below the mean high water mark are managed by Transport for NSW/Roads and Maritime.</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>A Preliminary Site Investigation (PSI) details the site history, contaminants of potential concern (COPC) and undertakes a conceptual risk assessment. The PSI concludes the site presents a low residual risk to impact on COPC in sub-surface materials, groundwater and sediment. 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>Five 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 4-10 lists the objectives of the *Coastal Management Act 2016* and whether the proposal is consistent with the objectives.

Table 4-10: Coastal Management Act 2016 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 safeguards and management 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 minor short term impacts to public access to the foreshore noting the wharf will still be operational during construction, and 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 safeguards and management 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 concept design process. |
| (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 |

| Objectives | Relevance to proposal |
|--|--|
| | operation during construction for visitor access to Taronga Zoo. |
| (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 B 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.

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 public ferry 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

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, 2020d) has been prepared for the proposal in accordance with the International Association for Public Participation Spectrum and the Roads and Maritime 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 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 5-1.

Table 5-1: 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 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 I). An Aboriginal heritage impact permit (AHIP) under the *National Parks and Wildlife Act 1974* is not required for the proposal.

5.3 ISEPP consultation

Appendix C 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 with Mosman Council 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 meeting was held between Transport for NSW and Mosman Council on 6 February 2020 to provide an update on concept design for the Taronga Zoo wharf upgrades in preparation for community engagement. The discussion involved confirmation of the validity of the concept design report (Aurecon, 2019a) and its recommendations for accessibility upgrades of the existing wharf, with Mosman Council requiring a comprehensive condition assessment.

A formal ISEPP letter for the proposal was issued on 21 December 2020 to Mosman Council. No response has been received at this time.

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.

5.4 SREP (Sydney Harbour Catchment) 2005 consultation

Appendix C 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) as the proposal:

- Involves the development of public water transport facilities (Schedule 2)
- Involves demolition (including demolition in relation to heritage items (Schedule 2)).

The Department of Planning, Industry and Environment (DPIE) (former Foreshores and Waterways Planning and Development Advisory Committee) has been consulted about the proposal as per the requirements of clause 31 of the SREP (Sydney Harbour Catchment). No response has been received at this time.

5.5 Government agency and stakeholder involvement

The following government agencies and stakeholders have been consulted regarding the proposal:

- DPIE Crown Land
- 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 in Table 5-2.

Table 5-2: Issues raised through government agency and stakeholder consultation

| Agency | Issue raised | Response/where addressed in REF |
|--|---|---------------------------------|
| DPI Fisheries | <p>DPI Fisheries has no objections to the proposed works.</p> <p>The consultation serves as notification under s199 of the <i>Fisheries Management Act 1994</i>.</p> <p>There is no requirement for Part 7 Fisheries permits for these works.</p> | Noted. |
| Port Authority of NSW (Harbour Master) | <p>No initial comments/concerns with this proposal.</p> <p>Ensure Harbour Master Approval is sought for the Disturbance of Seabed closer to project commencement.</p> | Noted. |
| DPIE Crown Land | <p>There is no Crown Land in this vicinity managed by Crown Lands.</p> <p>Crown Lands does not have any comment on this proposal.</p> | Noted. |

A meeting was held between Transport for NSW and Taronga Zoo management on 4 September 2020 to provide a briefing on the concept design for the wharf upgrade and to discuss impacts during construction including potential noise impacts on the zoo. A second meeting was held on 26 February 2021 to provide an update on the proposal, construction timing and potential construction impacts. Taronga Zoo will be further consulted during the public exhibition period of the REF.

5.6 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 will collate and consider the submissions received then determine whether the proposal should proceed as described or whether any changes are required. It would also decide if any additional environmental assessment, safeguards or management measures are needed.

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

6 Environmental assessment

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 B.

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=oeh2019annualsummary>
- Preliminary Site Investigation (Cardno, 2020a)
- Geotechnical Desktop Investigation (Aurecon, 2019b)
- Tidemap: Sydney Harbour (Tidetech, 2020)
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* (POEO Act)
- Concept Design Report (Aurecon, 2019a)
- Geotechnical Desktop Investigation (Aurecon, 2019b)

- Preliminary Site Investigation (PSI) (Cardno, 2020a), provided as Appendix D.

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 and scour.

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 of other vessels nearby. Wind shear on the water surface generates the strongest currents in the location of the proposal.

Waves

The location of the existing Taronga Zoo wharf is most exposed from the south through to south-west with fetch lengths of about 2100 to 2500 metres (Aurecon, 2019a). The proposal footprint would be subjected to wind waves. Primary wind waves are likely to emanate from the south and secondary waves from the south-west with 1 in 5-year

average recurrence interval (ARI) heights of up to 0.7 metres (Aurecon, 2019a). The proposal area is also subjected to vessel generated waves.

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 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 metres CD (or 1.5 metres AHD), based on measurements taken during the severe 1974 storms (Aurecon, 2019a).

Bathymetry (water depth)

The bathymetry at the site slopes from 0 metres CD, at the seawall, to -9.5 metres CD about 60 metres from the seawall, at the end of the existing wharf. Between about 8 metres and 15 metres from the seawall, the bathymetry decreases rapidly from -3 metres CD to -6 metres CD (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).

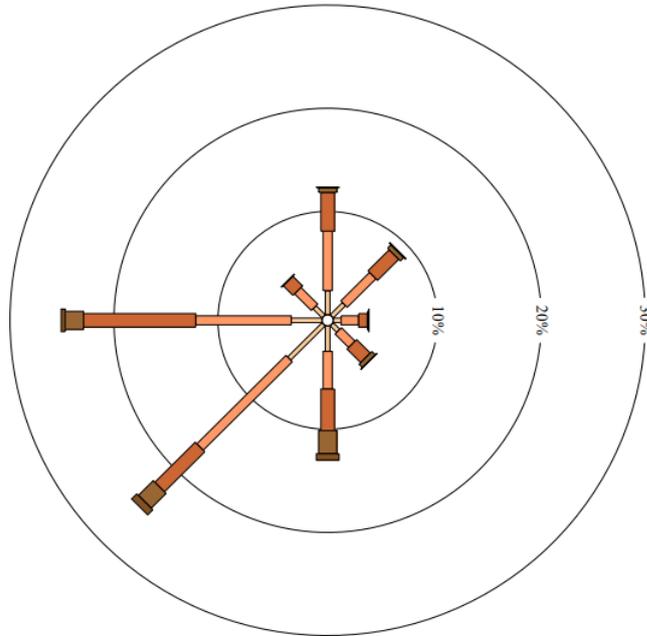
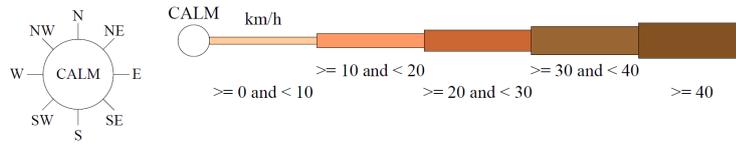
Sydney Harbour (Wedding Cake West) weather station (station number 066196) is located about 2.3 kilometres to the east of the proposal footprint. Morning and afternoon wind rose directional data is summarised in Table 6-1 and shown in Figure 6-1. Afternoon winds are generally stronger than morning winds tending towards 20-27 kilometres per hour with morning winds generally 15-19 kilometres per hour (BoM, 2020b).

Table 6-1: Wind conditions at Sydney Harbour (Wedding Cake West) weather station

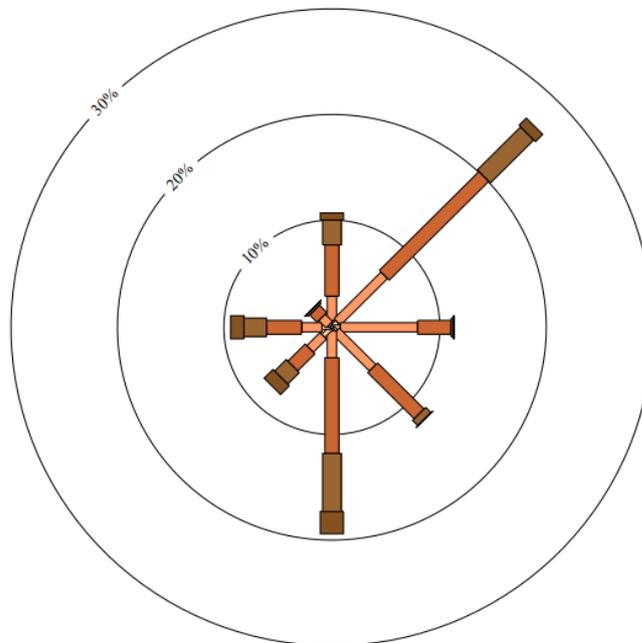
| | N | NE | E | SE | S | SW | W | NW | Calm |
|-----|-----|-----|-----|-----|-----|-----|-----|----|------|
| 9am | 12% | 9% | 4% | 5% | 12% | 25% | 25% | 5% | 3% |
| 3pm | 11% | 27% | 12% | 12% | 19% | 7% | 9% | 2% | 1% |

Source: BoM, 2020b

Sydney Harbour (Wedding Cake West) Site No. 066196
 18 September 1997 to 11 August 2020



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. A sandstone outcrop is visible to the north of the construction footprint.

Soils

Soils at the proposal footprint are likely to comprise colluvial deposits (comprising sandy soils underlain by the Hawkesbury soil formation at a shallow depth).

Most of the estuarine plane layer is likely to be composed of clay and silt, with variable shell content, however in shallow water, close to the shoreline, this layer is likely to contain high sand content. The high silt and clay content in a marine environment could create concerns with water turbidity associated with construction and low particle settlement rates. No previous geotechnical investigations have been undertaken near the wharf (Aurecon, 2019b).

The natural environment of the site has been heavily modified to form Athol Wharf Road and the Taronga Zoo wharf. There is the potential for material to have been imported to site to recontour the landscape.

Contamination

Sydney Harbour has extensive areas of polluted sediments mainly associated with the historical industrial character of the catchment. Key potential contamination sources in the construction footprint include contaminated nearshore sediments and stormwater discharge and surface water runoff.

A preliminary site investigation (PSI) was undertaken in 2020 for the Taronga Zoo wharf (Cardno, 2020a, Appendix D) to identify historical sources of potential contamination or potentially contaminating activities that may have taken place in the construction footprint. A review of the site history identified historical activities with potential to result in contamination, including (Cardno, 2020a, Appendix D):

- Use of fill material of unknown origin and impact for the construction of Athol Wharf Road
- Surface water runoff containing heavy metals and Polycyclic aromatic hydrocarbons (PAHs) from the road
- PAHs from machinery and equipment from the decommissioning of the former Taronga Zoo wharf and construction of existing wharf
- Contaminant transport from the greater Sydney Harbour and fuel leaks from vessels.

A risk assessment conducted as part of the PSI (Cardno, 2020a) identified that the construction footprint represents a low residual risk for potential contaminants in sub-surface materials, groundwater and sediment.

A search of the NSW EPA online contaminated land record of notices on 14 September 2020 did not identify notified sites within a 500 metres radius of the proposal footprint (Cardno, 2020a, Appendix D).

There is one premises, Taronga Zoo, located near the wharf which is operating under a licence issued under the POEO Act. The licence is for activities relating to sewage treatment processing by small plants. The premises is located immediately north of the existing wharf.

Acid sulfate soils

The Mosman LEP risk map indicated that the site was not within an area of known ASS.

A review of the Australian Atlas of Acid Sulfate Soils (ASRIS) on the 14 September 2020 indicated that there is a high probability of occurrence for ASS in the subtidal marine environments, with a low risk of ASS on the landside portion.

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 wharf 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 harbour (refer section 3.3.2). Potential disturbance of seabed sediments during removal of piles and the existing wharf elements (e.g. jetty canopy, portion of the existing) 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.

Erosion and scour

Any work taking place in the aquatic environment has the potential to cause erosion and scour. 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 associated 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, the impacts would be avoided and/or minimised.

Contamination and localised pollutant disturbance

The identified contaminants of potential concern (COPC) consist of PAHs, heavy metals, Total Recoverable Hydrocarbons (TRH) and Organochlorine pesticides/organophosphorus pesticides (OCP/OPP). However, the probability that these COPCs are present at the site is considered unlikely, resulting in a residual risk rating of low.

Land based

Erosion and sedimentation

Earthworks are proposed along the foreshore for construction of the accessible path, and footpath regrading works in the vicinity of the bus stop on Athol Wharf Road. During construction soils would be exposed potentially leading to erosion and sedimentation of the stormwater system and harbour. Implementation of mitigation measures outlined in section 6.1.4 would reduce the impacts.

Contamination

Potential for contaminated landside sub-surface soils and sediment was identified and given a low residual risk rating (Cardno, 2020a).

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

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

Water based

Erosion and scour

Under the proposal, new piles would be installed. As water flows around these structures there is the potential to create local scour and erosion. 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 continue through construction, with minimal change in ferry movements required once the new wharf is operational. As such, no significant impacts from sedimentation are anticipated.

Land based

As described in section 3.1, there are various landside modifications proposed including the removal of some foreshore vegetation to construct the new accessible ramp.

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

| ID | 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 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 <i>Protection of the Environment Operations (Waste) Regulation 2014</i> 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 | 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 |
| LS5 | Contaminated land | The piling methodology shall seek to mitigate the risk of sediment dispersal. | Contractor | Construction |
| LS6 | Erosion and sedimentation | 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 | Contractor | Pre-construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---------------------------|--|----------------|--------------|
| | | <p>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"> • Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • Reduce water velocity and capture sediment on site • Minimise the amount of material transported from site to surrounding pavement surfaces • Divert clean water around the site. | | |
| LS7 | 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. Prior to removing the sediment control device, conditions within the curtain would 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 |
| LS8 | 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 |
| LS9 | Erosion and scour | <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 |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|------|-------------------|--|----------------|--------------|
| LS10 | Erosion and scour | Works 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 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, 2009a, 2010a; OEH, 2011, 2012, 2013, 2014a, 2015, 2016a, 2017, 2018; DPIE, 2019a)
- Beachwatch Enterococci data download (DPIE, 2020a).

6.2.2 Existing environment

Taronga Zoo 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 percent), 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).

There is an existing stormwater discharge at the Taronga Zoo wharf which could be a source of potential contamination. 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, 2009a, 2010a; OEH, 2011, 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 placement and removal of piles. Impacts associated with the works and potential pollutants are discussed in section 6.1.3.

During removal of the existing wharf elements (e.g. canopy and portion of the existing wharf) there is potential for pollutants and debris to enter the waterway.

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 new piles and structures.

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.

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

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|------------------|---|----------------|---------------------------------|
| WQ1 | Accidental spill | <ul style="list-style-type: none"> A spill management plan will be developed as part of the CEMP and communicated to all staff working on site. 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 potentially polluting liquids stored at the work site. All workers will be advised of the location of the spill kit and trained in its use. | 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 (RMS, 2016c)</i> . (This Plan defines which types of spills need to be notified by external combat agencies). | 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 |

| ID | 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 elements (e.g. jetty canopy and portion of existing pontoon) to minimise the risk of pollutants and debris entering the waterway. The EWMS must be approved by Transport for NSW prior to the demolition works. | Contractor | Pre-construction |

6.3 Biodiversity

This section summarises the proposal's aquatic and terrestrial biodiversity. Appendix E contains a supporting paper prepared by Cardno (Cardno, 2021a).

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 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 (NSW Office of Environment and Heritage (OEH, 2016b)
- DPI – Environment, Energy and Science (EES) vegetation information system (VIS) Classification
- BioNet: containing information on threatened and protected species
- DPIE-EES Threatened Biodiversity Data Collection
- Department of Primary Industries (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
- 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 E.

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 three kilometres north-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 portion of the study area comprised of a vertical sandstone seawall/rock abutment bound by a corridor of intertidal and subtidal rocky reef and soft sediment habitat in the deeper areas. The harbour is mapped as Key Fish Habitat (KFH) and is estuarine thus, considered a Class 1 waterway – Major KFH (DPI, 2013; DPI, 2020a).

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

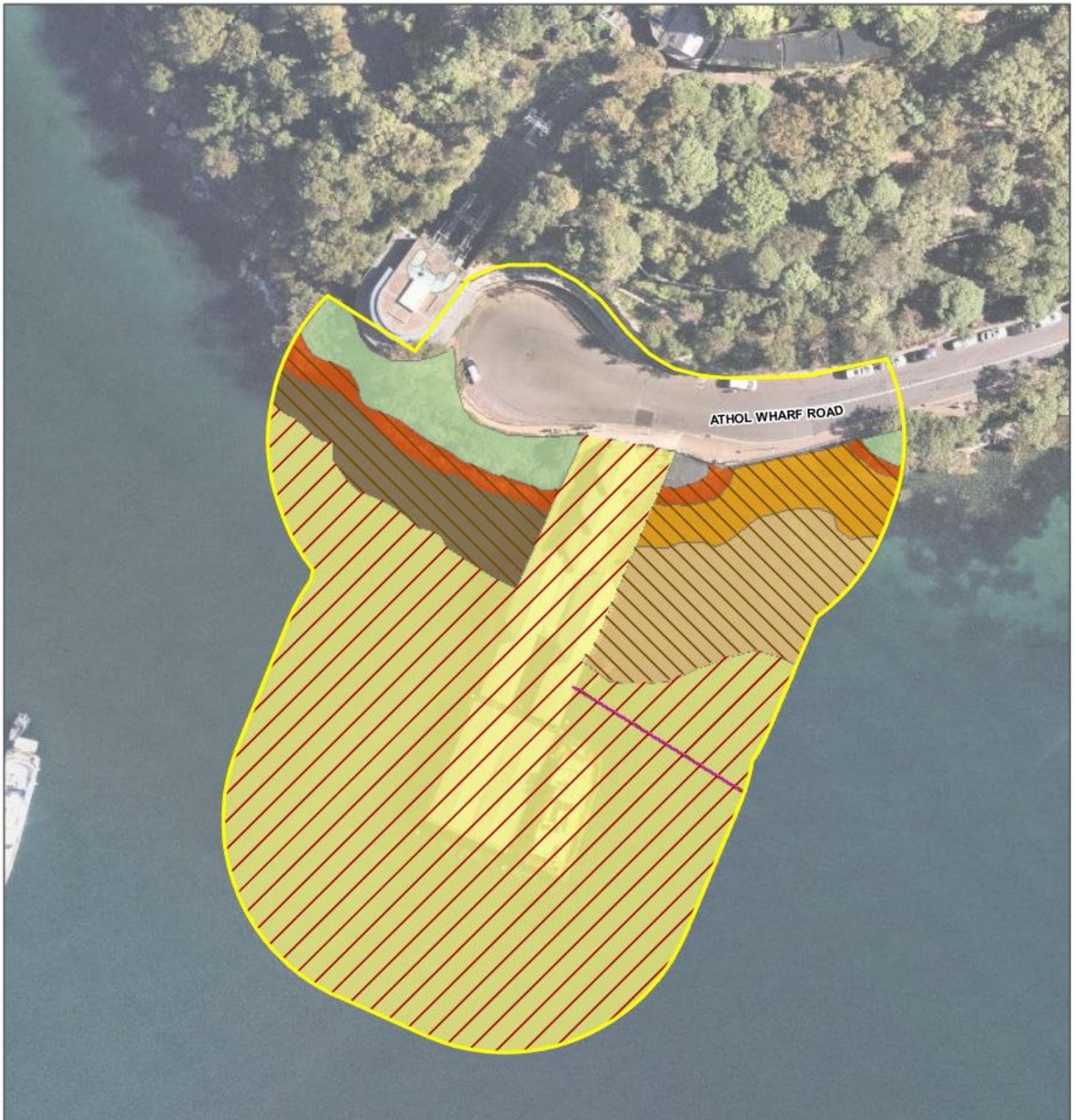
DPI Fisheries identify three types of key fish habitat (KFH) in their *Policy and Guidelines for Fish Habitat Conservation and Management* comprising:

- Type 1 (highly sensitive KFH)
- Type 2 (moderately 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 area was limited to the vertical sandstone seawall, the upper portions of the existing piles and loose boulders. Sydney Rock Oyster (*Saccostrea glomerata*) and barnacles (unidentified) clusters colonised these areas. 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 and up to 40 metres from the shoreline west and east of the existing wharf interchange, respectively. A submarine cable was observed within the study area, east of the existing wharf structure. The cable formed a platform for colonisation for subtidal sessile species. The species assemblages on the cable resembled similarly to those observed on the piles. Subtidal rocky reefs comprised of natural bedrock, dislodged natural rock, seawall fragments and trapped soft sediment (localised or transported from other areas of the harbour)
- 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

| | | |
|-----------------------------------|--|--|
| Biodiversity study area | Terrestrial Vegetation | Subtidal reef (low relief, pipe/cable) |
| KFH Type | Coastal Sandstone Foreshores Forest (PCT 1778) | Subtidal rocky reef (high relief) |
| Type 2 - Moderately sensitive KFH | Aquatic Habitat Type | Subtidal rocky reef (low relief) |
| Type 3 - Minimally sensitive KFH | Intertidal rocky reef | Subtidal rocky reef (medium relief) |
| | Rock/concrete revetment | Subtidal soft sediment |

FIGURE 6-2

1:1,000 Scale at A4
 0 5 10 15 20 m

Aquatic habitat and terrestrial vegetation within the study area
TARONGA ZOO



Map Produced by Carano NSW/ACT Pty Ltd (MOL)
 Date: 2021-02-12 | Project: AW2205108
 Coordinate System: GDA 1984 MGA Zone 58
 Wkt: AW2205108_GS048_Taronga_Aquatic-habitat.mxd_02
 Aerial imagery supplied by Neumas (Jan. 2021)

Threatened and protected flora

No threatened 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 was observed colonising 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 other marine vegetation (seagrass, saltmarsh, mangrove) were mapped patches of *Zostera* 75 metres east and 100 metres west of the study area.

Threatened and protected fauna

A review of the DPIE-EES BioNet database, DPI Threatened species list and the DAWE PMST revealed 10 aquatic related threatened species with potential to occur in the study locality. A full list is provided in Appendix E.

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 are:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act and endangered under the EPBC Act
- Black Rockcod (*Epinephelus daemeli*) listed as vulnerable 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. The FM Act and the EPBC Act provide for the protection of species. Twenty-five marine fauna protected under the FM Act have potential to occur within the study locality. These are listed in section 3.12 of Appendix E.

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 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 within one kilometre of the study area shoreline 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 and vibration sensitivity

Marine fauna in the harbour are likely to be exposed to an ambient level of noise from existing marine activities. 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).

Land based

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 Park is the Sydney Harbour National Park, about 400 metres east of the study area.

Terrestrial vegetation and habitat

The northern shoreline of the harbour in and around the study area remains one of the few foreshore areas with contiguous patches of remnant vegetation. With the exception of the Taronga Zoo facility, the surrounding areas include corridors which appear to be heavily vegetated with a few walking tracks, some of which, lead to a portion of the Sydney Harbour National Park to the east. Coastal Sandstone Foreshores Forest (Plant Community Type (PCT) 1778) occupies the largest area of any PCT in the study locality (about 289.47 hectares).

The extent of vegetation within the study area was limited by the cul-de-sac hardstand at the end of Athol Wharf Road, footpaths, the Sky Safari cable car infrastructure, the shoreline and the existing Taronga Zoo wharf interchange structures. Coastal Sandstone Foreshores Forest occurred on the steep escarpment along the foreshore west of the existing wharf. The Curlew Camp Artists Walk dissects this area where a narrow, cleared path tracks under a medium to dense canopy. This remnant patch of Coastal Sandstone Foreshores Forest is about 0.05 hectares (including the path) and extends along the foreshore westward to Sirius Cove Reserve, about 640 metres north-west of the study area. Terrestrial vegetation within the study area is shown in Figure 6-2.

Mature Port Jackson Fig (*Ficus rubiginosa*) and young Smooth-barked Apple (*Angophora costata*) were recorded on the rocky revetment about 35 metres east of the existing wharf.

A small area of rocky/concrete revetment abutting the western edge of the existing wharf interchange has a carpet of Asthma Weed (*Parietaria Judaica*) and Ground Asparagus (*Asparagus aethiopicus*). This area also had a stormwater outlet and services infrastructure pits and transitions into a sandstone intertidal and subtidal area.

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

The study area is located directly to the south of Taronga Zoo which is home to a number of native and non-native fauna in outdoor and indoor enclosures.

Threatened species and populations

A review of the DPIE-EES BioNet database, DPI Threatened species list and the DAWE PMST identified 97 threatened and protected terrestrial species with potential to occur in the study locality. A full list is provided in Appendix E.

Due to the presence of suitable habitat in the study area and/or known populations in the harbour, 14 terrestrial species were considered to have a moderate to high likelihood of occurrence. These are:

- Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) listed as endangered under the BC Act and EPBC Act
- Netted Bottlebrush (*Callistemon linearifolius*) listed as vulnerable under the BC Act
- Nine microbats listed as vulnerable under the BC Act:
 - Large-eared Pied Bat (*Chalinolobus dwyeri*)
 - 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*)
 - Eastern Cave Bat (*Vespadelus troughtoni*)
- Two birds listed as vulnerable under the BC Act:
 - Little Lorikeet (*Glossopsitta pusilla*)
 - Powerful Owl (*Ninox strenua*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

Weeds

Five priority weeds listed under the *Biosecurity Act 2015* for the Greater Sydney region were recorded in the vegetated areas within the study area. These are:

- Green cestrum (*Cestrum parqui*)
- Ground asparagus (*Asparagus aethiopicus*)
- Fireweed (*Senecio madagascariensis*)
- Madeira vine (*Anredera cordifolia*)
- Lantana (*Lantana camara*).

6.3.3 Potential impacts

Construction

Aquatic

Direct loss of aquatic vegetation and habitat

Direct impact from construction of the proposal would result from the removal and addition of a number of piles. These are:

- The removal of six ferry arrestor piles (500 millimetres diameter)
- Installation of four protection piles (610 millimetres diameter)
- Installation of four gangway support piles (on the southern end of the jetty; 508 millimetres diameter)

- Installation of three water-side access ramp piles (508 millimetres diameter; six other piles would be land-side).

The area of soft sediment habitat (Type 3 KFH) under the footprint of the piles that would be installed (<0.01 hectares) 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. In addition, the removal of the six ferry arrestor piles would allow for the colonisation of soft sediment assemblages into these areas when piles are permanently removed. Thus, the loss of these small areas of subtidal soft sediment due to the installation of new piles would not be a substantial loss and anchor areas in soft sediment would quickly recolonise following the removal of anchors.

The removal of some of the existing structure (six ferry arrestor piles) would also result in the removal of some marine vegetation, habitat and sessile/less mobile fauna on the piles and jetty structure. This constitutes a total vertical marine vegetation/habitat area of less than 0.01 hectares (refer Table 6-4). 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 new structures. The total vertical submerged area of the new structures available for colonisation (about 0.01 hectares) is about 1.4 times the vertical area to be removed. 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 6-4.

Table 6-4: Area of marine vegetation and habitat impacted by the proposal

| Vegetation and habitat | Area directly or indirectly impacted (hectares) |
|---|---|
| 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) | <0.01 |

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, the area of the proposed works 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.

Injury and mortality

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.

Underwater noise and vibration

Marine mammals and fish are sensitive to the impacts of underwater noise and vibration and it is anticipated there would be temporary disturbance from vessel/barge traffic, piling noise and vibration and anchoring during construction. These species are likely to recolonise the study area once conditions return to pre-construction levels.

Provided the mitigation measures outlined Table 6-5 are implemented no residual impacts to marine mammals are anticipated.

Pests

Construction activities over water have a 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 less than 0.01 hectares of native/exotic vegetation. This includes some native remnant trees and exotic understorey along the foreshore of the study area.

Vegetation to be removed forms part of the Coastal Sandstone Foreshores Forest PCT. This isolated patch was considered low condition as there were no characteristic mid-storey or groundcover species, but a cover of exotic Ground Asparagus and Asthma Weed was present. This low condition habitat may form potential habitat for some highly mobile, disturbance tolerant native fauna. This would result in the removal of potential habitat for native fauna. The majority of vegetation to be cleared is associated with the establishment of the new accessible ramp on the western side of the wharf. The removal of habitat resources is unlikely to have a significant impact on native fauna however, as there is an abundance of similar or better conditioned habitat across the study locality of which the study area only forms a small proportion.

Taronga Zoo

There is potential that elevated construction noise and vibration could impact the resident fauna in Taronga Zoo, immediately north of the study area. Noise modelling has been completed for construction activities (refer Section 6.4). Noise levels of approximately 65 dB(A) are predicted at the nearest animal enclosures to the works for

all of the modelled scenarios. Advice from Taronga Zoo would need to be sought prior to construction on likely impacts on resident Taronga Zoo fauna.

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 land 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 are 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 the study area and even the wider harbour.

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 Assessments of significance (AoS), which assess impacts on threatened species under the BC Act, FM Act and EPBC Act considered potentially occurring in the study area, are in Appendix E.

Clearing of landscaped vegetation of less than 0.01 hectares has potential to remove some roosting and foraging habitat for microbat species which are considered to potentially occur in the study area. 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. In addition the new wharf structures are likely to provide new roosting habitat for some of 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 structures 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.

Operation

Aquatic

The proposed accessible ramp on the western side of the existing wharf structure would sit permanently above the water's surface and avoid impacts to the seabed. However, this proposed structure would shade a portion of intertidal rocky reef and subtidal rocky reef habitat within the study area. 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) is not expected to

substantially change community assemblages as these areas generally lack marine vegetation.

The area within the vicinity of the study area 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 upgraded terminal are unlikely to be detectable in the highly variable boating environment within this area. There is potential for soft sediment habitat to be scoured from ferry jets while docking and departing the upgraded 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 upgraded wharf are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. The proposal would install 11 new waterside piles while removing six existing ferry arrestor piles. 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 DAWE is not required for biodiversity matters.

6.3.4 Safeguards and management measures

Table 6-5 lists the biodiversity safeguards and management measures that would be implemented to account for the impacts identified in section 6.3.3.

Table 6-5: Biodiversity safeguards and management measures

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|----|-------------------------------|---|-------------------|------------------|
| B1 | Biodiversity | <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"> • Documenting and establishing the limits of construction activities, including clearing, vessel traffic and anchoring • Establishment of no go zones • Implementation of tree protection measures. | Contractor | Pre-construction |
| B2 | Biodiversity | Retained vegetation in close proximity to construction activities will not be damaged or removed. | Contractor | Construction |
| B3 | Removal of native and habitat | Native vegetation and habitat removal will be minimised through detailed design. | Transport for NSW | Detailed design |
| B4 | Removal of native and habitat | 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). | Contractor | Pre-construction |
| B5 | Removal of native and habitat | 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 |
| B6 | Removal of native and habitat | The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) if | Contractor | Construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|--|--|-------------------|------------------|
| | | threatened ecological communities, not assessed in the biodiversity assessment, are identified in the construction footprint. | | |
| 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). | Transport for NSW | Detailed design |
| B8 | Removal of marine vegetation and habitat | Direct removal of marine vegetation and habitat limited to the footprint of the eleven piles and some minor anchoring during water-based construction activities. | Contractor | Construction |
| B9 | Removal of marine vegetation and habitat | Minimise anchoring where possible and avoid anchoring on subtidal rocky reef habitat. | Contractor | Construction |
| B10 | 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 should be encouraged to move away from the study area and White's Seahorse should be captured and relocated to nearby similar habitat using methods approved by DPI Fisheries. A White's Seahorse relocation plan will be developed in consultation with DPI Fisheries to dictate this activity. These activities are to be completed by a qualified marine ecologist. | Transport for NSW | Pre-construction |
| B11 | 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. | Transport for NSW | Pre-construction |
| B12 | 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 conservation and management Update 2013</i> (DPI, 2013). | Contractor | Construction |
| LS7 | Aquatic impacts | 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 | Contractor | Construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|------|-------------------------------|---|-------------------|-----------------|
| | | <p>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. Prior to removing the sediment control device, conditions within the curtain would 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> | | |
| LS10 | Aquatic impacts | Works associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts. | Contractor | Construction |
| WQ1 | Aquatic impacts | <ul style="list-style-type: none"> • A spill management plan will be developed as part of the CEMP and communicated to all staff working on site. • 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 potentially polluting liquids stored at the work site. • All workers will be advised of the location of the spill kit and trained in its use. | Contractor | Construction |
| B13 | Aquatic impacts | Piling to stop if marine mammals are observed within approximately 100 metres of the construction footprint and only to recommence once they have moved beyond 100 metres of the construction footprint or are not seen for at least 20 minutes. | Contractor | Construction |
| B14 | Changes to coastal processes | The detailed design should aim to avoid/minimise any impact to coastal processes and hydrology. | Transport for NSW | Detailed design |
| B15 | 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 |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|--|--|-------------------|------------------------------------|
| B16 | 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 |
| 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 |
| B18 | Invasion and spread of weeds, pests and diseases | Water-based equipment and vessels to be sourced from local suppliers where possible. Equipment and vessels will 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 | Light | Shading and artificial light impacts will be minimised through detailed design. | Transport for NSW | Detailed design |
| B21 | Noise and vibration | Consultation with Taronga Zoo will be undertaken to determine whether the expected noise and vibration impacts from construction are likely to have a detrimental impact on the nearby resident Taronga Zoo fauna and to determine suitable mitigation measures to address this if required. | Transport for NSW | Detailed design / Pre-construction |

6.4 Noise and vibration

This section summarises the proposals noise and vibration impacts. Appendix F contains a supporting technical paper prepared by Cardno (Cardno, 2021b).

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.

6.4.2 Existing environment

Noise monitoring and ambient noise levels

Existing noise levels surrounding the proposal were determined through unattended noise monitoring between 10 and 17 September 2020 for Logger 1, and between the 30 April and 7 May 2020 for Loggers 2 and 3. Details of noise monitoring locations and results are identified in Table 6-6. 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 intermittent local road traffic and nearby waterway vessels.

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

| ID | Location | Noise Level (dBA RBL ¹) | | |
|----------|--------------------|-------------------------------------|----------------------|--------------------|
| | | Day ² | Evening ² | Night ² |
| Logger 1 | Whiting Beach Road | 36 | 37 | 30 |
| Logger 2 | Musgrave Street | 45 | 41 | 38 |
| Logger 3 | 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 and recreational. Non-residential receivers include recreational and commercial areas such as Taronga Zoo, Athol Hall, Sydney Harbour National Park, Cremorne Point Garden and Walk and Cremorne Reserve Parkland.

Sensitive receivers around the proposal are listed in Table 6-7 and shown in Figure 6-4.

Table 6-7: Sensitive receivers and land uses around the proposal

| Label | Description | Land use |
|-------|------------------------------|---------------------------------|
| 1 | Residential North | Residential |
| 2 | Residential Northwest | Residential |
| 3 | Residential West | Residential |
| 4 | Taronga Zoo | Commercial / Passive Recreation |
| 5 | Sydney Harbour National Park | Passive Recreation |
| 6 | Athol Hall | Community Use |
| 7 | Curraghbeena Park | Passive Recreation |
| 8 | Cremorne Reserve Parkland | Passive Recreation |
| 9 | Cremorne Point Garden & Walk | Passive Recreation |
| 10 | Sydney Amateur Sailing Club | Passive Recreation |

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

Consideration has also been given to patrons of the 'Roar and Snore' at Taronga Zoo.

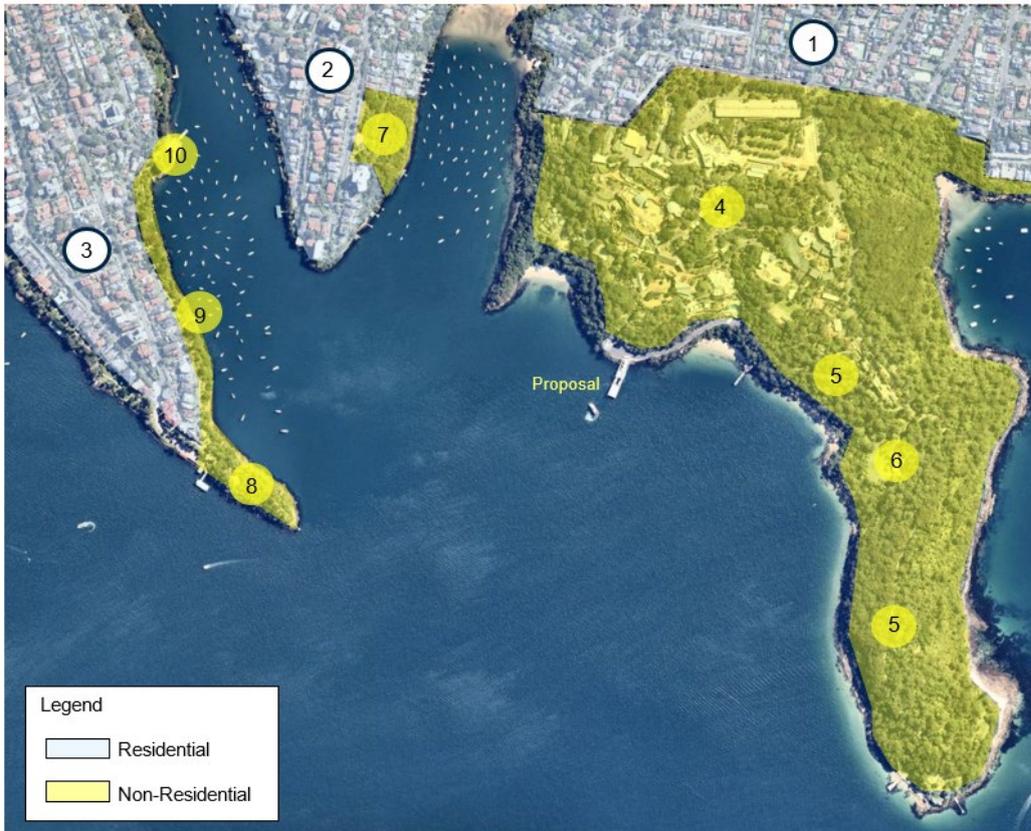


Figure 6-4: Sensitive receivers and surrounding land uses

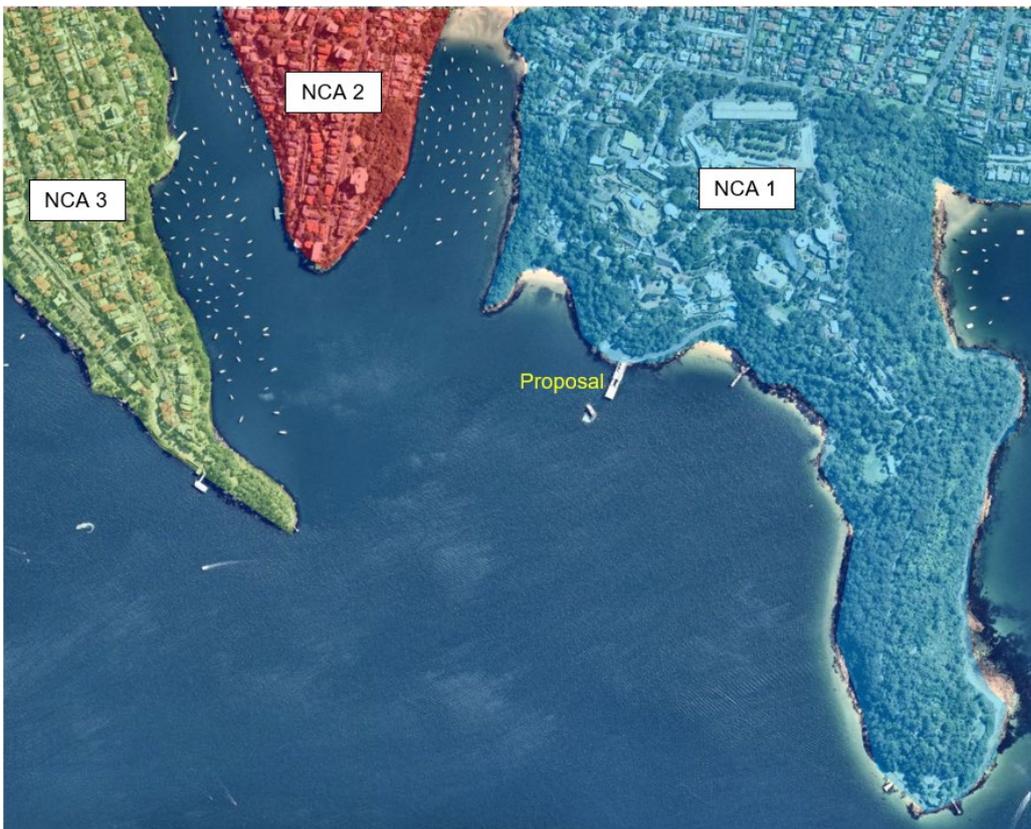


Figure 6-5: Noise catchment areas

6.4.3 Criteria

The *Construction Noise and Vibration Guideline* (CNVG)(RMS 2016b) 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:

- Interim Construction Noise Guideline (INCG)(DECC, 2009)
- Assessing Vibration – Technical Guideline (AVL:ATG)(DEC, 2006)
- Road Noise Policy (RNP) (DECCW, 2011).

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 6-8 and are based on the measures RBLs and the noise criteria detailed in the INCG.

Table 6-8: Noise management levels for each noise catchment area

| NCA | Noise Management Level, dB(A) | | | *Sleep Disturbance L _{A1} , 1 min |
|-----|------------------------------------|---|-------|---|
| | Standard Hours (RBL + 10 dB(A)) | Outside Standard Hours (RBL + 5 dB(A)) | | |
| | Day | Evening | Night | |
| 1 | 46 | 42 | 35 | 60 |
| 2 | 55 | 46 | 43 | 60 |
| 3 | 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 6-9 presents these recommended minimum working distances for specific construction activities.

Table 6-9: 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 |

6.4.4 Potential impacts

Construction

Construction scenarios

For assessment of construction and vibration impacts, five worst case scenarios were determined. Table 6-10 identifies the construction scenarios.

Table 6-10: Modelled construction scenarios

| Scenario No. | Description |
|--------------|--|
| 1b | Site establishment |
| 3 | Demolition of wharf, ferry arresters, café and roof structures |
| 4a | Installation of protection piles within waterway – drilling or piling (outside of hours) |

| Scenario No. | Description |
|--------------|---|
| 5 | Construction and fit out work (café, staff office and gangways) |
| 7 | Precast and roof structure installation |

Activity based noise

Each level of construction staging would include various types of equipment and be used during various times of the day. Table 6-11 lists the types of equipment and relevant sound power levels that would occur during construction and identify what scenario equipment would be used. Table 6-11 also identifies the scenario total sound power level (SPL).

Table 6-11: Plant and associated sound power levels

| Plant | SPL* | Scenario | | | | |
|-----------------------|------|----------|---|----|---|---|
| | | 1b | 3 | 4a | 5 | 7 |
| Barge | 108 | 1 | 1 | 1 | 1 | 1 |
| Barge Crane | 110 | | | 1 | | 1 |
| Bobcat | 105 | | | | | |
| Chainsaw | 114 | | | | | |
| Concrete Pump | 109 | | | | | |
| Concrete Truck | 109 | | | | | |
| Day-maker | 98 | | | 1 | 1 | |
| EWP | 98 | 1 | | | | 1 |
| Excavator | 108 | | | | | |
| Floating Boom (crane) | 105 | 1 | | 1 | 1 | 1 |
| Franna Crane | 98 | 1 | 1 | | | 1 |
| Generator | 98 | | 1 | 1 | 1 | 1 |
| Hand Tools | 94 | | 1 | 1 | 1 | 1 |
| Jack Hammer | 115 | | | | | |
| Oxy Acetylene Cutting | 96 | | | | | |
| Pavement Profiler | 117 | | | | | |
| Pile Hammer | 116 | | | 1 | | |
| Piling Rig (Screw) | 112 | | | | | |
| Pneumatic Drill | 115 | | 1 | | | |
| Pneumatic Hammer | 115 | | | | | |
| Road Truck | 108 | 1 | | | | |

| Plant | SPL* | Scenario | | | | |
|------------------------------|------|------------|------------|------------|------------|------------|
| | | 1b | 3 | 4a | 5 | 7 |
| Rock Breaker (mounted) | 118 | | | | | |
| Rock Drill | 118 | | | 1 | | |
| Truck | 110 | | | 1 | | |
| Truck (medium rigid) | 103 | 1 | 1 | | 1 | |
| Tug Boat | 108 | | | | | |
| Vibratory Roller | 109 | | | | | |
| Work Boat | 108 | 1 | 1 | 1 | | 1 |
| Total L_{Aeq} | | 114 | 117 | 119 | 111 | 114 |

* SPL – Sound Power Level, L_{Aeq}, 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 F. Predicted construction noise levels at each modelled NCA for each scenario are shown in Table 6-12. 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 6-12: Noise impact summary

| Criteria / Scenario | NCA1 | NCA2 | NCA3 |
|--|------|------|------|
| RBL standard hours, dB(A) | 36 | 45 | 38 |
| RBL out of hours (evening), dB(A) | 37 | 41 | 33 |
| RBL out of hours (night), dB(A) | 30 | 38 | 28 |
| Highly noise affected, dB(A), L _{Aeq 15min} | 75 | 75 | 75 |
| Scenario 1b (standard hours), dB(A), L _{Aeq 15min} | 36 | 52 | 50 |
| Scenario 3 (standard hours), dB(A), L _{Aeq 15min} | 40 | 55 | 54 |
| Scenario 4a (out of hours, night), dB(A), L _{Aeq 15min} | 41 | 58 | 56 |
| Scenario 5 (standard hours), dB(A), L _{Aeq 15min} | 40 | 50 | 48 |
| Scenario 7 (standard hours), dB(A), L _{Aeq 15min} | 43 | 53 | 51 |
| 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: >RBL + 30 dB(A) or >75 dB(A) | | | |

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 stage 4a (piling works outside of construction hours exceeding 60 dB(A)).

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 20 night shifts (from 11pm to 7am) proposed across the construction period of up to five 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.

Whilst Taronga Park Zoo falls within NCA 1 specific noise levels have not been predicted at finite points within the zoo as there are no formal NSW criteria for assessment of noise impacts on animals. Noise levels of approximately 65 dB(A) are predicted at the nearest animal enclosures to the works for all of the modelled scenarios. $L_{Aeq, 15min}$ noise levels of approximately 40-50 dB(A) are predicted at the 'Roar and Snore' within Taronga Zoo for all modelled scenarios. These predicted noise impacts are higher than the other nominated locations within NCA 1 due to the close proximity of the zoo to the construction works and due to the topography of the surrounding area providing screening to other locations within NCA 1.

Sleep disturbance

The most likely source of potential sleep disturbance from outside of construction hour works would be from piling 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.

The predicted L_{Amax} results are detailed in Table 6-10 of Appendix F and indicate that maximum construction noise levels are likely to exceed the sleep disturbance criteria (60 dB(A)) for the 'outside of standard hours' construction scenario, at some of the assessed receivers in NCA 2 and 3. Predicted L_{Amax} results at the 'Roar and Snore' within Taronga Zoo would fall within the range of 50-60 dB(A) which would not exceed the sleep disturbance criteria.

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
- 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 significant vibration sources associated with the construction work would be pile hammers and bored piling rigs. It is anticipated that no blasting would be required as part of this proposal.

The closest heritage structures are located at 10, 20 and 30-50 metres from the proposed piling works (the existing Taronga Zoo wharf remains and seawall, the Athol Wharf Tram Terminus and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. A483, LEP No. A482 and LEP No. I34 respectively, refer Figure 6-13). The proposed works would involve piling and the use of a rock hammer and other vibration intensive plant which would be located at less than the minimum safe working distance for cosmetic damage (50 metres).

A predicted vibration level of > 0.5 mm/s could be experienced at the Taronga Zoo wharf and seawall heritage structure. Similar results to those structures apply to the other heritage structures in proximity to the proposal to a lesser extent due to their larger separation distance of around 30-50 metres.

Therefore, due to the close proximity of the works, the vibrations associated with the piling and additional plant have the potential to cause impacts to the archaeological remains of the former wharf, as well as the extant remains of the sandstone seawall. However, only a small number of piles are required and the potential impacts could also be largely mitigated through control measures. As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

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 6-13 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 6-13: 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"> • Plant controls: <ul style="list-style-type: none"> – Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc. – Plant and equipment would be in good working order to prevent excess noise generation. – Locating static sources of noise such as the generators as remotely as possible from noise sensitive receivers – Use of broadband reversing alarms, or ‘quackers’, on mobile equipment in accordance with the relevant health and safety regulations – Use of temporary noise barriers where practical. The height and location of these barriers would 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 – 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 – Acoustic curtains (generally loaded vinyl based products), attached to wire construction fencing or laid over steel scaffold can also provide practical temporary noise barriers. We recommend that this is investigated for stationery | Contractor | Pre-construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|----|--------|--|----------------|--------|
| | | <p>plant within the worksites once a detailed schedule of works and plant is available</p> <ul style="list-style-type: none"> - Provision of a solid 2 m high anti-gawk barrier along the site work area boundaries may provide some reduction to nearby receivers, however this is only expected to benefit the lower levels of the nearby receivers. Local barriers will have minimal effects on noise reduction for receivers with multiple levels as there will still be a clear line of sight from the works to the receivers. Inclusion of an angled return at the top of the barrier (if this is practical to construct) may provide increased benefit to multiple storey receivers when the plant is located close to the barrier and is generally stationery. We recommend that this is further investigated once a detailed schedule of works and plant is available. • Management and behavioural controls: <ul style="list-style-type: none"> - Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings - Avoid the need for reversing in the construction area by creating a loop road or similar - Avoid dropping materials from height - Workers should avoid shouting, minimise talking loudly, and avoid slamming vehicle doors. • Allowing construction to occur only during approved construction hours, unless otherwise required as a condition of Transport for NSW safety requirements. • 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. • Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately. • Conducting additional monitoring if complaints are received or proposed activities and number of plants exceed those assumed in this assessment. • Modifying of work activities where noise or vibration is found to cause unacceptable impact. | | |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---------------------|---|--------------------------------|------------------------------------|
| | | <ul style="list-style-type: none"> Implementation of additional mitigation measures in accordance with the CNVG including notification, respite periods and alternate accommodation as reasonable and feasible. | | |
| NV2 | Noise and vibration | <ul style="list-style-type: none"> Carrying out works within standard daytime hours as follows: <ul style="list-style-type: none"> 7:00 am to 6:00 pm Monday to Friday 8:00 am to 1:00 pm Saturdays, no work on Sundays or public holidays. 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 or due to requirements to enable bus access. 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. All reasonable and feasible efforts should be undertaken to ensure noise levels will 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. | Contractor | Construction |
| NV3 | Noise and vibration | <ul style="list-style-type: none"> 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. Notification will be a minimum of 7 calendar days prior to the start of work. A contact telephone number and email address will be available for community feedback | Transport for NSW / Contractor | Pre-construction |
| B21 | Noise and vibration | Consultation with Taronga Zoo will be undertaken to determine whether the expected noise and vibration impacts from construction are likely to have a detrimental impact on the nearby resident Taronga Zoo fauna and to determine suitable mitigation measures to address this if required. | Transport for NSW | Detailed design / 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 NSW / Contractor | Pre-construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---|---|----------------|---------------------------------|
| NV5 | Vibration impact to heritage structures | Where works are proposed within the safe working limits for the heritage structures (Taronga Zoo wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. 134)), specialist advice will be sought from an appropriately qualified structural engineer, Transport for NSW Noise and Vibration specialist and Transport for NSW heritage advisor who are 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 should be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology and confirm the integrity of the sandstone retaining wall in the Taronga Zoo wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. 134). Assessment and monitoring of vibration impacts should adhere to: <ul style="list-style-type: none"> • 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. | 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 G contains a supporting paper (landscape and visual impact assessment, LCVIA) prepared by Cardno (Cardno, 2020b).

6.5.1 Methodology

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

The assessment intends to identify 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 combines the viewers' sensitivity to the proposed works/structures with the magnitude of the proposed works/structure within the existing views. Table 6-14 details the landscape character and visual impact grading matrix.

Table 6-14: Landscape character rating matrix

| | | 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 |
| | | | | | |

Source: TfNSW, 2020a

6.5.2 Existing environment

The wharf is positioned near the cul-de-sac at the end of Athol Wharf Road on the northern shore of Sydney Harbour. The wharf is located in close proximity to the southern entry point of Taronga Zoo and Sydney Harbour National Park, and Bradleys Head is located to the east of the wharf.

Landscape and urban context

The existing Taronga Zoo wharf is connected to the foreshore incorporating a concrete jetty with dual-berthing, canopy cover and two-lane gangways. Paths connect the jetty to the bus interchange on Athol Wharf Road and the entrance to Taronga Zoo.

The wharf provides the southern entry point to Taronga Zoo and Sydney Harbour National Park, with the foreshore landscape being significantly vegetated with native/exotic tree species along rock and sandstone cliff. The character of the foreshore area north and into Taronga Zoo is essentially dominated by natural features (vegetated hillsides) with built

form (buildings and structures associated with the operations of Taronga Zoo) being a recessive element.

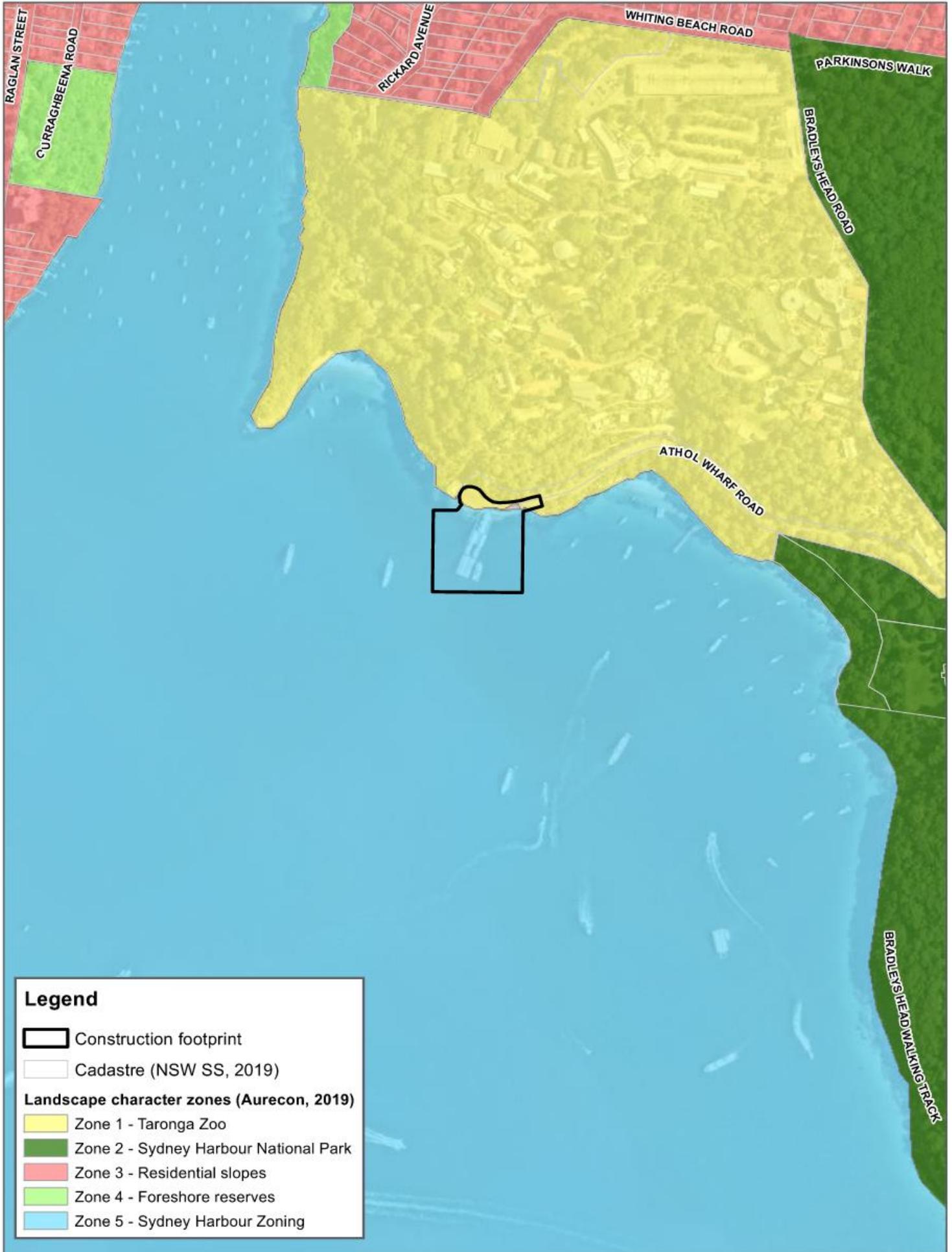
Broadly, the wharf site is located between Whiting Beach to the west (accessible via Curlew Camp Artist's Walk) and Bradleys Head to the east.

Landscape character zones

In assessing the landscape character of Taronga Zoo and how the proposed wharf upgrade would fit within the surrounding landscape, the study area was divided into five LCZ as described in Table 6-15 shown in Figure 6-6.

Table 6-15: Landscape character zones

| LCZ | Description |
|-------------------------------------|---|
| LCZ1 – Taronga Zoo | <p>Taronga Zoo is located on the shores of Sydney Harbour, within the suburb of Mosman. The zoo is an iconic tourist attraction on Sydney Harbour and boasts striking views of Sydney Harbour.</p> <p>The area is characterised by significant vegetation in a garden setting that stretches up from the foreshore to the ridgeline. A wide variety of buildings are scattered throughout the area taking on a wide variety of built forms from traditional to contemporary architectural types, which have been developed over the last 100 years, to cater for the vast array of animals that reside at the zoo.</p> <p>The zoo also includes a large cable car which stretches from the southern portion of the zoo to the main entry point.</p> |
| LCZ2 – Sydney Harbour National Park | <p>Sydney Harbour National Park comprises parts of Port Jackson, Sydney and its foreshores and various islands. Bradleys Head is part of the Sydney Harbour National Park which extends into Sydney Harbour. Bradleys Head is located to the east of the proposed design.</p> <p>The National Park is a prominent bushland area which wraps around the foreshore and Bradleys Head. A gentle bush walk weaves around the harbour headland providing scenic views of the Harbour which stretch back towards the Sydney Opera House and Sydney Harbour Bridge</p> |
| LCZ3 – Residential slopes | <p>This zone is characterised by a mix of two to three storey residential dwellings and four to eight storey residential flat buildings. Architectural styles and buildings vary from traditional architectural styles such as Victorian and Federation dwellings, to more contemporary styles incorporating traditional architectural elements</p> <p>The terrain generally slopes down from ridgelines towards the harbour and foreshore areas.</p> <p>Tree lined streets and mature vegetation is interspersed through the residential areas which form a significant part of the appearance of the zone.</p> |
| LCZ4 – Foreshore reserves | <p>Grassed recreational spaces and vegetated foreshores are prominent within the landscape character of the northern shore of Sydney Harbour. Bushland and large mature trees are particularly evident in these areas and break up the built elements from adjoining land uses.</p> <p>These areas are publicly available recreational spaces and environmental conservation zones adjacent to the Sydney Harbour.</p> |
| LCZ5 – Sydney Harbour | <p>Sydney Harbour is a large body of water, which formed from a flooded river estuary.</p> <p>The landform around the harbour includes peninsulas with steep slopes rising to ridgelines. Natural sandstone outcrops and manmade sandstone walls can be seen lining parts of the Harbour foreshore.</p> <p>Much of the foreshore surrounding the harbour is vegetated recreational areas, and residential dwellings.</p> |



Legend

-  Construction footprint
-  Cadastre (NSW SS, 2019)
- Landscape character zones (Aurecon, 2019)**
-  Zone 1 - Taronga Zoo
-  Zone 2 - Sydney Harbour National Park
-  Zone 3 - Residential slopes
-  Zone 4 - Foreshore reserves
-  Zone 5 - Sydney Harbour Zoning

**FIGURE
6-6**

1:5,500 Scale at A4
0 25 50 75 100
m

**Landscape character zones
TARONGA ZOO**



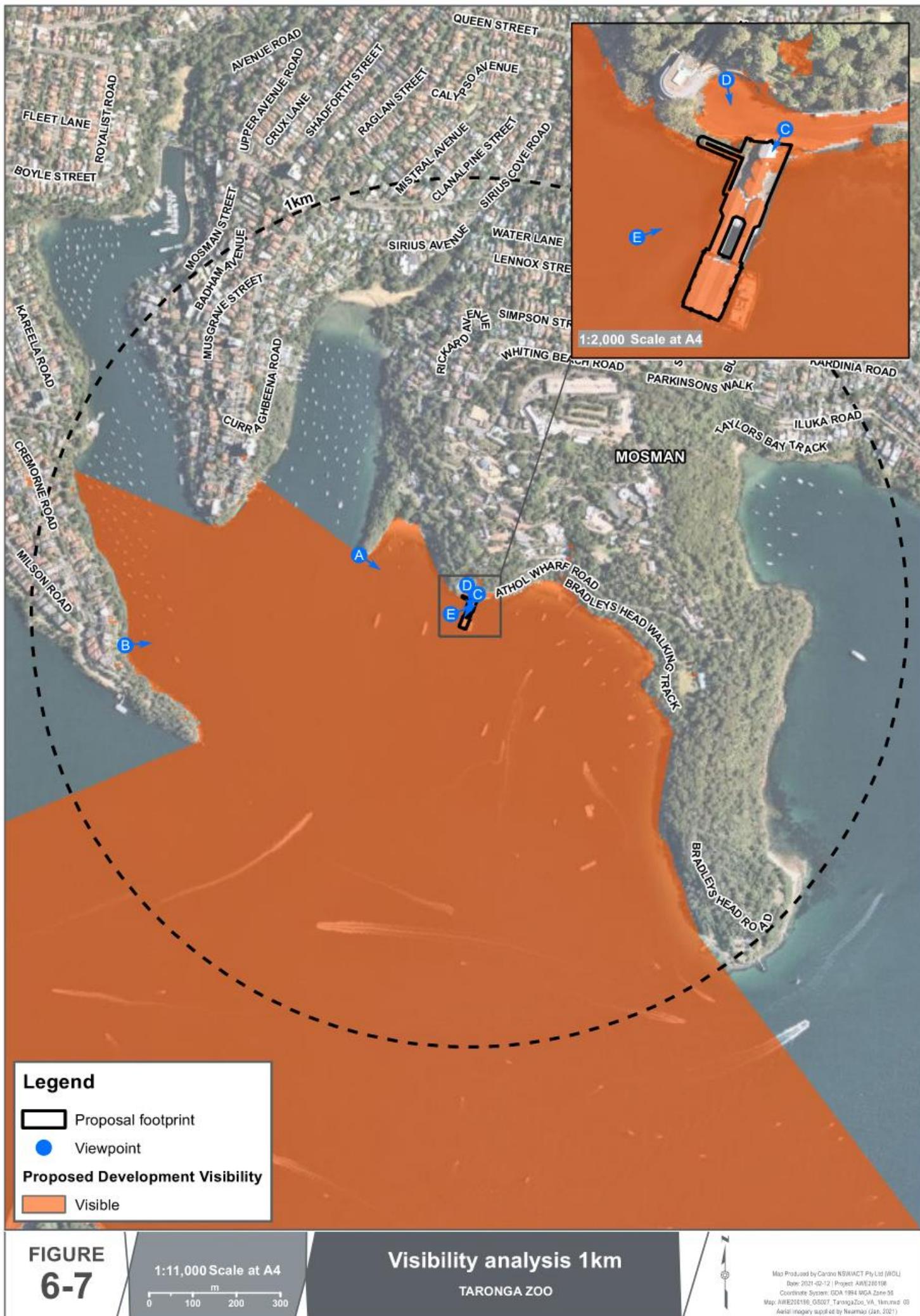
Map Produced by Canova NSWACT Pty Ltd (WGL)
Date: 2021-02-12 | Project: AWE200196
Coordinate System: GDA 1984 MGA Zone 56
Map: AWE200196_GS049_Taronga_REF_LandscapeCZ.mxd 02
Aerial imagery supplied by Neamap (Jan. 2021)

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 – 250m from the viewer
- Middle ground zone (MZ): 250 – 500m from the viewer
- Background zone (BZ): 500m or greater from the viewer.

Five viewpoints were selected in consultation with Transport for NSW to assess the visual impact of the proposal. The location of the viewpoints are shown in Figure 6-7 and described in the following sections.

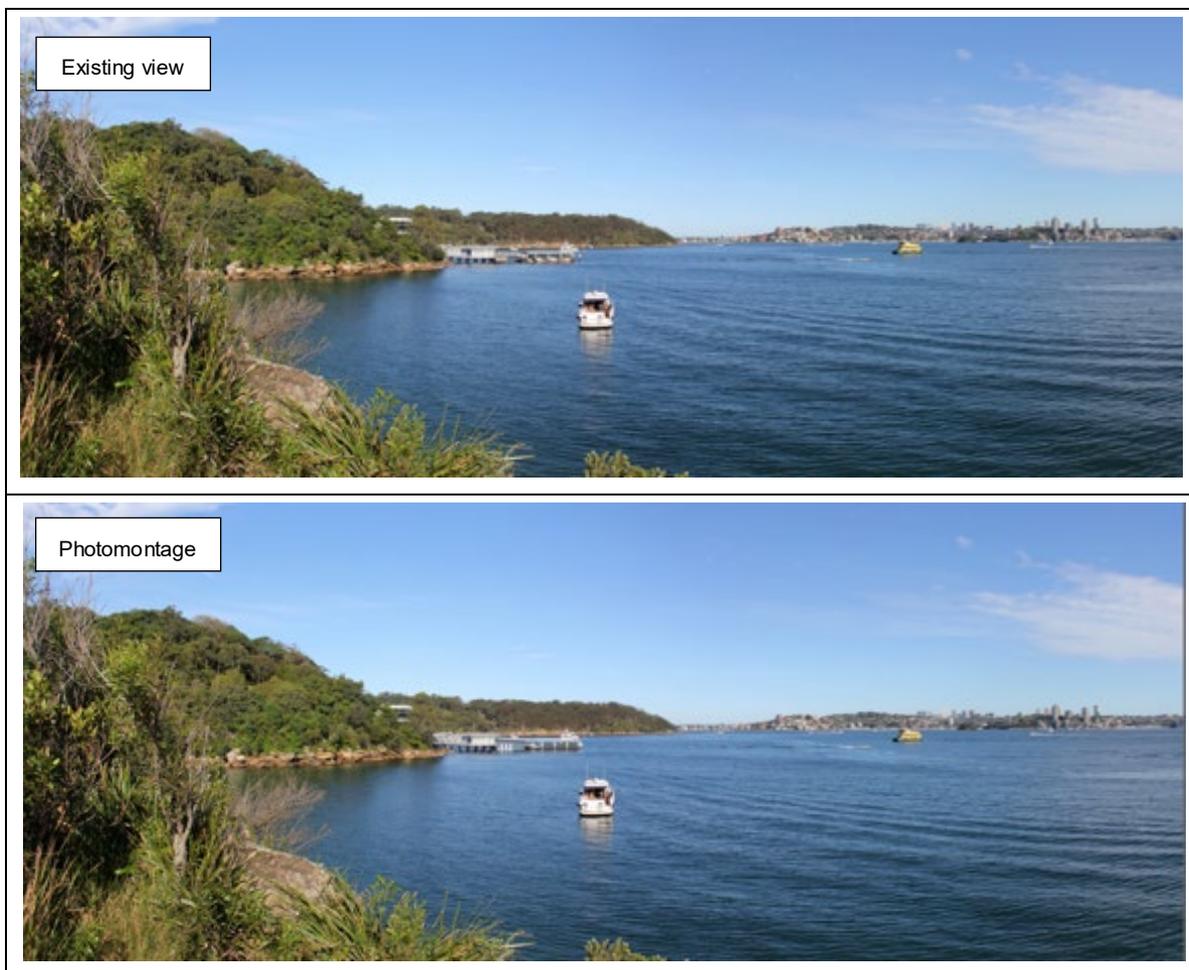


Viewpoint A

Viewpoint A is described in Table 6-16 and shown in Figure 6-8.

Table 6-16: Viewpoint A description

| Viewpoint | Description | Distance zone |
|--|---|---------------|
| Viewpoint A – Little Sirius Point/Whiting Beach headland looking south-east toward wharf | Viewpoint A is located at Little Sirius Point to the east of Whiting Beach, approximately 260 metres north-east of the wharf. The view includes the Sydney Harbour waterway, Taronga Zoo foreshore along Curlew Camp Artist’s Walk, and Bradleys Head in the distance. Horizon views are primarily vegetation associated with Bradleys Head (also a Scenic Protection Area) and the southern foreshore of Sydney Harbour. The existing Taronga Zoo wharf forms a small component of this broad view. It is recessive against the backdrop of Bradleys Head. | MZ |



Source: Urbaine, 2020

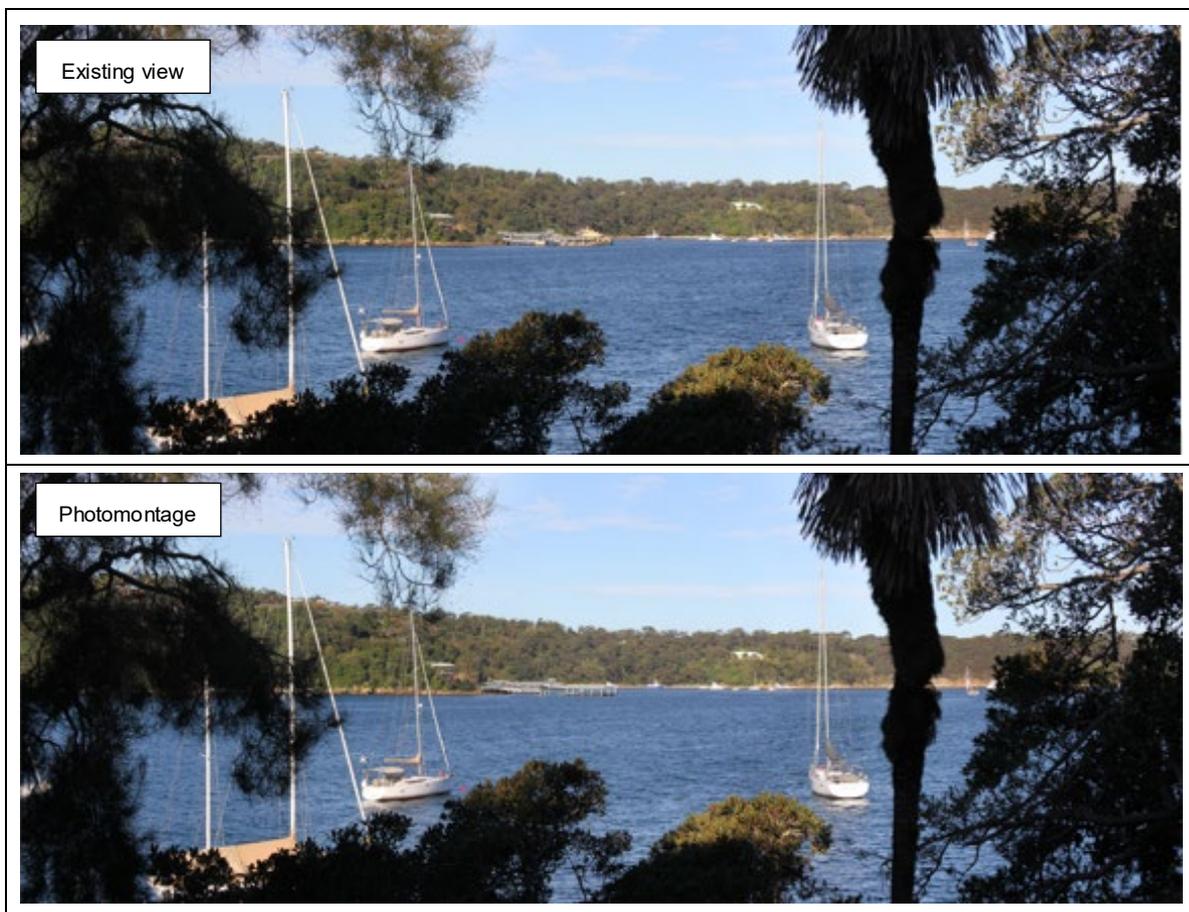
Figure 6-8: Viewpoint A

Viewpoint B

Viewpoint B is described in Table 6-17 and shown in Figure 6-9.

Table 6-17: Viewpoint B description

| Viewpoint | Description | Distance zone |
|---|---|---------------|
| Viewpoint B – Cremorne Reserve Path looking north-east toward wharf | Viewpoint B is located along Cremorne Reserve Path, approximately 780 m south-west of the wharf. The view includes the Sydney Harbour waterway, Taronga Zoo foreshore and Athol Beach. Horizon views are dominated by vegetation associated with Taronga Zoo (also a Scenic Protection Area). The existing Taronga Zoo wharf forms a small component of this broad view. It is recessive against the backdrop of Taronga Zoo. | BZ |



Source: Urbaine, 2020

Figure 6-9: Viewpoint B

Viewpoint C

Viewpoint C is described in Table 6-18 and shown in Figure 6-10.

Table 6-18: Viewpoint C description

| Viewpoint | Description | Distance zone |
|---|---|---------------|
| Viewpoint C – Athol Wharf Road pathway looking south toward wharf | Viewpoint C is located at the entrance to the wharf, directly adjacent to the bus stop toward the end of the Athol Wharf Road cul-de-sac. The viewpoint is elevated slightly above the site due to the landform and incorporates views of Sydney Harbour and the southern foreshore of Sydney Harbour in the distant horizon. | FZ |



Source: Urbaine, 2020

Figure 6-10: Viewpoint C

Viewpoint D

Viewpoint D is described in Table 6-19 and shown in Figure 6-11.

Table 6-19: Viewpoint D description

| Viewpoint | Description | Distance zone |
|--|--|---------------|
| Viewpoint D – Sydney Harbour looking north-east toward wharf | Viewpoint D is located in the Harbour, approaching the wharf from the south-west. The viewpoint includes the elevated highly vegetated landscape of Taronga Zoo, signage associated with Athol Wharf Road, and rocky and moderately vegetated foreshore. | FZ |



Source: Urbaine, 2020

Figure 6-11: Viewpoint D

Viewpoint E

Viewpoint E is described in Table 6-20 and shown in Figure 6-12.

Table 6-20: Viewpoint E description

| Viewpoint | Description | Distance zone |
|--|--|---------------|
| Viewpoint E – Taronga Zoo pathway at end of Athol Wharf Road looking south-east toward wharf | Viewpoint E is located on the Taronga Zoo entrance pathway at the end of Athol Wharf Road in the cul-de-sac. The viewpoint is elevated above the site of the existing wharf and incorporates views of Sydney Harbour, Bradleys Head and the southern foreshore of Sydney Harbour in the distant horizon. | FZ |



Source: Urbaine, 2020

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 gangways and two canopies and construction of the new accessible ramp
- Removal of vegetation to accommodate the new accessible ramp
- Established temporary compound site and/or barge to include site sheds, amenities shed and storage containers for tools and materials
- Minor excavation during construction of footpaths.

Construction work would have the greatest impact to values associated with the Residential, Sydney Harbour and Foreshore reserve LCZs where the effects would be:

- Change in the composition and setting of the wharf by its partial 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 6-21 summarises the landscape impact assessment on the LCZ identified in section 6.5.2. Appendix G provides additional detail on the landscape character zones.

Table 6-21: Landscape character assessment summary

| Zone | Sensitivity | Magnitude | Description of impact |
|--------------------|-------------|-----------|--|
| LCZ1 – Taronga Zoo | Moderate | Moderate | <p>Moderate</p> <p>The area boasts views of Sydney Harbour and slopes down within a significantly vegetated landscape.</p> <p>Highly patronised tourist attraction.</p> <p>Design would increase overall size however the materials and structure would be similar form to existing wharf.</p> <p>Taronga Zoo is a top tourist attraction within Sydney Harbour with an array of wildlife that are cared for and visited by many tourists. The zoo does however include a number of different large structures including the cable car and wharf structure, demonstrating that the site has been prone to change over the years.</p> <p>The proposed design of Taronga Zoo wharf consists of an additional ramped structure to the western side of the existing wharf and replacement of the existing gangways. Some vegetation clearing would be required for the proposed ramp however this is considered to be minor.</p> |

| Zone | Sensitivity | Magnitude | Description of impact |
|-------------------------------------|-------------|------------|--|
| LCZ2 – Sydney Harbour National Park | High | Low | <p>Moderate</p> <p>Uninterrupted scenic views from the National Park extend across the Harbour from existing walking tracks.</p> <p>The proposed works retains the existing structure with significant works occurring only on the western extent of the wharf structure.</p> <p>The National Park is a prominent bushland area which stretches out towards Bradleys Head and further east towards Georges Head lookout.</p> <p>The proposed design is relatively distant from the character zone which is located on the western extent of the existing wharf and would not present a contrast to the existing wharf structure.</p> |
| LCZ3 – Residential slopes | Moderate | Low | <p>Low-Moderate</p> <p>The residential slopes zone exhibits a very broad variety of building forms, masses, heights, materials and setbacks.</p> <p>The proposed ferry wharf upgrade is generally recognised as an extension to the existing wharf and whilst it would increase the overall size of the structure, it would not contribute to a significant contrast to the existing landscape.</p> <p>The interspersed mature vegetation is quite evident in this area.</p> <p>The residential zones are also relatively distant to the proposed design resulting in a low magnitude.</p> |
| LCZ4 – Foreshore reserves | High | Negligible | <p>Negligible</p> <p>Recreational and vegetated foreshore areas offer highly sensitive significant views towards the harbour, foreshore and Bay areas.</p> <p>The proposed design is distant from the character zone which is not recognised to present a contrast against the existing wharf structure.</p> <p>The area is predominately bushland with a visible tree canopy when viewed from the harbour.</p> <p>The character zone is distant from the proposed design and separated by an existing ridgeline.</p> |
| LCZ5 – Sydney Harbour | High | Low | <p>Moderate</p> <p>The wharf boasts significant views of the Harbours foreshore areas consisting of iconic landmarks, vegetated reserves and exclusive residencies.</p> <p>The proposed design is recognised as an extension to the existing wharf structure with the inclusion of a ramped pathway to the western side of the wharf. This would increase the overall size of the wharf structure, however, it would not be a significant contrast to the wharf and foreshore area.</p> |

| Zone | Sensitivity | Magnitude | Description of impact |
|------|-------------|-----------|---|
| | | | Sydney Harbour is one of the more scenic harbours in the world, and in proximity to the existing wharf contains minimal marine structures and a heavily vegetated foreshore associated with Taronga Zoo and the Sydney Harbour National Park. |

The landscape character impact of the proposed Taronga Zoo wharf, extending from existing wharf, is considered to be moderate to low on the surrounding character zones.

The proposed design is located within a sensitive area on the northern foreshore of Sydney Harbour. The landscape consists of a relatively vegetated foreshore area in proximity to Taronga Zoo, Sydney Harbour National Park lands and Sydney Harbour.

The proposed design, however, is essentially an extension to the existing wharf structure with an additional ramped structure proposed along the western side of the wharf. The design is not considered to have a significant contrast to the existing wharf area and is relatively distant from some sensitive landscape character zones. Some vegetation clearing is required to accommodate the new accessible ramp, however, this is considered to have a minor impact on the landscape. The additional structures would increase the overall size of the existing wharf however would not have a significant impact to the existing landscape character zones.

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 6-22 summarises the visual impact assessment.

Table 6-22: Visual impact assessment summary

| View-point | Visible element | Sensitivity | Magnitude | Description of impact |
|-------------------------|---|-------------|-----------|--|
| A (refer Figure 6-8) | Wharf platform and roof, gangway platform and roof. | High | Low | <p>Low-Moderate</p> <p>The view is in the direction of the Scenic Protection Area and the wharf is in a central location.</p> <p>Viewers would be expected to be highly sensitive to changes to these views across the harbour towards the relatively natural foreshore of the Taronga Zoon complex, however the quality of the view is already moderated by the presence of built form of variable visual quality (including the existing wharf).</p> <p>The magnitude of impact on the view of the new wharf complex is considered low as the proposal will introduce minimal change to the existing view.</p> |
| B (refer Figure 6-9) | Ramped pathway, wharf platform and roof, | High | Low | <p>Low</p> <p>The overall impact on the view of the new wharf complex is considered low as viewers would be highly sensitive to</p> |

| View-point | Visible element | Sensitivity | Magnitude | Description of impact |
|--------------------------|--|-------------|-----------|--|
| | gangway platform and roof. | | | changes to the view however the design will introduce minimal change. The quality of the view is already moderated by the presence of built form of variable visual quality (including the existing wharf). |
| C (refer Figure 6-10) | Ramped pathway, wharf platform and roof, gangway platform and roof. Removed trees are also a significant element of the changed view. | Moderate | High | Moderate-High The view is in the direction of the Scenic Protection Area and the wharf is in a central location. Viewers would be expected to be highly sensitive to changes to these views across the harbour towards the relatively natural foreshore of the Taronga Zoon complex, however the quality of the view is already moderated by the presence of built form of variable visual quality (including the existing wharf). The magnitude of impact on the view of the new wharf complex is considered low as the proposal will introduce minimal change to the existing view. |
| D (refer Figure 6-11) | Ramped pathway, wharf platform and roof, gangway platform and roof. Removed trees are also a significant element of the changed view. | High | Moderate | Moderate The overall impact on the view of the new wharf complex is considered moderate as it involves moderately substantial new built form of the path and removal of some trees, offset by an improved quality of built form and finishes. The quality of the view is already moderated by the presence of built form of variable visual quality (including the existing wharf). |
| E (refer Figure 6-12) | Ramped pathway, wharf platform and roof, gangway platform and roof. Removed trees are also a significant element of the changed view. | Moderate | Moderate | Moderate The overall impact on the view of the new wharf complex is considered moderate as it involves moderately substantial new built form of the path and removal of some trees, offset by an improved quality of built form and finishes. The quality of the view is already moderated by the presence of built form of variable visual quality (including the existing wharf). |

The overall visual impact of the proposed concept design for Taronga Zoo wharf, is considered moderate following the assessment of the viewpoints. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site.

The proposed design is seen as an extension to the existing wharf structure which is of a notably large size in comparison to other ferry wharves within Sydney Harbour. The accessible ramp in particular would increase the overall size of the wharf structure due to the switchback in the pathway. Some minor vegetation clearing would be required to accommodate the proposed accessible ramp; however, this is considered to have a minor impact on the overall visual context of the locality. Visually, the design is considered to be relatively in context with the existing wharf.

Ferry patrons and visitors to the Taronga Zoo are expected to be the most affected by the proposed design from a visual perspective; however, it should be noted that the proposed design is provided to benefit and improve the experience of patrons making the wharf interchange more accessible for ferry users and zoo visitors.

6.5.4 Safeguards and management measures

Table 6-23 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 6-23: Landscape character and visual amenity safeguards and management measures

| ID | 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"> • Similar visual structures (such as jetties, pontoons and wharfs) as those located within Neutral Bay, Neutral Harbour and Careening Cove • A coordinated palette of materials and colours to respond to the existing maritime and foreshore character • Low-scale landside and waterside works to improve accessibility, wayfinding and services • The approaches to and surrounds of the wharf designed to maximise amenity and keeping with the existing urban and landscape environment. • Landscape treatment of the approaches to the wharf to be appropriate and complimentary to the existing landscape of Taronga Zoo. | 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 surrounding receivers, including residential properties. | Contractor | Construction |
| LV4 | Landscape and visual | All impacted areas and ground surfaces will be reinstated as near as possible to their original state following the completion of works. | Contractor | Post-construction |

6.6 Non-Aboriginal heritage

This section summarises the proposal's non-Aboriginal heritage impacts. Appendix H 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 & 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 and *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 proposal 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

Taronga Zoo wharf historical background

In 1864 a wharf was established below Athol House at Bradleys Head, where a steep path provided access to the house and neighbouring inn. The wharf was purchased by Sydney Ferries Limited in 1906 and various upgrades were undertaken.

In 1916 a new wharf was constructed for the grand opening of Taronga Zoological Park on the southern foreshore of Ashton Park. Historical plans show the Athol Wharf located below Athol Hall on the eastern foreshore of Bradley's Head, about 400 metres south east of the new Taronga Zoo wharf (which also shared the name of 'Athol Wharf' at times). The 1916 subdivision plans show the wharf jutting out from the southern foreshore beneath the zoological park in a T-formation, and with the tram line established along the southern boundary of the zoo. Athol Wharf Road had not been established at this point.

The first Taronga Zoo wharf was located about 15 metres to the east of the existing wharf structure and was constructed between 1912 and 1916 for the opening of the Zoo. This structure was a flat timber square shaped wharf on several timber piles and piers. Photographs show the T-shape of the wharf, with a narrow ramp/gangway descending from the foreshore and seawall to the larger timber pontoon. The pontoon was enclosed with a low fence of horizontal beams, likely constructed of timber rather than metal. The pontoon appears to have been supported beneath and made stationary by timber piling, rather than being a floating structure encircled by piling.

By the mid-1920s the wharf had been expanded. A new timber waiting shed structure, which featured a parapet roof with a gabled section in the centre, was constructed at the northern end of the pontoon. To the south a new pontoon was added to the wharf structure, while the original gangway and pontoon were covered by timber waiting sheds. By the 1940s it appears that the wharf was somewhat dilapidated, with state government funding provided to the Taronga Park Trustees for the ‘removing and reconditioning’ of the pontoon and to rent a ‘substitute pontoon’. This record suggests that the southern pontoon was replaced in the mid-1940s while the original structures were retained.

The wharf remained in use until the mid 1980s, when it was demolished, and the existing Taronga Zoo wharf was constructed to the west. This modern wharf is constructed on timber piles and does not appear to have been heavily modified since construction. Around the same time the gondola lift and building providing access from the wharf to the Zoo was installed at the end of the road.

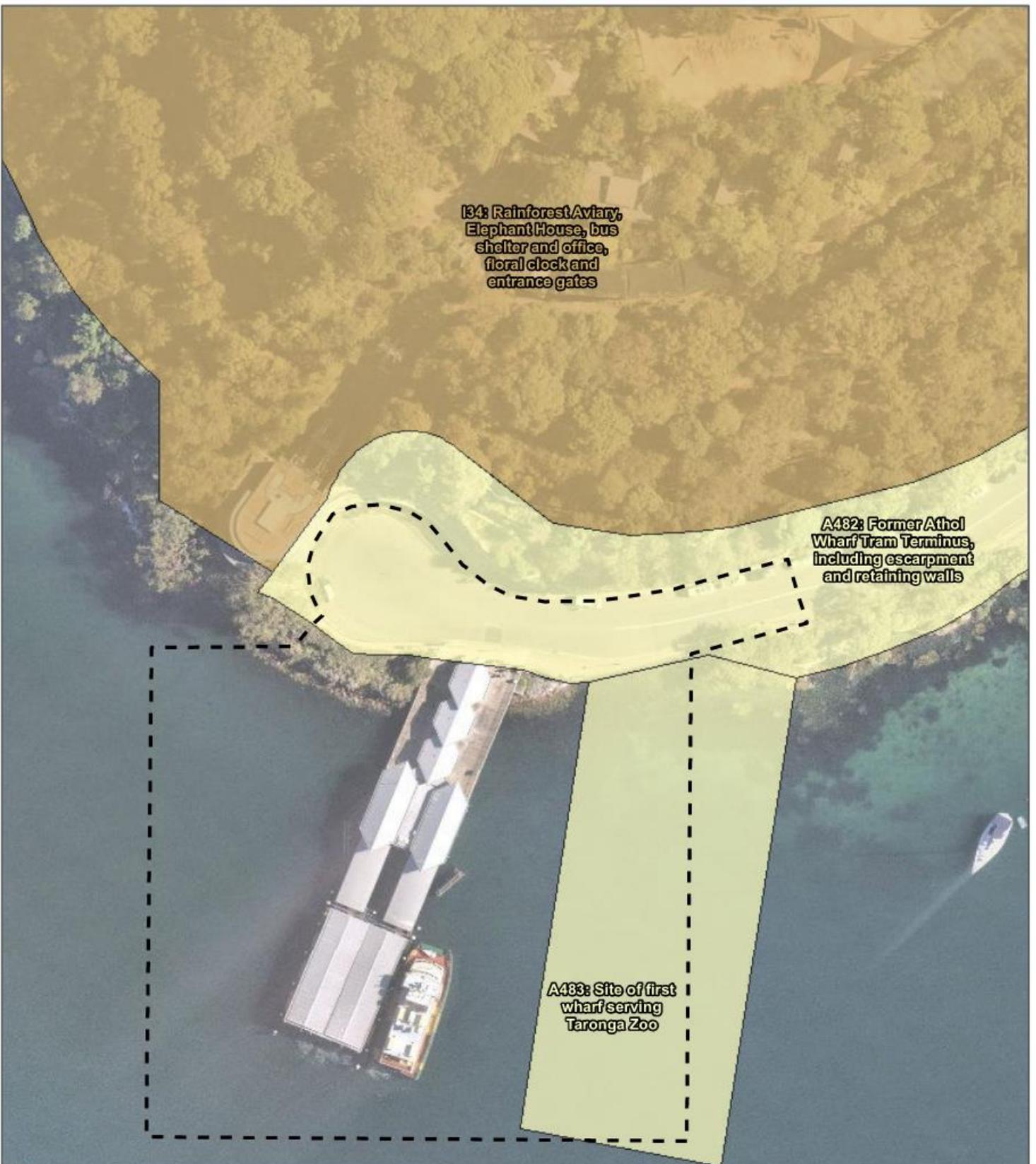
Listed heritage items

Table 6-24 lists the heritage items located within or next to 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 6-24. The extent of the one kilometre visual buffer zone is based on the visibility analysis shown on Figure 6-7

Table 6-24: List of heritage items in the vicinity of the proposal

| Item | Address | Significance | Listing | Distance from construction footprint |
|--|---|--------------|---|--------------------------------------|
| Athol Wharf Tram Terminus (including escarpment and retaining wall) | Athol Wharf Road, Mosman | Local | Mosman LEP no. A482 | Within |
| Taronga Zoo Wharf (remains and seawall) | Athol Wharf Road, Mosman | Local | Mosman LEP no. A483 | Within |
| Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock | Mosman | Local | Mosman LEP no. I34 SEPP No. 56 – Schedule 1 No. 13 | Adjacent |
| Sydney Opera House (buffer zone) | 2 Circular Quay East, Sydney (buffer zone extends to Argyle Street) | World | WHL 166rev NHL ID 105738 SHR no. 01685 City of Sydney LEP no. 11712 | Visual buffer zone (600m south-west) |

| Item | Address | Significance | Listing | Distance from construction footprint |
|---|--|--------------|--|--------------------------------------|
| | and Fitzroy Street) | | RNE ID 2353 RNTA 6088 | |
| Ashton Park | Sydney Harbour National Park Bradleys Head Road | Local | Mosman LEP no. I458 RNE ID 2874 | Visual buffer zone (280m south-east) |
| Athol Gardens Dance Hall and wharf Remains | Sydney Harbour National Park Bradleys Head Road | Local | Mosman LEP no. I459 | Visual buffer zone (410m south-east) |
| Group of 4 houses | 5–11 Raglan Street, Mosman | Local | Mosman LEP no. I230 RNE ID 103679 | Visual buffer zone (500m north-west) |
| 'The Castle', flats | 3 Raglan Street, Mosman | Local | Mosman LEP no. I229 | Visual buffer zone (520m north-west) |
| Divided road | Raglan Street, Mosman | Local | Mosman LEP no. I435 | Visual buffer zone (540m north-west) |
| Cremorne Point Conservation Area | Cremorne Point | Local | North Sydney LEP no. CA06 RNE ID 100862, 100861 | Visual buffer zone (600m west) |
| Cremorne Reserve (including Robertsons Point) | Cremorne Point | Local | North Sydney LEP no. I0136 | Visual buffer zone (600m west) |
| Site of Cremorne Smelter | Cremorne Reserve, east of 5 Green Street, Cremorne Point | Local | North Sydney LEP no. I0102 | Visual buffer zone (740m west) |
| Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials | Sydney Harbour National Park Bradleys Head Road | State | SHR no. 01838 Mosman LEP no. I460 SREP Part 2 item no. 25 RNE ID 2875, 2869, 2877, 2875 RNTA | Visual buffer zone (900m south-east) |



Legend

 Construction footprint

Heritage - Mosman LEP 2012 (DPE, Nov 2019)

 Item - General

 Item - Archaeological

**FIGURE
6-13**

1:1,000 Scale at A4



Heritage listings

TARONGA ZOO



Map Produced by Carina NSWACT Pty Ltd (MOL)
 Date: 2021-02-12 | Project: AWE200198
 Coordinate System: GDA 1984 MGA Zone 56
 Map: AWE200198_GS050_Taronga_REF_Heritage.mxd 02
 Aerial Imagery supplied by Neumap (Jan. 2021)

Archaeology

A preliminary archaeological assessment has identified that the construction footprint has potential to contain archaeological remains of locally significance, largely associated with the development of the original Taronga Zoo wharf and the former tramline. However, these archaeological remains are unlikely to be found in association with *in situ* artefact bearing deposits, such as intact occupation 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 1977*.

A summary of the findings of archaeological potential and significance is provided in Table 6-25. Areas of archaeological potential are shown in Figure 6-14.

Table 6-25: Summary of archaeological potential and significance

| Phase | Potential remains | Potential | Significance |
|--------------------------|---|------------|---|
| Phase 1 (1788-1912) | Evidence of informal land use, land clearance | Nil to low | Would not reach the threshold of local significance |
| Phase 2 (1912-1959) | Evidence of the former Taronga Zoo wharf (Athol Wharf), including timber piles, timber planks, ramp structure | High | Local (works) |
| | Evidence of the former Athol Wharf Road tram line and terminus, including tracks, timber slats, cut and fill construction deposits | Moderate | Local (works) |
| | Evidence of the initial establishment of Athol Wharf Road, such as former gravelled or asphalted road surfaces, kerbing and drainage, and postholes | Moderate | Would not reach the threshold of local significance |
| Phase 3 (c.1959-present) | Nil | Nil | N/A |



Legend

-  Construction footprint
-  Moderate-high potential for locally significant archaeological remains associated with former wharf and tramline

**FIGURE
6-14**

1:800 Scale at A4


**Areas of archaeological potential
TARONGA ZOO**



Map Produced by Canoco NSWACT Pty Ltd (WOL)
 Date: 2021-02-12 | Project: AWE200108
 Coordinate System: GDA 1984 MGA Zone 55
 Map: AWE200108_G0051_Taronga_ArchHeritage.mxd 02
 Aerial imagery supplied by Neumac (Jan. 2021)

6.6.3 Potential impacts

Construction

Direct and potential direct (physical) impacts

Taronga Zoo wharf (remains and seawall) (LEP no. A438)

As the Taronga Zoo wharf (remains and seawall) (LEP no. A438) heritage item is not located within the proposal footprint there would be no direct impact to the item.

The proposal would involve piling and the use of other vibration intensive plant that would be undertaken within the minimum safe working distance for cosmetic damage to heritage items (CNVG, RMS, 2016b). However, based on the nature of works and provided control measures are implemented it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposal would result in a neutral direct and negligible potential direct impact to Taronga Zoo wharf (remains and seawall) (LEP no. A483) which would not affect the overall significance of the heritage item.

Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482)

A portion of the Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482) is located within the proposal footprint. The proposed works within this portion of the heritage item would be limited to the regrading and widening of the existing footpath. This work would not impact the significant escarpment that forms part of the heritage item. It would however be undertaken in close proximity to the sandstone retaining wall that forms the southern boundary of the heritage item and is located underneath the existing footpath.

As a result, excavations within the footpath could potentially damage the underlying fabric of the retaining wall. However, the footpath works are relatively minor in nature and would not involve substantial excavations, and the proposed works would not involve the direct modification of the retaining wall itself. Furthermore, the proposal footprint would only be located within a small portion of the larger heritage item, therefore impacts to the overall heritage item would be minimal.

Based on the nature of works and provided control measures are implemented it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, there would be a negligible direct and potential direct impacts to Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482) which would not affect the overall significance of the heritage item.

Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34).

The proposal is located outside of the curtilage of Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34). As a result, there would be no direct impact to the heritage item.

Vibrations associated with the proposal could result in potential direct impacts, namely to the cable car station building. However, only a very small area of the much larger heritage item would potentially be affected by the vibrations, and the cable car station building is not considered to be an element that substantially contributes to the significance of the heritage item. As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposal would result in a neutral direct and negligible potential direct impact to Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34), however this impact would not affect the overall significance of the heritage item.

Impacts to archaeological resources

Based on the preliminary archaeological assessment the areas of significant archaeological potential (refer Figure 6-14) are located outside the proposal footprint, and earthworks associated with the proposal (limited to footpath regrading) are unlikely to cause impacts to potential archaeological remains of local significance. Overall it was assessed that the proposed works would result in nil impacts to archaeological remains of local significance.

Operation

Indirect (visual) impacts

The visual impact of the proposal was assessed for all heritage items identified within the visual buffer of the proposal (refer Appendix H for details) (refer Table 6-26). It was determined that the proposal would result in negligible impact to Taronga Zoo wharf (remains and seawall) (LEP no. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482) and Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34) which would not affect the overall significance of the heritage item. The proposal would result in a neutral visual impact to the remaining heritage items within the visual buffer zone.

Table 6-26: Summary of heritage impacts

| Item | Direct | Indirect (visual) | Potential direct | Archaeological |
|--|---------------|--------------------------|-------------------------|-----------------------|
| Taronga Zoo wharf (remains and seawall) | Neutral | Negligible | Negligible | Neutral |
| Athol Wharf Tram Terminus (including escarpment and retaining wall) | Neutral | Negligible | Negligible | Neutral |
| Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock | Neutral | Negligible | Negligible | Neutral |
| Sydney Opera House (buffer zone) | Neutral | Neutral | Neutral | Neutral |
| Ashton Park | Neutral | Neutral | Neutral | Neutral |
| Athol Gardens Dance Hall and Wharf Remains | Neutral | Neutral | Neutral | Neutral |
| Group of 4 houses | Neutral | Neutral | Neutral | Neutral |
| 'The Castle', flats | Neutral | Neutral | Neutral | Neutral |
| Divided Road | Neutral | Neutral | Neutral | Neutral |
| Cremorne Point Conservation Area | Neutral | Neutral | Neutral | Neutral |
| Cremorne Reserve (including Robertsons Point) | Neutral | Neutral | Neutral | Neutral |

| Item | Direct | Indirect (visual) | Potential direct | Archaeological |
|---|---------|-------------------|------------------|----------------|
| Site of Cremorne Smelter | Neutral | Neutral | Neutral | Neutral |
| Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials | Neutral | Neutral | Neutral | Neutral |

6.6.4 Safeguards and management measures

Table 6-27 lists the non-Aboriginal safeguards and management measures that would be implemented to account for the impacts identified in section 6.6.3.

Table 6-27: Non-Aboriginal safeguards and management measures

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---|---|----------------|------------------|
| H1 | 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 will be investigated for the implementation of heritage interpretation. | 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 archaeological 'works' such as evidence of the former tramline and terminus are unexpectedly encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts. | Contractor | Construction |
| H4 | Unexpected finds | The Roads and Maritime <i>Unexpected Heritage Item Procedure 2015</i> will be implemented if unanticipated heritage items or depositions are located during construction. | Contractor | Construction |
| H5 | 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 <i>Unexpected Heritage Items</i> (RMS, 2015) if unanticipated heritage items or depositions are located during construction. | Contractor | Pre-construction |
| NV5 | Vibration impact to heritage structures | Where works are proposed within the safe working limits for the heritage structures (Taronga Zoo wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. I34)), specialist advice will be sought from an appropriately qualified structural engineer, Transport for NSW Noise and Vibration specialist and Transport for NSW heritage advisor who are | Contractor | Pre-construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---|--|----------------|-------------------|
| | | 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. | | |
| 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 sandstone retaining wall in the Taronga Zoo wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. I34). Assessment and monitoring of vibration impacts should adhere to:</p> <ul style="list-style-type: none"> • 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. | Contractor | Construction |
| H6 | Vibration impact to heritage structures | If vibration monitors are attached to the retaining wall in the Taronga Zoo wharf (remains and seawall) (LEP no. A438) and Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482) heritage items or the buildings in Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34), 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 heritage structures | 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 Transport for NSW Heritage Advisor 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 | Visual impacts | All impacted road and footpath surfaces must be reinstated as near as possible to their original state following the completion of works. | Contractor | Post-construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|----------------------------------|--|-------------------|------------------------------------|
| H8 | Heritage Interpretation Strategy | In accordance with the sustainability requirements for the project, opportunities for the implementation of heritage interpretation will be investigated during detailed design. A Heritage Interpretation Strategy (HIS) will be prepared to discuss the various media for heritage interpretation appropriate to the location and heritage significance of the Taronga Zoo wharf. | Contractor | Detailed design |
| H9 | Design change | If any design changes result in additional excavations and impacts to potential archaeological remains of the Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482) or Taronga Zoo Wharf (remains and seawall) (LEP no. A438), further archaeological assessment and management will be required. If underwater excavations are proposed in the curtilage of Taronga Zoo Wharf (remains and seawall) (LEP no. A438), then a maritime archaeological assessment should be undertaken to assess the potential for impacts to maritime archaeological remains of the former wharf. | Transport for NSW | Detailed design / pre-construction |
| H10 | Design change | Any project redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to the Taronga Zoo 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 4 June 2020, included as Appendix I.

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 *Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW, 2010b).

6.7.2 Existing environment

The Stage 1 PACHCI assessment 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 *Due Diligence Code of Practice for the Protection of Aboriginal objects in NSW* (DECCW, 2010b) 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.

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 minor public domain works; 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 Taronga Zoo 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.

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 6-28 lists the Aboriginal heritage safeguards and management measures that would be implemented to account for the impacts identified in section 6.7.3.

Table 6-28: Aboriginal heritage safeguards and management measures

| ID | 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 | Unexpected heritage finds | The <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

Taronga Zoo wharf is located to the south of Taronga Zoo on Bradleys Head, to the east of the Warringah Freeway on Sydney's Lower North Shore. The wharf is accessed via Athol Wharf Road from Bradleys Head Road, which runs along the southern extent of the zoo and terminates at the wharf. Bradleys Head Road terminates at the end of the peninsula at Bradleys Head Light House.

The road network within the vicinity of the wharf is minimal and characterised by limited on-street parking. Speed limits are generally 50 kilometres per hour in the vicinity of the proposal.

Bus network

Taronga Zoo has two primary bus stops, the first being directly outside the wharf entrance on Athol Wharf Road and the second being the bus stop at the Zoo's entrance on Bradley Head Road. Entrance to the Zoo's northern entry point from the wharf may be gained by either taking the Sky Safari cable car or bus route 238. Alternatively, a five-minute walk from the wharf interchange along Athol Wharf Road leads to the southern zoo entrance.

Bus route 238 transports passengers from Taronga Zoo wharf to Balmoral Beach. Bus services along this route operate more frequently for trips between the ferry wharf and the Zoo's north entry point, rather than the full route. This shortened route is concentrated to periods when Zoo visitors are arriving in the morning and departing in the afternoon. The route operates 7 days a week including weekends and public holidays.

Train network

Milsons Point station and North Sydney station are located 5.7 kilometre and 5.4 kilometre (walking distance) away from the wharf, respectively. Both stations are part of the T1 North Shore, Northern and Western Line, providing connectivity to Hornsby, Epping, Penrith and Richmond. Frequency along this line ranges from three minutes between trains during peak period and 10 minutes during off-peak.

Bicycle network

The wharf currently has five uncovered bicycle parking hoops.

Bicycle friendly paths have been identified as either on-road marked cycling routes or suggested unmarked bike paths by Mosman Council. These routes link to larger arterial roads such as Military Road and Middle Head Road.

Pedestrian access

Pedestrian access to the wharf is along Athol Wharf Road from the southern Taronga Zoo entry as well as from the Taronga Zoo Sky Safari cable car. Taronga Zoo wharf also provides a starting point to the Balmoral Beach to Taronga Zoo foreshore walk.

Parking

Athol Wharf Road cul-de-sac outside the wharf is designated as either 'No Stopping', 'No Parking', or as a 'Bus Zone'. Unrestricted parking along the northern verge of Athol Wharf Road is available for 200 metres between the bus zone and the southern Zoo entrance.

Water transport

Ferry services

Taronga Zoo wharf is serviced by the F2 Taronga Zoo route which travels predominantly between Circular Quay and Taronga Zoo. However, during the weekday, the F2 ferry will make additional stops at Cremorne Point and Mosman Bay during the morning and afternoon peak. Weekend services are only between Taronga Zoo and Circular Quay.

The journey between Taronga Zoo and Circular Quay is about 12 minutes. The frequency of services varies from every 30 minutes during the weekday to every 20 minutes on weekends and public holidays.

The ferry service operates at Taronga Zoo at the following service rates:

- Weekdays: between 9am and 7pm, 21 services
- Weekends and public holidays: between 9am and 7.05pm, 29 services.

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 801 patrons (744 boarding, 57 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 1473 patrons.

Transdev is considered to be 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.

Commercial and recreational activity

Charter boats are able to use the existing wharf in accordance with the Transport for NSW *Wharf Access Policy*. Public transport ferry services have priority to access the wharf based on their timetabling.

Captain Cook Cruises (CCC) also operates a Taronga Zoo ferry service between Taronga Zoo, Circular Quay and Darling Harbour. The frequency of services is varied throughout the day due to the different routes undertaken by each CCC vessel. There are 13 services spread between 9am and 5pm during the weekday and 14 services on the weekend across the same time period. The journey between Darling Harbour and Taronga Zoo takes about 30 minutes.

Manly Fast Ferry also operates a Taronga Zoo Sightseeing Cruise between Darling Harbour and Manly via Circular Quay, and Taronga Zoo. These services run

throughout the week, generally between 9am and 4pm in the Manly direction and between 10am and 5pm towards Darling Harbour.

6.8.3 Potential impacts

Construction

Land transport

Construction vehicles would access the proposal via Athol Wharf Road. There would be a moderate number of heavy vehicles accessing the site via Athol Wharf Road during earthworks for the footpath regarding and accessible ramp construction. It is anticipated that most materials and equipment required for land based elements of the proposal would be delivered by road. Although Athol Wharf Road would remain open, temporary partial closure of the cul-de-sac and/or traffic management may be required during construction and demolition activities. These can potentially be undertaken at night to avoid any impacts to bus services and Taronga Zoo visitors.

Up to five heavy vehicles are likely to be used for construction and a maximum of ten light and heavy vehicles would be used for deliveries to site. The additional construction traffic expected within the area is considered minor and would be unlikely to affect the capacity of the road network. Any potential impacts associated with construction vehicles at the site would be mitigated through the preparation and implementation of a Traffic Management Plan (TMP).

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 around the wharf may be restricted at times due to potential temporary partial closure of the Athol Wharf Road cul-de-sac. However, this would be maintained by providing an alternate route around the construction footprint. Pedestrian and cyclist access to the foreshore would be limited during construction but still available.

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. Final access and parking arrangements would be confirmed by the construction contractor.

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

Due to the importance of the Taronga Zoo wharf to the adjoining Taronga Zoo and other recreational facilities, the wharf would remain operational during construction. Maritime vessel management would be required while certain elements of the proposal are being built and installed.

A maritime exclusion zone may be required during construction to prevent commercial and recreational traffic entering the area. This may also include changes to the F2 Circular Quay ferry schedule.

Restrictions on work sites on the Taronga Zoo wharf (e.g. restriction to use of one gangway) may also apply.

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 Athol Wharf Road 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 likely 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

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 footpaths around the wharf would be regraded to meet DDA standards, improving accessibility to the wharf from Athol Wharf Road.

Existing bicycle hoops would be retained at the interchange.

Water transport

Ferry operations to Taronga Zoo wharf interchange would continue through construction and 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 be allowed at the upgraded structure.

6.8.4 Safeguards and management measures

Table 6-29 lists the transport, access and parking safeguards and management measures that would be implemented to account for the impacts identified in section 6.8.3.

Table 6-29: Land transport, access and parking safeguards and management measures

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|----|----------------------------|---|-------------------|---------------------------------|
| T1 | Land transport and parking | <p>A Traffic Management Plan (TMP) will be prepared and will include the following.</p> <ul style="list-style-type: none"> Final access and parking arrangements Alternate pedestrian and cyclist access around the construction area 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. | Contractor | Pre-construction |
| T2 | Land transport and parking | 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 and parking | Public transport passengers will be notified of any impacts to transport services and the alternative transport options prior to the commencement of construction and ancillary facilities on Athol Wharf Road. This will include updates to the timetable (online and Opal app) indicating the construction works at the Taronga Zoo wharf. | Transport for NSW | Pre-construction / construction |
| T4 | Water transport | <ul style="list-style-type: none"> A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area. This zone will be clearly defined to communicate access for other water users. | Contractor | Pre-construction / construction |
| T5 | Water transport | <p>A Maritime TMP will be prepared and implemented during the water based construction work. The Maritime TMP will be prepared consultation with Transport for NSW and approved by the Harbourmaster.</p> <p>In addition, the proposal will:</p> <ul style="list-style-type: none"> Fit all buoys with lights | Contractor | Pre-construction / construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|----|-----------------|---|-------------------|---------------------------------|
| | | <ul style="list-style-type: none"> • Prepare Response Plans for emergencies and spills for all construction vessels • Fit at least one vessel with an Automatic Identification System (AIS) • Retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements • Prepare a Communications Plan for implementation during the work which must include 24/7 contact details, protocols for enquiries, complaints and emergencies. <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 J contains a Socio-Economic Impact Assessment (SEIA) prepared by Cardno (Cardno, 2020c).

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) (Practice Note) (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 Mosman LGA have been used (referred to as the study area in section 6.9), and the North Sydney–Mosman SA3 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:
 - 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, 2020)
 - Disability Inclusion Action Plan 2017-2021 (Mosman Council, 2017)
 - Mapping Mosman's Community Services and Programs (Mosman Council, 2018b)
 - Greater Sydney Harbour Estuary Coastal Management Program Scoping Study (BMT, 2018)
- Taronga Zoo Wharf Upgrade Concept Design (Aurecon, 2019a)
- Taronga Zoo Wharf Upgrade Stakeholder Meetings September, 2020 (details the outcomes of consultations conducted with Taronga Zoo management)
- 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 was also informed by studies commissioned as part of the REF and by stakeholder consultation undertaken during the concept design.

6.9.2 Existing environment

The proposal is located within the North Sydney–Mosman SA3 region. The North Sydney–Mosman SA3 is about 1897 hectares. The proposal is situated in the Mosman

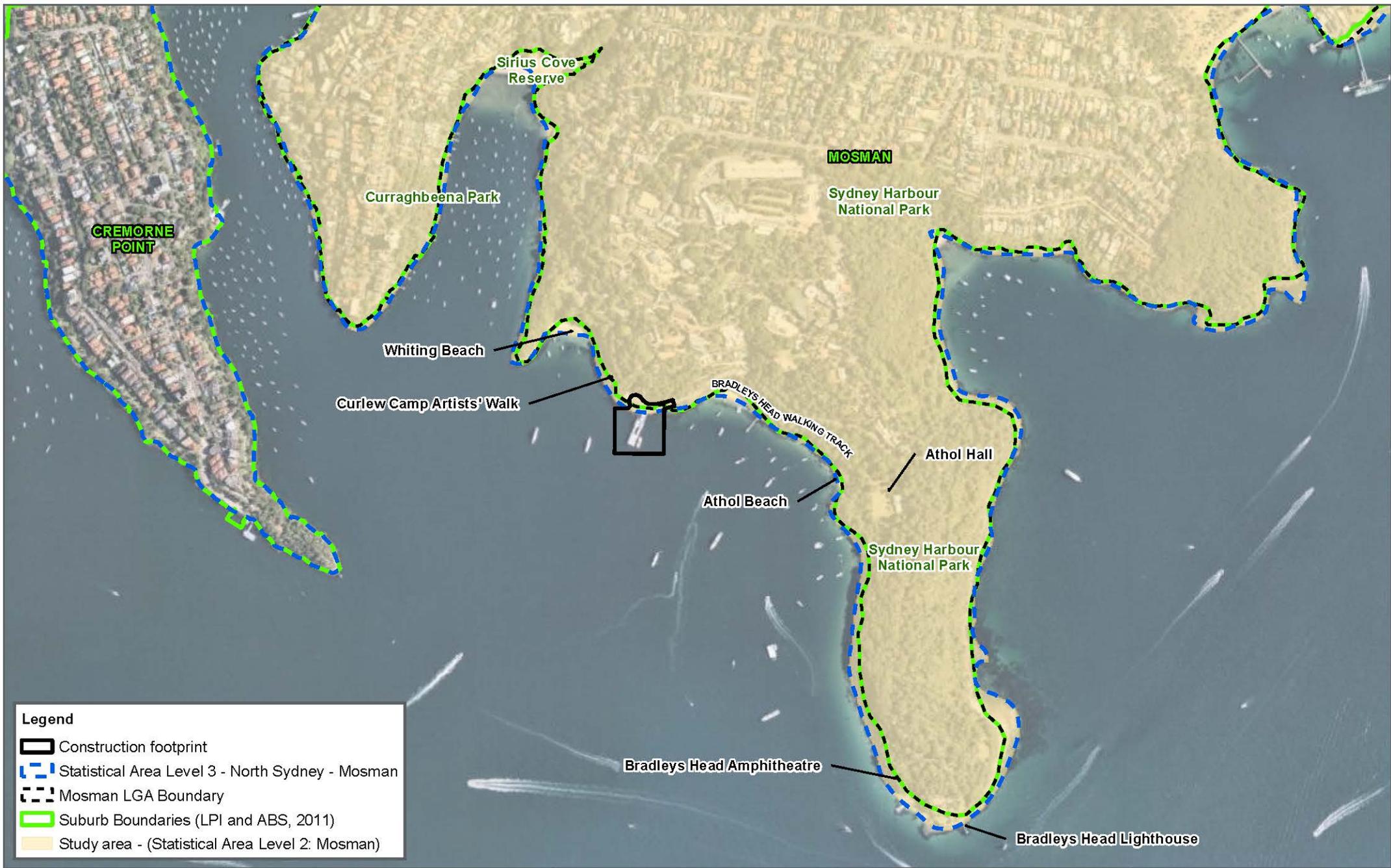
LGA (the socio-economic study area, refer Figure 6-15) which includes the suburbs of Mosman Bay, Middle Head - Georges Heights - Clifton Gardens, Mosman Junction, Mosman Central, Balmoral, Middle Harbour and Beauty Point – The Spit. The proposal is located in the suburb of Mosman Bay. The Study Area 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.

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



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 (ABS, 2016) number of local businesses due to the close proximity to the Sydney and North Sydney CBDs. 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.

The main types of local businesses and service providers within 500 metres include:

- Café located on wharf jetty
- Taronga Zoo and associated facilities
- Athol Hall Function Centre.

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 in the study area close to the proposal includes:

- Local parks and recreational areas including (refer Figure 6-15):
 - Sydney Harbour National Park
 - Whiting Beach
 - Athol Beach
 - Curlew Camp Artists' Walk
 - Bradleys Head Walking Track
 - Bradleys Head Amphitheatre
 - Sirius Cove Reserve

- Public transport facilities such as bus stops operating in the Athol Wharf Road and Bradleys Head Road.

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, 2017) 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 period of up to five months starting in late 2021. Due to the importance of the Taronga Zoo wharf to the adjoining Taronga Zoo and other recreational facilities, the construction and demolition activities would be staged and the wharf would remain operational during construction. However, there may be changes to Taronga Zoo wharf ferry timetable during construction.

Transport and access impacts

Existing bus services would be used to support access to Taronga Zoo and surrounding areas as bus transport would remain unchanged. Ferry customers travelling from the City could catch the existing 430 bus service to the Bradleys Head Road and then catch 238 bus service along Athol Wharf Road to Taronga Zoo as an alternative to using the ferry service, if required.

Although Athol Wharf Road would remain open, temporary partial closure of the Athol Wharf Road cul-de-sac may be required during construction and demolition activities. These can potentially be undertaken at night to avoid any impacts to bus services and Taronga Zoo visitors. Alternatively, the delivery of wharf components could be via barge and installed by barge mounted crane.

Disruptions to ferry timetables may result in increased travel times for ferry users in the event they need to use bus services, or a combination of bus and train, when compared to travelling by ferry. Taronga Zoo visitors may also use private vehicles during the construction period, which may result in additional traffic and parking issues during the weekends and public holidays. Any disruption would be minimised via notification ahead of construction, and consequent updates provided to customers.

There would be a number of heavy vehicles accessing the proposal site via Athol Wharf Road and Bradleys Head Road during demolition activities, earthworks, and for installation of the access ramp. It is anticipated that most materials and equipment required for the land-based elements of the proposal would be delivered by road. Temporary traffic lights or

stop-go provisions on Bradleys Head Road and Athol Wharf Road may be required if major deliveries take place by road. The additional construction traffic expected is considered minor in the context of existing levels of traffic in the area, and would be unlikely to affect the capacity of the road network. Any potential impact associated with construction vehicles accessing the site would be mitigated through the preparation and implementation of a TMP.

A maritime exclusion zone may be required around the proposal footprint during construction to prevent commercial and recreational traffic entering the works area.

It is expected that these short-term impacts during construction described would be offset by the benefits of the upgraded wharf and interchange during operation.

Noise impacts

The noise and vibration impact assessment (refer section 6.4) identified that for a the worst case scenario, construction noise levels are predicted to exceed management levels for 'standard' and 'non-standard' hours of operation for all construction stages at nearby residential receivers. The most likely source of potential sleep disturbance from outside of construction hours works would be from piling proposed as early morning works. Further information is provided in section 6.4.

Local amenity

Noise, vibration, air quality and visual impacts from construction activities would disrupt the amenity of the area. This would directly impact visitors to the Taronga Zoo and recreational users, as well as residents living 500 metres from 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. Some vegetation clearing is required to construct the accessible ramp, however, this is considered to have a minor impact. The loss of amenity, along with disruption to ferry timetables, may discourage the use of these areas in the vicinity of the wharf during construction.

Construction activities may be required during Saturday mornings (8am to 1pm) when the Taronga Zoo wharf is busy with Zoo visitors and recreational users, and these customers would be disrupted by the activities.

The management measures described in Chapter 7 would aim to minimise these impacts on local amenity.

Local businesses

The existing café at the wharf would need to be demolished during construction and would be closed for the entire construction phase. This would inconvenience Taronga Zoo visitors and recreational users to the area who patronise the café.

Indirect impacts to Taronga Zoo and other 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 businesses and the community would be undertaken to determine sensitive periods for surrounding businesses and other receivers. The management measures described in Chapter 6 aim to minimise these impacts.

Opportunities

Construction activity would generate regional demand for services such as recruitment agencies, construction companies, suppliers and construction services. Local businesses such as cafes would benefit from the presence of construction personnel.

Operation

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

Transport and access impacts

The existing wharf at Taronga Zoo is a large pontoon with two berths. The existing fixed jetty leading up to the bus stop and entrance to the Skyway is steep (1:10 grade) and the pontoon and shorter gangway are not fully DSAPT compliant. Customers with mobility needs currently use the gangways to get to the bottom of the jetty ramp. From there, assistance may be required for wheelchairs to get to the top of the jetty ramp.

The proposed wharf design includes a new covered DSAPT compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. Two new covered dual-lane aluminium gangways which would connect the fixed jetty structure to the pontoon would be constructed. The new features would provide an accessible pathway from the accessible ramp to the gangways and around the wharf facilities, including the Transdev office, toilet and café.

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 in patronage of the ferry service and additional commuter traffic travelling to and from the wharf.

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

Landscape and visual amenity impacts

The overall visual impact of the proposed concept design for Taronga Zoo wharf, is considered moderate following the assessment of the viewpoints. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site.

The proposed Taronga Zoo wharf, which is an extension from the existing wharf, is expected to have a moderate to low impact on the landscape character of the surrounding area (Cardno, 2020b, Appendix G). The design is not considered to represent a significant contrast to the existing wharf and is relatively distant from some sensitive receivers. Some vegetation clearing is required to accommodate the accessible ramped pathway, however, this is considered a minor impact on the landscape. The additional structures would increase the overall size of the existing wharf, however, would not have a significant impact on the existing landscape character.

Ferry patrons and visitors to the zoo are expected to be the most affected by the proposed design from a visual perspective; however, it should be noted that the proposed design is provided to benefit and improve the experience of patrons making the wharf interchange more accessible for ferry users and zoo visitors.

More detailed assessment of the visual impacts during operation are described in section 6.5.

Local businesses and community impacts

Once operational, the surrounding businesses may benefit from an increase in visitor numbers to Taronga Zoo and nearby parks, thereby supporting the economic sustainability of many businesses.

During operation, the extra lighting and security cameras at the wharf would deter antisocial behaviour and provide a safer night-time environment for ferry users. The design of the ferry wharf generally creates a clear hierarchy of space, enables safe access/egress, and

provides for both 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 6-30 lists the socio-economic safeguards and management measures that would be implemented to account for the impacts identified in section 6.9.3.

Table 6-30: Socio-economic safeguards and management measures

| ID | 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 would be implemented during construction to provide timely and accurate information to stakeholders during construction. It would include (as a minimum):</p> <ul style="list-style-type: none"> • Mechanisms to provide details and timing of proposed activities to affected residents and local businesses, including changes to traffic, public transport services and access • A contact name and telephone number for complaints. | Transport for NSW | Pre-construction / construction |
| SE2 | Socio-economic | <ul style="list-style-type: none"> • A webpage and free-call number will be established for enquiries regarding the proposal, and will remain active for the duration of construction. • Contact details will be clearly displayed at the entrance to the site. • All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received. | 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 wellbeing initiatives in the design and construction of the proposal. | Transport for NSW | Detailed design / construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|----|----------------------------|---|-------------------|---------------------------------|
| T2 | Land transport and parking | 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 and parking | Public transport passengers will be notified of any impacts to transport services and alternative transport arrangements prior to the commencement of construction and ancillary facilities on Athol Wharf Road. This will include updates to the timetable (online and Opal app) indicating the construction works at the Taronga Zoo wharf. | Transport for NSW | Pre-construction / construction |
| T4 | Maritime transport | <ul style="list-style-type: none"> A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area. This zone will be clearly defined to communicate access for other water users. | Contractor | Construction |

Other safeguards and management measures that would address socio-economic impacts are identified in section 6.4.5 (noise and vibration), section 6.5.4 (visual) and section 6.10.3 (air quality).

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 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 October 2020 for 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 1213 millimetres.

Sydney Harbour (Wedding Cake West) weather station (station number 066196) is located about 2.3 kilometres to the east of the proposal footprint. Morning and afternoon wind rose directional data is summarised in Table 6-1 (BoM, 2020b) and shown in Figure 6-1. Afternoon winds are generally stronger than morning winds tending towards 20-27 kilometres per hour with morning winds generally 15-19 kilometres per hour (BoM, 2020b).

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. excavations, 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 not increase so no additional impacts to the air quality expected from the operation of the proposal.

6.10.3 Safeguards and management measures

Table 6-31 lists the air quality safeguards and management measures that would be implemented to account for the impacts identified in section 6.10.2.

Table 6-31: Air quality safeguards and management measures

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|----------------|--|----------------|---------------------------------|
| AQ1 | Air quality | <p>Air quality during construction will be considered and addressed within the CEMP and would 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"> • Covering all loaded trucks and vessels • Machinery to be turned off rather than left to idle when not in use • 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 • Maintenance of all plant and equipment to ensure good operating conditions and exhaust emissions comply with the Protection of the Environment Operations Act 1997 • Maintaining the work site in a condition that minimises fugitive emissions such as minor dust • Appropriate sediment and erosion controls for any exposed earth or stockpiled waste. | 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 *Waste Avoidance and Resource Recovery Act 2001* (WARR Act).

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.

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.

Ancillary facilities would be contained within the site compound(s), and 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 banded 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 6-32 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 and management measures that address waste impacts are identified in section 6.1.4 (contamination) and section 6.2.4 (accidental spills).

Table 6-32: Waste management safeguards and management measures

| ID | 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 would 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"> • Appropriate measures to avoid and minimise waste associated with the proposal should be investigated and implemented where possible • Waste management, littering and general tidiness will be monitored during routine site inspections. | 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 <i>Protection of the Environment Operations (Waste) Regulation 2014</i> 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, risk and utilities

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 current footpath slopes and the transition between the pontoon and gangway. These features make it difficult for prams and wheelchairs to get on and off the ferries.

There are four alarmed life buoys in sheltered cases, two located on both outside walls of the pontoon area and two to the south of the pontoon. There are two additional life buoys available on both sides of the jetty, near the security roller doors.

There are no potentially hazardous and contaminated sites (as identified on the NSW EPA contaminated sites register) located within 500 metres of the site (refer section 6.1.2).

The preliminary assessment identified that the following services are present around the Taronga Zoo wharf:

- A submarine cable was observed within the proposal footprint, east of the existing wharf structure
- Electrical LV cables (Ausgrid)
- Sewer services (Sydney Water)
- Communications services (Telstra).

There is potential for unknown services to exist within the proposal footprint.

No flooding issues, or other hazards and risks are expected at the site.

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 for impacts to utilities.

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 protection piles adjacent to the wharf, 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 6-33 lists the hazards safeguards and management measures that would be implemented to account for the impacts identified in section 6.12.3.

Table 6-33: Hazards safeguards and management measures

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|-------------------|--|-------------------|-----------------|
| HR1 | Hazards and risks | 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 |
| HR2 | Hazards and risks | Further assessment of impacts to local utilities will be undertaken. | Transport for NSW | Detailed design |

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, 2009b). 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 Taronga Zoo wharf and a relative decrease in use of private motor vehicles by commuters to travel to and from Taronga Zoo. 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 6-34 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 6-34: Climate change and greenhouse gas safeguards and management measures

| ID | 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"> • Design of pontoons, waiting areas and gangways • Integrate coastal erosion control techniques around landside infrastructure • Drainage and storm water infrastructure • Specifications of materials in design • Weather protection features. | 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, 2020b) 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 6-35 lists the sustainability safeguards and management measures that would be implemented to account for the impacts identified in section 6.14.2.

Table 6-35: Sustainability safeguards and management measures

| ID | 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 will be provided prior to construction and include the following minimum components: <ul style="list-style-type: none"> • A completed electronic checklist demonstrating compliance with Transport for NSW's <i>NSW Sustainable Design Guidelines Version 4.0</i> (7TP-ST-114) • The Head Contractors sustainability goals and targets, internal procedures, and implementation strategy. | 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 sustainability are identified in section 6.9.4 (socio-economic), section 6.10.3 (air quality), section 6.11.4 (waste) and section 6.13.3 (climate change).

6.15 Cumulative impacts

6.15.1 Study area

Taronga Zoo wharf is within the Mosman LGA. Projects within the Mosman LGA and the Sydney Ferries Network 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 projects
- Sydney North Planning Panel Development and Planning Register
- Mosman Council Development Application Register.

Projects identified on the above registers that may impact the proposal have been identified in Table 6-36.

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 Taronga Zoo, which is part of the F2 Ferry Service that operates between Circular Quay and Taronga Zoo.

The Ferry wharf Upgrade Program includes planned upgrades to multiple wharves in the Sydney Ferries Network including North Sydney (F5) and South Mosman (F6).

During construction the wharf would remain operational, however the café would be closed.

Potential impacts from the construction and operation of identified past, present and future projects are summarised in Table 6-36.

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

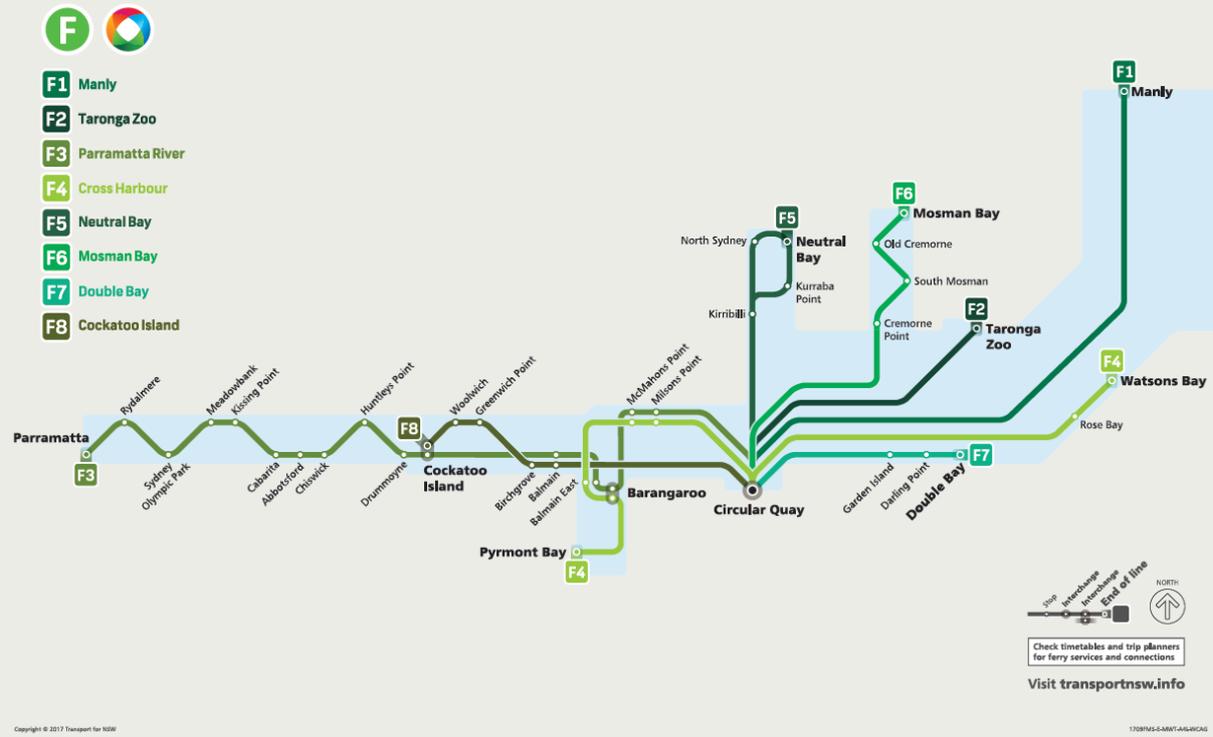


Figure 6-16: Sydney ferries network

6.15.3 Other projects and developments

Table 6-36: Past, present and future projects

| Project | Construction impacts | Operational impacts |
|-----------------------------|---|--|
| Ferry wharf Upgrade Program | <p>Upgrade of Taronga Zoo wharf would require additional boat movements within Sydney Harbour for the delivery of materials to the study area 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 greenhouses gases from construction activities. Greenhouse gases would be generated through the use of fossil fuels by construction plant and equipment, transportation of</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"> • Safety for commuters • Recreational facilities • Improved travel times • Improved customer experience due to upgraded facilities • The public domain and quality of customer experience. |

| Project | Construction impacts | Operational impacts |
|--|--|--|
| | <p>personnel and materials and the embodied carbon in the materials used such as concrete and steel. These impacts are considered to be minor.</p> | |
| <p>African Savannah and Congo Exhibits, Taronga Zoo (State Significant Development) SSD 8008.</p> <p>Partial demolition of the African Safari and Orangutan Rainforest exhibits and redevelopment to form the new African Savannah and Congo Forest exhibits including minor earthworks and regrading of the site.</p> <p>The project would be staged as follows:</p> <ul style="list-style-type: none"> • Stage 1 – the African Savannah exhibit • Stage 2 – the Congo Forest exhibit intended to commence construction in May 2021 and open in October 2022. | <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> |
| <p>DA 008.2020.00000098.001</p> <p>Site preparation including demolition of Platypus house and surrounding pathways approved September 2020.</p> <p>The early works application supports disruptive construction associated with the redevelopment of the Upper Australia Precinct of Taronga Zoo to begin earlier while visitor numbers are restricted during COVID-19.</p> | <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 6-37.

Table 6-37: Potential cumulative impacts

| Environmental factor | Construction | Operation |
|-----------------------|---|---|
| Socioeconomic | Cumulative impacts to patrons of the ferry network due to closure of Taronga Zoo wharf. | No operational impacts are anticipated. |
| Traffic and transport | Minor increase in marine traffic. | No operational impacts are anticipated. |

6.15.5 Safeguards and management measures

Table 6-38 lists the cumulative impacts safeguards and management measures that would be implemented to account for the impacts identified in section 6.15.4.

Table 6-38: Cumulative impacts safeguards and management measures

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---------------------------------|--|-------------------|---------------------------------|
| C1 | Cumulative construction impacts | <ul style="list-style-type: none"> • Consultation would include notification prior to the start of the works • Updates on any delays or changes to the construction period would also be communicated. | Transport for NSW | Pre-construction / construction |

7 Environmental management

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 would 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 would 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"> • Any requirements associated with statutory approvals • Details of how the project will implement the identified safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review. <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p> | Contractor/Transport for NSW project manager | Pre-construction / detailed design |
| 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 project manager | Pre-construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|------|--|--|--|----------------------------------|
| 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"> • Areas of non-Aboriginal heritage sensitivity • Waterside impacts. | Contractor/Transport for NSW project manager | 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 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 <i>Protection of the Environment Operations (Waste) Regulation 2014</i> 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 |
| LS4 | 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 |
| LS5 | Land surface and hydrology | The piling methodology shall seek to mitigate the risk of sediment dispersal. | Contractor | Construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|----------------------------|--|----------------|------------------|
| LS6 | Land surface and hydrology | <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"> • Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • Reduce water velocity and capture sediment on site • Minimise the amount of material transported from site to surrounding pavement surfaces • Divert clean water around the site. | Contractor | Pre-construction |
| LS7 | Land surface and hydrology | <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. Prior to removing the sediment control device, conditions within the curtain would 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 |
| LS8 | 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 |
| LS9 | Land surface and hydrology | 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 |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|------|----------------------------|---|----------------|---------------------------------|
| LS10 | Land surface and hydrology | Works associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts. | Contractor | Construction |
| WQ1 | Water quality | <ul style="list-style-type: none"> A spill management plan will be developed as part of the CEMP and communicated to all staff working on site. 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 potentially polluting liquids stored at the work site. All workers will be advised of the location of the spill kit and trained in its use. | Contractor | Pre-construction / Construction |
| 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). (This Plan defines which types of spills need to be notified by external combat agencies). | 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 elements (e.g. jetty canopy and portion of existing pontoon) to minimise the risk of pollutants and debris entering the waterway. The EWMS must be approved by Transport for NSW prior to the demolition works. | Contractor | Pre-construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|--------------|---|-------------------|------------------|
| B1 | Biodiversity | <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"> • Documenting and establishing the limits of construction activities, including clearing, vessel traffic and anchoring • Establishment of no go zones • Implementation of tree protection measures. | Contractor | Pre-construction |
| B2 | Biodiversity | Retained vegetation in close proximity to construction activities will not be damaged or removed. | Contractor | Construction |
| B3 | Biodiversity | Native vegetation and habitat removal will be minimised through detailed design. | Transport for NSW | Detailed design |
| B4 | 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). | Contractor | Pre-construction |
| B5 | 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 |
| 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). | Transport for NSW | Detailed design |
| B8 | Biodiversity | Direct removal of marine vegetation and habitat limited to the footprint of the eleven piles and some minor anchoring during water-based construction activities. | Contractor | Construction |
| B9 | Biodiversity | Minimise anchoring where possible and avoid anchoring on subtidal rocky reef habitat. | Contractor | Construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|--------------|--|-------------------|------------------|
| B10 | 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 should be encouraged to move away from the study area and White's Seahorse should be captured and relocated to nearby similar habitat using methods approved by DPI Fisheries. A White's Seahorse relocation plan will be developed in consultation with DPI Fisheries to dictate this activity. These activities are to be completed by a qualified marine ecologist. | Transport for NSW | Pre-construction |
| B11 | 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 | Pre-construction |
| B12 | 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 |
| B13 | Biodiversity | Piling to stop if marine mammals are observed within approximately 100 metres of the construction footprint and only to recommence once they have moved beyond 100 metres of the construction footprint or are not seen for at least 20 minutes. | Contractor | Construction |
| B14 | Biodiversity | The detailed design should aim to avoid/minimise any impact to coastal processes and hydrology. | Transport for NSW | Detailed design |
| B15 | 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 |
| B16 | 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 |
| 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 |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---------------------|--|-------------------|------------------------------------|
| B18 | Biodiversity | Water-based equipment and vessels to be sourced from local suppliers where possible. Equipment and vessels will 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 |
| B21 | Biodiversity | Consultation with Taronga Zoo will be undertaken to determine whether the expected noise and vibration impacts from construction are likely to have a detrimental impact on the nearby resident Taronga Zoo fauna and to determine suitable mitigation measures to address this if required. | Transport for NSW | Detailed design / Pre-construction |
| 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"> • Plant controls: <ul style="list-style-type: none"> – Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc. – Plant and equipment would be in good working order to prevent excess noise generation. – Locating static sources of noise such as the generators as remotely as possible from noise sensitive receivers – Use of broadband reversing alarms, or ‘quackers’, on mobile equipment in accordance with the relevant health and safety regulations – Use of temporary noise barriers where practical. The height and location of these barriers would 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 – 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 | Contractor | Pre-construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|--------|--|----------------|--------|
| | | <ul style="list-style-type: none"> - Acoustic curtains (generally loaded vinyl based products), attached to wire construction fencing or laid over steel scaffold can also provide practical temporary noise barriers. We recommend that this is investigated for stationery plant within the worksites once a detailed schedule of works and plant is available - Provision of a solid 2 m high anti-gawk barrier along the site work area boundaries may provide some reduction to nearby receivers, however this is only expected to benefit the lower levels of the nearby receivers. Local barriers will have minimal effects on noise reduction for receivers with multiple levels as there will still be a clear line of sight from the works to the receivers. Inclusion of an angled return at the top of the barrier (if this is practical to construct) may provide increased benefit to multiple storey receivers when the plant is located close to the barrier and is generally stationery. We recommend that this is further investigated once a detailed schedule of works and plant is available. • Management and behavioural controls: <ul style="list-style-type: none"> - Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings - Avoid the need for reversing in the construction area by creating a loop road or similar - Avoid dropping materials from height - Workers should avoid shouting, minimise talking loudly, and avoid slamming vehicle doors. • Allowing construction to occur only during approved construction hours, unless otherwise required as a condition of Transport for NSW safety requirements. • 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. • Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately. • Conducting additional monitoring if complaints are received or proposed activities and number of plants exceed those assumed in this assessment. • Modifying of work activities where noise or vibration is found to cause unacceptable impact. | | |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---------------------|---|--------------------------------|------------------|
| | | <ul style="list-style-type: none"> Implementation of additional mitigation measures in accordance with the CNVG including notification, respite periods and alternate accommodation as reasonable and feasible. | | |
| NV2 | Noise and vibration | <ul style="list-style-type: none"> Carrying out works within standard daytime hours as follows: <ul style="list-style-type: none"> 7:00 am to 6:00 pm Monday to Friday 8:00 am to 1:00 pm Saturdays, no work on Sundays or public holidays. 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 or due to requirements to enable bus access. 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. All reasonable and feasible efforts should be undertaken to ensure noise levels will 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. | Contractor | Construction |
| NV3 | Noise and vibration | <ul style="list-style-type: none"> 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. Notification will be a minimum of 7 calendar days prior to the start of work. A contact telephone number and email address will be available for community feedback. | 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 NSW / Contractor | Pre-construction |
| NV5 | Noise and vibration | Where works are proposed within the safe working limits for the heritage structures (Taronga Zoo wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. I34)), specialist advice will be sought from an appropriately qualified structural engineer, Transport for NSW Noise and Vibration specialist and Transport for NSW heritage advisor who are familiar with heritage structures to assess if vibrations associated with the proposed | Contractor | Pre-construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|----------------------|--|-------------------|---------------------------------|
| | | works will potentially result in impacts to heritage structures. Vibration monitoring will be carried out to confirm vibration levels prior to construction commencement. | | |
| NV6 | Noise and vibration | <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 sandstone retaining wall in the Taronga Zoo wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. I34). Assessment and monitoring of vibration impacts should adhere to:</p> <ul style="list-style-type: none"> • 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. | Contractor | Construction |
| 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"> • Similar visual structures (such as jetties, pontoons and wharfs) as those located within Neutral Bay, Neutral Harbour and Careening Cove • A coordinated palette of materials and colours to respond to the existing maritime and foreshore character • Low-scale landside and waterside works to improve accessibility, wayfinding and services • The approaches to and surrounds of the wharf designed to maximise amenity and keeping with the existing urban and landscape environment • Landscape treatment of the approaches to the wharf to be appropriate and complimentary to the existing landscape of Taronga Zoo. | Transport for NSW | Detailed design |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|-------------------------|---|----------------|-------------------|
| 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 surrounding receivers, including residential properties. | Contractor | Construction |
| LV4 | Landscape and visual | All impacted areas and ground surfaces will be reinstated as near as possible to their original state following the completion of works. | Contractor | Post-construction |
| H1 | 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 will be investigated for the implementation of heritage interpretation. | 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 archaeological 'works' such as evidence of the former tramline and terminus are unexpectedly encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts. | Contractor | Construction |
| H4 | Non-Aboriginal heritage | The Roads and Maritime <i>Unexpected Heritage Item Procedure 2015</i> will be implemented if unanticipated heritage items or depositions are located during construction. | Contractor | Construction |
| H5 | 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 <i>Unexpected Heritage Items</i> (RMS, 2015) if unanticipated heritage items or depositions are located during construction. | Contractor | Pre-construction |
| H6 | Non-Aboriginal heritage | If vibration monitors are attached to the retaining wall in the Taronga Zoo wharf (remains and seawall) (LEP no. A438) and Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482) heritage items or the buildings in Taronga Zoo – Upper and Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34), 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 |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|-------------------------|---|-------------------|------------------------------------|
| 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 Transport for NSW Heritage Advisor 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 |
| H8 | Non-Aboriginal heritage | In accordance with the sustainability requirements for the project, opportunities for the implementation of heritage interpretation will be investigated during detailed design. A Heritage Interpretation Strategy (HIS) will be prepared to discuss the various media for heritage interpretation appropriate to the location and heritage significance of the Taronga Zoo wharf. | Contractor | Detailed design |
| H9 | Non-Aboriginal heritage | If any design changes result in additional excavations and impacts to potential archaeological remains of the Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482) or Taronga Zoo Wharf (remains and seawall) (LEP no. A438), further archaeological assessment and management will be required. If underwater excavations are proposed in the curtilage of Taronga Zoo Wharf (remains and seawall) (LEP no. A438), then a maritime archaeological assessment should be undertaken to assess the potential for impacts to maritime archaeological remains of the former wharf | Transport for NSW | Detailed design / pre-construction |
| H10 | Non-Aboriginal heritage | Any project redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to the Taronga Zoo 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 |
| AH2 | Aboriginal heritage | The <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 |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|-----------------------|---|-------------------|---------------------------------|
| T1 | Traffic and transport | <p>A Traffic Management Plan (TMP) will be prepared and will include the following.</p> <ul style="list-style-type: none"> • Final access and parking arrangements • Alternate pedestrian and cyclist access around the construction area • 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. | Contractor | Pre-construction |
| T2 | Traffic and transport | 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 | Traffic and transport | Public transport passengers will be notified of any impacts to transport services and the alternative transport options prior to the commencement of construction and ancillary facilities on Athol Wharf Road. This will include updates to the timetable (online and Opal app) indicating the construction works at the Taronga Zoo wharf. | Transport for NSW | Pre-construction / construction |
| T4 | Traffic and transport | <ul style="list-style-type: none"> • A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area. • This zone will be clearly defined to communicate access for other water users. | Contractor | Pre-construction / construction |
| T5 | Traffic and transport | <p>A Maritime TMP will be prepared and implemented during the water based construction work. The Maritime TMP will be prepared consultation with Transport for NSW and approved by the Harbourmaster.</p> <p>In addition, the proposal will:</p> <ul style="list-style-type: none"> • Fit all buoys with lights • Prepare Response Plans for emergencies and spills for all construction vessels • Fit at least one vessel with an Automatic Identification System (AIS) • Retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements • Prepare a Communications Plan for implementation during the work which must include 24/7 contact details, protocols for enquiries, complaints and emergencies. <p>Any variation to the above will be agreed in advance with the Harbourmaster.</p> | Contractor | Pre-construction / construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|-----------------------|---|-------------------|-----------------------------------|
| T6 | Traffic and 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 |
| SE1 | Socio-economic | <p>A Communications and Stakeholder Engagement Plan will be developed prior to the commencement of construction and would be implemented during construction to provide timely and accurate information to stakeholders during construction. It would include (as a minimum):</p> <ul style="list-style-type: none"> • Mechanisms to provide details and timing of proposed activities to affected residents and local businesses, including changes to traffic, public transport services and access • A contact name and telephone number for complaints. | Transport for NSW | Pre-construction / construction |
| SE2 | Socio-economic | <ul style="list-style-type: none"> • A webpage and free-call number will be established for enquiries regarding the proposal, and will remain active for the duration of construction. • Contact details will be clearly displayed at the entrance to the site. • All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received. | 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 wellbeing 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 would 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"> • Covering all loaded trucks and vessels • Machinery to be turned off rather than left to idle when not in use | Contractor | Pre-construction / construction |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|------------------|--|-------------------|---------------------------------|
| | | <ul style="list-style-type: none"> • 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 • Maintenance of all plant and equipment to ensure good operating conditions and exhaust emissions comply with the Protection of the Environment Operations Act 1997 • Maintaining the work site in a condition that minimises fugitive emissions such as minor dust • Appropriate sediment and erosion controls for any exposed earth or stockpiled waste. | | |
| 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 would 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"> • Appropriate measures to avoid and minimise waste associated with the proposal should be investigated and implemented where possible • Waste management, littering and general tidiness will be monitored during routine site inspections. | 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 | 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 |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|-------------------|---|-------------------|--------------------------------|
| HR1 | Hazards and risks | 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 |
| HR2 | Hazards and risks | Further assessment of impacts to local utilities will be undertaken. | Transport for NSW | Detailed design |
| 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"> • Design of pontoons, waiting areas and gangways • Integrate coastal erosion control techniques around landside infrastructure • Drainage and storm water infrastructure • Specifications of materials in design • Weather protection features. | Contractor | Detailed design |
| 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 will be provided prior to construction and include the following minimum components: <ul style="list-style-type: none"> • A completed electronic checklist demonstrating compliance with Transport for NSW's <i>NSW Sustainable Design Guidelines Version 4.0</i> (TTP-ST-114) | Contractor | Detailed design |

| No. | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---------------------------------|---|--------------------------------|-----------------------------------|
| | | <ul style="list-style-type: none"> The Head Contractors sustainability goals and targets, internal procedures, and implementation strategy. | | |
| 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 construction impacts | <ul style="list-style-type: none"> Consultation would include notification prior to the start of the works. Updates on any delays or changes to the construction period would also be communicated. | Transport for NSW | Pre-construction / construction |

7.3 Licensing and approvals

A summary of the licences and approvals required for the proposal is provided in Table 7-2.

Table 7-2: Summary of licensing and approvals required

| Instrument | Requirement | Timing |
|--|--|---------------------------------|
| <i>Fisheries Management Act 1994</i> | Permit under section 37 of the FM Act is required to relocate seahorses. | Prior to start of the activity. |
| <i>Roads Act 1993</i> | Consultation with Mosman Council is required for works on Athol Wharf Road. | 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. |

8 Justification and conclusion

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 (TNSW, 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. Minor adverse impacts are expected as a result of vegetation removal to

accommodate the new accessible ramp. 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

The 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. | Through the assessment in Chapter 6, it has been identified that the proposal would not significantly impact on any natural or artificial resources. The proposal would result in community benefits through facilitation of a safe and reliable ferry service to Taronga Zoo for the next 50 years. |
| 1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment. | The proposal's urban design includes high quality, durable and low impact materials to minimise ongoing maintenance requirements. This provides for a sustainable urban environment over its 50 year design life. |
| 1.3(c) To promote the orderly and economic use and development of land. | The proposal includes continuation of the use of the proposal location as a ferry wharf. |
| 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 impact to aquatic ecology would result from the proposal. Vegetation removal (of less than 0.01 hectares) is expected to occur 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. |

| Object | Comment |
|--|---|
| 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 2.3.2. |
| 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 proposal.

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 E.

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 7, including avoiding, reusing, recycling, managing waste during construction and operation, would be implemented.

8.3 Conclusion

The proposed Taronga Zoo 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.

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 Mosman Council is not required.

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 *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Department of Agriculture, Water and the Environment (DAWE) is not required.

9 Certification

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
15 March 2021

I have examined this review of environmental factors and accept it on behalf of Transport for NSW.



James Paddock
Project Manager
Infrastructure and Place
15 March 2021

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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 |
| ASMA | Australian Maritime Safety Authority |
| ASRIS | Australian Atlas of Acid Sulfate Soils |
| ASS | acid sulphate 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 |
| CCC | Captain Cook Cruises |
| CCTV | closed circuit television |
| CD | Chart datum |
| CEMP | Construction Environmental Management Plan |
| CHL | Commonwealth Heritage List |
| Coastal Management SEPP | <i>State Environmental Planning Policy (Coastal Management) 2018</i> |
| CNVG | Roads and Maritime Construction Noise and Vibration Guideline |
| 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. |
| COPC | contaminants of potential concern |
| 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. |
| 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 |
| Disability Standards 2010 | Disability (Access to Premises – Buildings) Standards (2010) |
| DPC | Department of Premier and Cabinet |
| DPE | Former Department of Planning and Environment |
| DPI | Department of Primary Industries |
| DPIE | Department of Planning, Industry and Environment |
| DSAPT | <i>Disability Standards for Accessible Public Transport 2002</i> |
| DUAP | Former Department of Urban Affairs and Planning |

| Term/ Acronym | Description |
|---------------|---|
| EIS | Environmental Impact Statement |
| EPA | Environment Protection Agency |
| EP&A Act | <i>Environmental Planning and Assessment Act 1979</i> (NSW). Provides the legislative framework for land use planning and development assessment in NSW |
| EPBC Act | <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process. |
| EPL | Environmental Protection Licence |
| 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</i> (NSW) |
| FZ | foreground zone |
| FWUP | Ferry Wharf Upgrade Program |
| HAT | Highest Astronomical Tide |
| Heritage Act | <i>Heritage Act 1977</i> |
| ICNG | <i>Interim Construction Noise Guideline</i> |
| ISEPP | <i>State Environmental Planning Policy (Infrastructure) 2007</i> |
| KFH | key fish habitat |
| 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 |
| MCA | multi-criterion analysis |
| MNES | Matters of national environmental significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> . |
| MZ | middle ground zone |
| NCA | noise catchment area |
| NCC | National Construction Code 2019 Volumes 1, 2 and 3 (Formerly Building Code of Australia) |
| NHL | National Heritage List |
| NML | noise management level |
| NPW Act | <i>National Parks and Wildlife Act 1974</i> |
| OCP/OPP | Organochlorine pesticides/organophosphorus pesticides |
| 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 |

| Term/ Acronym | Description |
|---------------------|--|
| PMST | Protected Matters Search Tool |
| POEO Act | <i>Protection of the Environment Operations Act 1997</i> |
| Proposal, the | The upgraded wharf proposed to be constructed at Taronga Zoo, 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 |
| RNE | Register of the National Estate |
| RNTA | Register of the National Trust of Australia (NSW) |
| Roads and Maritime | 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 |
| SOHI | Statement of Heritage Impact |
| SPL | Sound power level |
| 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> |
| TAP | Transport Access Program |
| TfNSW | Transport for NSW |
| TGSI | Tactile Ground Surface Indicators |
| TMP | Traffic Management Plan |
| TRH | total recoverable hydrocarbons |
| VIS | vegetation information system |
| WARR Act | <i>Waste Avoidance and Resource Recovery Act 2001</i> |
| WHL | World Heritage List |
| WMP | Waste Management Plan |

Appendix A

Proposal drawings

FERRY WHARF UPGRADE PROGRAM - PACKAGE 3

TARONGA ZOO WHARF INTERCHANGE

100% CONCEPT DESIGN SUBMISSION

ARCHITECTURE:

- FWUP3-COX-TZ-ZZ-DR-AR-1101_C - Architecture - General Arrangement
- FWUP3-COX-TZ-ZZ-DR-AR-8101_C - Architecture - 3D Views / Perspective
- FWUP3-COX-TZ-ZZ-DR-AR-1501_C - Architecture - Demolition Plan
- FWUP3-COX-TZ-ZZ-DR-AR-2101_C - Architecture - Landside Plan
- FWUP3-COX-TZ-ZZ-DR-AR-2102_C - Architecture - Waterside Plans
- FWUP3-COX-TZ-ZZ-DR-AR-2105_C - Architecture - Roof Plan
- FWUP3-COX-TZ-ZZ-DR-AR-3001_C - Architecture - Elevations
- FWUP3-COX-TZ-ZZ-DR-AR-4001_C - Architecture - Sections

MARITIME:

- FWUP3-RHD-TZ-ZZ-DR-MA-0001_A - Maritime - Navigation Layout
- FWUP3-RHD-TZ-ZZ-DR-MA-0101_B - Maritime - Plan and Sections - Sheet 1

CIVIL:

- FWUP3-AUR-TZ-ZZ-DR-CI-0001_C - Civil - Site Plan and Typical Cross Section

FEDERATED MODEL:

- FWUP3-AUR-TZ-ZZ-CM-ZZ-0001_C - Federated Model (Saved as standalone file).

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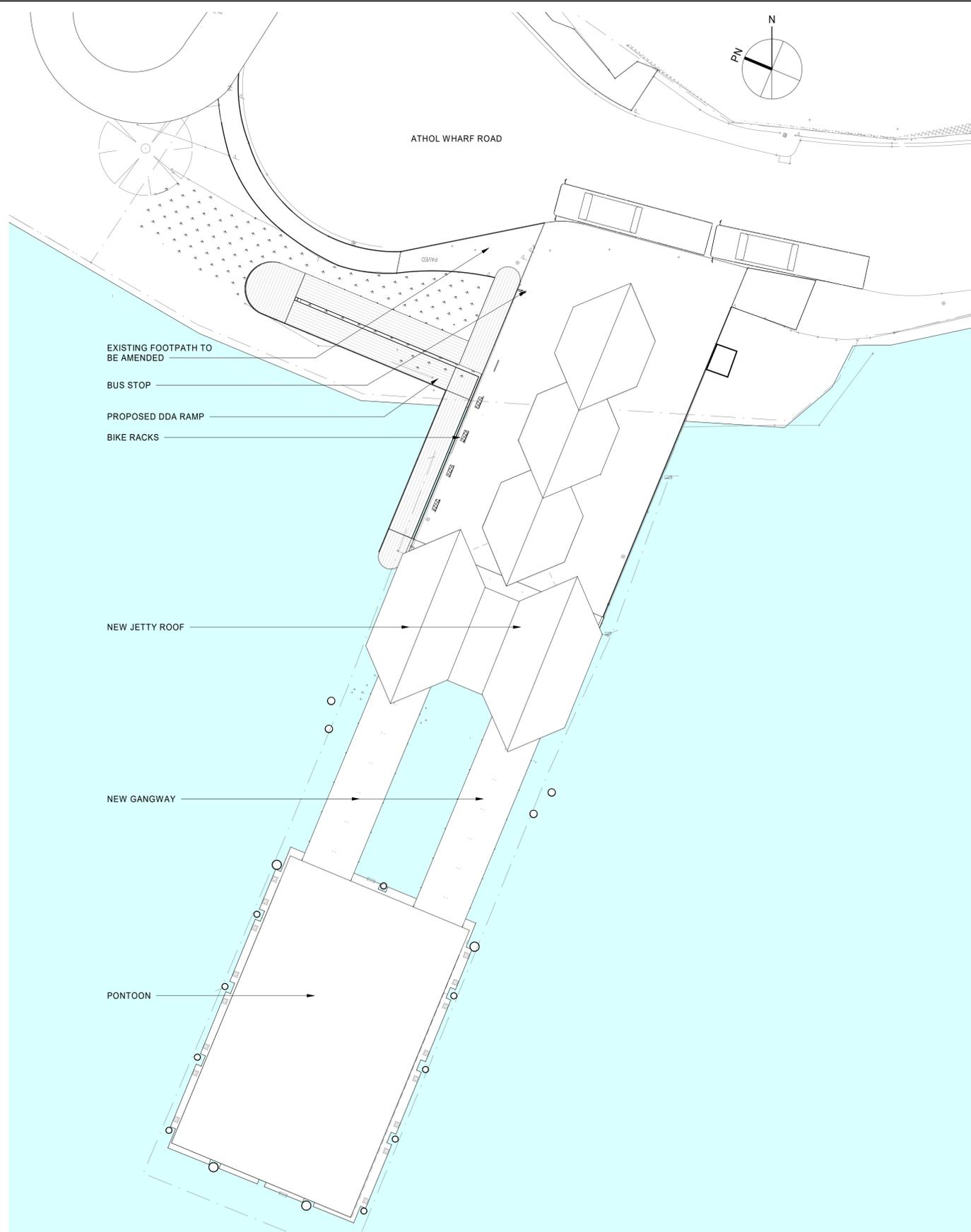
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| EXTERNAL REFERENCE FILES | | REV | DATE | AMENDMENT / REVISION DESCRIPTION | WVR No. | APPROVAL | SCALES ON A3 SIZE DRAWING | DRAWINGS / DESIGN PREPARED BY | FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO Cover Sheet | |
| | | A | 15.03.19 | 30% DESIGN | | | NTS |  | RMS REGISTRATION No. | |
| | | B | 28.05.19 | 90% DESIGN | | | |  | ISSUE STATUS CONCEPT DESIGN | |
| | | C | 19.06.19 | 100% DESIGN | | | |  | EDMS No. | |
| | | | | | | | | | SHEET No. 0000 | |
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1 GENERAL ARRANGEMENT
SCALE 1:200 @A1



EXISTING TARONGA ZOO WHARF
(CREDIT TO GOOGLE MAP)

GENERAL NOTES:
ALL SEABED BASED LEVELS (CONTOURS) TO CHART DATUM (CD). ALL LAND BASED LEVELS TO AUSTRALIAN HEIGHT DATUM (AHD). 0.000AHD=+0.925CD;
REFER TO MARITIME DRAWINGS FOR PONTOON AND GANGWAY DETAILS;
REFER TO STRUCTURE DRAWINGS FOR RETAINING WALL DETAILS;
REFER TO CIVIL DRAWINGS FOR PATH AND PARKING AREA DETAILS

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| DRAWING FILE LOCATION / NAME BIM 360/1504196 - Ferry Wharf Upgrade/FWUP3-COX-TZ-ZZ-M3-AR-0001.rvt #FWUP3-COX-AR-TZ-ZZ-DR-1101 | |
| DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | |

| REV | DATE | AMENDMENT / REVISION DESCRIPTION | APPROVAL |
|-----|----------|----------------------------------|----------|
| A | 11.04.19 | 30% CONCEPT | |
| B | 14.05.19 | 90% CONCEPT | |
| C | 11.06.19 | 100% CONCEPT | |

| PROJECT BREAKDOWN STRUCTURE | |
|--|----------------------------|
| SCALE ON A1 SIZE DRAWING | OR AS SHOWN |
| | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |

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| | | | |
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| PLOT DATE / TIME 19/06/2019 1:50:56 PM | | PLOT BY | |
| TITLE | NAME | DATE | |
| DRAWN | XIANG PAN | 14.05.19 | |
| DRG CHECK | TONY TANG | 14.05.19 | |
| DESIGN | KATE MACDONALD | 14.05.19 | |
| DESIGN CHECK | | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 | |
| DESIGN MANAGER | | | |

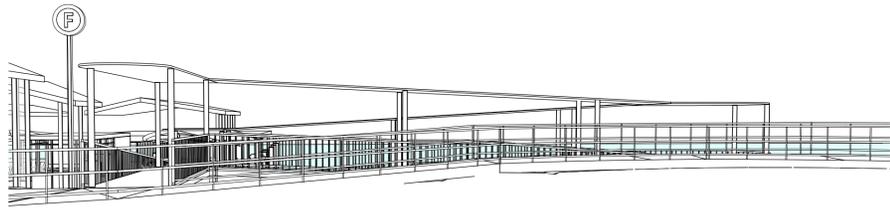
CLIENT

NSW Government

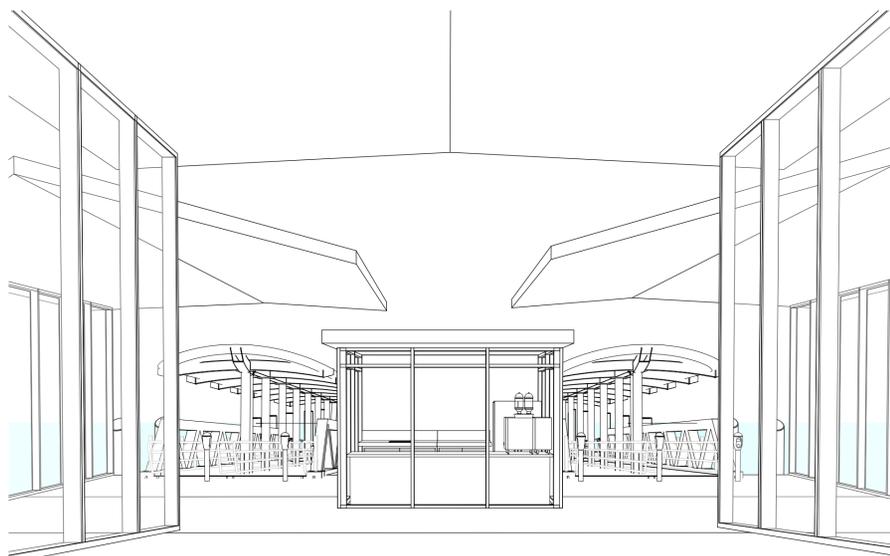
Transport
Roads & Maritime Services

| | | | |
|--|-----------|------------------|------------|
| ARCHITECTURE FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO General Arrangement | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No 1101 | ISSUE C |

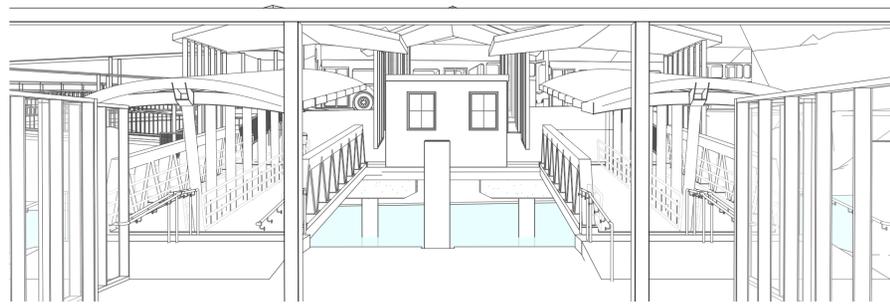
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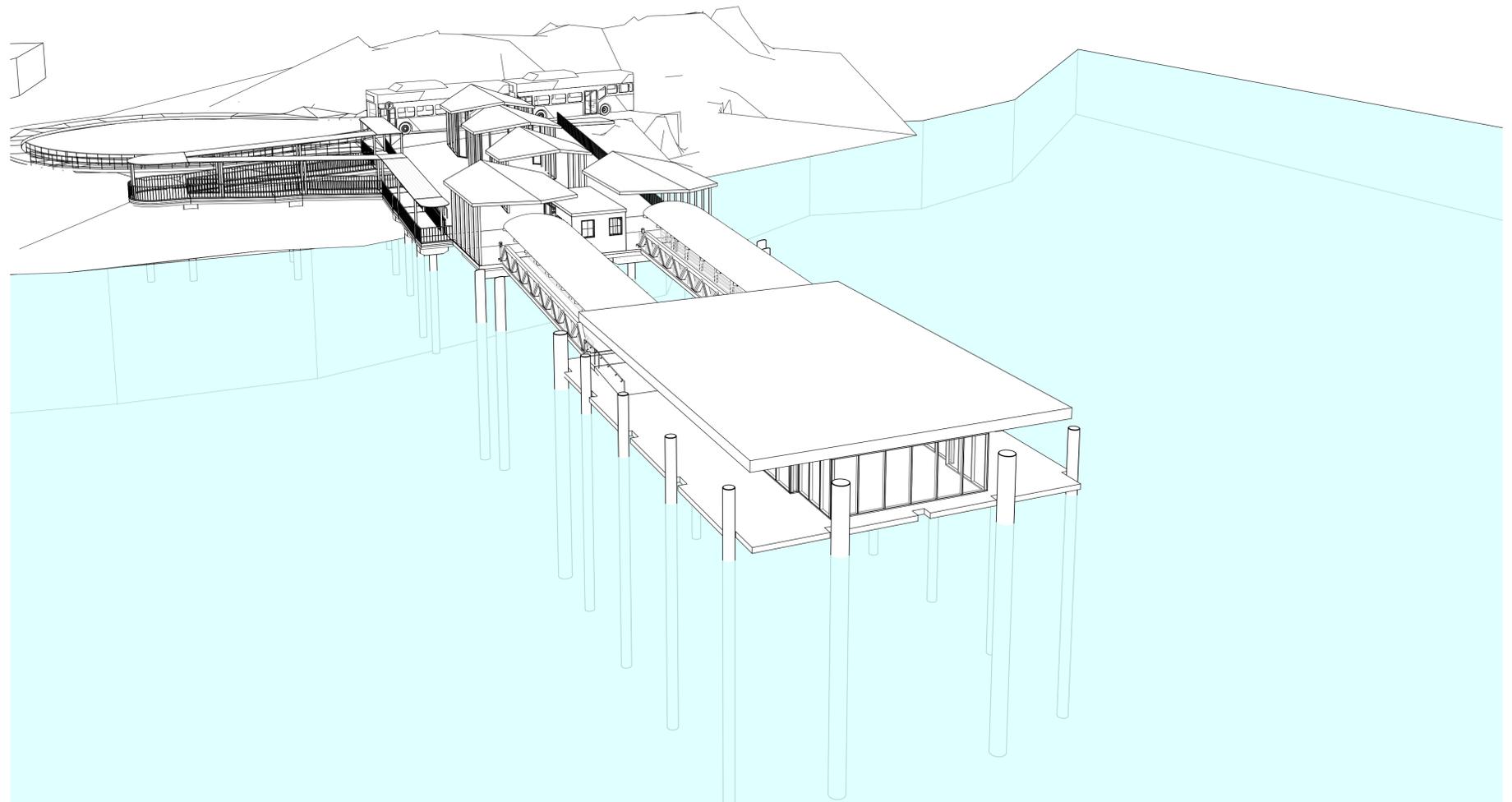
1 VIEW FROM BUS STOP
8101



2 VIEW TOWARDS ACCESSIBLE PATH
8101



3 VIEW FROM PONTOON
8101



4 PERSPECTIVE
8101

NOT FOR CONSTRUCTION

DISCLAIMER:
ALL PLANTS ARE INDICATIVE;
FERRY BOAT IS INDICATIVE;
SURROUNDING BUILDINGS ARE INDICATIVE, FOR INFORMATION ONLY

DOCUMENT NUMBER
FWUP3-COX-TZ-ZZ-DR-AR-8101

ARCHITECTURE
**FERRY WHARF UPGRADE PROGRAM - PACKAGE 3
AT SYDNEY HARBOUR
TARONGA ZOO**

3D Views / Perspective

RMS REGISTRATION No OF PLANS

| | | | |
|--------------------------------|-----------|-------------------------|-------------------|
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No 8101 | ISSUE C |
|--------------------------------|-----------|-------------------------|-------------------|

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| DRAWING FILE LOCATION NAME BIM 360/504196 - Ferry Wharf Upgrade/FWUP3-COX-TZ-ZZ-M3-AR-0001.rvt /FWUP3-COX-AR-TZ-ZZ-DR-8101 | | | |
| DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | REV | DATE | AMENDMENT / REVISION DESCRIPTION |
| | A | 11.04.19 | 30% CONCEPT |
| | B | 14.05.19 | 90% CONCEPT |
| | C | 11.06.19 | 100% CONCEPT |

| | |
|--|----------------------------|
| PROJECT BREAKDOWN STRUCTURE | APPROVAL |
| SCALE ON A1 SIZE DRAWING | |
| OR AS SHOWN | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |

| | |
|--|----------------------------|
| PROJECT BREAKDOWN STRUCTURE | |
| APPROVAL | |
| SCALE ON A1 SIZE DRAWING | |
| OR AS SHOWN | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |

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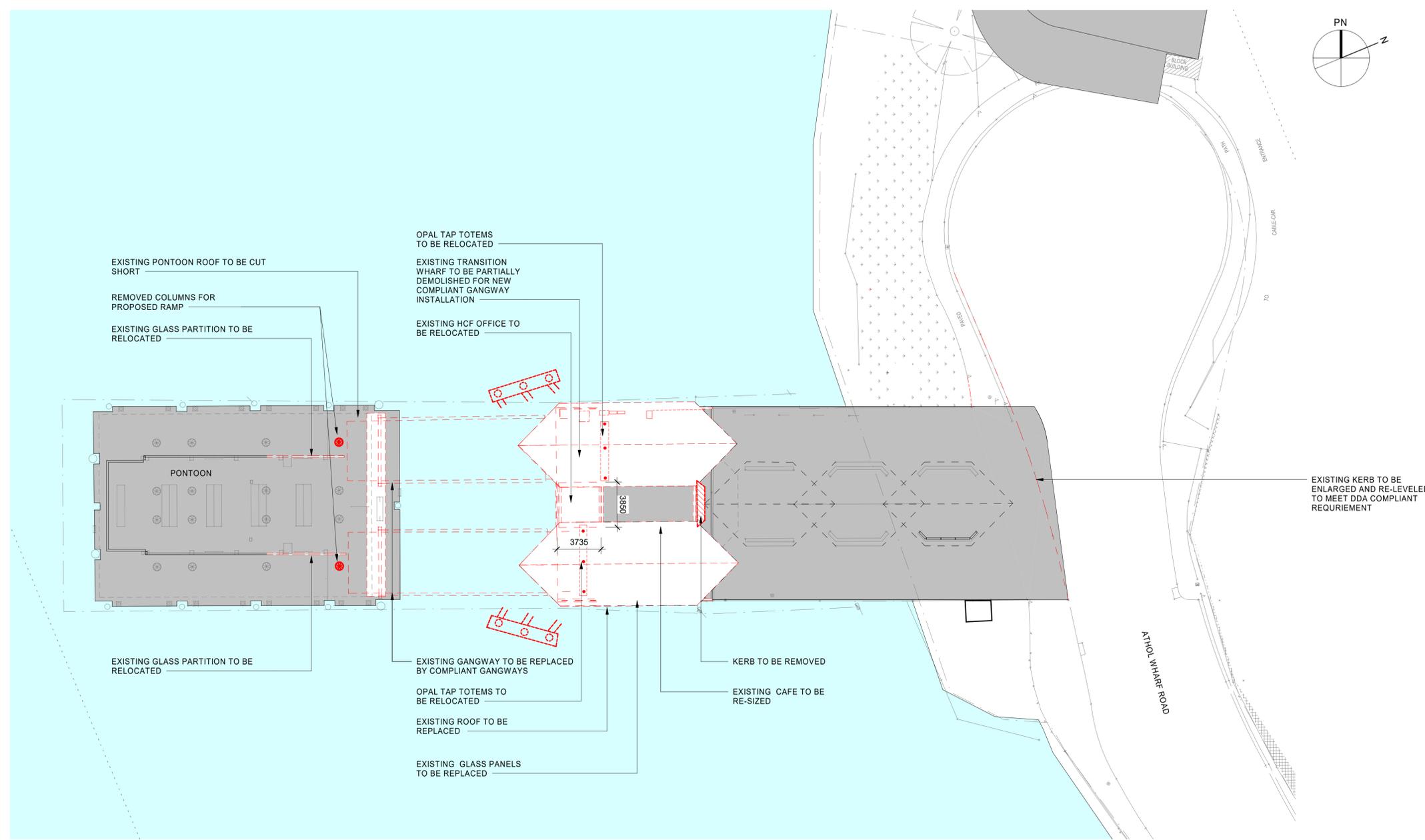
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| TITLE | NAME | DATE |
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| DRG CHECK | TONY TANG | 14.05.19 |
| DESIGN | KATE MACDONALD | 14.05.19 |
| DESIGN CHECK | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 |
| DESIGN MANAGER | | |

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1 DEMOLITION PLAN
SCALE 1 : 200 @A1

--- DEMOLISHED ELEMENTS
 [Hatched Box] EXCAVATED AREA

GENERAL NOTES:
 FOR DETAILS ON ITEMS TO DEMOLISHED AND PLANS, REFER TO CONSTRUCTABILITY REPORT / PLAN

NOT FOR CONSTRUCTION

DOCUMENT NUMBER
FWUP3-COX-TZ-ZZ-DR-AR-1501

| | |
|---|--|
| DRAWING FILE LOCATION / NAME BIM 360/1504196 - Ferry Wharf Upgrade/FWUP3-COX-TZ-ZZ-M3-AR-0001.rvt /FWUP3-COX-AR-TZ-ZZ-DR-1501 | |
| DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | |

| REV | DATE | AMENDMENT / REVISION DESCRIPTION | APPROVAL |
|-----|----------|----------------------------------|----------|
| A | 11.04.19 | 30% CONCEPT | |
| B | 14.05.19 | 90% CONCEPT | |
| C | 11.06.19 | 100% CONCEPT | |

| | |
|-----------------------------------|---------------------|
| PROJECT BREAKDOWN STRUCTURE | |
| SCALE ON A1 SIZE DRAWING | |
| | |
| OR AS SHOWN | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |

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|---|----------------|----------|--|
| PLOT DATE / TIME 19/06/2019 9:05:10 AM | | PLOT BY | |
| TITLE | NAME | DATE | |
| DRAWN | XIANG PAN | 14.05.19 | |
| DRG CHECK | TONY TANG | 14.05.19 | |
| DESIGN | KATE MACDONALD | 14.05.19 | |
| DESIGN CHECK | | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 | |
| DESIGN MANAGER | | | |

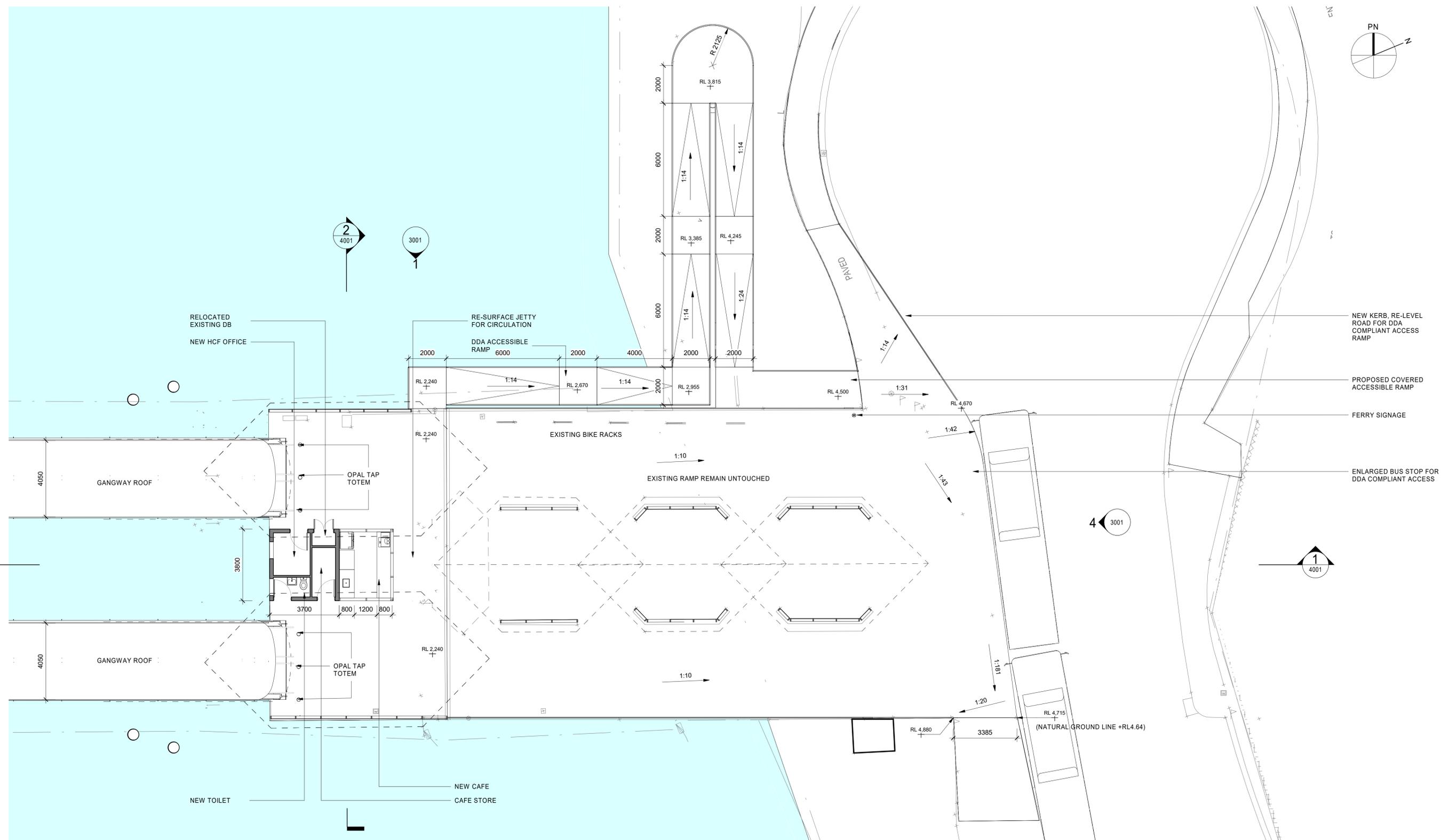
CLIENT

NSW GOVERNMENT | **Transport** Roads & Maritime Services

| | | | |
|--|-----------|-------------------|------------|
| ARCHITECTURE FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO Demolition Plan | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No. 1501 | ISSUE C |

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1 JETTY AND LANDSIDE PLAN
2101 SCALE 1:100 @A1

NOTE:
REFER TO CIVIL DRAWING FOR PAVEMENT DESIGN AND EARTHWORKS,
REFER TO STRUCTURE DRAWING FOR DDA RAMP DESIGN;
ALL LEVELS IN METRES MGA;
ALL DIMENSIONS IN MM

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DOCUMENT NUMBER
FWUP3-COX-TZ-ZZ-DR-AR-2101

| | |
|--|--|
| DRAWING FILE LOCATION NAME BIM 360/504196 - Ferry Wharf Upgrade/FWUP3-COX-TZ-ZZ-M3-AR-0001.rvt /FWUP3-COX-AR-TZ-ZZ-DR-2101 | |
| DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | |

| REV | DATE | AMENDMENT / REVISION DESCRIPTION | APPROVAL |
|-----|----------|----------------------------------|----------|
| A | 11.04.19 | 30% CONCEPT | |
| B | 14.05.19 | 90% CONCEPT | |
| C | 11.06.19 | 100% CONCEPT | |

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|-----------------------------------|---------------------|
| PROJECT BREAKDOWN STRUCTURE | |
| SCALE ON A1 SIZE DRAWING | |
| | |
| OR AS SHOWN | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |

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|---|----------------|----------|--|
| PLOT DATE / TIME 19/06/2019 1:52:06 PM | | PLOT BY | |
| TITLE | NAME | DATE | |
| DRAWN | XIANG PAN | 14.05.19 | |
| DRG CHECK | TONY TANG | 14.05.19 | |
| DESIGN | KATE MACDONALD | 14.05.19 | |
| DESIGN CHECK | | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 | |
| DESIGN MANAGER | | | |

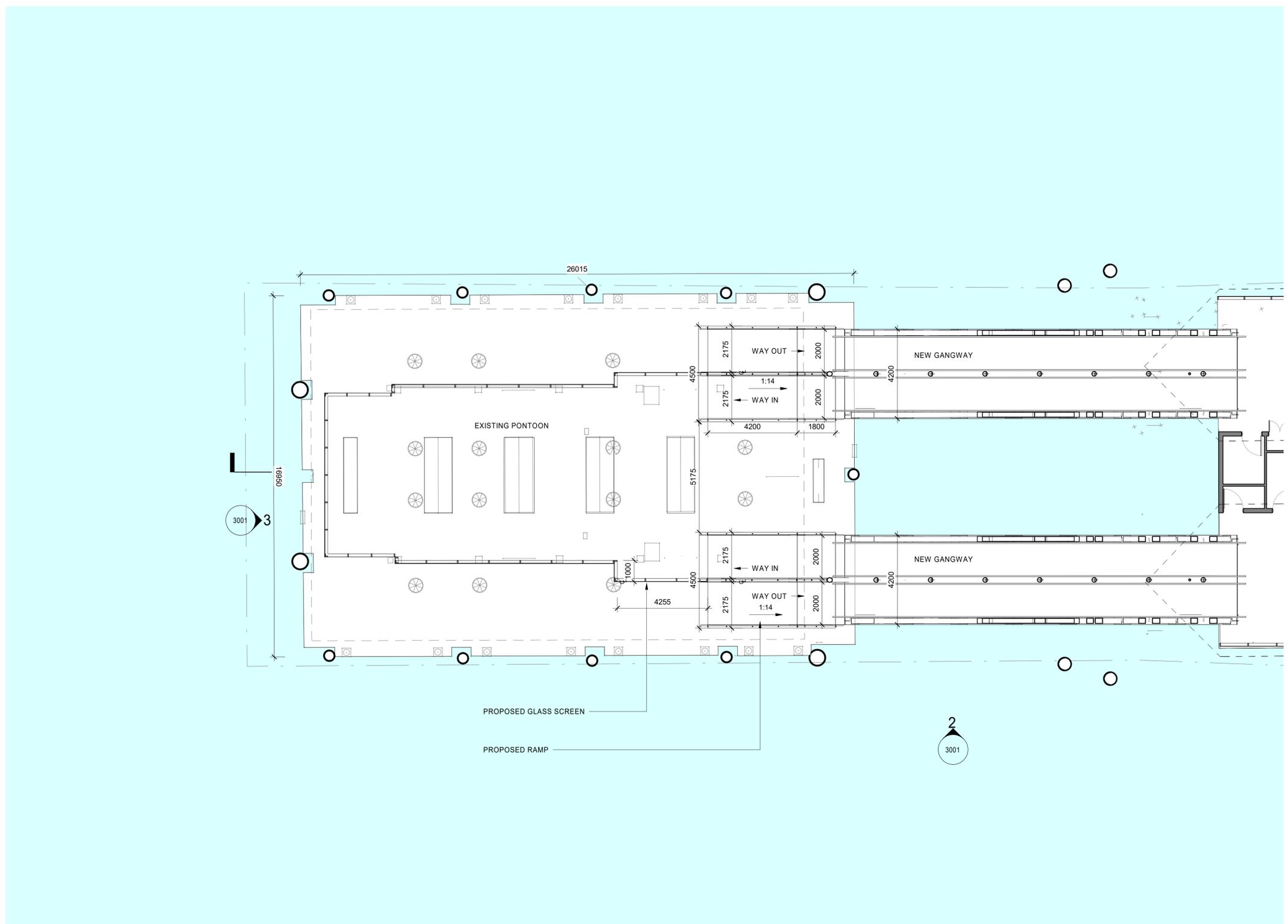
CLIENT

Transport
Roads & Maritime
Services

| | | | |
|--|-----------|-------------------|------------|
| ARCHITECTURE FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO Landside Plan | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No. 2101 | ISSUE C |

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1 GANGWAY AND PONTOON PLAN
SCALE 1 : 100 @A1

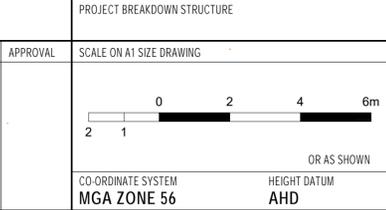
NOTE:
REFER TO MARITIME DRAWINGS FOR
WATERSIDE STRUCTURE DESIGNS

NOT FOR CONSTRUCTION

DOCUMENT NUMBER
FWUP3-COX-TZ-ZZ-DR-AR-2102

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| | A | 11.04.19 | 30% CONCEPT |
| | B | 14.05.19 | 90% CONCEPT |
| | C | 11.06.19 | 100% CONCEPT |

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| PROJECT BREAKDOWN STRUCTURE | SCALE ON A1 SIZE DRAWING |
| | OR AS SHOWN |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |



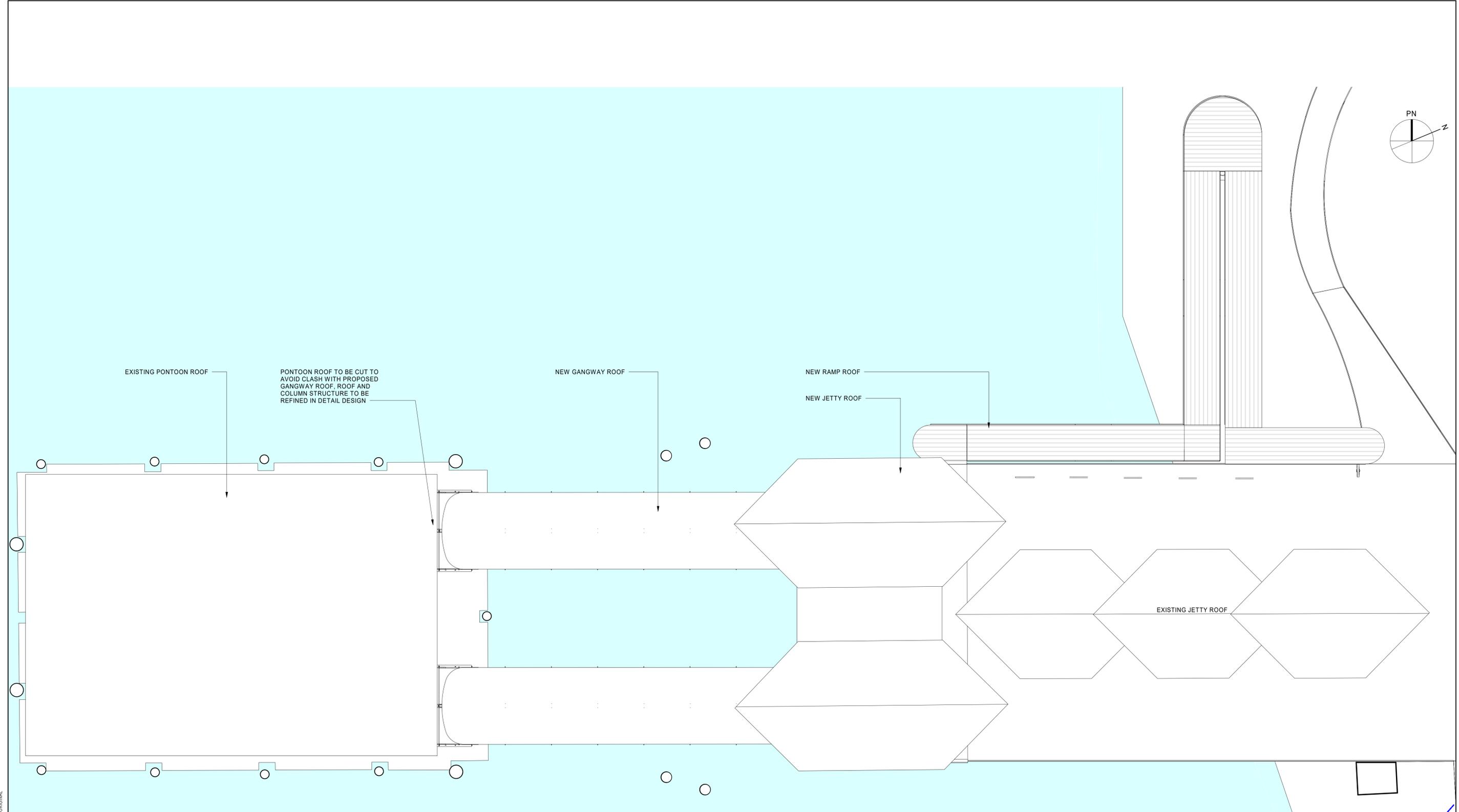
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| TITLE | NAME | DATE |
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| DRG CHECK | TONY TANG | 14.05.19 |
| DESIGN | KATE MACDONALD | 14.05.19 |
| DESIGN CHECK | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 |
| DESIGN MANAGER | | |



| | | | |
|---|-----------|-------------------|------------|
| ARCHITECTURE FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO Waterside Plan | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No. 2102 | ISSUE C |

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1 ROOF PLAN
2105 SCALE 1:100 @A1

NOTES:
REFER TO MARITIME DRAWINGS FOR
WATERSIDE STRUCTURE DESIGNS

NOT FOR CONSTRUCTION

DOCUMENT NUMBER
FWUP3-COX-TZ-ZZ-DR-AR-2105

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| DRAWING FILE LOCATION NAME BIM 360/504196 - Ferry Wharf Upgrade/FWUP3-COX-TZ-ZZ-M3-AR-0001.rvt #FWUP3-COX-AR-TZ-ZZ-DR-2105 | |
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| REV | DATE | AMENDMENT / REVISION DESCRIPTION | APPROVAL |
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| B | 14.05.19 | 90% CONCEPT | |
| C | 11.06.19 | 100% CONCEPT | |

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| PROJECT BREAKDOWN STRUCTURE | |
| SCALE ON A1 SIZE DRAWING | |
| | |
| OR AS SHOWN | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |

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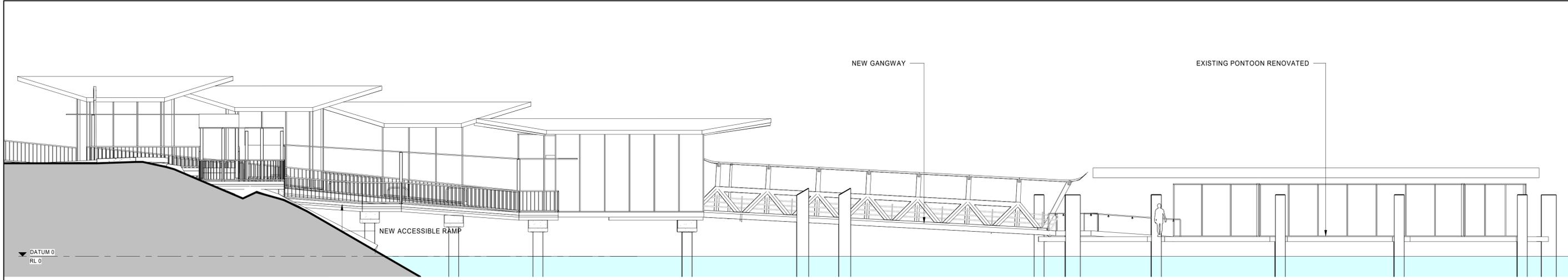
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| DESIGN | KATE MACDONALD | 14.05.19 | |
| DESIGN CHECK | | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 | |
| DESIGN MANAGER | | | |

CLIENT

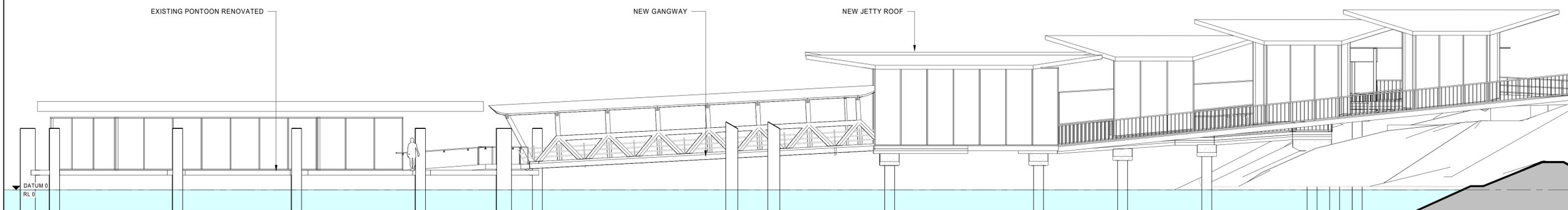
Transport
Roads & Maritime Services

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|---|-----------|-------------------|------------|
| ARCHITECTURE FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO | | | |
| Roof Plan | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No. 2105 | ISSUE C |

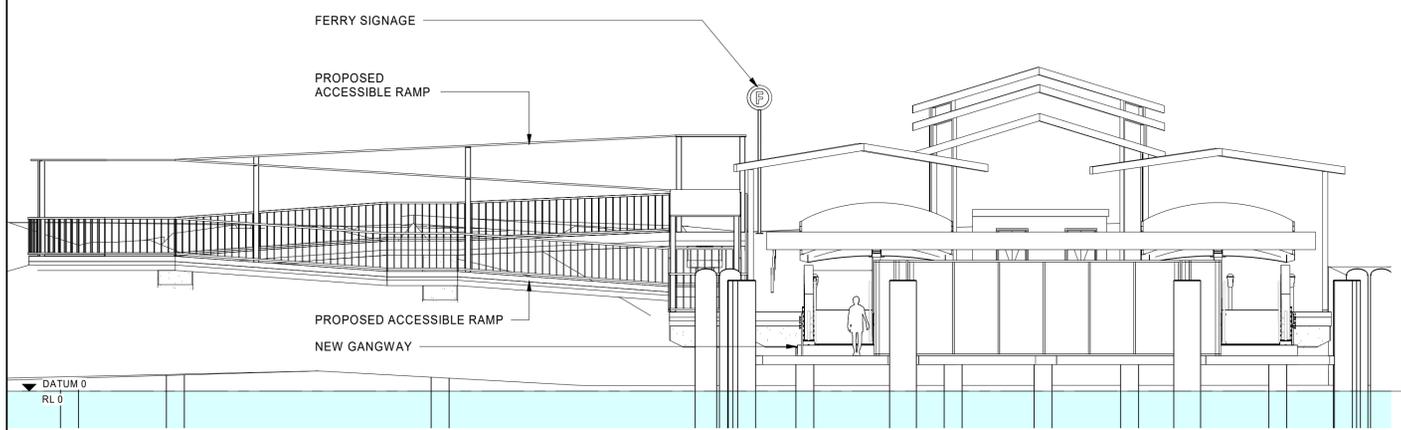
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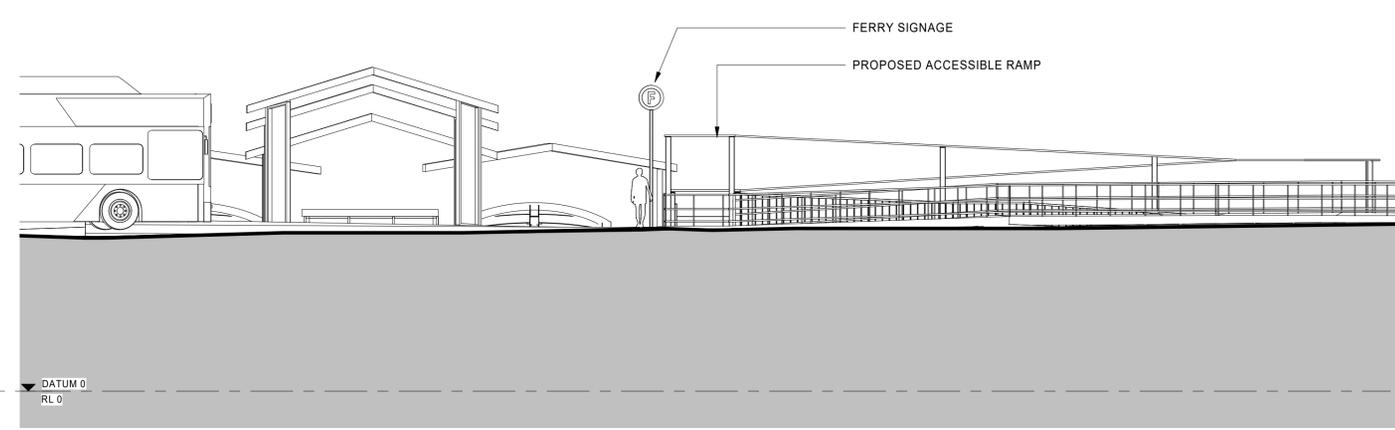
1 WEST ELEVATION
3001 SCALE 1 : 100 @A1



2 EAST ELEVATION
3001 SCALE 1 : 100 @A1



3 SOUTH ELEVATION
3001 SCALE 1 : 100 @A1



4 NORTH ELEVATION
3001 SCALE 1 : 100 @A1

GENERAL NOTES:
ALL SEABED BASED LEVELS (CONTOURS) TO CHART DATUM (CD). ALL LAND BASED LEVELS TO AUSTRALIAN HEIGHT DATUM (AHD). 0.000AHD=+0.925CD;

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DOCUMENT NUMBER
FWUP3-COX-TZ-ZZ-DR-AR-3001

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| DRAWING FILE LOCATION / NAME BIM 360/504196 - Ferry Wharf Upgrade/FWUP3-COX-TZ-ZZ-M3-AR-0001.rvt /FWUP3-COX-AR-TZ-ZZ-DR-3001 | |
| DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | |

| REV | DATE | AMENDMENT / REVISION DESCRIPTION | APPROVAL |
|-----|----------|----------------------------------|----------|
| A | 11.04.19 | 30% CONCEPT | |
| B | 14.05.19 | 90% CONCEPT | |
| C | 11.06.19 | 100% CONCEPT | |

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|-----------------------------------|---------------------|
| PROJECT BREAKDOWN STRUCTURE | |
| SCALE ON A1 SIZE DRAWING | |
| | |
| OR AS SHOWN | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |

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| PLOT DATE / TIME 19/06/2019 11:57:57 AM | | PLOT BY | |
| TITLE | NAME | DATE | |
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| DRG CHECK | TONY TANG | 14.05.19 | |
| DESIGN | KATE MACDONALD | 14.05.19 | |
| DESIGN CHECK | | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 | |
| DESIGN MANAGER | | | |

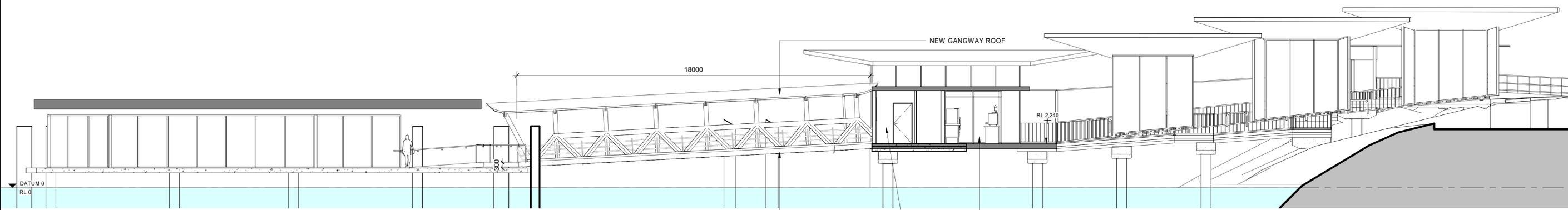
CLIENT

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Roads & Maritime
Services

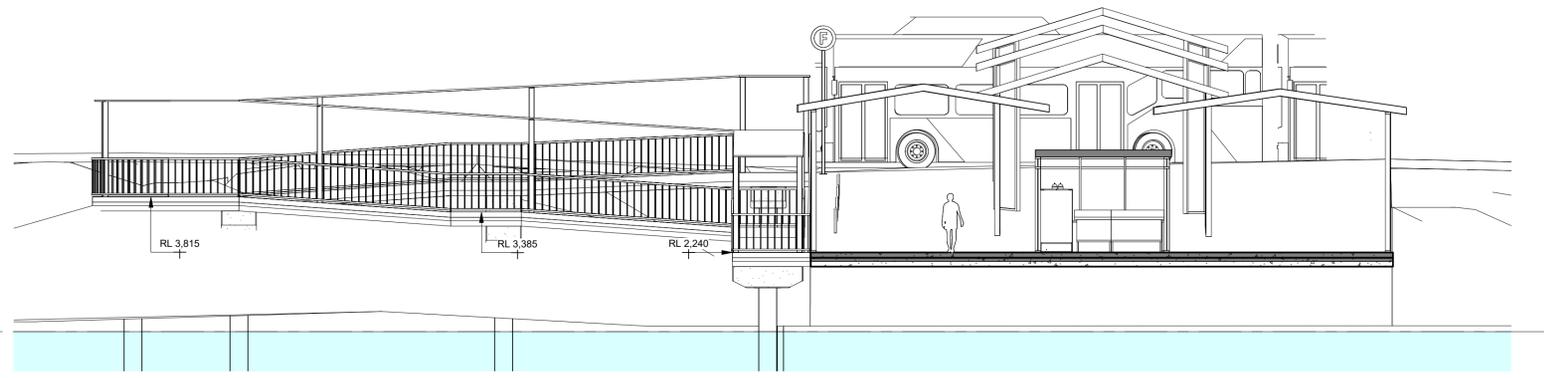
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| ARCHITECTURE FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO | | | |
| Elevations | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No. 3001 | ISSUE C |

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1 LONG SECTION
4001 SCALE 1:100 @A1



2 CROSS SECTION
4001 SCALE 1:100 @A1

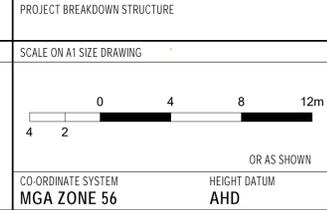
GENERAL NOTES:
ALL SEABED BASED LEVELS (CONTOURS) TO CHART DATUM (CD). ALL LAND BASED LEVELS TO AUSTRALIAN HEIGHT DATUM (AHD). 0.000AHD=+0.925CD;

NOT FOR CONSTRUCTION

DOCUMENT NUMBER
FWUP3-COX-TZ-ZZ-DR-AR-4001

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| DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | REV | DATE | AMENDMENT / REVISION DESCRIPTION |
| | A | 11.04.19 | 30% CONCEPT |
| | B | 14.05.19 | 90% CONCEPT |
| | C | 11.06.19 | 100% CONCEPT |

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|-----------------------------------|---------------------|
| PROJECT BREAKDOWN STRUCTURE | APPROVAL |
| SCALE ON A1 SIZE DRAWING | |
| | |
| CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD |



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| PLOT DATE / TIME 19/06/2019 11:57:07 AM | | PLOT BY | |
| TITLE | NAME | DATE | |
| DRAWN | XIANG PAN | 14.05.19 | |
| DRG CHECK | TONY TANG | 14.05.19 | |
| DESIGN | KATE MACDONALD | 14.05.19 | |
| DESIGN CHECK | | | |
| ZONE MANAGER | SATVIR MAND | 14.05.19 | |
| DESIGN MANAGER | | | |

CLIENT

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Roads & Maritime
Services

| | | | |
|---|-----------|-------------------|------------|
| ARCHITECTURE FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO | | | |
| Sections | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No. 4001 | ISSUE C |

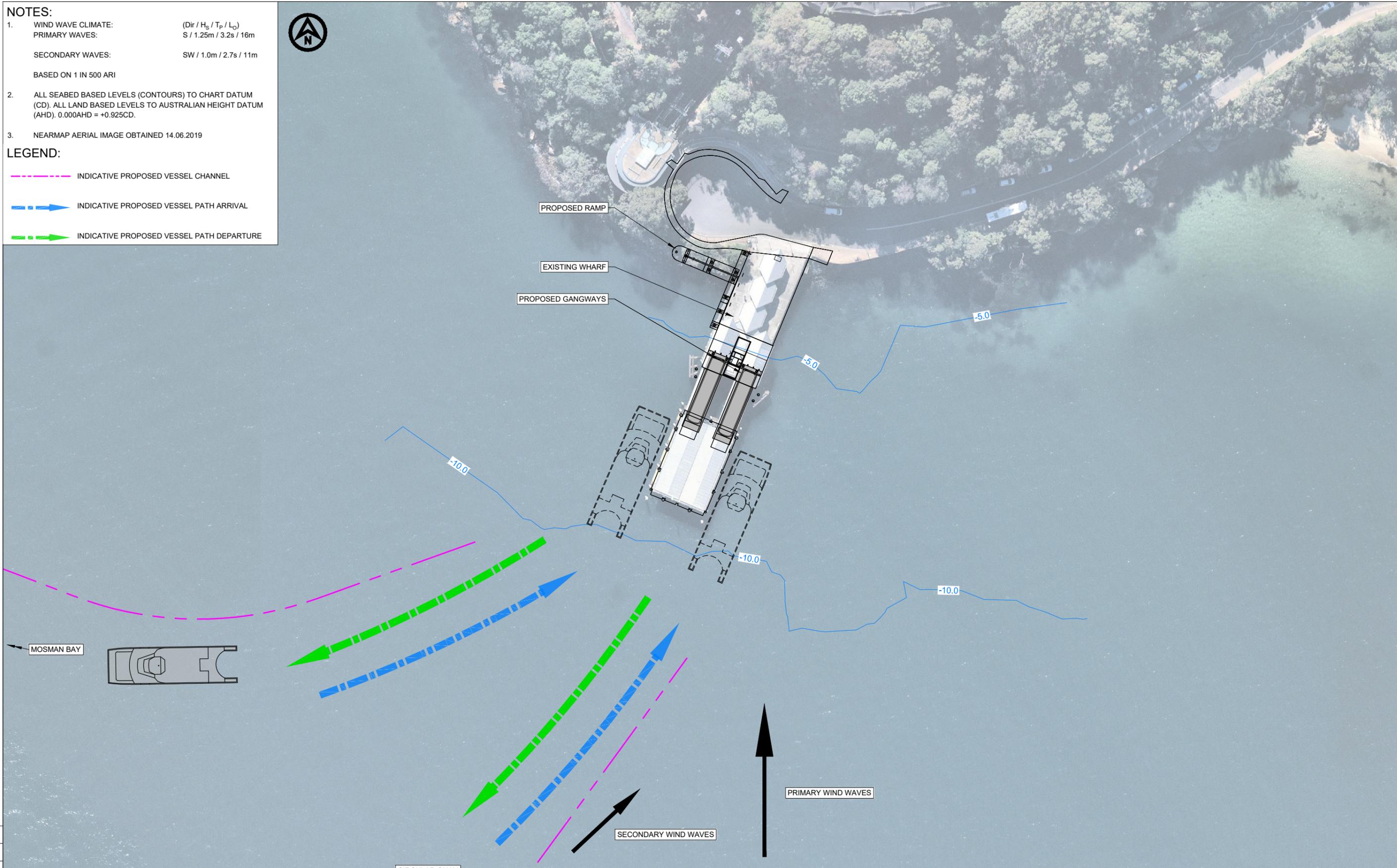
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NOTES:

- WIND WAVE CLIMATE: (Dir / H_s / T_p / L₀)
 PRIMARY WAVES: S / 1.25m / 3.2s / 16m
 SECONDARY WAVES: SW / 1.0m / 2.7s / 11m
 BASED ON 1 IN 500 ARI
- ALL SEABED BASED LEVELS (CONTOURS) TO CHART DATUM (CD). ALL LAND BASED LEVELS TO AUSTRALIAN HEIGHT DATUM (AHD). 0.000AHD = +0.925CD.
- NEARMAP AERIAL IMAGE OBTAINED 14.06.2019

LEGEND:

- INDICATIVE PROPOSED VESSEL CHANNEL
- INDICATIVE PROPOSED VESSEL PATH ARRIVAL
- INDICATIVE PROPOSED VESSEL PATH DEPARTURE



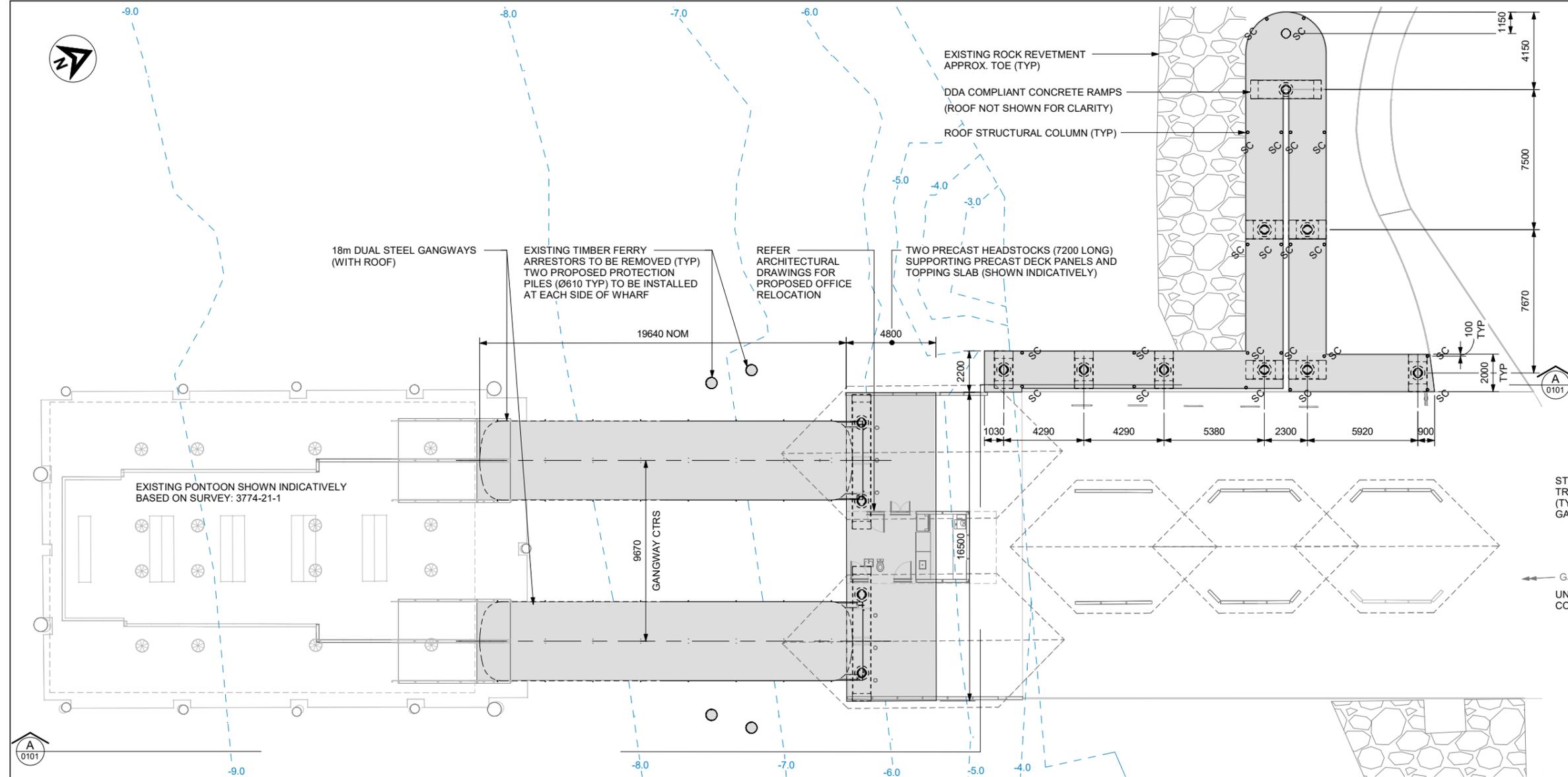
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| DRAWING FILE LOCATION / NAME C:\Users\220076\Box\PA1905 SL SHWUP Stage 3\PA1905 SL SHWUP Stage 3 Team\PA1905 Technical Data\12 Taronga Zoo\Concept Design\FWUP3-RHD-TZ-ZZ-M2-M-0001.DWG | | DESIGN LOT CODE 0001.DWG | DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | | PLOT DATE / TIME 18-Jun-19 4:07:47 PM | PLOT BY JARROD COLTMAN | CLIENT | DOCUMENT NUMBER FWUP3-RHD-TZ-ZZ-DR-MA-0001 | PART 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|-----------------|-----------------------------|---|---------|--|--|-------------------------------|--|-----------|-------|----------------|----------|-----------|--|--|--------|---------------|----------|--------------|--|--|-------------|--|--|--------------|-----------------|----------|--|--|----------------------|----------|-----------|-------|--|--|------|---|
| EXTERNAL REFERENCE FILES | REV A | DATE 18.06.19 | AMENDMENT / REVISION DESCRIPTION 100% CONCEPT DESIGN | WVR No. | APPROVAL RS | SCALES ON A3 SIZE DRAWING 1:1000 (A3) | DRAWINGS / DESIGN PREPARED BY | MARITIME FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO Navigational Layout | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | <table border="1"> <thead> <tr> <th>TITLE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DRAWN</td> <td>JARROD COLTMAN</td> <td>18.06.19</td> </tr> <tr> <td>DRG CHECK</td> <td></td> <td></td> </tr> <tr> <td>DESIGN</td> <td>RAKHBIR SINGH</td> <td>18.06.19</td> </tr> <tr> <td>DESIGN CHECK</td> <td></td> <td></td> </tr> <tr> <td>DESIGN MNGR</td> <td></td> <td></td> </tr> <tr> <td>PROJECT MNGR</td> <td>MICHAEL SANDERS</td> <td>18.06.19</td> </tr> </tbody> </table> | | TITLE | NAME | DATE | DRAWN | JARROD COLTMAN | 18.06.19 | DRG CHECK | | | DESIGN | RAKHBIR SINGH | 18.06.19 | DESIGN CHECK | | | DESIGN MNGR | | | PROJECT MNGR | MICHAEL SANDERS | 18.06.19 | <table border="1"> <thead> <tr> <th>RMS REGISTRATION No.</th> <th>EDMS No.</th> <th>SHEET No.</th> <th>ISSUE</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>0001</td> <td>A</td> </tr> </tbody> </table> | | RMS REGISTRATION No. | EDMS No. | SHEET No. | ISSUE | | | 0001 | A |
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| DRG CHECK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| DESIGN CHECK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DESIGN MNGR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROJECT MNGR | MICHAEL SANDERS | 18.06.19 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RMS REGISTRATION No. | EDMS No. | SHEET No. | ISSUE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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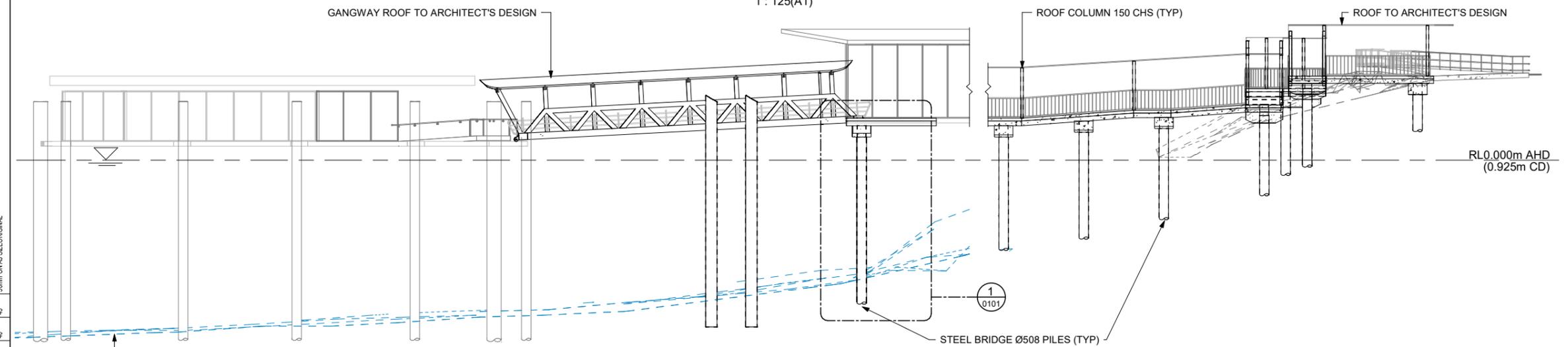
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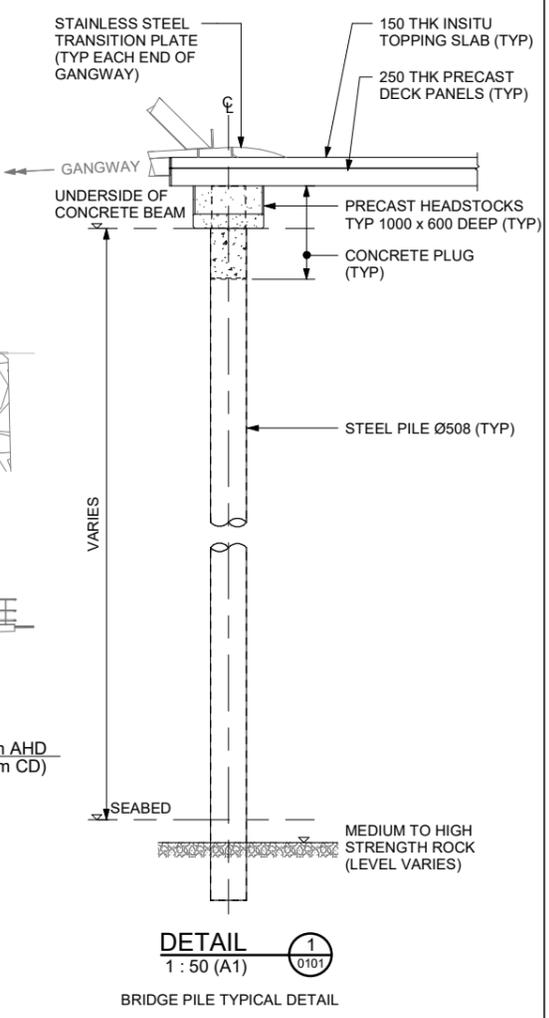
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WHARF PLAN
1: 125(A1)



SECTION
1: 125 (A1)



DETAIL
1: 50 (A1)

BRIDGE PILE TYPICAL DETAIL

- NOTES:**
1. ALL SEABED BASED LEVELS (CONTOURS) TO CHART DATUM (CD). ALL LAND BASED LEVELS TO AUSTRALIAN HEIGHT DATUM (AHD). 0.000AHD = +0.925CD.
 2. ALL DIMENSIONS ARE IN MILLIMETERS UNO
 3. REFER TO ARCHITECTURAL DRAWINGS FOR DEMOLITION PLAN.

NOT FOR CONSTRUCTION

DOCUMENT NUMBER: **FWUP3-RHD-TZ-ZZ-DR-MA-0101**

| | |
|---|----------|
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| DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING | |
| REV | DATE |
| A | 28.05.19 |
| B | 18.06.19 |

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| AMENDMENT / REVISION DESCRIPTION | APPROVAL |
| 90% CONCEPT DESIGN | RS |
| 100% CONCEPT DESIGN | RS |

| | |
|-----------------------------|--------------------------|
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| | 0 1000 2000 3000mm |
| | 1000 500 0 2.5 5 7.5m |
| | 2.5 1.25 OR AS SHOWN |
| CO-ORDINATE SYSTEM | HEIGHT DATUM |
| MGA ZONE 56 | AHD |

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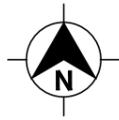
COX Royal HaskoningDHV

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| TITLE | NAME | DATE | |
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| DRG CHECK | | | |
| DESIGN | RAKHBIR SINGH | 18.06.19 | |
| DESIGN CHECK | | | |
| ZONE MANAGER | | | |
| DESIGN MANAGER | MICHAEL SANDERS | 18.06.19 | |

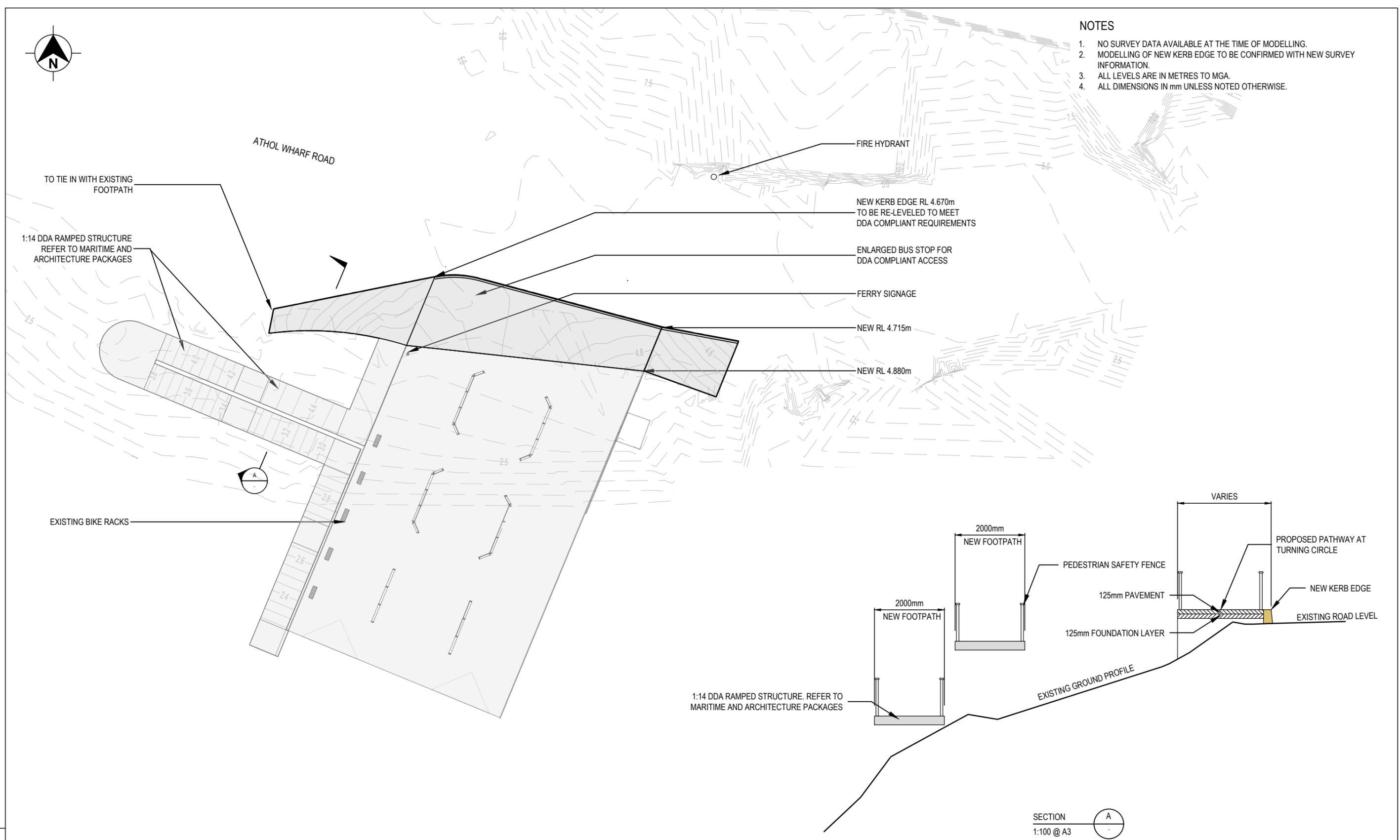
NSW GOVERNMENT

Transport
Roads & Maritime Services

| | | | |
|---|-----------|------------------|------------|
| MARITIME FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 AT SYDNEY HARBOUR TARONGA ZOO | | | |
| Plan and Sections - Sheet 1 | | | |
| RMS REGISTRATION No OF PLANS | | | |
| ISSUE STATUS CONCEPT DESIGN | BRIDGE No | SHEET No 0101 | ISSUE B |



- NOTES**
1. NO SURVEY DATA AVAILABLE AT THE TIME OF MODELLING.
 2. MODELLING OF NEW KERB EDGE TO BE CONFIRMED WITH NEW SURVEY INFORMATION.
 3. ALL LEVELS ARE IN METRES TO MGA.
 4. ALL DIMENSIONS IN mm UNLESS NOTED OTHERWISE.



LAYOUT
1:250 @ A3

SECTION A
1:100 @ A3

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| | | | | | | | | | |
|---|--|-----------------|---|----------------------------------|---|--------------------------------|-----------------------------------|---|----|
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| | | B | 28/05/19 | 90% CONCEPT | | | SCALE 1:250m | www.aurecongroup.com | |
| | | C | 18/06/19 | 100% CONCEPT | | | 0 1 2 3 4 | COX | |
| | | | | | | | SCALE 1:100m | Royal HaskoningDHV | |
| | | | | | | | CO-ORDINATE SYSTEM MGA ZONE 56 | HEIGHT DATUM AHD | |
| | | | | | | | | DRAWN: HELENE ESPAG 18/06/19 | |
| | | | | | | | | DRG CHECK: FRANCOIS VAN STADEN 18/06/19 | |
| | | | | | | | | DESIGN CHECK: ANTHONY CLARKE 18/06/19 | |
| | | | | | | | | DESIGN MNGR: MAYURI NATHOO 18/06/19 | |
| | | | | | | | | PROJECT MNGR: CAROLYN MCCALLIG 18/06/19 | |
| NOT FOR CONSTRUCTION | | | | | | | | RMS REGISTRATION No. | |
| FERRY WHARF UPGRADE PROGRAM - PACKAGE 3 SYDNEY HARBOUR TARONGA ZOO | | | | | | | | PART 1 | |
| Site Plan and Typical Cross Section | | | | | | | | ISSUE STATUS CONCEPT DESIGN | |
| EDMS No. | | | | | | | | SHEET No. 0001 | |
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Appendix B

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 sections of the wharf and Athol wharf Road. Impacts would be minimised through implementing the safeguards and management measures identified in section 7.1 of the REF.</p> | Moderate, short-term negative |
| <p>Operation of the wharf would have improved public transport facilities at Taronga Zoo.</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. The proposal would remove less than 0.01 hectares of native/exotic vegetation.</p> | Minor, short term negative |
| <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 positive |
| <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>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> | Moderate, long 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>No long-term impacts to environmental quality and value are anticipated.</p> | Moderate, short 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> | Minor/ negligible long term |
| <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>Three piles (508 millimetres in diameter) would be drilled into low-medium relief rocky reef, close to the shoreline. Four protection piles (610 millimetres in diameter) and four gangway support piles (508 millimetres in diameter) would be driven into subtidal soft sediment habitat in deeper water.</p> | Minor, short term, negative |
| <p>The area of low-medium relief rocky reef and soft sediment habitat under the footprint of the piles would be permanently impacted. Areas used for anchoring of the barge during construction would be</p> | Negligible, long term |

| Factor | Impact |
|--|----------------------------|
| <p>temporarily impacted. This would include the direct removal of macroalgae and sessile marine fauna from subtidal rocky reefs and epifauna and infauna from soft sediment habitats. The new wharf structures would shade less than 0.01 hectares of subtidal rocky reef habitat. These are not considered substantial impacts to marine biodiversity as the type of rocky reef and soft sediment habitats in the study area constitutes the majority of subtidal habitat in the harbour. These community assemblages are ubiquitous and are quick to recolonise temporarily disturbed areas.</p> <p>The removal of six ferry arrestor piles would result in the removal of marine vegetation, habitat and sessile/less mobile fauna currently colonising these areas. However, the majority of these species are common in subtidal rocky reefs and other parts of the wharf structure, and would quickly colonise the piles of the new wharf and pontoon.</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 is unlikely to endanger any species of animal, plant or other form of life, whether living on land, in water or in the air.</p> | No impact |
| <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> | Long term negative |
| <p>The proposal would result in improvements in user amenity for the wharf.</p> | Long term positive |
| <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> | Minor, short term negative |
| <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> | Minor, short term negative |
| <p>k) Any reduction in the range of beneficial uses of the environment?</p> <p>The proposal would not reduce the range of beneficial uses of the environment.</p> | No impact |
| <p>l) Any pollution of the environment?</p> <p>Construction related activities may result in pollution 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> | Minor, short term negative |
| <p>m) Any environmental problems associated with the disposal of waste?</p> <p>All wastes generated by the proposal would be disposed of at an off-site facility which is licenced to receive such waste.</p> <p>There would be no significant environmental problems associated with waste disposal.</p> | Minor, short term negative |
| <p>n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</p> | No impact |

| Factor | Impact |
|---|-----------------------------------|
| <p>All resources required by the proposal are readily available and are not likely to become in short supply.</p> | |
| <p>o) Any cumulative environmental effect with other existing or likely future activities?</p> <p>Assessment of cumulative impacts for the proposal is provided in section 6.12.</p> <p>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.</p> <p>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?</p> <p>Consideration of coastal processes and coastal hazards is detailed in section 6.1.</p> <p>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? No threatened species were observed during the field survey, however, potential habitat for some threatened species occurs in the study area. Ten species were considered to have a moderate to high likelihood of occurrence near the study area including White's Seahorse (listed as endangered under the FM Act and EPBC Act) and the Black Rockcod (listed as vulnerable under the FM Act and the EPBC Act). The proposal is unlikely to significantly impact threatened species. 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. Mitigation measures are proposed to survey for Black Rockcod and White's Seahorse at the start of construction so that individuals in the area 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 C

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) |
| 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) |

| Issue | Potential impact | Yes/No | If 'yes' consult with | ISEPP clause |
|------------------------------|---|--------|-----------------------|-------------------|
| 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 responsible for maintenance? | Yes | Mosman Council | ISEPP cl.13(1)(f) |

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 communications buffer land | Is the work on buffer land around the 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. | No | - | ISEPP cl. 16(2)(h) |
| 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)? | No | - | 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 |
| 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 |

| Issue | Potential impact | Yes/No | If 'yes' consult with | SREP clause |
|--------------------------------------|--|--------|--|----------------------------------|
| Houseboats | Do the works include a houseboat or houseboats? | No | - | SREP cl.31(2)(a)(i) & Schedule 2 |
| Inclinators | Do the works include an inclinator? | 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 |
| Public water transport facilities | Do the works include public water transport facilities? | Yes | DPIE (former Foreshores and Waterways Planning and 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 |

| Issue | Potential impact | Yes/ No | If 'yes' consult with | SREP clause |
|--|--|------------|--|----------------------------------|
| 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 foreshore and the waterway). | No | - | SREP cl.31(2)(a)(i) & Schedule 2 |
| 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? | Yes | DPIE (former Foreshores and Waterways Planning and Development Advisory Committee) | SREP cl.31(2)(a)(i) & Schedule 2 |

Appendix D

Preliminary Site Investigation

Preliminary Site Investigation

Taronga Zoo Wharf Upgrade

AWE200198



Prepared for
Transport for NSW

21 December 2020

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| | |
|----------------|--|
| Prepared for | Transport for NSW |
| Project Name | Taronga Zoo Wharf Upgrade |
| File Reference | AWE200198_R205_Rev0_Taronga Zoo_PSI.docx |
| Job Reference | AWE200198 |
| Date | 21 December 2020 |
| Version Number | Rev 0 |

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Effective Date 21/12/2020

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Date Approved 12/12/2020

Document History

| Version | Effective Date | Description of Revision | Prepared by | Reviewed by |
|---------|------------------|---------------------------|--------------|--------------|
| V01 | September 2020 | Draft for internal review | Dan McCallum | Bob Campbell |
| Rev A | 22 October 2020 | Client Review | Dan McCallum | Bob Campbell |
| Rev B | 10 December 2020 | Client Review | Dan McCallum | Bob Campbell |
| Rev 0 | 21 December 2020 | Final | Dan McCallum | Bob Campbell |

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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 Taronga Zoo wharf. TfNSW proposes to upgrade the wharf interchange at Taronga Zoo (the proposal) as part of the NSW Government's Transport Access Program (TAP). The proposal is to improve access to the wharf via a new accessible ramp and the addition of other accessible elements, including longer gangways and modifications to the existing jetty and pontoon to allow for accessible and more efficient passenger services.

Construction of the land-based elements would involve limited earthworks including regrading of existing footpaths and piling, and removal of vegetation on the foreshore for construction of the new accessible ramp. Construction of the water-based elements including replacement of the existing gangways between the existing jetty structure and pontoon, and construction of the accessible ramp would require piling within the waterway.

Cardno conducted a site inspection and reviewed previous environmental investigations, background information and historical aerial imagery. The objectives of the PSI were to:

- > Identify historical sources of potential contamination or potentially contaminating activities that may have taken place on or adjacent to the proposal
- > 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 Athol Wharf Road, Taronga Zoo 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 that occurred on the 12 March 2020, the main sources of possible contamination are outlined below:

- > The current impacts and origin of soils at the Site are unknown. The Site history indicates that there is low risk that impacted soils are present at the Site
- > It is considered possible that groundwater at the Site is impacted by tidal influences from Sydney Harbour. The condition of water entering the Site from the harbour can change depending on tides and storm events (Birch and Taylor, 2004). If subsurface soil is impacted, it is likely that tidal flows could be transporting contaminants into Sydney Harbour from the Site.

Conclusions

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 and road construction and maintenance of the wharf.

Sediment

Previous investigations by Birch and Taylor (2004) indicate that sediment at the Site could contain elevated levels of contaminants.

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.

Recommendations

Given the results of the assessment, the following is recommended:

- > Limited soil sampling to the depth of excavation to ensure the safety of construction workers and provide indicative waste classification of the materials to be removed
- > The piling methodology shall seek to mitigate the risk of sediment dispersal
- > Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's *Waste Classification Guidelines: Part 1 Classifying Waste* (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
- > The above works be undertaken by a suitably qualified contaminated land specialist
- > An Unexpected Finds Protocol should be followed for excavation and pile boring.

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1 Introduction

1.1 Background

Transport for NSW (TfNSW) proposes to upgrade the wharf interchange at Taronga Zoo (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 (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 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 ramp
- > 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 Taronga Zoo Wharf as part of the TAP. The water based features of the proposal would include:

- > Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- > Removal of existing gangways
- > Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- > Two new transition ramps on the existing pontoon to cater for the new gangways
- > Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- > Construction of a new covered *Disability Standards for Accessible Public Transport* (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- > Removal and relocation of the Transdev office and café on the existing jetty
- > Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- > Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- > Relocation of existing Opal Card readers and Opal top-up machine
- > Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the Proposal would include:

- > Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- > Retention of the five existing bicycle parking hoops
- > Retention of the public telephone booth
- > Removal of foreshore vegetation to construct the new accessible ramp.

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 limited earthworks including regrading of existing footpaths and piling, and removal of vegetation on the foreshore for construction of the new accessible ramp. Construction of the water-based elements including replacement of the existing gangways between the existing jetty structure and pontoon, and construction of the accessible ramp would require piling within the waterway.

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 Taronga Zoo 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 Environment Protection Agency (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 (DUPA, 1999)
- > *Waste Classification Guidelines*. NSW Environment Protection Authority (EPA, 2014)
- > *Consultants reporting on contaminated land Contaminated land guidelines*. (EPA, 2020)
- > *Mosman Council Local Environment Plan 2012* (Mosman LEP 2012).

2 Site condition and surrounding environment

The Site is located directly south of Taronga Zoological Park on Athol Wharf Road, Mosman NSW. The Site is bounded by Taronga Zoological Park to the north and Sydney Harbour to the south, east and 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 | Athol Wharf Road, Mosman |
| Approximate Site Area | 0.1 hectare |
| Title Details | Taronga Zoo wharf is not located on land identified with lot and Deposited Plan (DP) numbers. Athol Wharf Road. Works below mean high water mark. |
| Local Government Area (LGA) | Mosman Council |
| Suburb | Mosman |
| Site Owners at the time of this engagement | Mosman Council (landside) and Transport for NSW/Roads and Maritime (waterside) |

2.2 Site description

The Site is irregular in shape and located near the cul-de-sac at the end of Athol Wharf Road at Mosman at the foreshore of Taronga Zoo. It is understood that Taronga Zoo Wharf has remained unchanged since at least 1986, with the previous ferry wharf footprint located slightly to the east. Currently the Site consists of a concrete footpath and the ferry wharf adjoining from the southern extent of the peninsula.

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 a berthing point for the F2 Taronga Zoo ferry network. |
| Weather condition | Overcast. |
| Site Slope and Drainage Features | <p>The Site is located on the southern foreshore of Mosman and is comprised of a landside and waterside portion. The site is comprised of hardstand surfaces where the wharf meets the land in the northern portion of the Site, with dense, low-lying vegetation is located to the west of the wharf landside entrance. The waterside portion is comprised of Sydney Harbour with Taronga Zoo Wharf above.</p> <p>The landside portion of the Site is relatively flat and is approximately 6 mAHD above the waterside portion. The eastern side of the ferry wharf has a sandstone retaining wall separating the landside portion and waterside portion while the western side of the ferry wharf is comprised of a rocky revetment supporting the vegetation. Approximately 15 metres to the north of the Site is a rocky outcrop which rises sharply to approximately 16 mAHD. The Site is located at the end of Athol Wharf Road which increases in elevation to the east.</p> <p>During rainfall events it is expected that overland flow from Athol Wharf Road will be directed toward the Site due to the sloping topography. A culvert was observed on the western side of the ferry wharf within the sandstone retaining wall. It is anticipated that overland flow along Athol Wharf Road is collected in pits within the kerb of the cul-de-sac and directed through the culvert into Sydney Harbour.</p> |
| Nearby water bodies | A portion of the Site lies within Sydney Harbour, which adjoins the Site to the south. |

| Item | Observations |
|--|--|
| Site surface coverings | The landside portion of the Site is hardstand with dense vegetation along the foreshore of the western side of the ferry wharf. |
| Site cut and fill | The natural environment of the site has been heavily modified to form Athol Wharf Road and the Taronga Zoo Wharf. There is the potential for material to have been imported to site to recontour the landscape. |
| Surface soils | Sandy silts, silty loam |
| Potential asbestos in building materials | A hazardous materials assessment was not undertaken on the heritage listed bus shelter. |
| Manufacturing, industrial or chemical processes and infrastructure | Ferry wharf which acts as a berthing point for ferries on the F2 Taronga Zoo Network. |
| Fuel storage tanks (USTs/ASTs) | Not observed. |
| Dangerous goods | Not observed. |
| Solid waste deposition | General waste and recycling receptacles were observed to the east of the Site. |
| Liquid waste disposal features | Not observed. |
| Evidence of previous site contamination investigations | N/A |
| Evidence of land contamination (staining or odours) | Not observed. |
| Evidence of groundwater contamination | Not observed. |
| Groundwater use | Not observed. |
| Vegetation | The only vegetation present is along the foreshore on the western side of the wharf. Directly west of the wharf entrance is a tree approximately 4 metres in height. Further west the foreshore is primarily composed of dense shrubs. |

2.3 Surrounding land use

Land uses surrounding the Site are detailed in Table 2-3.

Table 2-3 Surrounding land use

| Direction | Land Use | Description of Land |
|-----------|-------------------------------|---|
| North | Road / Recreation | Athol Wharf Road beyond which is Taronga Zoo |
| West | Waterways / Recreation / Road | Sydney Harbour / Curlew Camp Artist's Walk / Athol Wharf Road |
| East | Waterways / Road | Sydney Harbour / Athol Wharf Road |
| South | Waterways | Sydney Harbour |

2.4 Topography and drainage

The Site is located on the southern foreshore of Mosman. The landside portion of the Site is relatively flat and is approximately 6 mAHD above the waterside portion. The eastern side of the ferry wharf has a sandstone retaining wall separating the landside portion and waterside portion while the western side of the ferry wharf is comprised of a rocky revetment supporting the vegetation. Approximately 15 metres to the north of the Site is a rocky outcrop which rises sharply to approximately 16 mAHD. The Site is located at the end of Athol Wharf Road which increases in elevation to the east. Currently the Site is a mixture of a hardstand footpath and grass-covered areas, with a stormwater outlet observed. It is understood that surface water drainage discharges into Neutral Harbour during rainfall events.

The bathymetry at the site slopes from 0 metres, at the seawall to -9.5 metres Chart Datum (CD) about 60 metres from the seawall, at the end of the existing wharf. Between about 8 metres and 15 metres from the seawall, the bathymetry decreases rapidly from -3 metres to -6 metres CD.

2.5 Flood potential

The *Mosman Local Environmental Plan 2012* (Mosman LEP 2012) does not contain flood risk maps, however it is 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. A sandstone outcrop was visible to the north of the Site.

2.6.1 Acid sulfate soils

A review of the Australian Atlas of Acid Sulfate Soils (ASRIS) on the 14 September 2020 indicated that there is a high probability of occurrence for ASS in the subtidal marine environments, with a low risk of ASS in the landside portion.

2.6.2 Salinity

During the background information review, salinity risk maps were not identified for the Site. Cardno considers 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 500 metres of the Site.

The waterside portion of the Site includes 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 would vary from tide and storm flows (Birch and Taylor, 2004).

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).

A summary of the report is provided below.

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 due to cost.

The location of the site is within the lower harbour, downstream of the Harbour Bridge as it is well flushed. The sediment within the area contained relatively low concentrations of the following analytes:

- > Copper (<100 mg/kg)
- > Lead (<100 mg/kg)
- > Zinc (200 mg/kg)
- > Chlordane (<5 mg/kg)
- > PCB (<2 mg/kg)
- > DDT (<20 mg/kg)
- > DDD (<2 mg/kg)
- > Dieldrin (<1 mg/kg).

The results indicate that there is no point source contamination of sediments in this area, and that it is likely that sediments at this location are representative of lower background levels of contaminants in Sydney Harbour.

2.9 EPA records search

2.9.1 Contaminated land record of notices

The Contaminated Land Record of Notices is maintained by the Department of Planning, Industry and Environment (DPIE) in accordance with Part 5 of the *Contaminated Land Management Act 1997* (CLM Act) and contains regulatory notices issued by the Environment Protection Authority (EPA) in relation to contaminated sites.

A search of the Contaminated Land Record of Notices on 14 September 2020 did not identify notified 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 14 September 2020 within 500 metres of the Site and identified one (1) site with a current license. Results are summarised in Table 2-4.

Table 2-4 PoEO public register

| Site Name | Address | Activity | EPL Number | Distance (m) / Direction |
|---|----------------------------|---|------------|--------------------------|
| Taronga Zoo (includes area outside fenced compound) | Bradleys Head Road, Mosman | Sewage treatment processing by small plants | 1677 | 5m / north-west |

2.9.3 List of contaminated sites notified to the EPA

A search of the list of Contaminated Sites Notified to the EPA was undertaken on 2 April 2020. This search 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 landside portion of the Site is within an area zoned SP2 – Infrastructure. The SP2 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 previous infrastructure.

The waterside portion of the Site is within land zoned either W1 - Maritime Waters or W2 – Environmental Protection under the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*. The zones have the following objectives:

- > W1 Maritime Waters
 - 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,
 - 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
 - to promote equitable use of the waterway, including use by passive recreation craft.
- > W2 – Environmental Protection:
 - to protect the natural and cultural values of waters in this zone,
 - to prevent damage or the possibility of longer term detrimental impacts to the natural and cultural values of waters in this zone and adjoining foreshores,
 - to give preference to enhancing and rehabilitating the natural and cultural values of waters in this zone and adjoining foreshores,

- to provide for the long-term management of the natural and cultural values of waters in this zone and adjoining foreshores.

3 Site history

3.1 Historical aerial photograph review

Seventeen historical aerial photographs were obtained for the proposal 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 resolution) | No wharf is located within the current Site. The landside portion is unsealed and the waterside is Sydney Harbour. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road which is possibly unsealed and the previous Taronga Zoo Wharf |
| | | West | Athol Wharf Road which is unsealed and Sydney Harbour |
| 1943 | No wharf is located within the current Site. The landside portion is unsealed and the waterside is Sydney Harbour. | North | Taronga Zoo is located on the north on the rocky outcrop. Further development has been undertaken at Taronga Zoo |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road which is sealed and the previous Taronga Zoo Wharf |
| | | West | Athol Wharf Road which is sealed and Sydney Harbour |
| 1951 | No wharf is located within the current Site. The landside portion is unsealed and the waterside is Sydney Harbour. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and the previous Taronga Zoo Wharf |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1955 | No wharf is located within the current Site. The landside portion is unsealed and the waterside is Sydney Harbour. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and the previous Taronga Zoo Wharf. Works along the foreshore to create retaining wall |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1961 (low resolution) | No wharf is located within the current Site. The landside portion is unsealed and the waterside is Sydney Harbour. | North | Taronga Zoo is located on the north on the rocky outcrop. |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and the previous Taronga Zoo Wharf |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1965 | No wharf is located within the current Site. The landside portion is unsealed and | North | The Athol Wharf Road cul-de-sac is present. Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and the previous Taronga Zoo Wharf., with the retaining wall extended further south into Sydney Harbour |

| Year | Description of Site | Off-Site Direction | Description |
|------|--|--------------------|---|
| | the waterside is Sydney Harbour. | West | Athol Wharf Road and Sydney Harbour |
| 1975 | No wharf is located within the current Site. The landside portion is unsealed and the waterside is Sydney Harbour. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and the previous Taronga Zoo Wharf |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1978 | No wharf is located within the current Site. The landside portion is unsealed and the waterside is Sydney Harbour. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and the previous Taronga Zoo Wharf. Activity next to the old Taronga Zoo Wharf in the waterside portion (barge), for decommissioning |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1986 | The existing Taronga Zoo Wharf has been constructed. | North | Taronga Zoo is located on the north on the rocky outcrop. The southern entry to the zoo has been constructed near the wharf |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road, the previous Taronga Zoo Wharf has been decommissioned and removed |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1991 | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop. |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1994 | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |
| | | West | Athol Wharf Road and Sydney Harbour |
| 1998 | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |
| | | West | Athol Wharf Road and Sydney Harbour |
| 2004 | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop. Development is being undertaken within the central portion of the zoo |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |
| | | West | Athol Wharf Road and Sydney Harbour |
| 2007 | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop. Development has been completed in the central portion of the zoo |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |

| Year | Description of Site | Off-Site Direction | Description |
|----------------------------|---------------------|--------------------|--|
| | | West | Athol Wharf Road and Sydney Harbour |
| 2011 | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |
| | | West | Athol Wharf Road and Sydney Harbour |
| 2017 | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |
| | | West | Athol Wharf Road and Sydney Harbour |
| 2020 (source: near map) | Taronga Zoo Wharf. | North | Taronga Zoo is located on the north on the rocky outcrop |
| | | South | Sydney Harbour |
| | | East | Athol Wharf Road and Sydney Harbour |
| | | West | Athol Wharf Road and Sydney Harbour |

3.2 Heritage

A search of the DPIE website indicated that there are three 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 sites

| Site Name | Significance | Distance (m) |
|--|--------------|--------------|
| Former Athol Wharf Tram Terminus, including escarpment and retaining walls | Local | 0 on-site |
| Site of first wharf serving Taronga Zoo | Local | 2 south-east |
| Rainforest Aviary, Elephant House, bus shelter and office, floral clock and entrance gates | Local | 5 north-west |

3.3 Summary of relevant historical activities

The Site has remained largely unchanged since 1986, as described in Table 3-1. 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 historical activities and potential causes of contamination

| Year | Information Source | Interpretation | Site Activities |
|----------------|------------------------------|---|--|
| Pre 1930 | Historical Aerial Photograph | <ul style="list-style-type: none"> Use of fill material of unknown origin and impact | <ul style="list-style-type: none"> Construction of Athol Wharf Road |
| 1930 – ongoing | Historical Aerial Photograph | <ul style="list-style-type: none"> Surface water runoff containing heavy metals and PAHs from the road | <ul style="list-style-type: none"> Ferry wharf |
| 1978-1986 | Historical Aerial Photograph | <ul style="list-style-type: none"> PAHs from machinery and equipment | <ul style="list-style-type: none"> Decommissioning of former Taronga Zoo Wharf and construction of current Taronga Zoo Wharf. |

3.4 Contaminants of potential concern

Based on the available site history the contaminants of potential concern (COPCs) 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"> Fill material of unknown origin and impact Tidal flows of contaminated water into subsurface profile. | <ul style="list-style-type: none"> PAH Heavy metals OCP/OPP. |
| Waterside | <ul style="list-style-type: none"> Contaminant transport from the greater Sydney Harbour Fuel leaks from vessels. | <ul style="list-style-type: none"> PAH TRH Heavy metals OCP/OPP. |

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 current ferry wharf since 1986. Sources of contamination at the Site are considered to be surface water runoff from Athol Wharf Road and potentially impacted fill materials at the Site. |
| Site Current and Future Use | The current use of the Site is a ferry wharf adjoining Athol Wharf Road. 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 is 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 & Taylor, 2006). |
| COPCs – Soil & Sediment | <ul style="list-style-type: none"> ▪ PAH ▪ Heavy metals ▪ OCP/OPP |
| Potential Human Receptors | <ul style="list-style-type: none"> ▪ Current and future users of the Taronga Zoo ferry service ▪ Maintenance workers ▪ Future construction workers ▪ Users of Sydney Harbour |
| Potential Environmental Receptors | <ul style="list-style-type: none"> ▪ Sydney Harbour ▪ Aquatic biota and vegetation ▪ Soil biota and vegetation |
| Potential Human Exposure Pathways | <ul style="list-style-type: none"> ▪ Inhalation of particles ▪ Dermal contact and ingestion of contaminated soils |
| Potential Environmental Exposure Pathways | <ul style="list-style-type: none"> ▪ Tidal influences transporting contaminants from the Site ▪ Uptake of contaminants from surrounding soil biota and vegetation |

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 risks 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 provided in Table 5-1.

Table 5-1 Risk matrix

| | | Consequence (Potential Impact) | | | | |
|--------------------------------------|---------------|--------------------------------|-------------|---------|----------|-------------|
| | | 1. Minor | 2. Moderate | 3. High | 4. Major | 5. 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 low 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 construction activity or tidal influences | Moderate | Unlikely | Low |
| Groundwater | Waterside | Potential migration of contaminants out of the Site from tidal influences. | Moderate | Unlikely | Low |
| Sediment | Waterside | Impacted sediment material | Moderate | Unlikely | Low |

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 12 March 2020, the main sources of possible contamination are outlined below:

- > The current impacts and origin of soils at the Site are unknown. The Site history indicates that there is low risk that impacted soils are present at the Site
- > It is considered possible that groundwater at the Site is impacted by tidal influences from Sydney Harbour. The condition of water entering the Site from the harbour can change depending on tides and storm events (Birch & Taylor, 2004). If subsurface soil is impacted, it is likely that tidal flows could be transporting contaminants into Sydney Harbour from the Site.

6 Conclusions

Cardno has prepared a PSI at Taronga Zoo Ferry Wharf for the project footprint of the ferry wharf upgrade on behalf of TfNSW.

It is understood that the Site has remained largely unchanged as a location for the ferry wharf since approximately 1986. The surrounding area has remained relatively unchanged with the exception of developments at Taronga Zoo to the north. 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 and road construction and maintenance of the ferry wharf.

6.1.2 Sediment

Previous investigations by Birch and Taylor (2004) indicate that sediment at the Site would be representative of lower background levels of contaminants within Sydney Harbour.

6.1.3 Groundwater

Impacts to groundwater are currently unknown, there are no groundwater bores on-site.

6.2 Recommendations

Given the results of the assessment, the following is recommended:

- > Limited soil sampling to the depth of excavation to ensure the safety of construction workers and provide indicative waste classification of the materials to be removed
- > The piling methodology shall seek to mitigate the risk of sediment dispersal
- > Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's *Waste Classification Guidelines: Part 1 Classifying Waste* (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
- > The above works be undertaken by a suitably qualified contaminated land specialist
- > An Unexpected Finds Protocol should be followed for excavation and pile boring.

7 References

- ANZECC (1999) *Guidelines for the Assessment of On-Site Containment of Contaminated Soil*, Australian and New Zealand Environment and Conservation Council (ANZECC), September 1999.
- Birch & 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.
- 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.
- 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.
- DUAP (1998), *Managing Land Contamination: Planning Guidelines: SEPP 55 Remediation of Land*. NSW Department of Urban Affairs and Planning, April 1999.
- EPA (2014) *Waste Classification Guidelines*. New South Wales Environment Protection Authority (EPA), November 2014.
- LI Resources (2020) *Due Diligence Insight Report. Property Details: Taronga Zoo Wharf*. Land Insight and Resources, 14 September 2020.
- NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure (NEPM)*. National Environment Protection Council (NEPC) 1999.
- OEH (2020) *Guidelines for Consultants Reporting on Contaminated Sites*. New South Wales Office of Environment & Heritage (OEH), April 2020, Updated 5 May 2020.
- TfNSW (2015) *Transport Access Program*. Transport for NSW, NSW Government.

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:

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- > 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

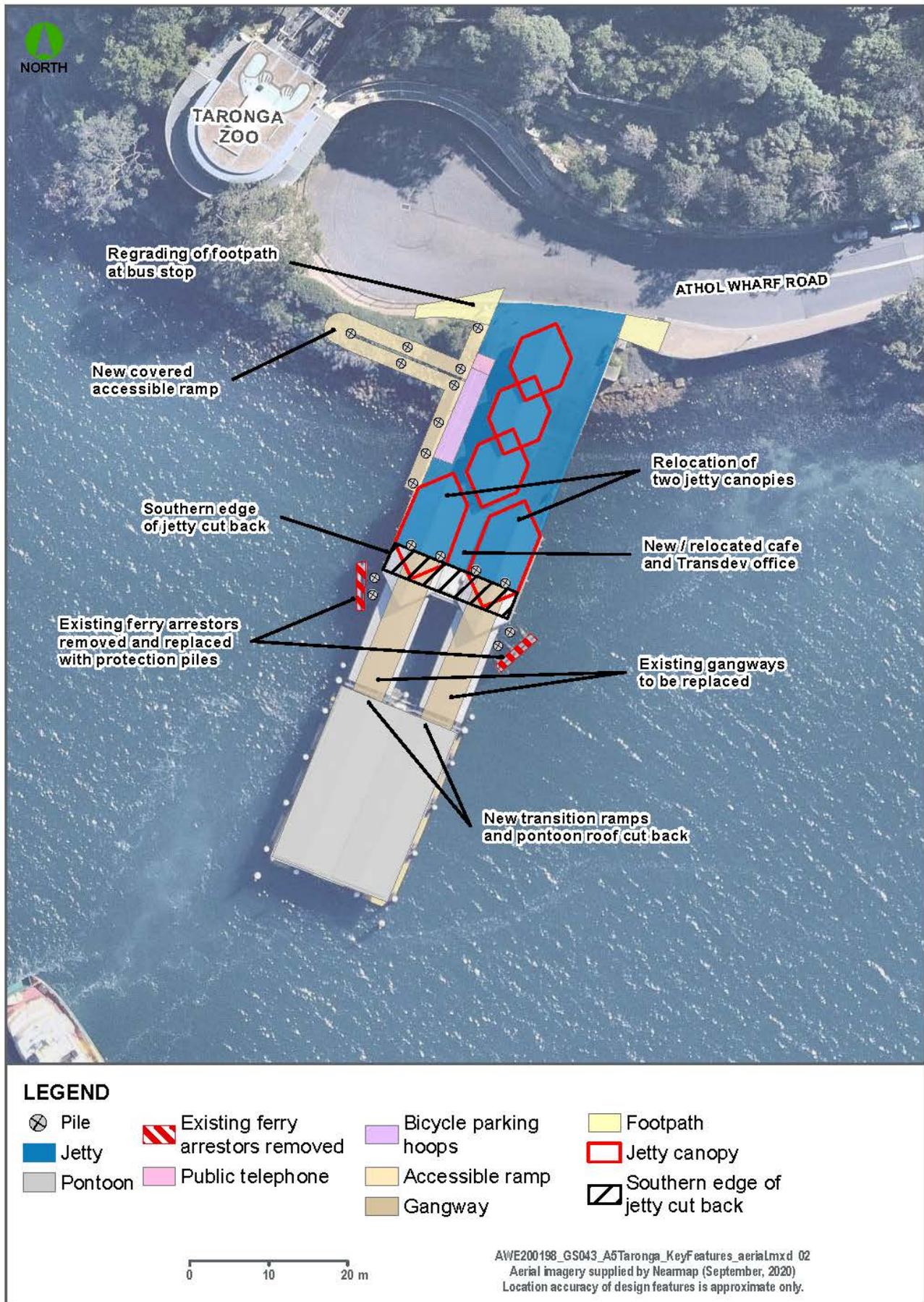


Figure 1: Key features of the proposal



Figure 2: Construction footprint and proposal footprint

APPENDIX

B

SITE PHOTOGRAPHS



Photograph 1: Facing west, Taronga Zoo Wharf adjoining Athol Wharf Road. Southern entrance to Taronga Zoo in the background.



Photograph 2: Facing east, culvert within sandstone brick retaining wall which divides Athol Wharf Road and Sydney Harbour.



Photograph 3: Facing west, rocky retaining wall underlying dense, low-lying vegetation.

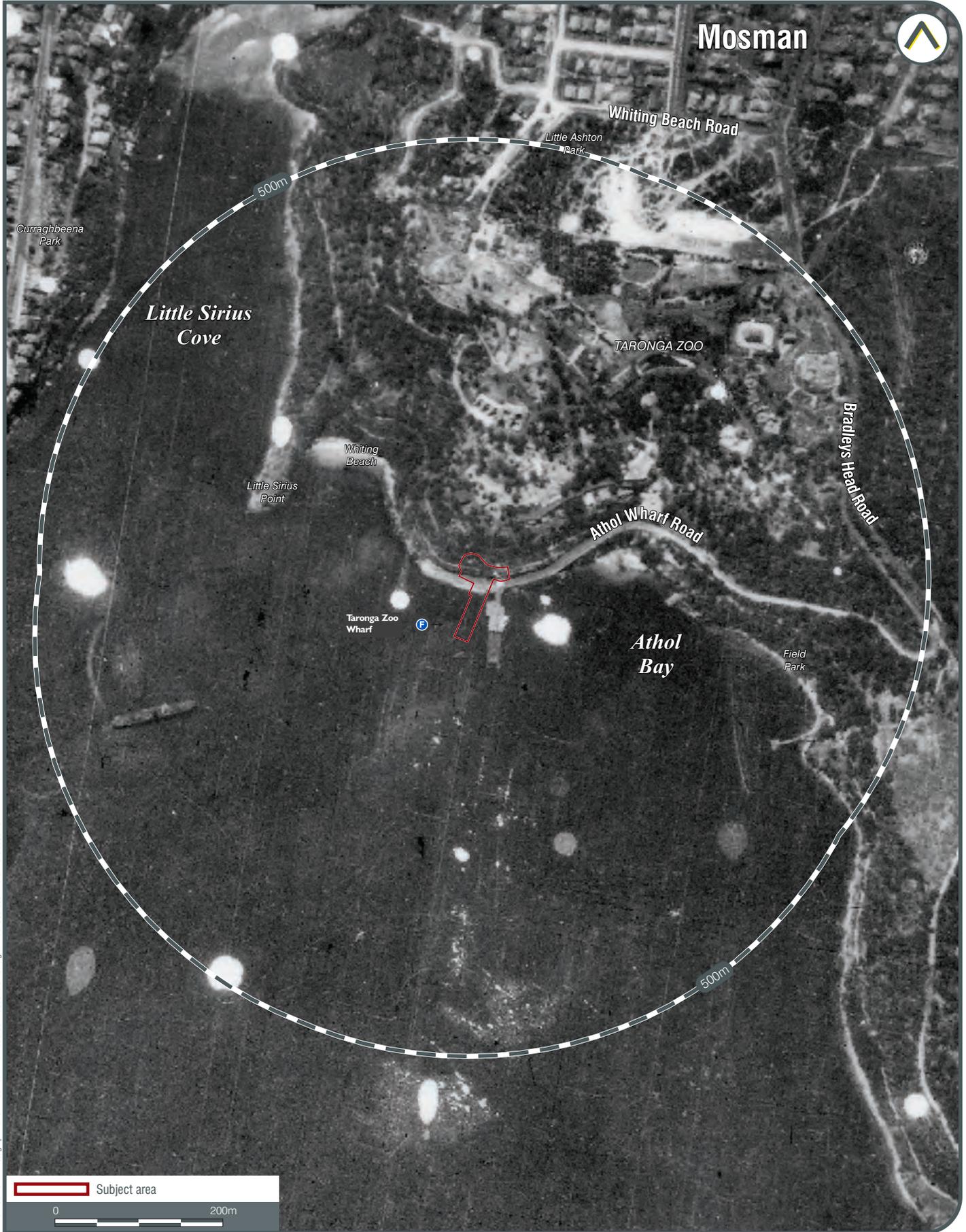


Photograph 4: Facing south-west, Taronga Zoo ferry wharf and Sydney Harbour.

APPENDIX

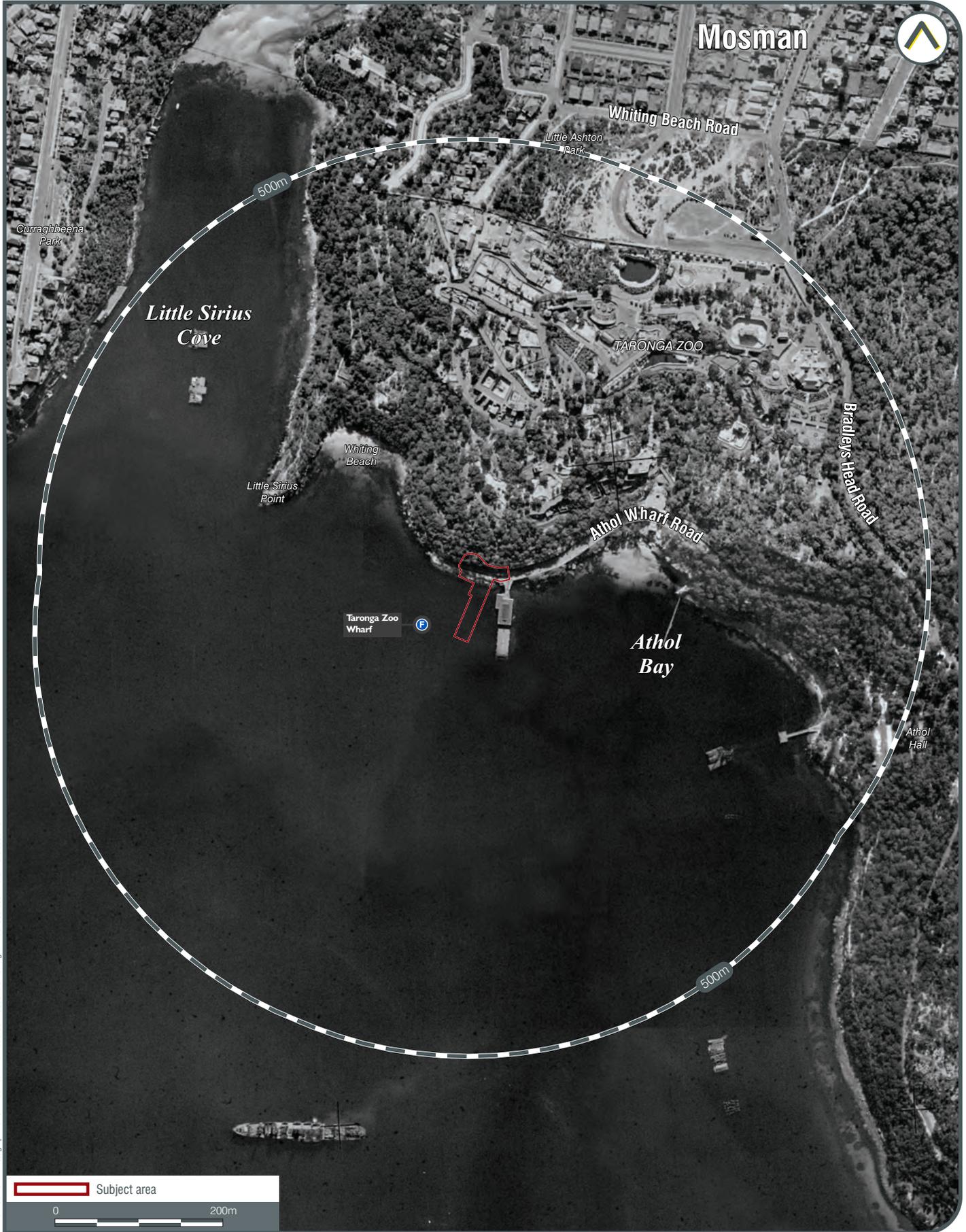
C

HISTORICAL IMAGERY



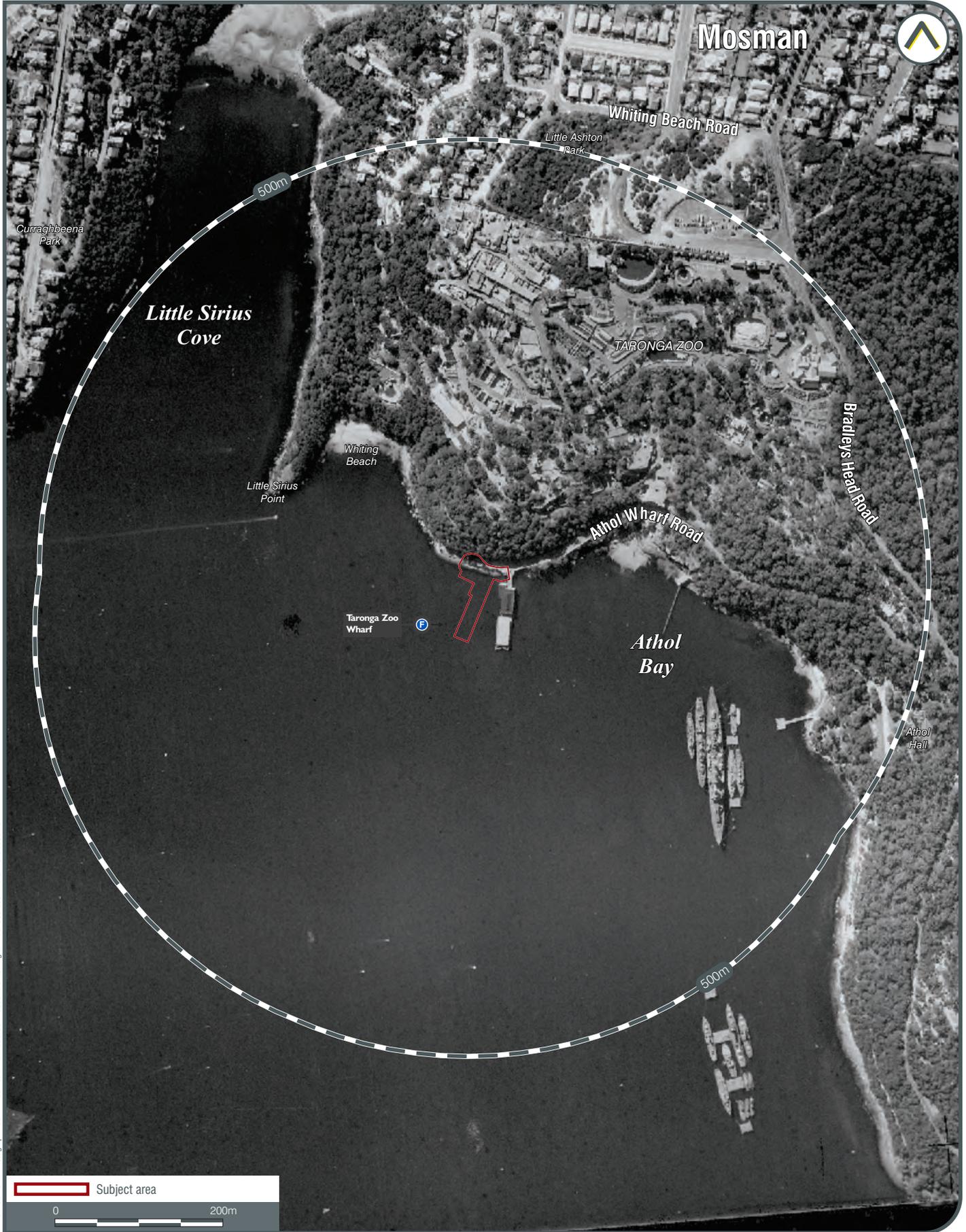
LIR-01486 Aerial Photograph, 2020, 14.09.2020. Data source: Please refer to "Digital Data Sources" in the Product Guide

HISTORIC AERIAL PHOTOGRAPH - 1930



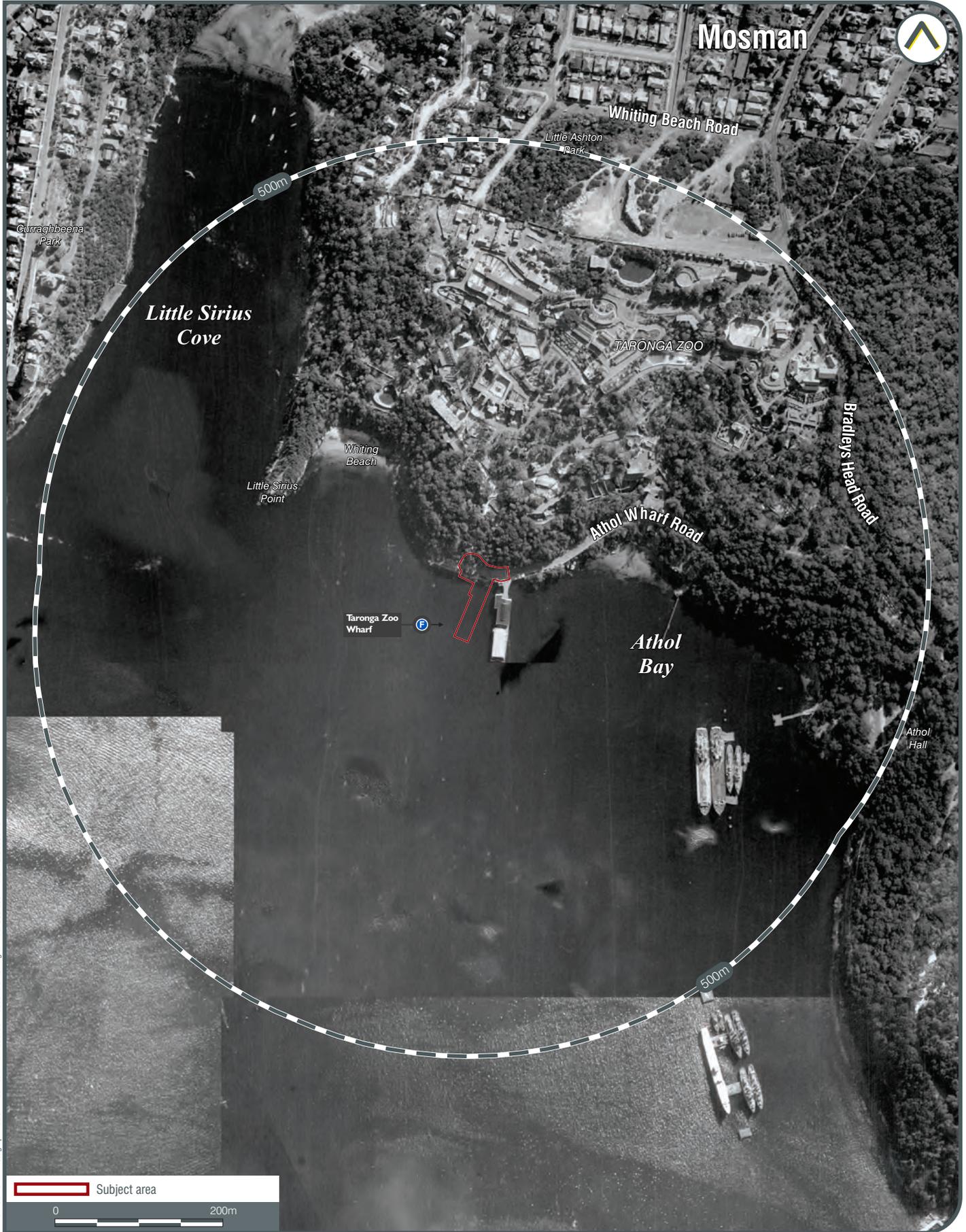
LUR-01486 Aerial Photograph 1943 14 09 2020. Data source: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 1943



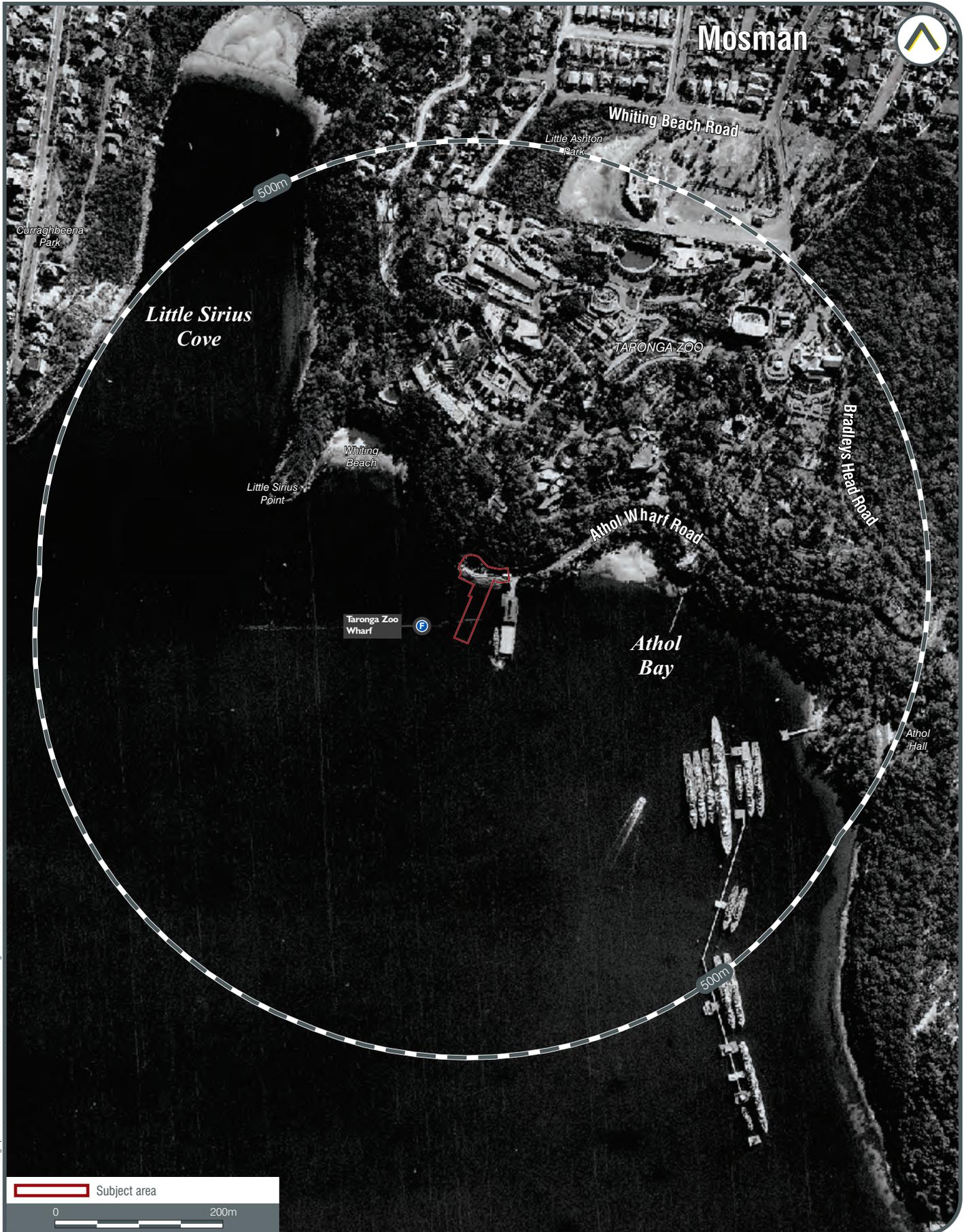
LUR-01486 Aerial Photograph 1951 14 09 2020. Data source: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 1951



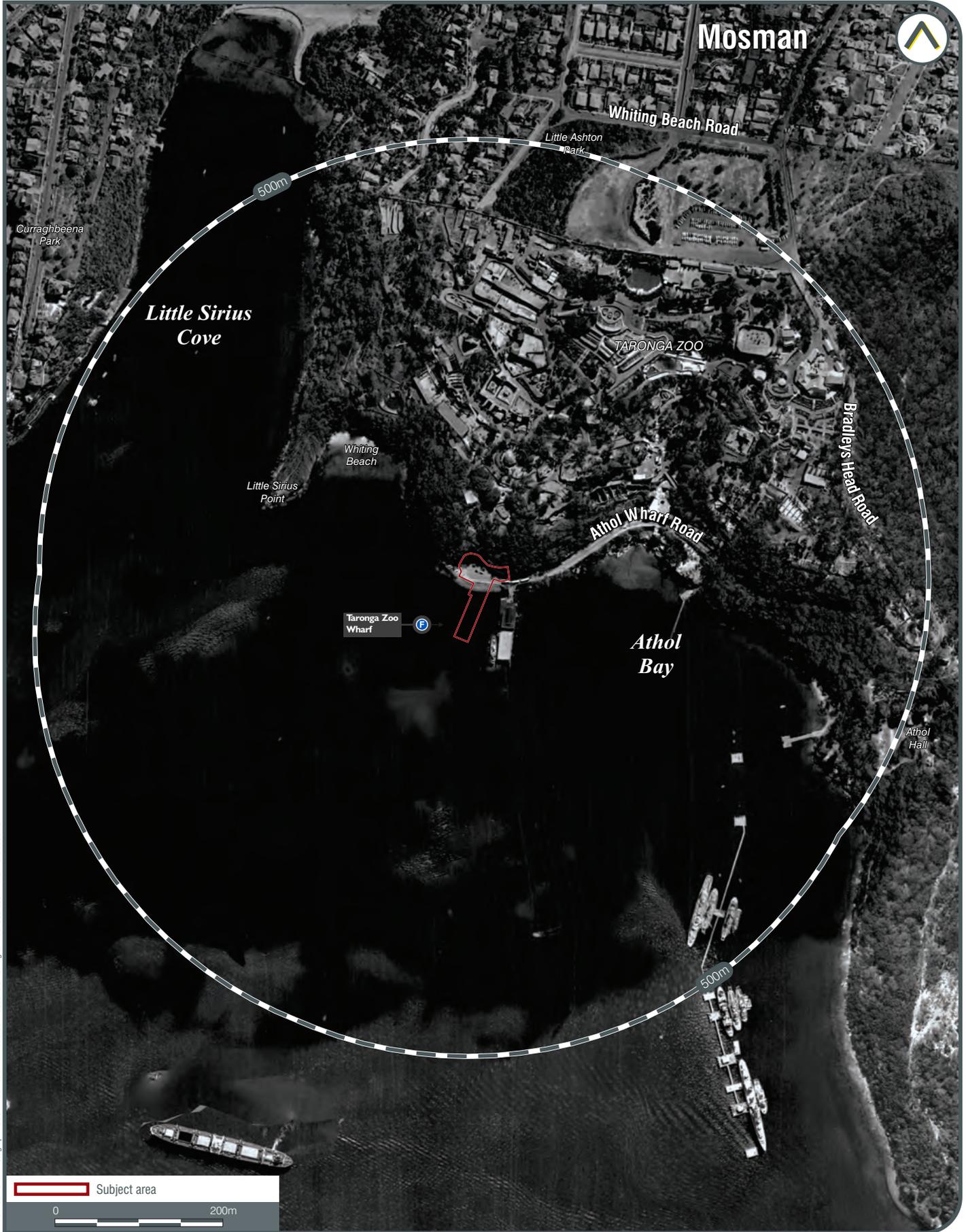
LIR-01486 Aerial Photograph, 1955, 14.09.2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 1955



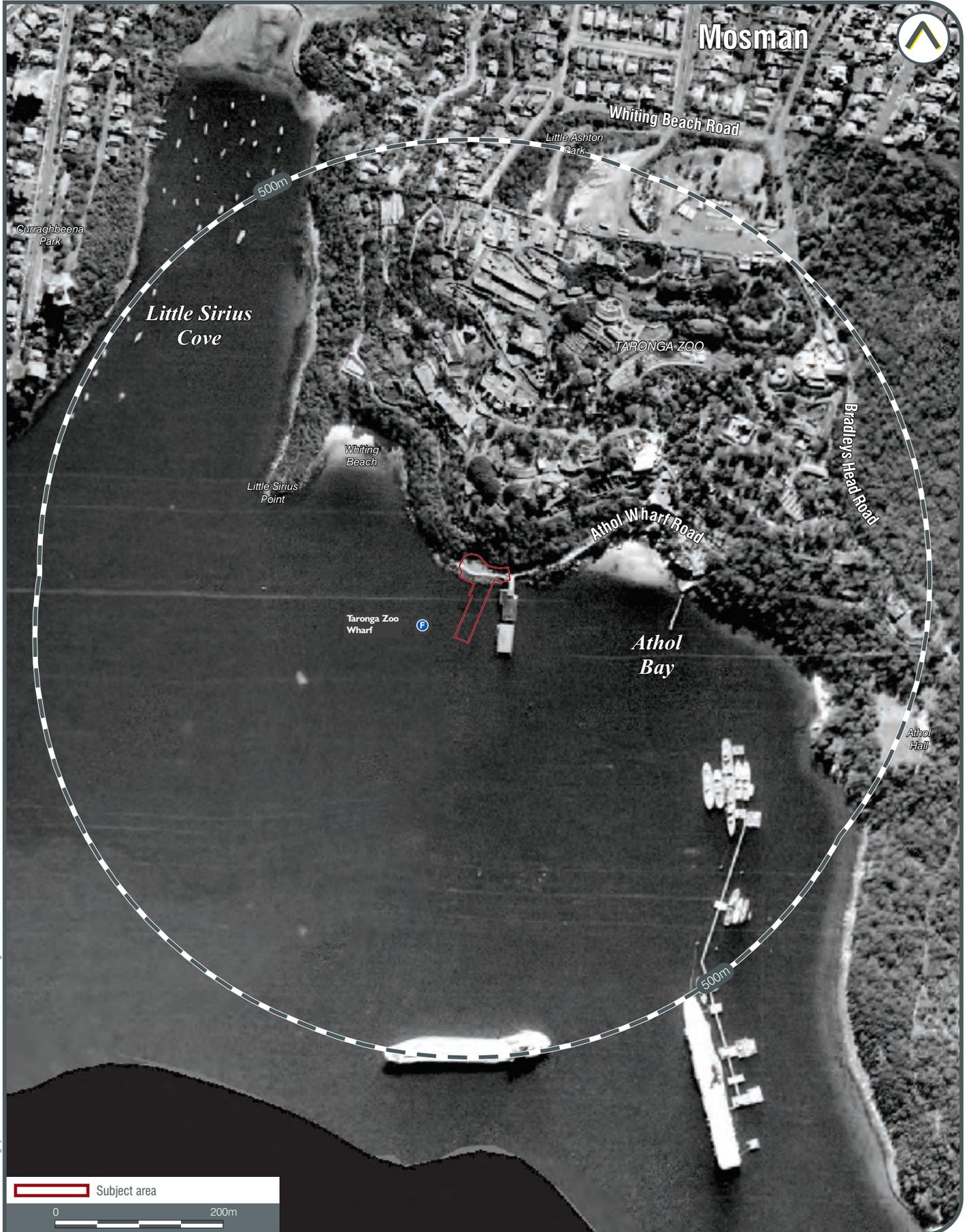
LIR-01486 Aerial Photograph 1961 14 09 2020. Data source: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 1961



LUR-01486 Aerial Photograph, 1965-14-09-2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide.

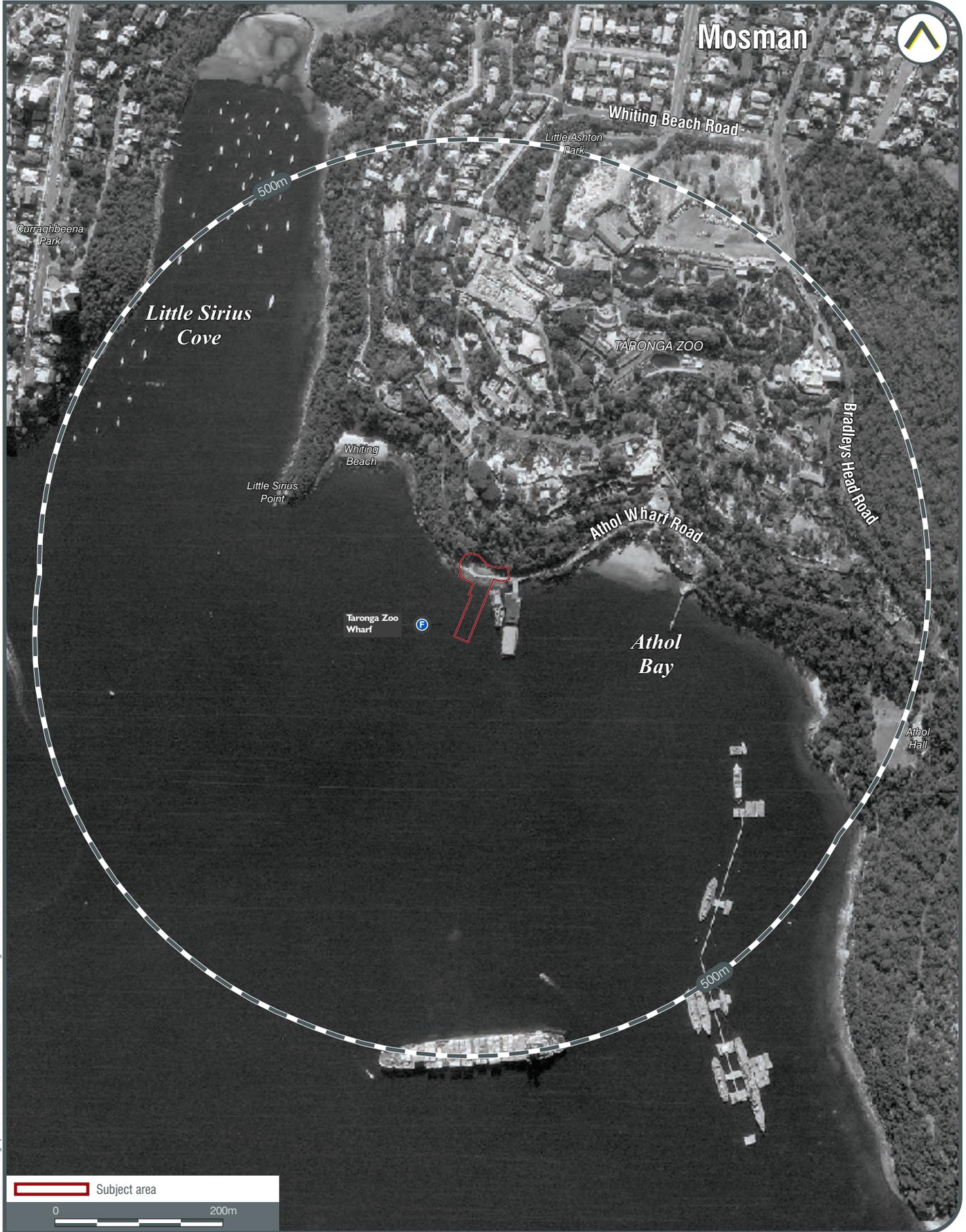
HISTORIC AERIAL PHOTOGRAPH - 1965



LIR-01486 Aerial Photograph: 1975-14-09 2020. Data source: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 1975





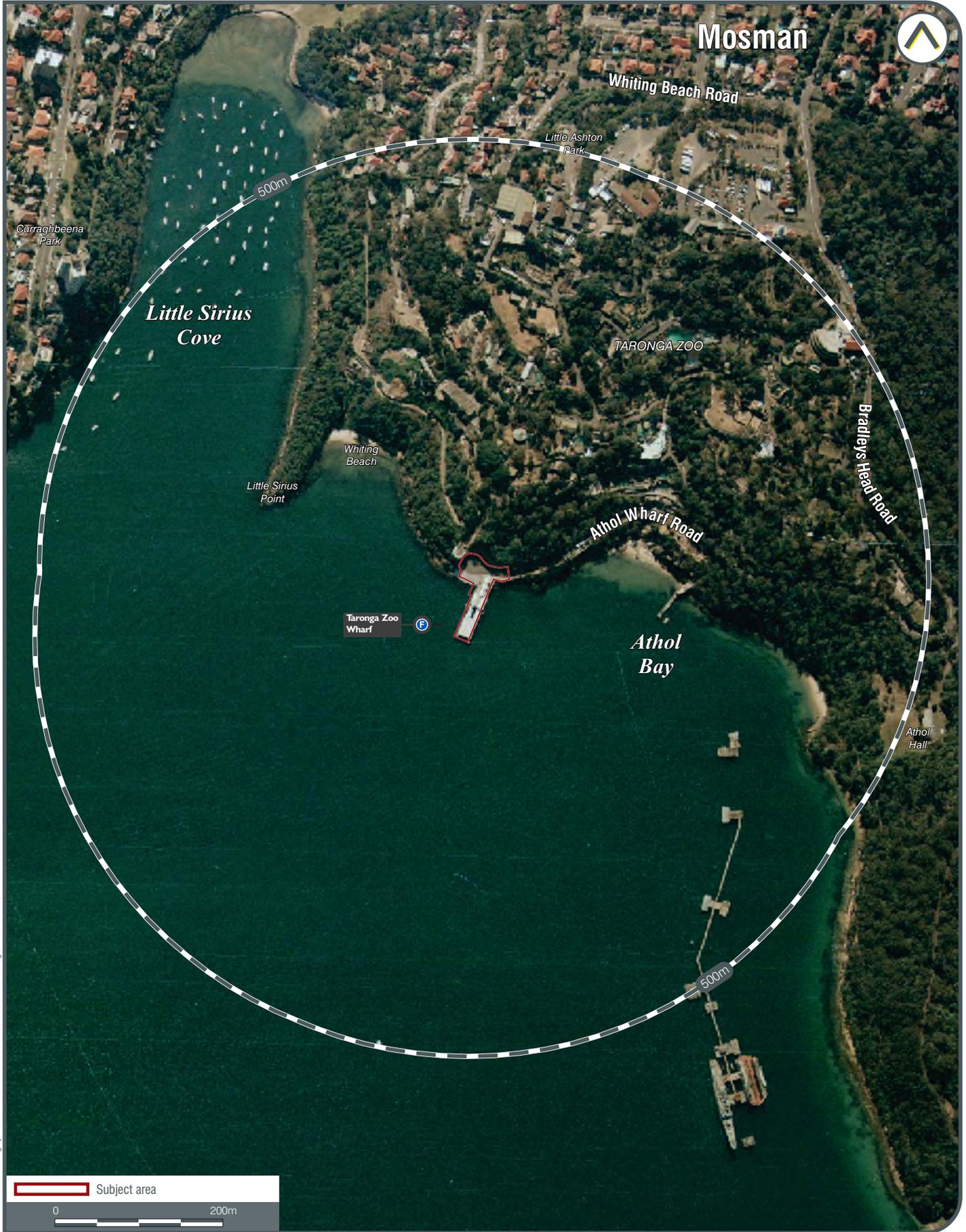
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HISTORIC AERIAL PHOTOGRAPH - 1978



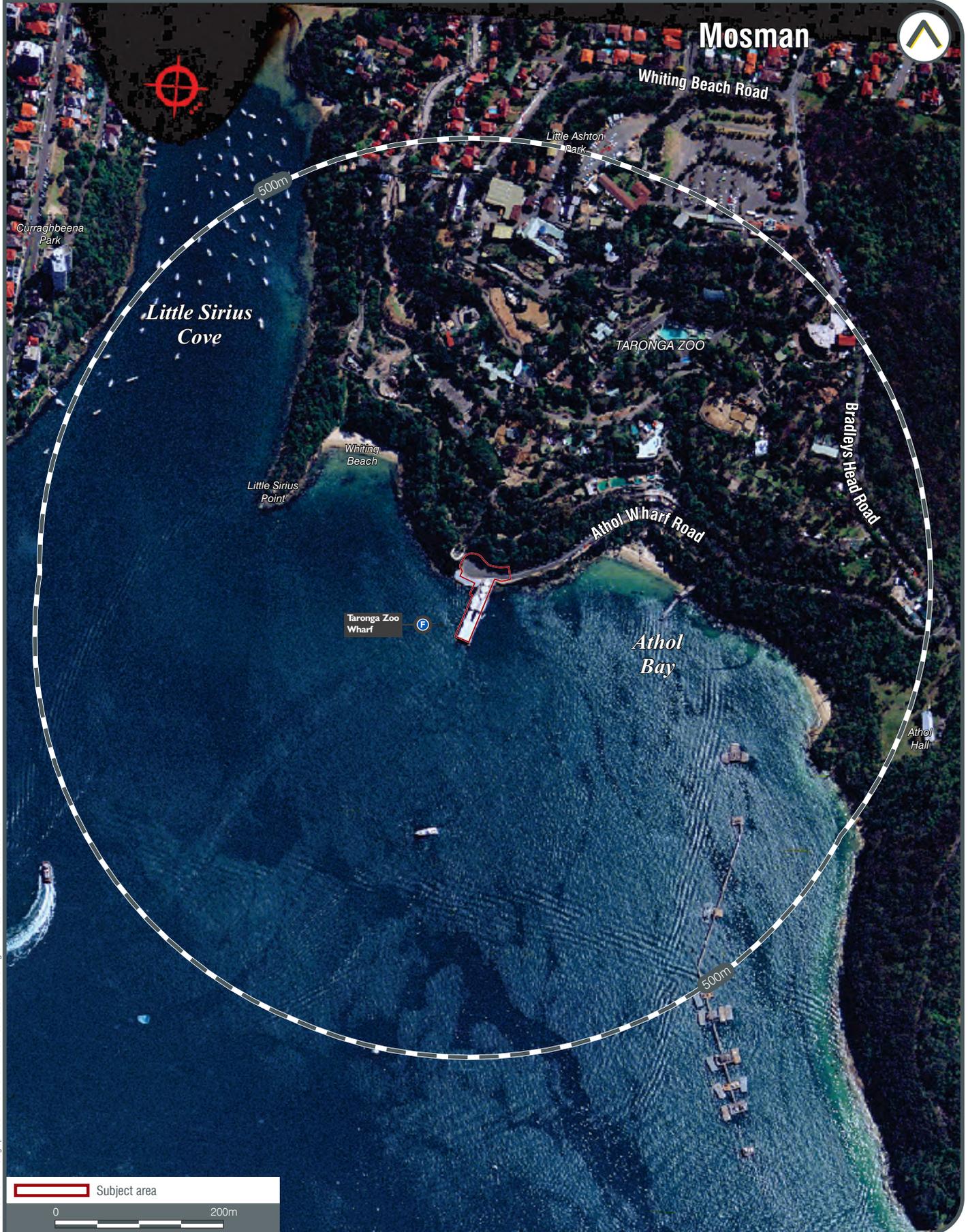
LUR-01486 Aerial Photograph, 1986:14:09:2020. Data source: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 1986



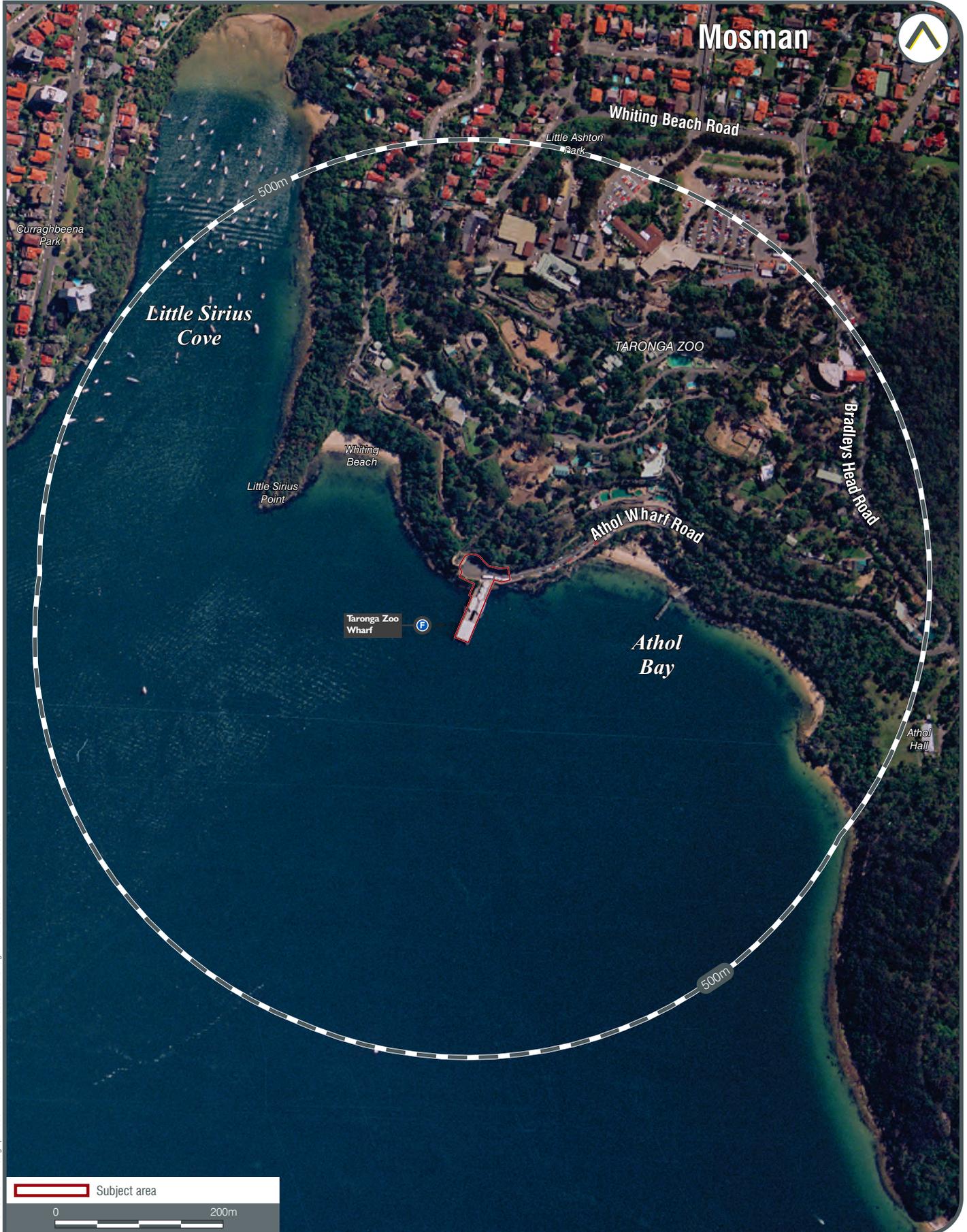
LUR-01486 Aerial Photograph 1991-14-09-2020. Data source: Please refer to "Digital Data Sources" in the Product Guide

HISTORIC AERIAL PHOTOGRAPH - 1991



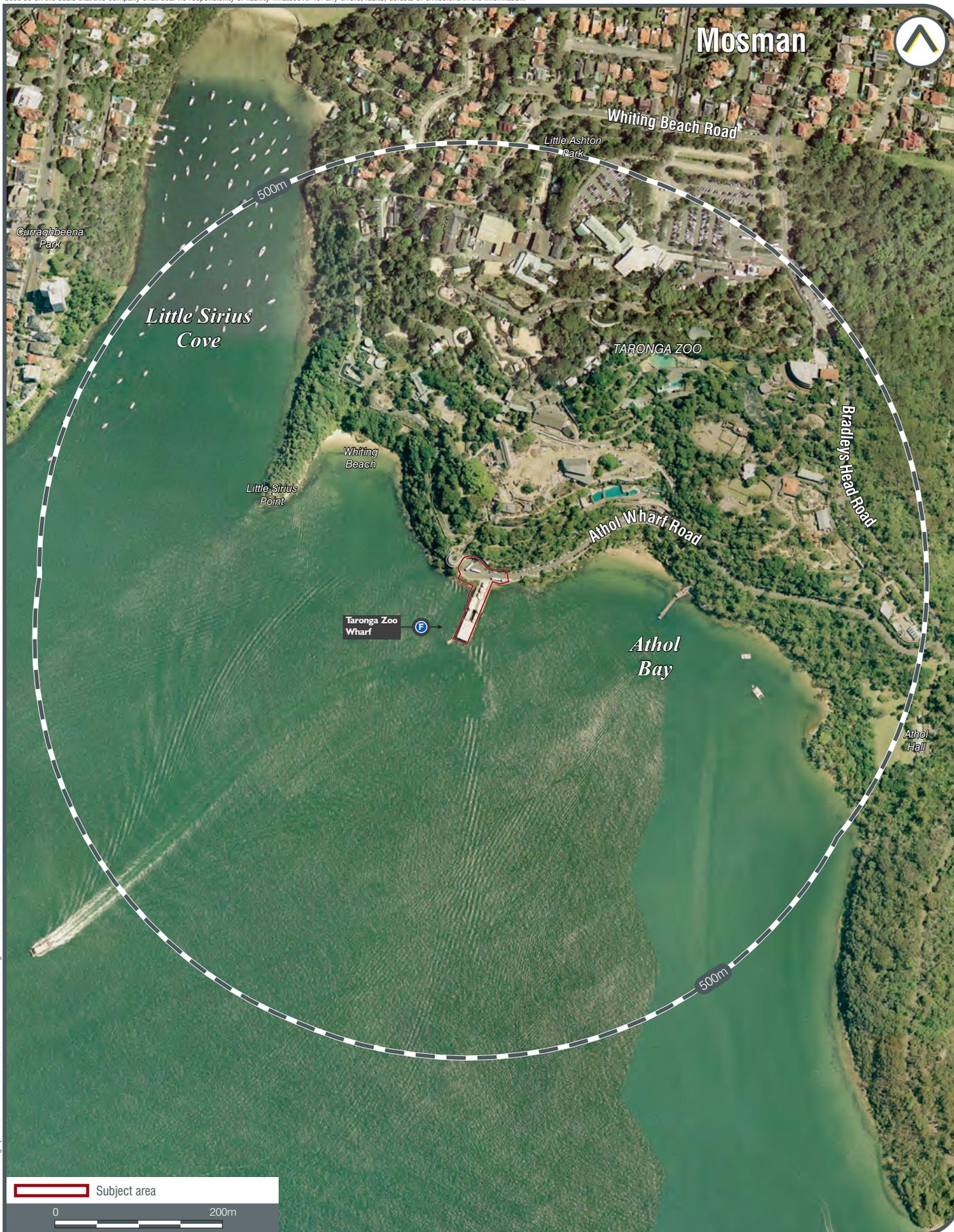
LUR-01486 Aerial Photograph 1994, 14.09.2020. Data source: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 1994



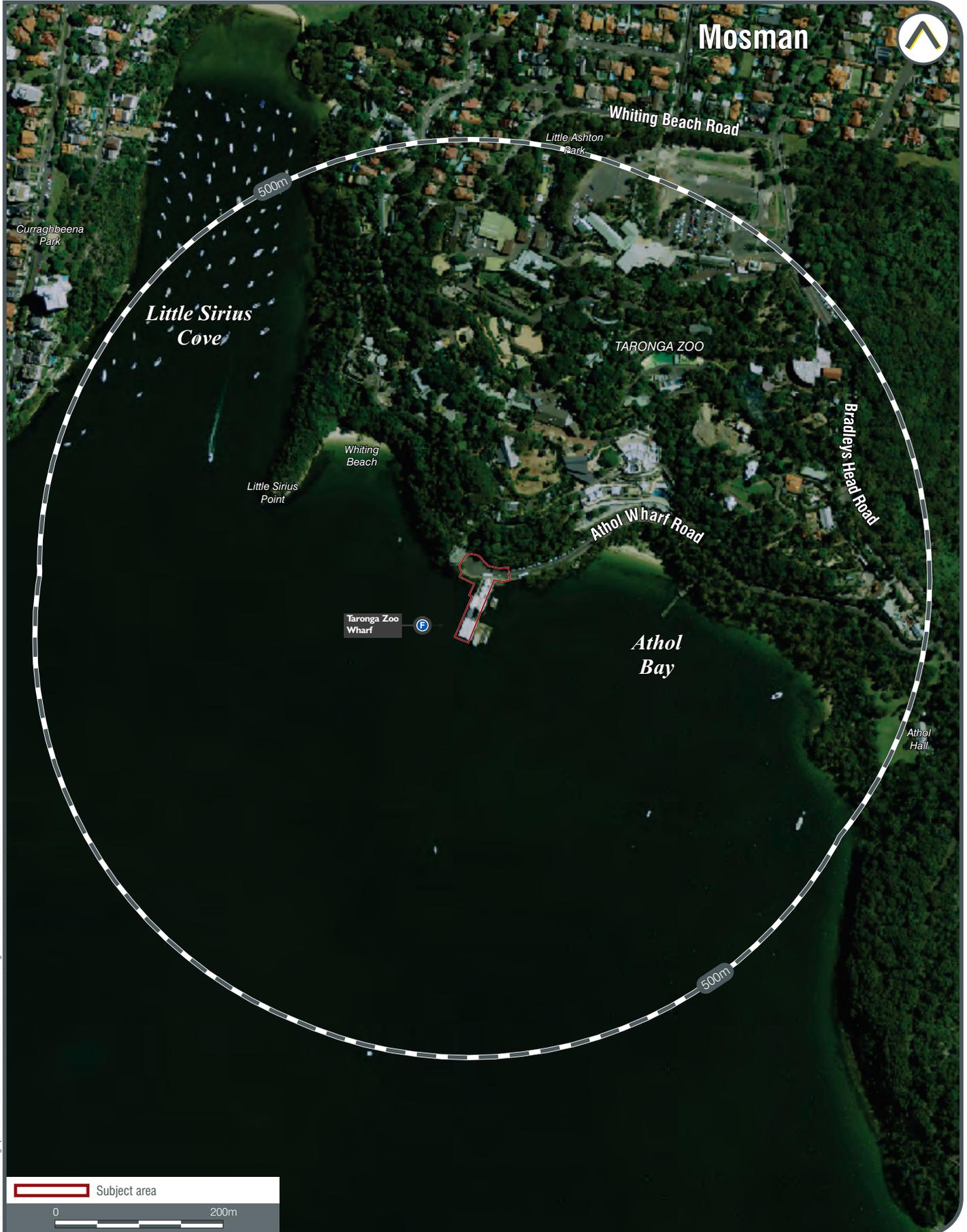
LUR-01486 Aerial Photograph 1998; 14.09.2020. Data source: Please refer to "Digital Data Sources" in the Product Guide

HISTORIC AERIAL PHOTOGRAPH - 1998



LIR-01486 Aerial Photograph 2004-14-09-2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide

HISTORIC AERIAL PHOTOGRAPH - 2004



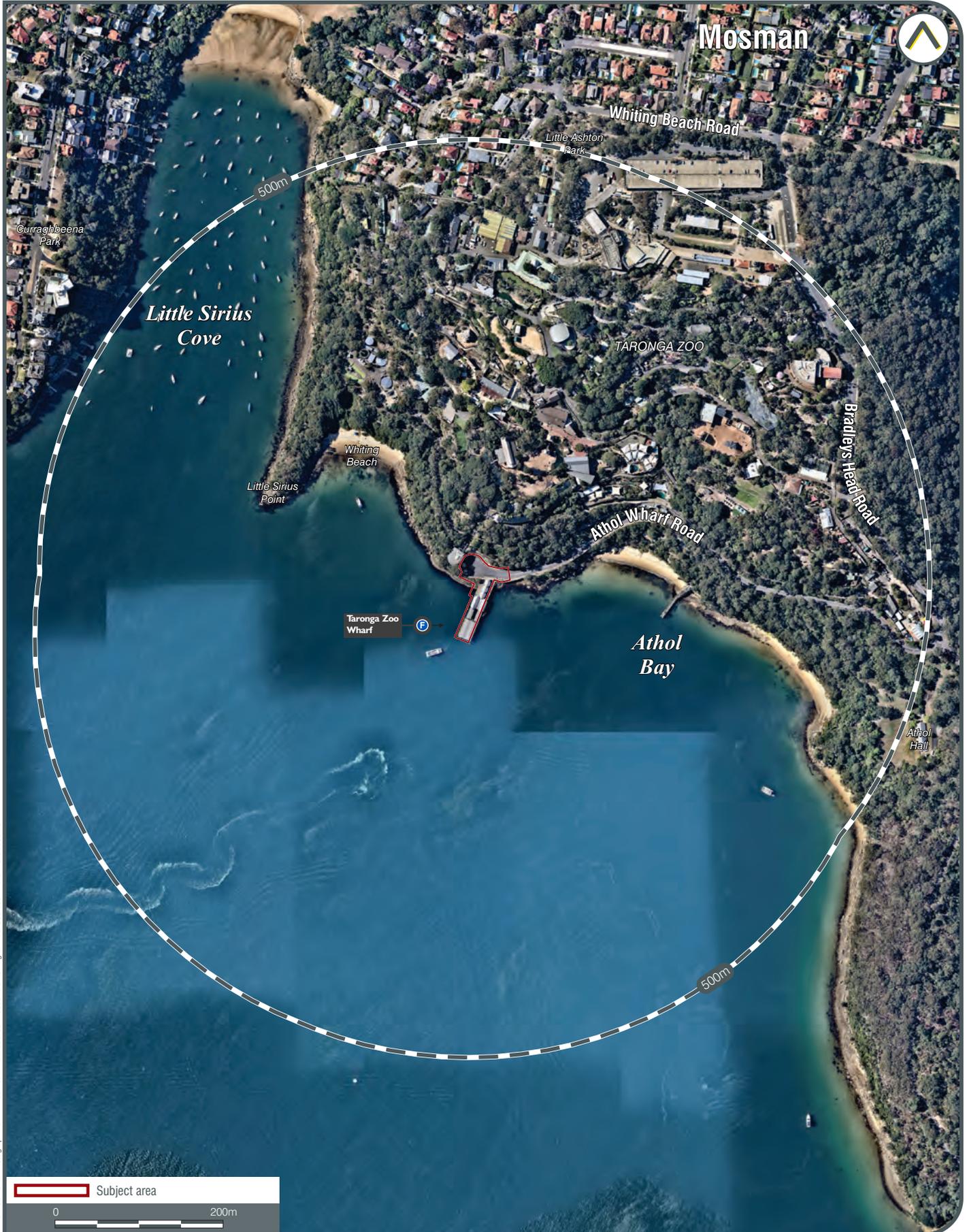
LUR-01486 Aerial Photograph 2007-14-09 2020. Data source: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 2007



LIR-01486 Aerial Photograph 2011 14 09 2020. Data source: Please refer to "Digital Data Sources" in the Product Guide

HISTORIC AERIAL PHOTOGRAPH - 2011



LIR-01486 Aerial Photograph 2017-14-09-2020. Data sources: Please refer to "Digital Data Sources" in the Product Guide.

HISTORIC AERIAL PHOTOGRAPH - 2017

Appendix E

Biodiversity Assessment Report



Taronga Zoo Wharf Upgrade

Biodiversity Assessment Report

Transport for NSW

Taronga Zoo Wharf Upgrade

Biodiversity Assessment Report

Transport for NSW | March 2021

Prepared by Cardno (NSW/ACT) Pty Ltd

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Document controls

Approval and authorisation

| | |
|--|---|
| Title | Taronga Zoo Wharf Upgrade Biodiversity Assessment Report |
| Accepted on behalf of Transport for NSW by: | Bob Rimac Senior Project Manager |
| Signed: | |
| Dated: | |

Document status

| Document status | Description | Date | Prepared by | Reviewed by |
|------------------------|-------------------------------|------------------|--|--------------------|
| V1 | Draft for internal review | 14 October 2020 | Dilys Zhang Brendan Alderson Jake Ludlow | Craig Blount |
| Rev A | Draft for client review | 21 October 2020 | Dilys Zhang | Craig Blount |
| Rev B | Final draft for client review | 23 February 2021 | Dilys Zhang | Belinda Crichton |
| Rev 0 | Final for client | 12 March 2021 | Dilys Zhang | Belinda Crichton |

Executive summary

The Taronga Zoo 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 the removal of a portion of the existing wharf.

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 proposal construction and operation. The biodiversity assessment was informed by a review of existing information in the study area and the wider study locality, as well as a field survey of the study area.

The study area is located near Taronga Zoo on the northern foreshore of Sydney Harbour. The terrestrial (land) portion of the study area was limited by the cul-de-sac hardstand at the end of Athol Wharf Road, footpaths, the Sky Safari cable car infrastructure, the shoreline and the existing Taronga Zoo wharf interchange structures. The marine (water) portion of the study area is comprised of a vertical sandstone seawall and concrete revetment bound by a corridor of subtidal low-medium relief rocky reef and soft sediment habitat in deeper areas. There was a small section of remnant native vegetation in the study area which was considered to be low to medium in ecological condition. There were no mangroves, saltmarsh or seagrass in or next to the study area. The subtidal rocky reef (Type 2 Key Fish Habitat, KFH) and large debris/rubble in soft sediment habitats (Type 3 KFH) were colonised by a mosaic of macroalgae.

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 14 terrestrial and two marine threatened flora and fauna species:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the *Fisheries Management Act 1994* (FM Act) and endangered under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- Black Rockcod (*Epinephelus daemeli*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) listed as endangered under the BC Act and EPBC Act
- Netted Bottlebrush (*Callistemon linearifolius*) listed as vulnerable under the BC Act
- Nine microbats listed as vulnerable under the BC Act:
 - Large-eared Pied Bat (*Chalinolobus dwyeri*)
 - 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*)
 - Eastern Cave Bat (*Vespadelus troughtoni*)
- Two birds listed as vulnerable under the BC Act:
 - Little Lorikeet (*Glossopsitta pusilla*)
 - Powerful Owl (*Ninox strenua*)

- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

The proposal would remove less than 0.01 hectares of native/exotic vegetation which forms part of the Coastal Sandstone Foreshores Forest plant community type (PCT). Where possible, this would be reintegrated following construction completion. Proposal impacts on vegetation and terrestrial habitat would not substantially fragment or isolate existing vegetation or habitat. 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.

Three piles (508 millimetres in diameter) would be drilled into low-medium relief rocky reef, close to the shoreline. Four protection piles (610 millimetres in diameter) and four gangway support piles (508 millimetres in diameter) would be driven into subtidal soft sediment habitat in deeper water. The area of low-medium relief rocky reef and soft sediment habitat under the footprint of the piles would be permanently impacted. Areas used for anchoring of the barge during construction would be temporarily impacted. This would include the direct removal of macroalgae and sessile marine fauna from subtidal rocky reefs and epifauna and infauna from soft sediment habitats. The new wharf structures would shade less than 0.01 hectares of subtidal rocky reef habitat. These are not considered substantial impacts to marine biodiversity as the type of rocky reef and soft sediment habitats in the study area constitutes the majority of subtidal habitat in the harbour. These community assemblages are ubiquitous and are quick to recolonise temporarily disturbed areas.

The removal of six ferry arrestor piles would result in the removal of marine vegetation, habitat and sessile/less mobile fauna currently colonising these areas. However, the majority of these species are common in subtidal rocky reefs and other parts of the wharf structure, and would quickly colonise the piles of the new piles.

Under Section 199 of the FM Act, consultation with NSW Department of Primary industries (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 piles and the installation of new piles. Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required. However, through consultation with NSW DPI (Fisheries) (on 4 February 2021), this is not required for the piling and pile removal works associated with this proposal.

Sediment mobilisation from piling and other water-based construction activities and vessel wash and scour were also identified as potential proposal impacts. However, the study area is likely to be frequently exposed to elevated levels of sediment associated with rainfall, sea conditions and vessel traffic within the area. Thus, with the appropriate controls, a slight, temporary increase in these impacts is not expected to substantially impact marine biodiversity. Vessel traffic to the new wharf during operation would likely be similar to current conditions.

There is currently no evidence of marine pests or disease in the study area. Impacts from the potential introduction/spread of marine pests would be managed during construction.

There is potential noise impacts on resident fauna in Taronga Zoo with noise levels predicted to exceed background levels during the day and night. Advice would need to be sought from Taronga Zoo prior to construction regarding impacts on resident Taronga Zoo fauna.

The proposal is unlikely to significantly impact threatened species. 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. Mitigation measures are proposed to survey for Black Rockcod and White's Seahorse at the start of construction so that individuals in the area are not harmed.

Species impact statements (SIS) were not considered to be required.

Considering the above and assuming 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. |
| 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 Environmental Planning and Assessment 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 http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf). |
| 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 http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf). 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 Taronga Zoo 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 |
| HAT | Highest astronomical tide |
| 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 |

| | |
|-------|---|
| RBL | Rating background levels (noise) |
| 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 |
| TSS | Total suspended solids |

1 Introduction

1.1 Proposal background

Transport for NSW (TfNSW) proposes to upgrade the wharf at Taronga Zoo (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 2.1 of the Review of Environmental Factors (REF).

The proposal is located within the local government area (LGA) of Mosman Council. Taronga Zoo wharf is located on the northern foreshores of Sydney Harbour, at the southern end of Taronga Zoo at a Sky Safari cable car station. Taronga Zoo wharf sits at the bottom of an escarpment at the end of the Athol Wharf Road cul-de-sac.

1.2 The proposal

The proposal is to upgrade the Taronga Zoo Wharf as part of the TAP.

The water based features of the proposal would include:

- Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- Removal of existing gangways
- Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- Two new transition ramps on the existing pontoon to cater for the new gangways
- Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- Construction of a new covered *Disability Standards for Accessible Public Transport* (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- Removal and relocation of the Transdev office and café on the existing jetty
- Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- Relocation of existing Opal Card readers and Opal top-up machine
- Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the proposal would include:

- Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- Retention of the five existing bicycle parking hoops
- Retention of the public telephone booth
- Removal of foreshore vegetation to construct the new accessible ramp.

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 Taronga Zoo wharf Interchange Upgrade, and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

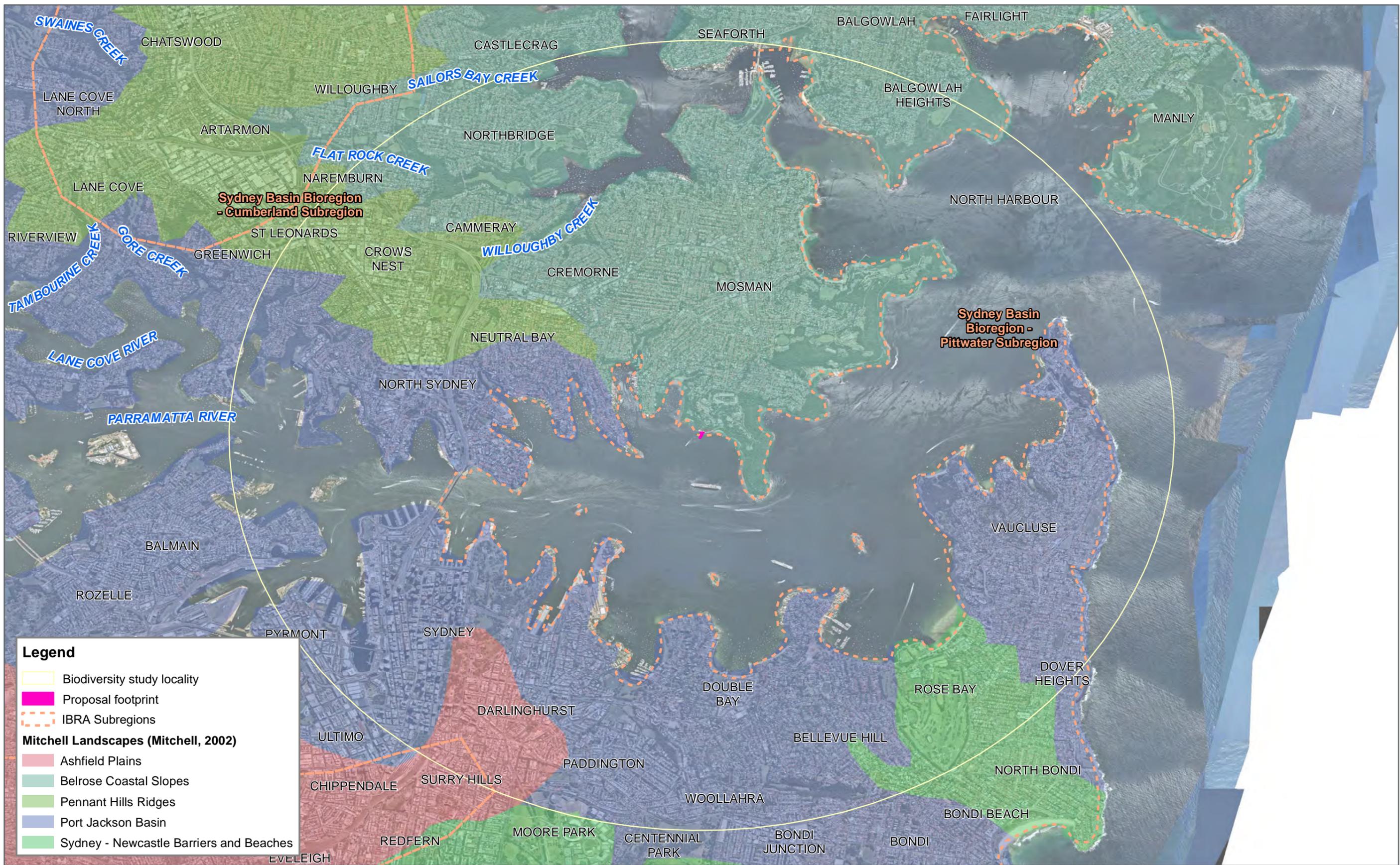
Sections 7.2A of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FM Act) require that the significance of the impact on threatened species, and threatened ecological communities (TECs) is assessed using a five-part test (BC Act) or the 7-part test (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 that 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)
- Construction footprint – Area around the proposal footprint required for construction including the compound area. The compound area would be located within the proposed construction footprint and on floating construction barges adjacent to the wharf structure (Figure 1-3).
- Study area - refers to the proposal and surrounding areas covered by this BAR (about 1.19 hectares and excludes private properties and the top of the escarpment) (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

- Biodiversity study locality
- Proposal footprint
- 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
 TARONGA ZOO

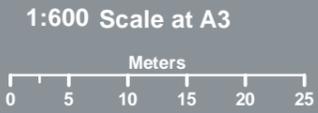


Map Produced by National Water & Environment
 Date: 2020-10-09 | Project: AWE200198
 Coordinate System: GCS_GDA_1994
 Map: AWE200198_GS0XX_Taronga_StudyLocality.mxd 01
 Aerial Imagery supplied by Nearmaps (2020)



Legend

- Proposal footprint
- Compound area
- Biodiversity study area



Project and Study Areas
FIGURE 1.3
TARONGA ZOO



Cardno
Map Produced by National Water & Environment
Date: 2021-02-23 | Project: AWE200198
Coordinate System: GCS GDA 1994
Map: AWE200198_GS006_Taronga_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
- Craig Blount (BSc (Hons), PhD) – Senior Principal Environmental Scientist.

2.2 Background research

A review of information and data was completed in July 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
- 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 Taronga Zoo 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 (Section 10.3). The relevant sections of this 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 24 July 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 June 2020. 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 sunny with light winds. There was 2.1 millimetres of rainfall 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 |
|------------|------------------------|---------------|----------------|-----------------------|------------------------------------|----------------------------------|
| 24/07/2020 | 10.7-18.7 | 0 | WSW tending E | 22 | 11:05am (1.5 m) 11:08pm (1.9 m) | 4:59am (0.3 m) 4:47pm (0.5 m) |

2.4.2 Vegetation surveys

The terrestrial portion of the study area includes the section south of the Athol Wharf Road cul-de-sac and the limit of the seawall and the existing wharf structure. 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 undertaken to describe and map the type, extent and condition of vegetation. The floristics of the site was also recorded. The formation, class and plant community type (PCT) was described for any native vegetation in accordance with the DPIE – EES VIS classification. Commensurate TECs associated with PCTs were also identified where applicable.

Priority weeds listed for the Greater Sydney region were recorded and the extent of infestation described, if detected.

2.4.3 Targeted flora surveys

Targets flora surveys were completed during the vegetation survey for the following species considered to have a moderate to high likelihood of occurrence in the study area:

- Sunshine Wattle (*Acacia terminalis subsp. terminalis*)
- Netted Bottlebrush (*Callistemon linearifolius*).

Some vegetated areas of the foreshore (towards the water's edge) could not be safely accessed during the field survey, thus a visual habitat assessment for habitat suitability was 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 highest astronomical tide (HAT) 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 the 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

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 the most populated city in Australia. 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 benched hill slopes and discontinuous cliffs. The cliffed margins are on Triassic quartz sandstone, lithic sandstone and shales. The bathymetry of the study area and the wider harbour 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 fringe of one of the shallow bays on the northern side of the harbour (Figure 1-4).

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).

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). Further ASS investigations prior to construction would be required (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.

Geotechnical and contamination assessments have been recommended during the detailed design stage as water-based contamination is predicted to be contained within the sediments (Aurecon Australasia Pty Ltd, 2019). Land-based soil contamination is currently unknown and would be informed by the proposed project-specific geotechnical and contamination assessments.

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 or mobilisation of soils have the potential to increase sedimentation and turbidity beyond the natural range (Aurecon Australasia Pty Ltd, 2019).

3.4 Terrestrial vegetation

The northern shoreline of the harbour in and around the study area remains one of the few foreshore areas with contiguous patches of remnant vegetation. With the exception of the Taronga Zoo facility, the surrounding areas include corridors which appear to be heavily vegetated with a few walking tracks, some of which, lead into a portion of the Sydney Harbour National Park to the east. Coastal Sandstone Foreshores Forest (PCT 1778) occupies the largest area of any PCT in the study locality (about 289.47 hectares).

The extent of vegetation within the study area was limited by the cul-de-sac hardstand at the end of Athol Wharf Road, footpaths, the Sky Safari cable car infrastructure, the shoreline and the existing Taronga Zoo wharf interchange structures. Coastal Sandstone Foreshores Forest occurred on the steep escarpment along the foreshore west of the existing wharf interchange (refer Figure 3-1 and Figure 3-5). The Curlew Camp Artists Walk dissects this area where a narrow, cleared path tracks under a medium to dense canopy. This remnant patch of Coastal Sandstone Foreshores Forest is about 0.05 hectares (including the path, refer Table 3-1) and extends along the foreshore westward to Sirius Cove Reserve, about 640 metres north-west of the study area.

Overstorey species were characteristic of Coastal Sandstone Foreshores Forest and included adult Bangalay (*Eucalyptus botryoides*), Sydney Peppermint (*Eucalyptus piperita*) and Coast Banksia (*Banksia integrifolia*). Typical midstorey and shrub species of this PCT recorded in this patch included Blueberry Ash (*Elaeocarpus reticulatus*), *Acacia longifolia*, Coffee Bush (*Breynia oblongifolia*) and Sweet Pittosporum (*Pittosporum undulatum*). Stands of native Slender Tea-tree (*Leptospermum trinervium*) was also recorded towards the existing wharf interchange (Figure 3-2). This native midstorey assemblage co-occurred with exotic species including Balloon Vine (*Cardiospermum grandiflorum*) and three priority weeds, Lantana (*Lanata camara*), Madeira Vine (*Anredera cordifolia*) and Green Cestrum (*Cestrum parqui*) (see Section 3.6). Although characteristic Coastal Sandstone Foreshore Forest groundcover species like Spiny-headed Mat-rush (*Lomandra longifolia*) and Weeping Grass (*Microlaena stipoides*) occurred here, there was also a substantial proportion of exotic species including Kikuyu (*Pennisetum clandestinum*), Asthma Weed (*Parietaria judaica*) and two more priority weeds, Ground Asparagus (*Asparagus aethiopicus*) and Fireweed (*Senecio madagascariensis*) (see Section 3.6).

The presence of characteristic native species in all strata, the retention of structural complexity, the extent of exotic species and evidence of modification (e.g. non-characteristic native species) renders this patch of Coastal Sandstone Foreshores Forest as moderate in condition.



Figure 3-1: Moderate Coastal Sandstone Foreshores Forest west of the existing wharf interchange below the Sky Safari infrastructure



Figure 3-2: Coastal Sandstone Foreshores Forest mixed with a stand of Slender Tea-tree

Mature Port Jackson Fig (*Ficus rubiginosa*) and young Smooth-barked Apple (*Angophora costata*) were recorded on the rocky revetment about 35 metres east of the existing wharf interchange (refer Figure 3-3 and Figure 3-5). This area occupied less than 0.01 hectares (Table 3-1) and extended out of the study area eastward. It is likely that Coastal Sandstone Foreshores Forest may have propagated to this area based on the presence of Smooth-barked Apple in this stand of vegetation. However, this patch is considered low condition as there were no characteristic midstorey or groundcover species and a cover of exotic Ground Asparagus and Asthma Weed persisted. Furthermore, this stand was also isolated from the contiguous patches of Coastal Sandstone Foreshore Forest by Athol Wharf Road and boulders on the foreshore.

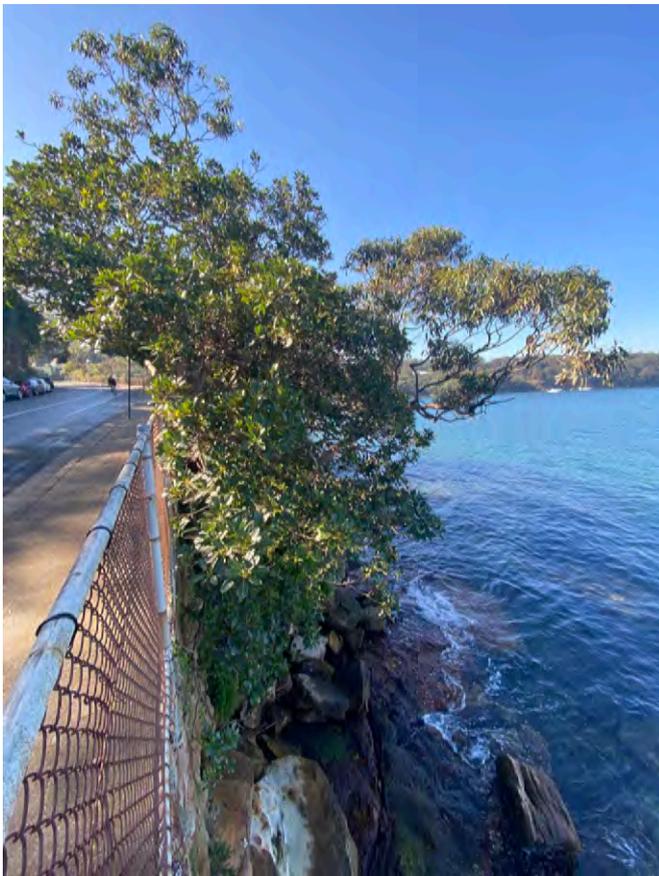


Figure 3-3: Low condition Coastal Sandstone Foreshore Forest on rock revetment

A small area of rocky/concrete revetment abutting the western edge of the existing wharf interchange boasts a carpet of Asthma Weed and Ground Asparagus (refer Section 3.6, Figure 3-4 and Figure 3-5). This area also had a stormwater outlet and services infrastructure pits and transitions into a sandstone intertidal and subtidal area.

The list of flora species recorded during the field survey is provided in Annexure A.

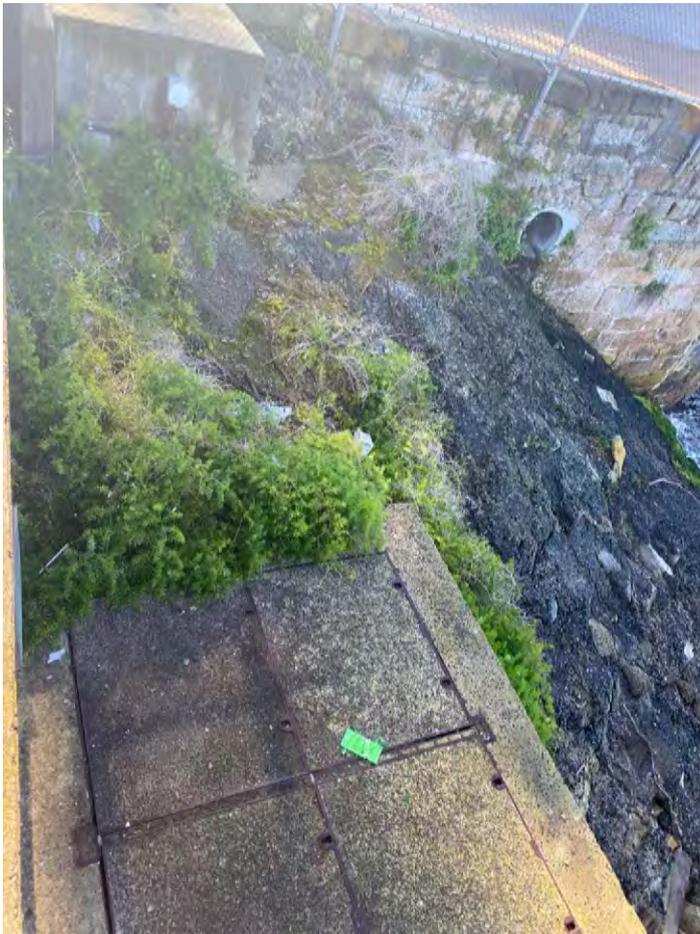


Figure 3-4: Rocky/concrete revetment abutting the existing wharf interchange

Table 3-1: Areas of terrestrial vegetation within the study area

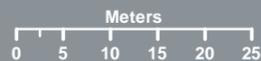
| Terrestrial vegetation | Area in study area (ha) |
|---|-------------------------|
| Coastal Sandstone Foreshores Forest (PCT 1778) – low condition | <0.01 |
| Coastal Sandstone Foreshores Forest (PCT 1778) – moderate condition | 0.05 |
| Exotic vegetation (on rocky/concrete revetment) | <0.01 |
| Total | 0.06 |



Legend

- Biodiversity study area
- Proposal footprint
- Coastal Sandstone Foreshores Forest (PCT 1778)

1:750 Scale at A3



Terrestrial Vegetation
FIGURE 3.5
TARONGA ZOO



Map Produced by National Water & Environment
 Date: 2020-10-09 | Project: AWE200198
 Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Map: AWE200198_GS00X_Taronga_TerrestrialVeg.mxd 01
 Aerial Imagery supplied by Nearmaps (2020)

3.5 Terrestrial fauna habitat

Coastal Sandstone Foreshores Forest forms 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/fruitletting. 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 small area of exotic vegetation 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 above HAT 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.

The study area is located directly to the south of Taronga Zoo which is home to a number of native and non-native fauna in outdoor and indoor enclosures. The current Taronga Zoo layout map with the location of enclosures can be found at: https://taronga.org.au/sites/default/files/2020-10/TZMap_Ed11v07.pdf.

3.6 Priority weeds

Five 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).

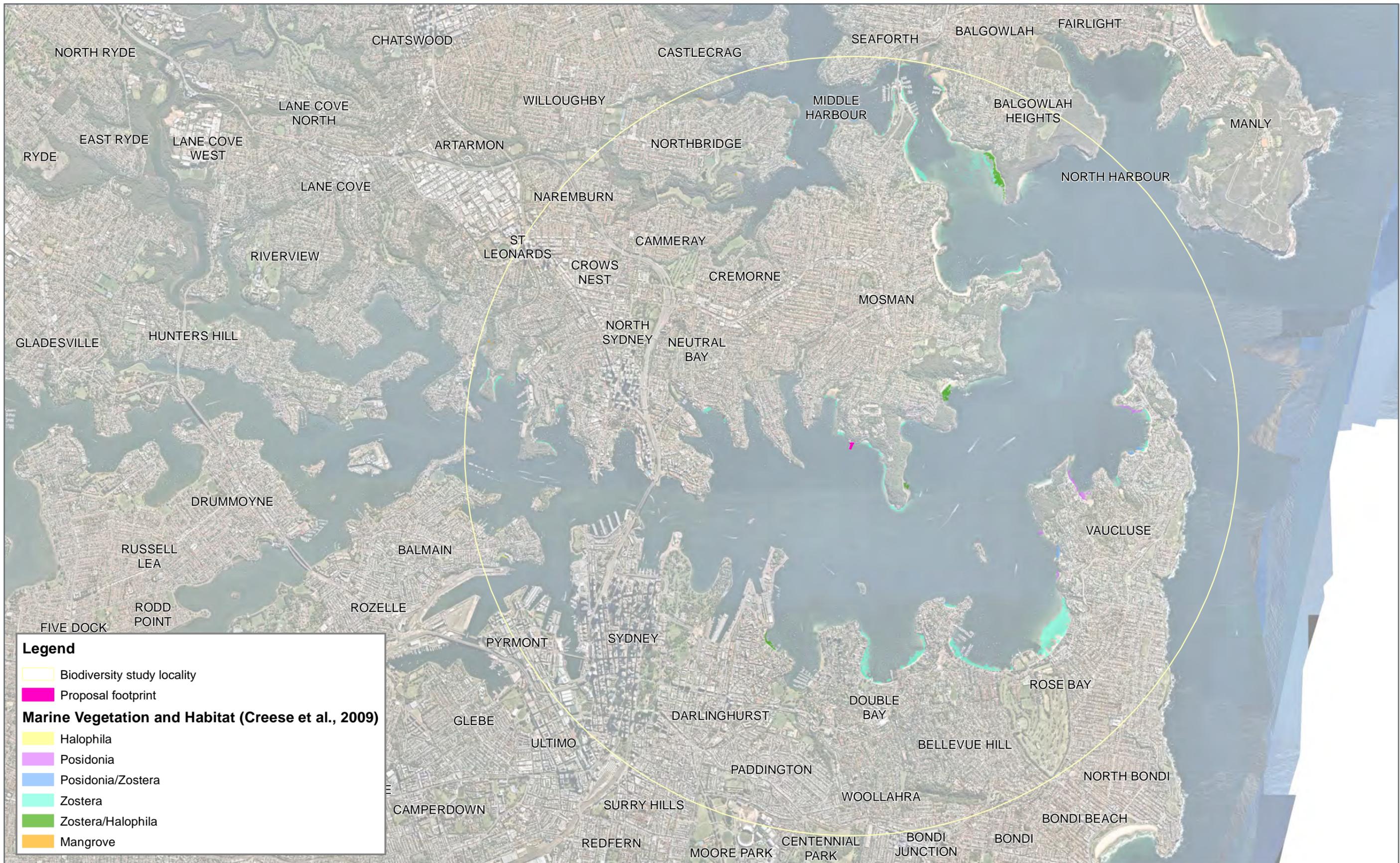
Table 3-2: Priority weeds recorded in the study area and their associated duty

| Scientific name | Common name | Extent of infestation | Duty |
|---------------------------------|------------------|---|---|
| <i>Cestrum parqui</i> | Green Cestrum | Some individuals in the understorey of remnant vegetation | Regional Recommended Measure (land managers should mitigate the risk of new weeds being introduced to land used for grazing livestock. Land managers should mitigate spread from their land. Plant should not be bought, sold, grown, carried or released into the environment) |
| <i>Asparagus aethiopicus</i> | Ground Asparagus | Mats in the understorey of remnant vegetation and on rocky/concrete revetment | Prohibition on dealings (must not be imported into the State or sold) |
| <i>Senecio madagascariensis</i> | Fireweed | Some individuals in the understorey of remnant vegetation | Prohibition on dealings (must not be imported into the State or sold) |
| <i>Anredera cordifolia</i> | Madeira Vine | Some occurrences wrapped around vegetation | Prohibition on dealings (must not be imported into the State or sold) |
| <i>Lantana camara</i> | Lantana | Some individuals in the understorey of remnant vegetation | Prohibition on dealings (must not be imported into the State or sold) |

3.7 Marine vegetation and habitat

The marine study area comprised of a partially artificial seawall and the intertidal and subtidal areas surrounding the existing Taronga Zoo wharf interchange. 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 mapped patches of *Zostera* 75 metres east and 100 metres west of the study area (Creese, et al., 2009; NSW OEH, 2016) (Figure 3-6).



1:55,000 Scale at A3



Marine Vegetation and Habitat in Study Locality

FIGURE 3.6
TARONGA ZOO



Map Produced by National Water & Environment
 Date: 2020-10-09 | Project: AWE200198
 Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Map: AWE200198_GS00X_Taronga_MarineVegHabLocality.mxd 01
 Aerial Imagery supplied by Nearmaps (2020)

Soft sediment habitats were associated with rock rubble, shell grit and solid waste materials. These unconsolidated materials were sparse in some areas (Figure 3-7) and dense in others, particularly under the existing wharf interchange. Rubble, shell grit and solid waste materials formed a colonisation platform for some sessile organisms including *Ecklonia radiata*, *Sargassum* spp. and sponges (Phylum Porifera; Figure 3-7). This soft sediment habitat occupied the majority of the subtidal environment (about 0.73 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. These 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 shell grit



Figure 3-8: Soft sediment habitat with sparsely colonised sessile species

The intertidal rocky reef was limited to the vertical sandstone seawall, the upper portions of the existing piles and loose boulders, although the adjoining subtidal rocky reef may be exposed during low spring tides (Table 3-3 and Figure 3-14). Sydney Rock Oyster (*Saccostrea glomerata*) and barnacles (unidentified) clusters colonised these areas and extended about 1 metre up the seawall from the base of the reef.

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 and up to 40 metres from the shoreline west and east of the existing wharf interchange, respectively (Figure 3-14). The eastern section comprised of low (0.10 hectares) to medium (0.05 hectares) relief reefs (Table 3-3). Medium relief reef occurred closest to shore while low relief reef extended into the channel (Figure 3-14). High relief reef was recorded to the west of the existing wharf interchange and occupied about 0.06 hectares (Figure 3-14). Subtidal rocky reefs comprised of natural bedrock, dislodged natural rock, seawall fragments and trapped soft sediment (localised or transported from other areas of the harbour).

A submarine cable was observed within the study area (Figure 3-9), east of the existing wharf structure (Figure 3-14). The cable formed a platform for colonisation for subtidal sessile species. The species assemblages on the cable resembled similarly to those observed on the piles.

Macroalgae and other sessile species recorded on subtidal rocky reefs of all reliefs commonly occur in similar habitat in the harbour. Areas of high wave energy were mostly colonised by lower profile sessile species including Sydney Rock Oysters, turfing algae (ie *Haliptilon* sp., *Corallina* sp.), *Padina* sp., *Colpomenia* sp., *Zonaria* sp., *Dichtyota dichotoma*, *Sargassum* sp., *Ulva* sp. and mussels (Class Bivalvia) (Figure 3-10). *Ecklonia radiata* and *Sargassum* spp. forest mosaics were generally found on other subtidal reefs areas (Figure 3-11). These subtidal rocky reef species also colonised the upper three metres of vertical submerged areas on existing piles and the pontoon although the communities on these structures were more characteristic of high wave energy areas (Figure 3-12). The lower sections of existing piles were colonised by sponge and ascidian mosaics (Figure 3-13).



Figure 3-9: Subtidal rocky reef assemblages on the submarine cable



Figure 3-10: Subtidal rocky reef assemblages in high wave energy areas



Figure 3-11: *Ecklonia radiata* and *Sargassum* spp. mosaics on subtidal rocky reefs



Figure 3-12: Sessile species on the top three metres of existing piles and the pontoon



Figure 3-13: Sessile species on the lower sections of existing piles

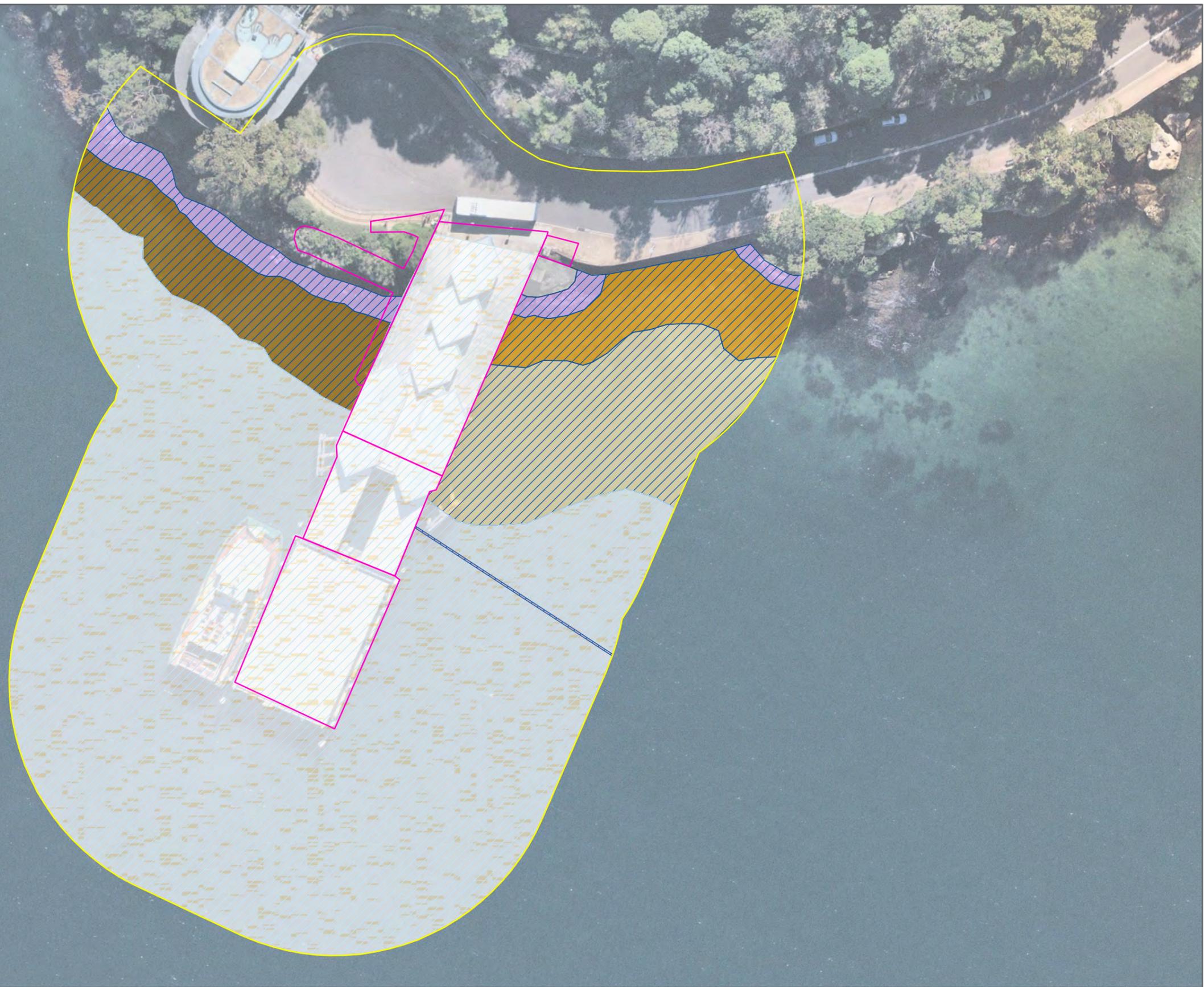
Soft sediment areas are considered Type 3 – Minimally sensitive KFH as these areas are generally characterised by unstable or unvegetated sand or mud substrate (NSW DPI, 2013). The intertidal and subtidal rocky reefs of the study area are considered Type 2 – Moderately sensitive KFH as they meet the 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) | 0.03 |
| Subtidal rocky reef, including the submarine cable (Type 2 KFH) | 0.20 |
| Soft sediment (Type 3 KFH) | 0.73 |
| Total | 0.96 |

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 transient 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 Rock Blackfish (*Girella elevata*), Silver Sweep (*Scorpius lineolata*), Striped Cardinalfish (*Ostorhinchus fasciatus*), Fanbelly Leatherjacket (*Monacanthus chinesis*) and Eastern Hulafish (*Trachinops taeniatus*).

The list of marine fauna species recorded during the field survey is provided in Annexure A.



Legend

- Biodiversity study area
- Proposal footprint
- Intertidal rocky reef
- Rock/concrete revetment
- Subtidal reef (low relief, pipe/cable)
- Subtidal rocky reef (high relief)
- Subtidal rocky reef (low relief)
- Subtidal rocky reef (medium relief)
- Subtidal soft sediment

KFH Type

- Type 2 - Moderately sensitive KFH
- Type 3 - Minimally sensitive KFH

1:750 Scale at A3



Marine Vegetation and Habitat in Study Area

FIGURE 3.14
TARONGA ZOO



Map Produced by National Water & Environment
 Date: 2020-10-09 | Project: AWE200198
 Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Map: AWE200198_GS0XX_Taronga_MarineVegHab.mxd 03
 Aerial imagery supplied by Nearmaps (2020)

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 within one kilometre of the study area shoreline 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)

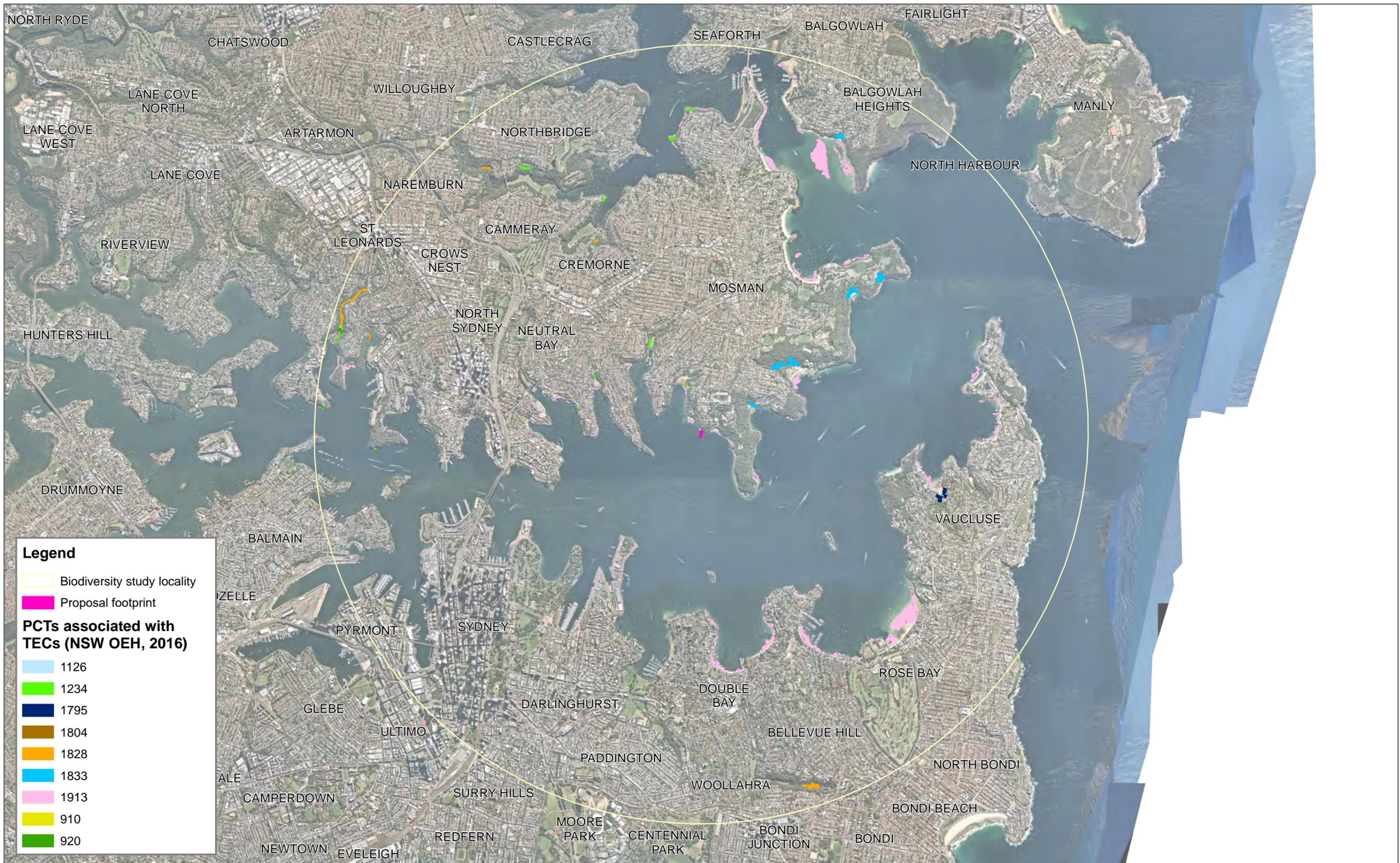
Coastal Sandstone Foreshores Forest (PCT 1778) is not associated with any TECs. However, seven potential TECs have been mapped within the locality (Figure 3-15) (NSW OEH, 2016). These, and their proximity to the study area, are detailed in Table 3-4.

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 thicket (PCT 910) | Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (endangered) | Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (critically endangered) | 4.47 | ~0.66 km north-east |
| Coastal escarpment littoral rainforest (PCT 1833) | | | | |

| | | | | |
|---|--|---|-------|---------------------|
| 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) | 0.60 | ~1.53 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) | 1.23 | ~0.60 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 | ~3.21 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 | ~2.03 km north-east |
| Coastal sandstone gallery rainforest (PCT 1828) | Hygrocybeae Community of Lane Cove Bushland Park in the Sydney Basin Bioregion (critically endangered) | - | 2.42 | ~2.77 north-west |
| 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) | 27.89 | ~0.08 km east |

*Marine vegetation discussed in Section 3.7.



1:55,000 Scale at A3



TECs in Study Locality
 FIGURE 3.15
 TARONGA ZOO



Map Produced by National Water & Environment
 Date: 2020-11-17 | Project: AWE200198
 Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Map: AWE200198_GS0XX_Taronga_TECLocality.mxd 02
 Aerial Imagery supplied by Nearmaps (2020)

3.10 Groundwater dependent ecosystems

There are no aquatic or terrestrial GDEs in the study area (BoM, 2020b). The closest mapped GDEs are in the bushland bounding Athol Beach, about 400 metres south-east and in a reserve at Curraghbeena Park, about 550 metres north-west of the study area.

3.11 Threatened species and populations

A review of the DPIE-EES BioNet database, NSW DPI Threatened species list and the DAWE PMST revealed 107 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 107 threatened species, four were amphibians, 22 were flora, one was an invertebrate, 47 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, sixteen 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 and the EPBC Act
- Black Rockcod (*Epinephelus daemeli*) listed as vulnerable under the FM Act and vulnerable under the EPBC Act
- Sunshine Wattle (*Acacia terminalis subsp. terminalis*) listed as endangered under the BC Act and EPBC Act
- Netted Bottlebrush (*Callistemon linearifolius*) listed as vulnerable under the BC Act
- Nine microbats listed as vulnerable under the BC Act:
 - Large-eared Pied Bat (*Chalinolobus dwyeri*)
 - 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*)
 - Eastern Cave Bat (*Vespadelus troughtoni*)
- Two birds listed as vulnerable under the BC Act:
 - Little Lorikeet (*Glossopsitta pusilla*)
 - Powerful Owl (*Ninox strenua*)
- 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 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 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, Assessments of Significance (AoSs) under the FM Act and the EPBC Act have been prepared to inform the impact assessment (Annexure D).

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).

Two native flora, Sunshine Wattle and Netted Bottlebrush both listed under the BC Act and EPBC Act (Sunshine Wattle only) were considered to have a moderate to high likelihood of occurrence in the study area due to the available amount of suitable habitat. Sunshine Wattle was considered to have a high likelihood of occurrence due to its very limited distribution between Botany Bay to the northern foreshore of Port Jackson and numerous recent sightings of individuals in the locality. Some vegetated areas of the foreshore (towards the water's edge) could not be safely accessed during the field survey, thus a visual habitat assessment for habitat suitability was completed with suitable habitat present within the study area, AoSs under the BC Act and EPBC Act have been completed for each species (Annexure D).

Nine 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).

Two birds, both listed under the BC Act, were considered to have moderate likelihood of occurrence in the study area. Coastal Sandstone Foreshores Forests provide potential foraging habitat for birds, particularly when in bloom/fruited, while trees and shrubs can provide breeding/roosting habitat common to urban areas. Disturbance-tolerant birds may also forage in the small areas of exotic vegetation within the study area. The impacts of the proposal on foraging resources and removal of vegetation for these species are assessed in AoSs under the BC Act (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 |
|---|----------------------------|----------------|-----------|----------------------------|--------------------------|
| Amphibians | | | | | |
| <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 | - | 46 (BioNet) | None |
| Flora | | | | | |
| <i>Acacia bynoeana</i> | Bynoe's Tiny Wattle | E | V | (PMST) | None |
| <i>Acacia terminalis subsp. terminalis</i> | Sunshine Wattle | E | E | 125 (BioNet) (PMST) | High |
| <i>Allocasuarina glareicola</i> | - | E | E | 49 (BioNet) (PMST) | None |
| <i>Allocasuarina portuensis</i> | Nielson Park She-oak | E | E | (PMST) | Low |
| <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) | Moderate |
| <i>Cryptostylis hunteriana</i> | Leafless Tongue-orchid | V | V | (PMST) | None |

| Scientific Name | Common Name | BC Act/FM Act* | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|--|--------------------------------|----------------|------------|----------------------------|--------------------------|
| <i>Doryanthes palmeri</i> | Giant Spear Lily | V | - | 2 (BioNet) | Low |
| <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>Haloragodendron lucasii</i> | Hal | E | E | (PMST) | None |
| <i>Lasiopetalum joyceae</i> | - | V | V | (PMST) | 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>Syzygium paniculatum</i> | Magenta Lilly Pilly | V | V | 108 (BioNet) (PMST) | Low |
| <i>Thesium australe</i> | Austral Toadflax | V | V | (PMST) | None |
| Invertebrates | | | | | |
| <i>Synemon plana</i> | Golden Sun Moth | E | CE | (PMST) | None |
| Birds | | | | | |
| <i>Anthochaera phrygia</i> | Regent Honeyeater | CE | CE | (PMST) | Low |
| <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 |

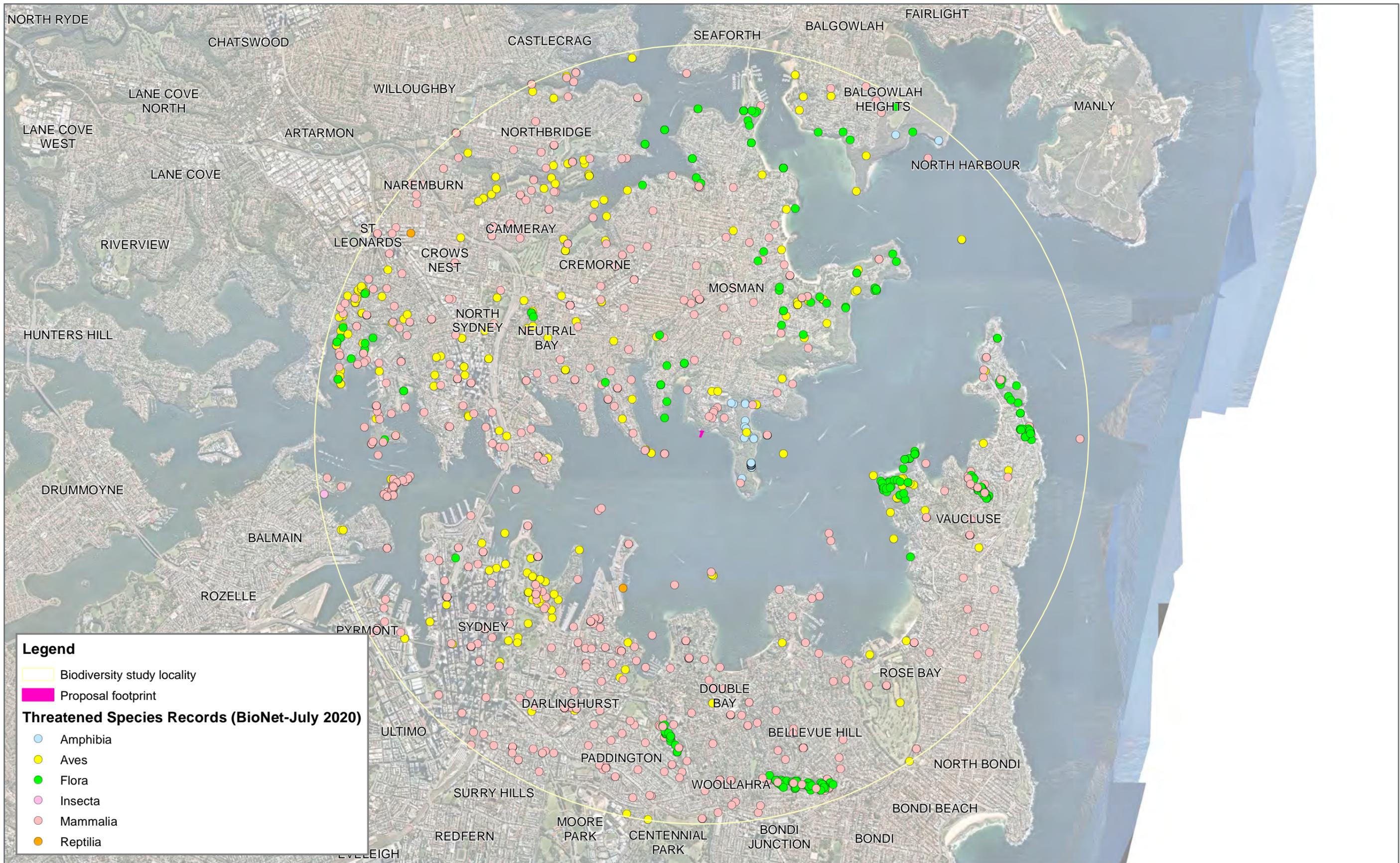
| Scientific Name | Common Name | BC Act/FM Act* | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|------------------------------------|-------------------------------------|----------------|------------|----------------------------|--------------------------|
| <i>Calidris tenuirostris</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>Falco hypoleucos</i> | Grey Falcon | E | V | (PMST) | Low |
| <i>Glossopsitta pusilla</i> | Little Lorikeet | V | - | 6 (BioNet) | Moderate |
| <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) | Low |
| <i>Hieraetus morphnoides</i> | Little Eagle | V | - | 2 (BioNet) | None |
| <i>Hirundapus caudacutus</i> | White-throated Needletail | | V, Mi, Ma | 5 (BioNet) (PMST) | Low |
| <i>Ixobrychus flavicollis</i> | Black Bittern | V | - | 2 (BioNet) | Low |
| <i>Lathamus discolor</i> | Swift Parrot | E | CE, Ma | 3 (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>Neophema chrysogastera</i> | Orange-bellied Parrot | CE | CE | (PMST) | Low |
| <i>Ninox connivens</i> | Barking Owl | V | - | 2 (BioNet) | None |

| Scientific Name | Common Name | BC Act/FM Act* | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|--|-----------------------------|-------------------|--------------|----------------------------|--------------------------|
| Ninox strenua | Powerful Owl | V | - | 185 (BioNet) | Moderate |
| <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 | 2 (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 |
| <i>Ptilinopus superbus</i> | Superb Fruit-dove | V | Ma | 5 (BioNet) | Low |
| <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) | Low. |
| Fish and Syngnathids | | | | | |
| <i>Hippocampus whitei</i> | White's Seahorse | E (FM Act) | E, Ma | (DPI) (PMST) | High |
| <i>Epinephelus daemeli</i> | Black Rockcod | V (FM Act) | V | (DPI) (PMST) | High |

| Scientific Name | Common Name | BC Act/FM Act* | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|--|--|----------------|-----------|----------------------------|--------------------------|
| <i>Prototroctes maraena</i> | Eastern Grayling | E (FM Act) | V | (PMST) | Low |
| 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) | High |
| <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 |
| <i>Falsistrellus tasmaniensis</i> | Eastern False Pipistrelle | V | - | 1 (BioNet) | Moderate |
| <i>Isoodon obesulus</i> | Southern Brown Bandicoot (eastern/south eastern) | E | E | (PMST) | None |
| <i>Megaptera novaeangliae</i> | Humpback Whale | V | V, Mi | 8 (BioNet) (PMST) | Low |
| <i>Micronomus norfolkensis</i> | Eastern Coastal Free-tailed Bat | V | - | 10 (BioNet) | Moderate |
| <i>Miniopterus australis</i> | Little Bent-winged Bat | V | - | 5 (BioNet) | Moderate |
| <i>Miniopterus orianae oceanensis</i> | Large Bent-winged Bat | V | - | 75 (BioNet) | Moderate |
| <i>Myotis macropus</i> | Southern Myotis | V | - | 47 (BioNet) | Moderate |
| <i>Petaurus norfolcensis</i> | Squirrel Glider | V | - | 1 (BioNet) | None |
| <i>Petauroides volans</i> | Greater Glider | - | V | (PMST) | None |
| <i>Petrogale penicillata</i> | Brush-tailed Rock-wallaby | E | V | (PMST) | Low |

| Scientific Name | Common Name | BC Act/FM Act* | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|--|---|----------------|-----------|-----------------------------|--------------------------|
| <i>Phascolarctos cinereus</i> | Koala (combined populations Qld, NSW and the ACT) | V | V | 4 (BioNet) (PMST) | Low |
| <i>Pseudomys novaehollandiae</i> | New Holland Mouse | - | V | (PMST) | None |
| <i>Pteropus poliocephalus</i> | Grey-headed Flying Fox | V | V | 1045 (BioNet) (PMST) | High |
| <i>Saccolaimus flaviventris</i> | Yellow-bellied Sheath-tail-bat | V | - | 1 (BioNet) | Moderate |
| <i>Scoteanax rueppellii</i> | Greater Broad-nosed Bat | V | - | 1 (BioNet) | Moderate |
| <i>Vespadelus troughton</i> | Eastern Cave Bat | V | - | 1 (BioNet) | Moderate |
| 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) | Low |
| <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 |
| <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**.



1:55,000 Scale at A3



Threatened Species Records in Study Locality

FIGURE 3.16
TARONGA ZOO



Map Produced by National Water & Environment
 Date: 2020-10-09 | Project: AWE200198
 Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Map: AWE200198_GS0XX_Taronga_TSLocality.mxd 01
 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 |
| <i>Charadrius ruficapillus</i> | Red-capped Plover | - | Ma | (PMST) | Low |
| <i>Himantopus</i> | Pied Stilt | - | Ma | (PMST) | Low |

| Scientific Name | Common Name | FM Act* | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|--------------------------------------|----------------------------|---------|-----------|----------------------------|--------------------------|
| <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 |
| <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 |

| Scientific Name | Common Name | FM Act* | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|------------------------------------|--------------------------|---------|-----------|----------------------------|--------------------------|
| <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 within Athol Bay. However, connectivity exists within the urban landscape with large, contiguous patches of moderate and low condition Coastal Sandstone Foreshores Forests and other native vegetation.

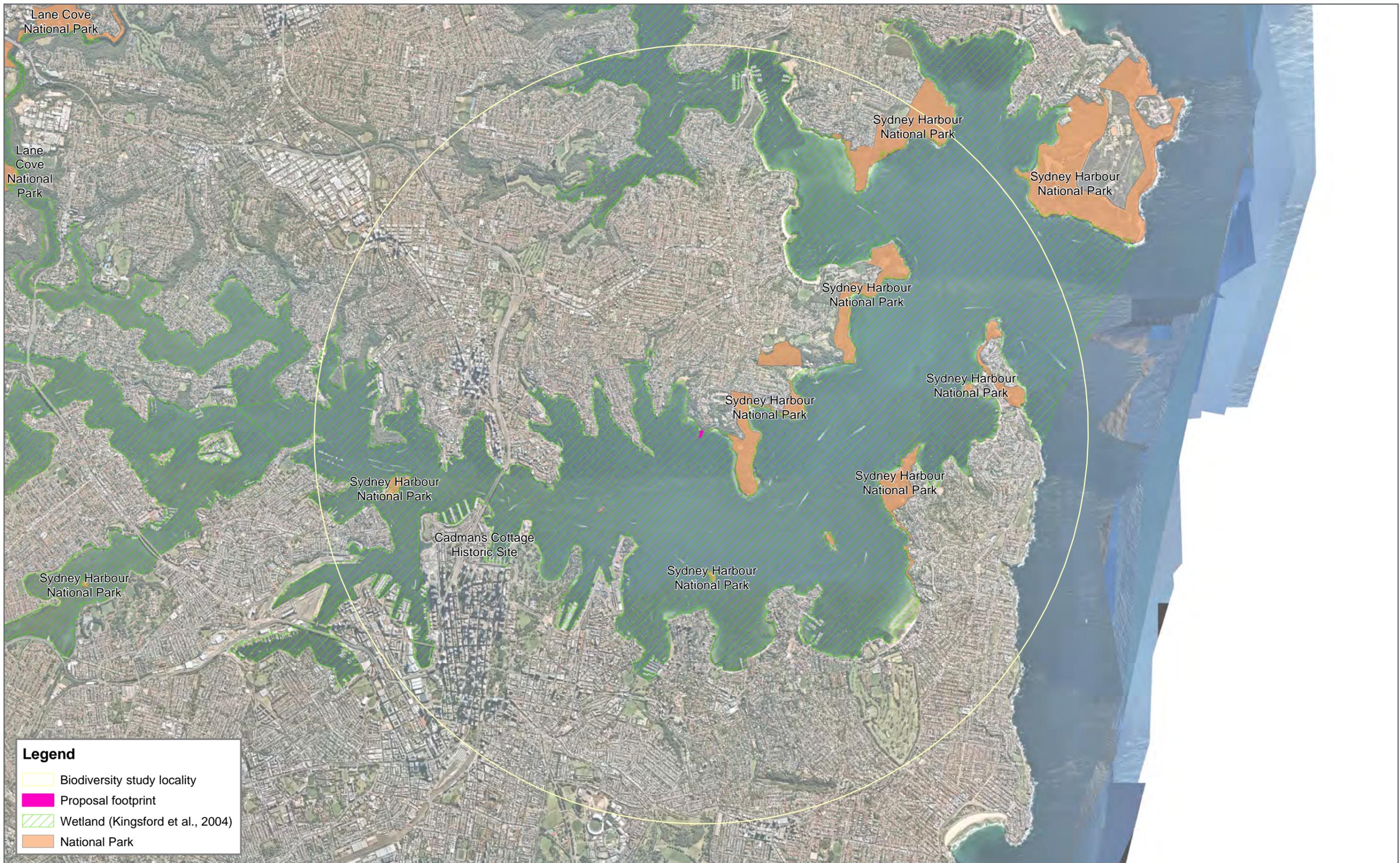
Athol Bay forms part of the marine corridor that is the Parramatta Estuary and is easily accessible for marine and estuarine species.

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 Park is the Sydney Harbour National Park, about 400 metres east of the study area (Figure 3-17). No Aquatic Reserves or Marine Parks occur within the study area or the study locality.



Legend

- Biodiversity study locality
- Proposal footprint
- Wetland (Kingsford et al., 2004)
- National Park

1:55,000 Scale at A3



Conservation Areas and Wetlands in Study Locality

FIGURE 3.17
TARONGA ZOO



Map Produced by National Water & Environment
 Date: 2020-10-14 | Project: AWE200198
 Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Map: AWE200198_GS0XX_Taronga_ConservationAreas.mxd 01
 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 28 bird species and eight 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 | 2 (BioNet) (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 |
| <i>Calidris melanotos</i> | Pectoral Sandpiper | Mi, Ma | (PMST) | Low |
| <i>Calidris ruficollis</i> | Red-necked Stint | Mi, Ma | (PMST) | Low |

| Scientific Name | Common Name | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|----------------------------------|-----------------------|-----------|----------------------------|--------------------------|
| <i>Calonectris leucomelas</i> | Streaked Shearwater | Mi, Ma | (PMST) | Low |
| <i>Charadrius bicinctus</i> | Double-banded Plover | Mi, Ma | (PMST) | Low |
| <i>Charadrius veredus</i> | Oriental Plover | Mi, Ma | 1 (BioNet) | 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>Pluvialis squatarola</i> | Grey Plover | Mi, Ma | 1 (BioNet) | Low |
| <i>Rhipidura rufifrons</i> | Rufous Fantail | Mi, Ma | (PMST) | None |
| <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 |
| Mammals and Elasmobranchs | | | | |
| <i>Balaenoptera edeni</i> | Bryde's Whale | Mi | (PMST) | Low |
| <i>Caperea marginata</i> | Pygmy Right Whale | Mi | (PMST) | Low |
| <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 |

| Scientific Name | Common Name | EPBC Act* | Number of records (source) | Likelihood of occurrence |
|------------------------|-------------------------------|-----------|----------------------------|--------------------------|
| <i>Orcinus orca</i> | Killer Whale | Mi | (PMST) | Low |
| <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 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 less than 0.01 hectares of native/exotic vegetation. This includes some native remnant trees and exotic understorey along the foreshore of the study area (Table 4-1 and Figure 4-1).

Vegetation to be removed forms part of the Coastal Sandstone Foreshores Forest PCT. This isolated patch was considered low condition as there were no characteristic mid-storey or groundcover species, but a cover of exotic Ground Asparagus and Asthma Weed was present. This low condition habitat may form potential habitat for some highly mobile, disturbance tolerant native fauna. This would result in the removal of potential habitat for native fauna. The majority of vegetation to be cleared is associated with the establishment of a new accessible ramp on the western side of the wharf. The removal of habitat resources is unlikely to have a significant impact on native fauna however, as there is an abundance of similar or better conditioned habitat across the study locality of which the study area only forms a small proportion.

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 are 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 the Study area and even the wider harbour.

4.1.2 Marine vegetation and habitat

The proposal would not require large-scale disturbance of the seabed. Part of the proposed works is the removal and addition of a number of piles within the proposed project footprint. These include:

- The removal of six ferry arrestor piles (500 millimetres diameter)
- Installation of four protection piles (610 millimetres diameter)
- Installation of four gangway support piles (on the southern end of the jetty; 508 millimetres diameter)
- Installation of three water-side access ramp piles (508 millimetres diameter; six others would be land-side).

The area of soft sediment habitat (Type 3 KFH) under the footprint of the piles that would be installed (<0.01 ha) 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. In addition, the removal of the six ferry arrestor piles would allow for the colonisation of soft sediment assemblages into these areas when piles are permanently removed. Thus, the loss of these small areas of subtidal soft sediment due to the installation of new piles would not be a substantial loss and anchor areas in soft sediment would quickly recolonise following the removal of anchors.

The removal of some of the existing structure (six ferry arrestor piles) would also result in the removal of some marine vegetation, habitat and sessile/less mobile fauna on the piles. This constitutes a total vertical marine vegetation/habitat area of less than 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 new structures. The total vertical submerged area of the new structures available for colonisation (about 0.01 hectares) is about 1.4 times the vertical area to be removed. 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. An area of <0.01 hectares of the rocky reef platform 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. Consultation with NSW DPI (Fisheries) was undertaken to meet the requirements under Section 199 of the FM Act.

A permit under Section 205 of the FM Act would be also required to 'harm' marine vegetation as per the definition of 'harm' detailed in Section 3.12. However, through consultation with NSW DPI

(Fisheries) (on 4 February 2021), NSW DPI (Fisheries) advised that there are no objections to the proposed works and no permit to harm marine vegetation is required.

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, the area of the proposed works 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

| Vegetation and habitat | Area to be directly and indirectly impacted/removed (ha) |
|---|--|
| Native/exotic gardens | <0.01 |
| 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) | <0.01 |
| Total | 0.01 |



Legend

- Proposal footprint
- Coastal Sandstone Foreshores Forest (PCT 1778)
- Intertidal rocky reef
- Subtidal rocky reef (high relief)
- Soft Sediment



Vegetation and Habitat to be Impacted
FIGURE 4.1
TARONGA ZOO



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).

There is potential that elevated construction noise and vibration could impact the resident fauna in Taronga Zoo, immediately north of the study area. Noise modelling has been completed for construction activities (Appendix C of the Noise and Vibration Impact Assessment: Taronga Zoo Wharf Upgrade (Cardno, 2021)). The existing background noise levels during the day and night at Taronga Zoo are 36 dB(A) and 30 dB(A) respectively. Noise levels of approximately 65 dB(A) are predicted at the nearest animal enclosures to the works for all of the modelled scenarios. Advice would need to be sought prior to construction on impacts on resident Taronga Zoo fauna (see Table 5-1).

With the correct controls, proposal construction is unlikely to cause mortality to coastal or mobile marine fauna and resident fauna at Taronga Zoo.

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 less than 0.01 hectares has potential to remove some 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 Bat 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. The new wharf structures are likely to provide new roosting habitat for some of 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 structures 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 some native remnant vegetation hence, the proposal triggers this KTP. However, the vegetation to be removed occurs on a highly disturbed foreshore, is on the edge of a patch and has a understorey of mostly exotic vegetation. Thus, the clearing of native vegetation as a result of the project is not considered to substantially exacerbate this KTP.

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:

- 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 11 new waterside piles within the study area. The size of these structures is 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

Upon the completion of construction, the operation of the Taronga Zoo wharf interchange would return to existing conditions thus, no impacts to coastal and marine fauna and resident fauna of Taronga Zoo as a result of the proposal are anticipated.

4.2.1 Marine vegetation and habitat

The proposed accessible ramp on the western side of the existing wharf structure would sit permanently above the water's surface and avoid impacts to the seabed. However, this proposed structure would shade a portion of intertidal rocky reef and subtidal rocky reef habitat within the study area. 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) is not expected to substantially change community assemblages as these areas generally lack marine vegetation (Table 4-1 and Figure 4-1).

The area within the vicinity of the study area 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 upgraded terminal are unlikely to be detectable in the highly variable boating environment within this area. There is potential for soft sediment habitat to be scoured from ferry jets while docking and departing the upgraded 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).

The structures of the upgraded wharf are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. The proposal would install 11 new waterside piles while removing six existing ferry arrestor piles. 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

Taronga Zoo wharf is within the Mosman LGA. Projects within the Mosman LGA and the Sydney Ferries Network have been considered for the purposes of this cumulative impact assessment as per Section 6.15 of 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>Upgrade of Taronga Zoo Wharf would require additional boat movements within Sydney Harbour for the delivery of materials to the study area 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 greenhouses gases from construction activities.</p> <p>Greenhouse gases would be generated through the use of fossil fuels by construction plant and 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> | <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"> a) Safety for commuters b) Recreational facilities c) Improved travel times d) Improved customer experience due to upgraded facilities <p>The public domain and quality of customer experience.</p> |
| <p>African Savannah and Congo Exhibits, Taronga Zoo (State Significant Development) SSD 8008.</p> <p>Partial demolition of the African Safari and Orangutan Rainforest exhibits and redevelopment to form the new African Savannah and Congo Forest exhibits including minor earthworks and regrading of the site.</p> <p>African Savannah and Congo Exhibits, Taronga Zoo (State Significant Development) SSD 8008 MOD 2.</p> <p>The modification as determined 31 October 2018 approves the staging of the above SSD as follows: Stage 1 – the African Savannah exhibit intends to commence</p> | <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> |

| Project | Construction impacts | Operational impacts |
|--|---|--|
| <p>construction in March 2018 and open in February 2020; Stage 2 – the Congo Forest exhibit intended to commence construction in May 2021 and open in October 2022.</p> | | |
| <p>DA 008.2020.00000098.001 Site preparation including demolition of Platypus house and surrounding pathways approved September 2020. The early works application supports disruptive construction associated with the redevelopment of the Upper Australia Precinct of Taronga Zoo to begin earlier while visitor numbers are restricted during COVID-19.</p> | <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> |

5 Avoid, minimise and mitigation

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

| Impact | ID | Mitigation measures | Responsibility | Timing and duration | Likely efficacy of mitigation | Residual impacts anticipated |
|---|----|---|----------------|---------------------|-------------------------------|---|
| All project impacts | B1 | 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 limited to such measures as: <ul style="list-style-type: none"> • Documenting and establishing the limits of construction activities, including clearing, vessel traffic and anchoring • Establishment of no go zones • Implementation of tree protection measures. | Contractor | Pre-construction | Effective | None |
| | B2 | Retained vegetation in close proximity to construction activities will not be damaged or removed. | Contractor | Construction | Effective | None |
| Removal of native vegetation, threatened species habitat and habitat features | B3 | Native vegetation and habitat removal will be minimised through detailed design. | TfNSW | Detailed design | Effective | <0.01 ha of native vegetation to be removed. |
| | B4 | Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). | Contractor | Pre-construction | Effective | <0.01 ha of native vegetation to be permanently removed. |
| | B5 | Vegetation and habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). | Contractor | Construction | Effective | As per 'Removal of marine vegetation and habitat' |
| | B6 | 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 | Proven | |
| Removal of marine vegetation and habitat | B7 | 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). | TfNSW | Detailed design | Effective | Removal of minimal subtidal rocky reef and soft sediment habitat below the installed piles. |
| | B8 | Direct removal of marine vegetation and habitat limited to the footprint of the eleven piles and some minor anchoring during water-based construction activities. | Contractor | Construction | Effective | Removal of part of the existing wharf structure. |
| | B9 | Minimise anchoring were possible and avoid anchoring on subtidal rocky reef habitat. | Contractor | Construction | Effective | |

| Impact | ID | Mitigation measures | Responsibility | Timing and duration | Likely efficacy of mitigation | Residual impacts anticipated |
|-----------------|-----|---|----------------|---------------------|-------------------------------|--|
| | B10 | 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 should be encouraged to move away from the study area and White's Seahorse should be captured and relocated to nearby similar habitat using methods approved by NSW DPI (Fisheries). A White's Seahorse relocation plan will be developed in consultation with DPI Fisheries to dictate this activity. These activities are to be completed by a qualified marine ecologist. | TfNSW | Pre-construction | Effective | However, the installation of the new wharf structures is likely to replace this removed habitat. |
| | B11 | 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 | |
| Aquatic impacts | B12 | Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011) and Section 3.3.2 <i>Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013</i> (NSW DPI, 2013). | Contractor | Construction | Effective | Potential localised sediment mobilisation. |
| | LS7 | <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 Prior to removing the sediment control device, conditions within the curtain would 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. |

| Impact | ID | Mitigation measures | Responsibility | Timing and duration | Likely efficacy of mitigation | Residual impacts anticipated |
|--|------|--|----------------|---------------------|-------------------------------|--|
| | LS10 | Works 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 | A spill management plan will be developed and communicated to all staff working on site. 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 potentially polluting liquids at the work site. All workers will be advised of the location of the spill kit and trained in its use. | Contractor | Construction | Effective | None |
| | B13 | Piling to stop if marine mammals are observed within approximately 100 metres of the construction footprint and only to recommence once they have moved beyond 100 metres of the construction footprint or are not seen for at least 20 minutes. | Contractor | Construction | Effective | None |
| Changes to coastal processes | B14 | The detailed design should aim to avoid/minimise any impact to coastal processes and hydrology. | TfNSW | Detailed design | Effective | Potential localised changes to currents. |
| Injury and mortality of fauna | B15 | Fauna will be managed in accordance with <i>Guide 9: Fauna handling</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). | Contractor | Construction | Effective | None |
| Invasion and spread of weeds, pests and diseases | B16 | Weed species will be managed in accordance with <i>Guide 6: Weed management</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). | Contractor | Construction | Effective | None |
| | B17 | Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011). | Contractor | Construction | Effective | None |
| | B18 | Water-based equipment and vessels to be sourced from local suppliers where possible. Equipment and vessels will be cleaned and inspected prior to entering the construction footprint. | Contractor | Construction | Effective | None |
| | B19 | Occurrence of any marine pests must be reported to NSW DPI Fisheries. | Contractor | Construction | Effective | None |
| Light | B20 | Shading and artificial light impacts will be minimised through detailed design. | TfNSW | Detailed design | Effective | None |

| Impact | ID | Mitigation measures | Responsibility | Timing and duration | Likely efficacy of mitigation | Residual impacts anticipated |
|---------------------|-----|--|----------------|------------------------------------|-------------------------------|------------------------------|
| Noise and vibration | B21 | Consultation with Taronga Zoo will be undertaken to determine whether the expected noise and vibration impacts from construction are likely to have a detrimental impact on the nearby resident Taronga Zoo fauna and to determine suitable mitigation measures to address this if required. | TfNSW | Detailed design / Pre-construction | Effective | |

6 Offset strategy

The proposal is expected to clear less than 0.01 hectares of low condition Coastal Sandstone Foreshores Forest PCT is expected to be removed for the establishment of a new accessible ramp on the western side of the wharf. The vegetation was considered low condition due to the absence of characteristic mid-storey or groundcover species and groundcover presence of exotics. This low condition habitat may form potential habitat for some highly mobile, disturbance-tolerant native fauna. The removal of habitat resources is unlikely to have a significant impact on native fauna however, as there is an abundance of similar or better conditioned habitat across the study locality of which the study area only forms a small proportion.

The proposal is expected to impact less than 0.01 hectares of marine vegetation on intertidal and subtidal rocky reefs as well as less than 0.01 hectares of vertically colonised marine vegetation on the existing wharf structures to be removed (Table 4-1). About 0.01 hectares of submerged surface area would be available for recolonisation of marine vegetation and other sessile species as part of the new structure.

7 Conclusion

The proposal forms part of the Ferry Wharf Upgrade Program and the TAP and is focused on the upgrade of the Taronga Zoo wharf interchange. This includes a number of land and water-based activities and the removal of a portion 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 on the northern foreshores of Sydney Harbour, at the southern end of Taronga Zoo. The terrestrial portion of the study area consisted of some remnant native vegetation included in the Coastal Sandstone Foreshores Forest PCT while the marine portion was comprised of a vertical sandstone seawall/rock abutment bound by a corridor of intertidal and subtidal rocky reef and soft sediment habitat in the deeper areas. There were no mangroves, saltmarsh or seagrass in or next to the study area however, a mosaic of macroalgae and habitat-forming species 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 13 terrestrial and two marine threatened fauna species:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act and the EPBC Act
- Black Rockcod (*Epinephelus daemeli*) listed as vulnerable under the FM Act and vulnerable under the EPBC Act
- Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) listed as endangered under the BC Act and EPBC Act
- Netted Bottlebrush (*Callistemon linearifolius*) listed as vulnerable under the BC Act
- Nine microbats listed as vulnerable under the BC Act:
 - Large-eared Pied Bat (*Chalinolobus dwyeri*)
 - 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*)
 - Eastern Cave Bat (*Vespadelus troughtoni*)
- Two birds listed as vulnerable under the BC Act:
 - Little Lorikeet (*Glossopsitta pusilla*)
 - Powerful Owl (*Ninox strenua*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act

The proposal would include the removal of less than 0.01 hectares of low condition native Coastal Sandstone Foreshores Forest and exotic vegetation. The removal of habitat resources is unlikely to have a substantial impact on native fauna as there is an abundance of similar or better condition habitat across the study locality.

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, eight piles (four at 610 millimetres in diameter and four at 508 millimetres in diameter) would be located on subtidal soft sediment habitat, while three piles (508 millimetres in diameter) would be located on subtidal and intertidal rocky reef. 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.

The removal of the existing piles would result in the removal of less than 0.01 hectares of marine vegetation, habitat and sessile/less mobile fauna on the piles. These species are common in subtidal rocky reefs and would quickly colonise the new piles (about 0.01 hectares of available space) provided suitable materials are used for the new piles.

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 (accessible ramp) would also shade less than 0.01 hectares of intertidal and subtidal rocky reef 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. Consultation with NSW DPI (Fisheries) was undertaken to meet the requirements under Section 199 of the FM Act.

A permit under Section 205 of the FM Act would be also required to 'harm' marine vegetation. However, through consultation with NSW DPI (Fisheries) (on 4 February 2021), NSW DPI (Fisheries) advised that there are no objections to the proposed works and no permit to harm marine vegetation is required.

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 the study area.

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.

There is potential for noise and vibration during construction to impact on the resident fauna of Taronga Zoo with noise level above background levels during the day and night. Advice would need to be sought prior to construction on impacts on resident Taronga Zoo fauna.

Considering the above, the proposal is unlikely to significantly impact coastal and marine biodiversity.

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Annexure A

Species recorded

Recorded flora

| Family | Scientific name | Common name | Native/exotic | Priority weed |
|----------------|-----------------------------------|-----------------------|---------------|---------------|
| Asparagaceae | <i>Asparagus aethiopicus</i> | Ground Asparagus | Exotic | ✓ |
| Asteraceae | <i>Bidens pilosa</i> | Cobbler's Pegs | Exotic | - |
| | <i>Senecio madagascariensis</i> | Fireweed | Exotic | ✓ |
| Basellaceae | <i>Anredera cordifolia</i> | Madeira Vine | Exotic | ✓ |
| Elaeocarpaceae | <i>Elaeocarpus reticulatus</i> | Blueberry Ash | Native | - |
| Fabaceae | <i>Acacia longifolia</i> | - | Native | - |
| Lamiaceae | <i>Westringia fruticosa</i> | Coast Rosemary | Native | - |
| Lomandraceae | <i>Lomandra longifolia</i> | Spiny-headed Mat-rush | Native | - |
| Menispermaceae | <i>Stephania japonica</i> | Snake Vine | Native | - |
| Moraceae | <i>Ficus rubiginosa</i> | Port Jackson Fig | Native | - |
| Myrtaceae | <i>Angophora costata</i> | Smooth-barked Apple | Native | - |
| | <i>Eucalyptus botryoides</i> | Bangalay | Native | - |
| | <i>Eucalyptus piperita</i> | Sydney Peppermint | Native | - |
| | <i>Leptospermum trinervium</i> | Slender Tea-tree | Native | - |
| Phyllanthaceae | <i>Breynia oblongifolia</i> | Coffee Bush | Native | - |
| Pittosporaceae | <i>Pittosporum undulatum</i> | Sweet Pittosporum | Native | - |
| Plantaginaceae | <i>Plantago lanceolata</i> | Lamb's Tongue | Exotic | - |
| Poaceae | <i>Ehrharta erecta</i> | Panic Veldtgrass | Exotic | - |
| | <i>Microlaena stipoides</i> | Weeping Grass | Native | - |
| | <i>Pennisetum clandestinum</i> | Kikuyu | Exotic | - |
| Proteaceae | <i>Banksia integrifolia</i> | Coast Banksia | Native | - |
| Sapindaceae | <i>Cardiospermum grandiflorum</i> | Balloon Vine | Exotic | - |

| Family | Scientific name | Common name | Native/exotic | Priority weed |
|-------------|---------------------------|---------------|---------------|---------------|
| Solanaceae | <i>Cestrum parqui</i> | Green Cestrum | Exotic | ✓ |
| Urticaceae | <i>Parietaria judaica</i> | Asthma Weed | Exotic | - |
| Verbenaceae | <i>Lantana camara</i> | Lantana | Exotic | ✓ |

Recorded fauna

| Family | Scientific name | Common name | Native/exotic |
|---------------|--|------------------------|---------------|
| Ascidian | | Tunicates | |
| Apogonidae | <i>Ostorhinchus fasciatus</i> | Striped Cardinalfish | Native |
| Asteropseidae | <i>Petricia vernicina</i> | - | Native |
| Cnidaria | | Jellyfish | |
| Columbidae | <i>Columba livia</i> | Rock Dove | Exotic |
| Corallinaceae | <i>Haliptilon</i> sp. | Turfing algae | Native |
| | <i>Corallina</i> sp. | - | Native |
| Dictyotaceae | <i>Dichtyota dichotoma</i> | Forkweed | Native |
| | <i>Padina pavonica</i> | - | Native |
| | <i>Zonaria angustata</i> | - | Native |
| Girellidae | <i>Girella elevata</i> | Rock Blackfish | Native |
| Hirundinidae | <i>Hirundo neoxena</i> | Welcome Swallow | Native |
| Kyphosidae | <i>Scorpis lineolate</i> | Silver Sweep | Native |
| Laridae | <i>Chroicocephalus novaehollandiae</i> | Silver Gull | Native |
| Monacanthidae | <i>Monacanthus chinensis</i> | Fanbelly Leatherjacket | Native |
| Ostreidae | <i>Saccostrea glomerata</i> | Sydney Rock Oyster | Native |
| Plesiopidae | <i>Trachinops taeniatus</i> | Eastern Hulafish | Native |

| Family | Scientific name | Common name | Native/exotic |
|------------------|----------------------|--------------|---------------|
| Sargassaceae | Sargassum sp. | | Native |
| Sturnidae | Acridotheres tristis | Common Myna | Exotic |
| Scytosiphonaceae | Colpomenia peregrina | Oyster Thief | Native |
| Thecostraca | | Barnacles | |
| Ulvaceae | Ulva lactuca | Sea Lettuce | Native |

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 per cent 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. |
| <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. | 46 (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 terminalis</i> subsp. <i>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. | 125 (BioNet) (PMST) | High. Not recorded during the field survey in the accessible areas. However, there are substantial recent records of individuals in the nearby vegetation and suitable habitat occurs 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> . | 49 (BioNet) (PMST) | None. No suitable habitat within the study area. |
| <i>Allocasuarina portuensis</i> | Nielson Park She-oak | E | E | The original known habitat of the Nielsen 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 Vaucluse 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. | (PMST) | Low. No records in the study locality. Preferred habitat not 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. |
| <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) | Moderate. Not recorded during the field survey in the accessible areas. However, suitable habitat occurs 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>Eucalyptus 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. | 2 (BioNet) | Low. Although the local geography is suitable for this species, no associated vegetation occurs 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 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>Eucalyptus capitellata</i>) and Scribbly Gum (<i>Eucalyptus haemastoma</i>). | (PMST) | None. No suitable habitat within the study area. |
| <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. |
| <i>Haloragodendron lucasii</i> | Hal | E | E | The known locations of this species are confined to a very narrow distribution on the north shore of Sydney. Associated with dry sclerophyll forest. Reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. Associated with high soil moisture and relatively high soil-phosphorus levels. | (PMST) | None. No suitable habitat within the study area. |
| <i>Lasiopetalum joyceae</i> | - | V | V | Restricted on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River between Berrilee and Duffys Forest. Occurs in 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>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. |
| <i>Pimelea curviflora</i> var. <i>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 shale/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>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. | 108 (BioNet) (PMST) | Low. Preferred habitat not 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 | | | | | | |
| <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 | | | | | | |
| <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. Preferred habitat not within the study area. |

| Scientific Name | Common Name | BC Act/FM Act | EPBC Act | Habitat requirements* | Number of records (source)+ | Likelihood of occurrence |
|-------------------------------|-------------------------|---------------|------------|---|-----------------------------|--|
| <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. No records in the study locality. 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. |
| <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. No records in the study locality. 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. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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. No records in the study locality. 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>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. |
| <i>Calyptorhynchus lathami</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. |
| <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. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |

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|-------------------------------|---------------------|---------------|-----------|---|-----------------------------|---|
| <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. No records in the study locality. Prefers specific habitat that is available in the study area but is suboptimal in condition and size. |
| <i>Falco hypoleucos</i> | Grey Falcon | E | V | Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. | (PMST) | Low. No records in the study locality. Prefers specific habitat that is available in the study area but is widely available. |
| <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) | Moderate. Potential foraging habitat present in the study area. |
| <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 although suboptimal in condition and size. |

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|-------------------------------|---------------------------|---------------|-----------|--|-----------------------------|---|
| <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) | Low. May fly through and forage in study area however, study area habitat is widely distributed. |
| <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. | 5 (BioNet) (PMST) | Low. May fly over 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. Potential habitat occurs in the study area. |
| <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>). | 3 (BioNet) (PMST) | Moderate. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |

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|-----------------------------------|-------------------------------------|---------------|----------|---|-----------------------------|---|
| <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>E. 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 ² . 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. Preferred habitat does not occur within the study area. |
| <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) | Low. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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. No records in the study locality. Prefers specific habitat that is available in the study area but is suboptimal in condition and size. |

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|------------------------------|-----------------------|---------------|-----------|---|-----------------------------|---|
| <i>Limosa 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. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |
| <i>Neophema chrysogaster</i> | Orange-bellied Parrot | CE | CE | The Orange-bellied Parrot breeds in the south-west of Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern South Australia and southern Victoria. There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. On the mainland, the Orange-bellied Parrot spends winter mostly within three kilometres of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes and saltmarshes. The species also inhabits small islands and peninsulas and occasionally saltworks and golf courses. Birds forage in low samphire herbland or taller coastal shrubland. | (PMST) | Moderate. No records in the study locality. 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. | 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>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. | 185 (BioNet) | Moderate. Some foraging and roosting habitat present in the study area. |
| <i>Numenius 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. No records in the study locality. 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. |

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|---|------------------------|---------------|----------|---|-----------------------------|--|
| <i>Pachyptila turtur subantarctica</i> | Fairy Prion (Southern) | - | V | The southern subspecies (<i>subantarctica</i>) 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. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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. | 2 (BioNet) (PMST) | Moderate. 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. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |

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|-------------------------------------|--------------------------|---------------|----------|--|-----------------------------|--|
| <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. No records in the study locality. 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) | Low. Preferred habitat not 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. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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) | Moderate. Some foraging habitat present in the study area however, is 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. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |

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|------------------------------------|-----------------------------|---------------|-----------|---|-----------------------------|--|
| <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. No records in the study locality. 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. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |
| <i>Thalassarche cauta cauta</i> | Shy Albatross | V | V, Ma, Mi | 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. | (PMST) | Low. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |

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|---|------------------------|---------------|-----------|---|-----------------------------|---|
| <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. No records in the study locality. 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. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |
| <i>Thinornis rubricollis rubricollis</i> (syn. <i>Thinornis cucullatus cucullatus</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. No records in the study locality. 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) | Moderate. Potential foraging and roosting habitat occurs within the study area. |
| Fish | | | | | | |
| <i>Hippocampus whitei</i> | White's Seahorse | E (FM Act) | E, Ma | 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 | V (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 saves, 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. |
| <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. | (PMST) | Low. No records in the study locality. May occur in the study area during the marine phase of life-cycle albeit at the end of its range and habitat is widespread. |
| Mammals | | | | | | |
| <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) | Moderate. 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) | Moderate. 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 preferred 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) | High. Foraging and roosting habitat present in the study area. |
| <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. |
| <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) | Moderate. 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 foraging and roosting habitat is present in the study area. |

| Scientific Name | Common Name | BC Act/FM Act | EPBC Act | Habitat requirements* | Number of records (source)+ | Likelihood of occurrence |
|--|---|---------------|----------|---|-----------------------------|---|
| <i>Isoodon obesulus</i> <i>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 records in the study locality. 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. | 8 (BioNet) (PMST) | Moderate. 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 tree hollows but will also roost under bark or in manmade structures. Usually solitary but have been recorded to roost communally. | 10 (BioNet) | Moderate. Potential foraging and roosting habitat is present in the study area. |
| <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 foraging and roosting habitat is present in the study area. |

| Scientific Name | Common Name | BC Act/FM Act | EPBC Act | Habitat requirements* | Number of records (source)+ | Likelihood of occurrence |
|---------------------------------------|-----------------------|---------------|----------|--|-----------------------------|---|
| <i>Miniopterus orianae 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. | 75 (BioNet) | Moderate. Potential foraging and roosting habitat is present in the study area. |
| <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. | 47 (BioNet) | Moderate. Potential foraging and roosting habitat is present in the study area. |
| <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 preferred habitat within the study area. |
| <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) | None. No records in the study locality. Preferred habitat not within the study area. |

| 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) | Low. No records in the study locality. Habitat in the study area has some suitable features but is considered suboptimal at best. |
| <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. | 4 (BioNet) (PMST) | Low. Optimal habitat not within the study area (no primary/secondary feed trees). |
| <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. |
| <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. | 1045 (BioNet) (PMST) | High. Potential foraging habitat is present in the study area. |
| <i>Saccolaimus flaviventris</i> | Yellow-bellied Sheath-tail-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 foraging and roosting habitat is present in the study area. |
| <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 and roosting habitat is present in the study area. |

| Scientific Name | Common Name | BC Act/FM Act | EPBC Act | Habitat requirements* | Number of records (source)+ | Likelihood of occurrence |
|-----------------------------|--------------------|---------------|-----------|--|-----------------------------|--|
| <i>Vespadelus trougtoni</i> | Eastern Cave Bat | V | - | Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. | 1 (BioNet) | Moderate. Potential foraging and roosting habitat is present in the study area. |
| Reptiles | | | | | | |
| <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) | Moderate. 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. No records in the study locality. May swim through the study area albeit widespread. |
| <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) | Moderate. 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>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. No records in the study locality. May swim through the study area albeit widespread. |
| <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) | Low. No records in the study locality. Suboptimal habitat is considered to occur 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. No records in the study locality. 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 | 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. | (DPI) (PMST) | Low. No records in the study locality. May swim through the study area albeit widespread. No aggregate sites know in the harbour. |
| <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. No records in the study locality. May swim through the study area albeit widespread. |
| <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. No records in the study locality. 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 |
|-----------------|-------------|---------------|----------|-----------------------|-----------------------------|--------------------------|
|-----------------|-------------|---------------|----------|-----------------------|-----------------------------|--------------------------|

* 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. | 2 (BioNet) (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. No records in the study locality. 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. No records in the study locality. Almost exclusively aerial so unlikely to land in the study area but may fly through. |
| <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. No records in the study locality. 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. No records in the study locality. Prefers specific habitat that is available in the study area but is suboptimal in condition and size. |

| Scientific Name | Common Name | EPBC Act | Habitat requirements* | Number of records (source)+ | Likelihood of occurrence |
|-------------------------------|------------------------|----------|--|-----------------------------|---|
| <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. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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. No records in the study locality. 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. No records in the study locality. 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. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |
| <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. No records in the study locality. Prefers specific habitat that is available in the study area but is suboptimal in condition and size. |

| Scientific Name | Common Name | EPBC Act | Habitat requirements* | Number of records (source)+ | Likelihood of occurrence |
|-----------------------------|---------------------|----------|--|-----------------------------|--|
| <i>Charadrius veredus</i> | Oriental Plover | Mi, Ma | The Oriental Plover is a non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Most records are along the north-western coast, between Exmouth Gulf and Derby in Western Australia, and there are records at a few scattered sites elsewhere, mainly along the northern coast, such as in the Top End, the Gulf of Carpentaria and on Cape York Peninsula. Forage among short grass or on hard stony bare ground, but also on mudflats or among beachcast seaweed on beaches. Sometimes roost on soft wet mud or in shallow water of beaches and tidal mudflats, and also occasionally in dry, open habitats, such as saltmarsh or paddocks. | 1 (BioNet) | Low. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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. No records in the study locality. 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. No records in the study locality. 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. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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. No records in the study locality. 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>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. |
| <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. No records in the study locality. 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 of saline wetlands with exposed mudflats at the edges. | (PMST) | Low. No records in the study locality. 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. No records in the study locality. 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>Pluvialis squatarola</i> | Grey Plover | Mi, Ma | Non-breeding visitor to Australia, Grey Plovers usually forage on large areas of exposed mudflats and beaches of sheltered coastal shores such as inlets, estuaries and lagoons. They usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments such as estuaries or lagoons. | 1 (BioNet) | Low. No records in the study locality. Prefers specific habitat not in the study area however, it may fly through. |
| <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>Eucalyptus cypellocarpa</i>), Narrow-leaved Peppermint (<i>Eucalyptus radiata</i>), Mountain Ash (<i>Eucalyptus regnans</i>), Alpine Ash (<i>Eucalyptus delegatensis</i>), Blackbutt (<i>Eucalyptus pilularis</i>) or Red Mahogany (<i>Eucalyptus resinifera</i>); usually with a dense shrubby understorey often including ferns. | (PMST) | None. No suitable habitat within the study area. |
| <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. No records in the study locality. 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. No records in the study locality. 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. No records in the study locality. 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. No records in the study locality. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal. |
| <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. No records in the study locality. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal. |
| <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. No records in the study locality. 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 |
|-----------------|-----------------|----------|--|-----------------------------|--|
| Lamna nasus | 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. No records in the study locality. Some foraging habitat present in the study area however, is suboptimal and widely distributed. |
| Manta alfredi | 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. |
| Manta birostris | 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. |
| Orcinus orca | Killer Whale | Mi | In Australia, orcas are recorded from all states, with concentrations reported around Tasmania. Sightings are also frequent in South Australia and Victoria. A sighting at Yirrkala in April 1999 provides evidence that they also occur in Northern Territory waters. Orcas are frequently seen in the Antarctic south of 60° S and have been recorded from Heard and Macquarie Islands. Macquarie Island appears to be a key locality, with orcas regularly reported there. The preferred habitat of orcas includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters. They may be more common in cold, deep waters, but off Australia, orcas are most often seen along the continental slope and on the shelf, particularly near seal colonies. Orcas have regularly been observed within the Australian territorial waters along the ice edge in summer. | (PMST) | Low. No records in the study locality. 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>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. No records in the study locality. 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>.

+ 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:

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. |
| <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. |

| Scientific Name | Common Name | FM Act | EPBC Act | Habitat requirements* | Number of records (source)+ | Likelihood of occurrence |
|--------------------------------------|----------------------------|--------|----------|---|-----------------------------|---|
| <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 | | | | | | |
| <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. | (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. |
| <i>Epinephelus coioides</i> | Estuary Cod | 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. 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. | (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 lanceolatus</i> | Queensland Groper | P | Ma | 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 Gropers 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. | (DPI) | Moderate. Potential habitat is present in the study area albeit towards the end of the species range. |
| <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. | (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. | (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. | (PMST) | High. Potential habitat is present in the study area. |
| <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. | (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>Hippocampus abdominalis</i> | Big-belly Seahorse | P | Ma | <p>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.</p> <p>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.</p> | (PMST) | <p>High.</p> <p>Potential habitat is present in the study area.</p> |
| <i>Histiogamphelus briggsii</i> | Crested Pipefish | P | Ma | <p>Endemic to temperate waters of south-eastern Australia, from New South Wales, south to Victoria and Tasmania, and westwards to Gulf St Vincent.</p> <p>Crested pipefish inhabit inshore sandy areas, singly or in small aggregations, often amongst detached seaweed or along the margins of <i>Posidonia</i> seagrass beds and in open sandy areas at 3–20 m; most common in Bass Strait.</p> | (PMST) | <p>High.</p> <p>Potential habitat is present in the study area.</p> |
| <i>Lissocampus runa</i> | Javelin Pipefish | P | Ma | <p>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.</p> | (PMST) | <p>High.</p> <p>Potential habitat is present in the study area.</p> |
| <i>Maroubra perserrata</i> | Sawtooth Pipefish | P | Ma | <p>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.</p> | (PMST) | <p>High.</p> <p>Potential habitat is present in the study area.</p> |
| <i>Notiocampus ruber</i> | Red Pipefish | P | Ma | <p>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.</p> | (PMST) | <p>High.</p> <p>Potential habitat is present in the study area.</p> |
| <i>Paraplesiops bleekeri</i> | Eastern Blue Devil | P | - | <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.</p> | (DPI) | <p>High.</p> <p>Potential habitat is present in the study area.</p> |

| 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. | (PMST) | High. Potential habitat is present in the study area. |
| <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. | (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 macroalgae in 15-25 m. | (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>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. | (PMST) | Low. Prefers specific habitat not characterised by study area. |
| <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. | (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. | (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. | (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. | (PMST) | High. Potential habitat is present in the study area. |
| <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). | (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 |
|-------------------------|--------------------------|--------|----------|---|-----------------------------|--|
| Vanacampus margaritifer | 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. | (PMST) | High. Potential habitat is present in the study area. |

* 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), an ecologist 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 and the EPBC Act
- Black Rockcod (*Epinephelus daemeli*) listed as vulnerable under the FM Act and vulnerable under the EPBC Act
- Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) listed as endangered under the BC Act and EPBC Act
- Netted Bottlebrush (*Callistemon linearifolius*) listed as vulnerable under the BC Act
- Nine microbats listed as vulnerable under the BC Act:
 - Large-eared Pied Bat (*Chalinolobus dwyeri*)
 - 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*)
 - Eastern Cave Bat (*Vespadelus troughtoni*)
- Two birds listed as vulnerable under the BC Act:
 - Little Lorikeet (*Glossopsitta pusilla*)
 - Powerful Owl (*Ninox strenua*)
- 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 partial removal of vegetation comprising of low condition Coastal Sandstone Foreshores Forest (PCT 1778) and exotics. 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 removal of the native/exotic habitat would temporarily remove some suboptimal 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 partially remove up to 0.01 hectares of low condition PCT 1778 and exotics on the foreshore which is potential foraging and roosting habitat for these species. The vegetation is considered low condition due to the lack of characteristic midstorey or groundcover species with exotic coverage. The partial removal of suboptimal foreshore vegetation would allow connectivity and not fragment potential habitat. As the original wharf structure above the water line is remaining, similar roosting habitat (e.g. rooves) would be reinstated when the 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 (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. Weed control would be implemented as part of the proposal thus, this KTP is unlikely to be exacerbated (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 partially removed is comprised of low condition PCT 1778 and exotics. 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 0.01 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, weed control measures would be implemented as part of the proposal to avoid the spread of exotic vegetation to higher condition habitat in nearby areas. 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-eared Pied Bat (*Chalinolobus dwyeri*), Large Bent-winged Bat (*Miniopterus orianae oceanensis*), Little Bent-winged Bat (*Miniopterus australis*), Southern Myotis (*Myotis macropus*), Eastern Cave Bat (*Vespadelus troughtoni*))

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 Large-eared Pied Bat 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. 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 Eastern Cave Bat usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings.

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 (e.g. rooves). 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 partial 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 foraging habitat would only be temporarily disturbed during construction.

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 partially remove up to 0.01 hectares of low condition PCT1778 and exotics forming 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 partial removal of this area of vegetation and the existing wharf structures will allow connectivity and is not predicted to further fragment or isolate habitat for these species.

Furthermore, 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 (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. Weed control would be implemented as part of the proposal thus, this KTP is unlikely to be exacerbated (also see Section 4.1.7).

Conclusion

While there is potential foraging habitat for these five species throughout the study area, this habitat is widespread and not optimal. The proposal would remove up to 0.01 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, weed control measures would be implemented as part of the proposal to avoid the spread of exotic vegetation to higher condition habitat in nearby areas 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.

Birds (Little Lorikeet (*Glossopsitta puiusilla*) and Powerful Owl (*Ninox strenua*))

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.

Coastal Sandstone Foreshores Forests provide potential foraging habitat for birds, particularly when in bloom/fruited. Trees and shrubs can provide breeding/roosting habitat common to urban areas. The Little Lorikeet forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (*Angophora* spp.), paperbarks (*Melaleuca* spp.) and other tree species. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.

The Powerful Owl is widely distributed throughout NSW in the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. 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 (*Syncarpia glomulifera*), Black Sheoak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis*) and a number of Eucalypt species.

The proposed works would require the partial removal of up to 0.01 hectares of low condition PCT 1778 and exotics along the foreshore of the study area. The vegetation to be removed would potentially remove some foraging habitat, however the removed native/exotic gardens is considered suboptimal foraging habitat for each species, with ample foraging habitat available in the wider study area. No trees with hollows were observed in the study area. 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 0.01 hectares of low condition PCT 1778 and exotics, potential foraging habitat for these species. The vegetation is considered low condition due to the lack of characteristic midstorey or groundcover species with exotic coverage. There is currently a high degree of habitat fragmentation across the wide locality. The removal of this vegetation is not predicted to further fragment or isolate habitat for these aerial species, but allow connectivity. As discussed in (1), the habitat to be removed is not considered optimal for foraging, with contiguous patches of suitable habitat in the wider study area. 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 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 these bird species but is considered to impose only minimal impact on the total extent of potential habitat in the locality (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. Weed control would be implemented as part of the proposal thus, this KTP is unlikely to be exacerbated (also see Section 4.1.7).

Conclusion

While there is potential habitat for these species to exist within the study area, the removal of the low condition PCT 1778 is unlikely to have a significant impact as there is an abundance of similar or better quality habitat across the study locality of which the study area only forms a small proportion. Furthermore, weed control measures would be implemented as part of the proposal to avoid the spread of exotic vegetation to higher condition habitat in nearby areas. Based on this, the proposal is unlikely to significantly impact these two species and a SIS is not required.

Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) listed as endangered under the BC Act and Netted Bottlebrush (*Callistemon linearifolius*) listed as vulnerable under the BC Act

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 Sunshine Wattle has a 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. Sydney Harbour is identified as a priority management site, with several recent individual sightings recorded in the wider study area.

The Netted Bottlebrush, 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.

The proposal would partially remove up to 0.01 hectares of low condition PCT 1778 and exotics on the foreshore which is potential habitat for these species. The vegetation is considered low condition due to the lack of characteristic midstorey or groundcover species with exotic coverage and much of the nearby higher condition vegetation would not be impacted by the proposal. The partial removal of suboptimal foreshore vegetation would allow connectivity and not further fragment potential habitat. Disturbance of vegetation can result in the introduction or spread of exotic flora (ie 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. 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 0.01 hectares of low condition PCT 1778 and exotics on the foreshore which is potential habitat for these species. The vegetation in the study area form part of a fragmented urban landscape. The partial removal of this area of vegetation will allow future connectivity and is not predicted to further fragment or isolate habitat for these species. Furthermore, the proportion of potential habitat to be impacted by the proposal is very small compared to what is available in the wider locality, therefore is the proposal is unlikely to further 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 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* temporarily triggers this KTP. However, the native vegetation to be cleared does not constitute remnant vegetation (also see Section 4.1.7). The proportion of potential habitat to be impacted by the proposal is very small compared to what is available in the wider locality.

Invasion and establishment of exotic vines and scramblers and *Invasion of native plant communities by exotic perennial grasses* is unlikely to trigger/exacerbate by the proposal as weed control measures will be implemented as part of the proposal. Furthermore, controls would be implemented to avoid the introduction/spread of exotic species during construction.

Conclusion

While there is potential habitat for these species to exist within the study area, the removal of the low condition PCT 1778 and exotics are unlikely to have a significant impact as there is an abundance of similar or better quality habitat across the study locality and of which the study area only forms a small proportion. Although *Clearing of native vegetation* KTP is triggered, the proportion of clearing and the low condition of vegetation that is proposed to be cleared would not substantially exacerbate this KTP. Based on this, the proposal is unlikely to significantly impact these two 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 0.01 ha which could constitute 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 0.01 ha. 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 Port Jackson Fig (*Ficus rubiginosa*) to the west of the proposed access ramp 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 (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. Weed control would be implemented as part of the proposal thus, this KTP is unlikely to be exacerbated (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. 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 (<0.01 hectares) and existing piles and pontoon. 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 will 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 has potential to reside in subtidal rocky reef and artificial structures, which are both present in the study area. However, optimal habitat and known populations are found elsewhere in the harbour (eg 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 considered 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 new piles to be installed would form potential habitat for the species once habitat-forming species have colonised and the total surface area of these new structures is 1.4 times that to be removed. 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.

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 4.1.7. 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 wharf 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*) – vulnerable (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/high 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 4.1.7. 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.

Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) – endangered (EPBC Act)

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

- (a) Lead to a long-term decrease in the size of a population

The Sunshine Wattle has 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. The proposal would directly remove up to 0.01 hectare of low condition PCT 1778 and exotics but would retain higher condition vegetation nearby. The removal of suboptimal foreshore vegetation would not affect connectivity and seed dispersal and any individuals lost as a result of the clearing (albeit unlikely) is not considered to lead to the long-term decrease in the size of the population

- (b) Reduce the area of occupancy of the species

See (a). The proposal will reduce the area of available habitat to the species. However, the proportion of potential habitat to be impacted by the proposal is very small compared to what is available in the wider locality, occurs on a highly disturbed foreshore and considered low condition. No individuals were recorded during the field survey in the study area. Thus, as it is unlikely that this species currently resides in the study area, the loss of a small areas of suboptimal habitat is not considered to reduce the area of occupancy of the Sunshine Wattle.

- (c) Fragment an existing population into two or more populations

The greatest threat to the Sunshine Wattle is habitat loss due to urban development. There is currently a high degree of habitat fragmentation across the wide locality. Although the Sunshine Wattle has a very limited distribution, the current low condition of the area to be partially removed is rendered as suboptimal and no individuals were observed during the field survey, with optimal habitat for the Sunshine Wattle in prevalent in the wider study area. Thus, the proposal would not fragment an important population of the Sunshine Wattle.

- (d) Adversely affect habitat critical to the survival of a species

See (b).

- (e) Disrupt the breeding cycle of a population

As stated above there would be a minor impact on the overall habitat of the Sunshine Wattle, with better quality habitat available in the wider study area.

- (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 an endangered species becoming established in the endangered species' habitat

Weed control would be implemented as part of the proposal thus, it is unlikely that exotic species harmful to the Sunshine Wattle would become established in nearby, suitable habitat.

- (h) Introduce disease that may cause the species to decline

The proposal has the potential to introduce diseases such as Phytophthora (*Phytophthora cinnamomi*) and Myrtle Rust (*Austropuccinia psidii*) foreign equipment or materials brought onto the construction site if not managed appropriately. Sunshine Wattle is generally less prone to the disease specifically, rather indirectly affected by death of surrounding trees due to the disease. The potential for introduced diseases was considered possible with a proposal of this nature and appropriate controls would be implemented during construction and operation to reduce this threat.

- (i) Interfere substantially with the recovery of the species

The Draft Recovery Plan for the Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) (Department of Environment, Climate Change and Water (NSW) (2010) outlines the following actions:

- Coordinate the recovery of the Sunshine Wattle
- Conserve the Sunshine Wattle using land-use and conservation planning mechanisms
- Identify and minimise threats operating at sites where the Sunshine Wattle occurs
- Promote surveys, research and monitoring that will assist with the management of the Sunshine Wattle
- Provide stakeholders with information to assist in conserving the Sunshine Wattle
- Raise awareness about the threats to the subspecies and involve the community in the recovery program

The recovery actions listed above are largely not applicable to the proposal as they focus on priority conservation lands that are primarily 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 habitat in the wider study area the proposal is not expected to interfere substantially with this recovery action by removing a very small proportion of vegetation. Furthermore, vegetation prevalent with exotic species would be replaced with native species local to the Sydney region during landscaping.

Conclusion

The Sunshine Wattle if present, will temporarily suffer a small reduction in potential habitat, however this habitat occurs on a highly disturbed foreshore and is considered low in condition. The proposal is unlikely to reduce the population size of the Sunshine Wattle or decrease the reproductive success of this species. The proposal will not interfere with the recovery of the Sunshine Wattle and will not contribute to the key threats to this species. Thus, the proposal is unlikely to significantly impact the Sunshine Wattle 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 <0.01 hectare 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 to be removed is considered low condition foraging habitat for the species.

- (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, or
- 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.

White's Seahorse (*Hippocampus whitei*) – endangered (EPBC Act)

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

(a) Lead to a long-term decrease in the size of population

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).

The study area is considered to provide suitable habitat for White's Seahorse in low to medium relief rocky reef (<0.01 hectares) and existing piles and pontoon. The potential loss of individuals from the removal of this habitat would decrease the size of the local population. However, in order to avoid loss of any individuals of this species, targeted surveys will 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 lead to the long-term decrease in the size of the local population of White's Seahorse.

(b) Reduce the area of occupancy of the species

As indicated in (a), White's Seahorse has potential to reside in subtidal rocky reef and artificial structures, which are both present in the study area. However, optimal habitat and known populations are found elsewhere in the harbour (eg 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 remove existing piles, considered suitable habitat for the species, with a total surface areas of <0.01 ha. The proposal would also shade <0.01 hectares of subtidal rocky reef which may lead to a change in assemblages in this habitat. These are considered small proportions of potential habitat for the species in the study area and the wider harbour and shading of potential habitat is unlikely to remove these areas from use by the species. The new piles to be installed would form potential habitat for the species once habitat-forming species have colonised. The surface area of the newly installed piles would amount to 1.4 times that to be removed. Hence, although the proposal will remove an existing area of occupancy of the species, a greater area of replacement habitat would be reinstated. The proposal is unlikely to reduce the area of occupancy of the White's Seahorse.

(c) Fragment an existing population into two or more populations

As indicated in (a) and (b), the White's Seahorse habitat occurs in nearshore areas in the harbour. This species exhibits high site fidelity and does not have a pelagic juvenile stage. Young are known to either disperse short distances from or simply settle at the birth site. Although high abundances of this species have not been recorded in the study area, there are multiple known locations in the harbour where juveniles may disperse from. However, the proposal is not expected to install any structures or alter ferry operations such that potential dispersal corridors along the foreshore would become fragmented or isolated. Thus, the proposal is unlikely to fragment an existing population of White's Seahorse in the harbour into two or more populations.

(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, or
- For the reintroduction of populations or recovery of the species.

See (a) and (b). The proposal has potential to alter potential, sub-optimal habitat for the species. Some of this sub-optimal habitat would be temporally lost or permanently shaded. However, lost habitat would be reinstated (in a greater area than that lost) and shaded habitat would still be available and considered a potential area of occupancy. Thus, the proposal is unlikely to adversely affect habitat critical to the survival of the White's Seahorse.

(e) Disrupt the breeding cycle of a population

Research found that White's Seahorse displays life-long monogamy, with three pairs observed remaining bonded over three consecutive breeding years (Harasti, et al., 2012). Thus, the loss of any individuals would disrupt the breeding cycle of White's Seahorse. No individuals are expected to be lost as a result of the project (see (a)). Any individuals occurring within the study area would be relocated prior to construction by a qualified marine ecologist using researched methods to avoid disruption to their lifecycle. Habitat would be selected by a marine ecologist and individuals would only be relocated to nearby, like-for-like habitat (as per advice from NSW DPI (Fisheries)). Hence, the proposal is unlikely to disrupt the breeding cycle of a 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). The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the White's Seahorse is likely to decline.

(g) Result in invasive species that are harmful to an endangered species becoming established in the endangered 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 White's Seahorse to decline. Invasive species that would alter White's Seahorse habitat could be introduced via the aforementioned vectors however, proposal controls would be in place to avoid introducing or spreading invasive species. Thus, the proposal is unlikely to introduce or spread invasive species that are harmful to White's Seahorse.

(h) Introduce disease that may cause the species to decline

As per (g).

(i) Interfere substantially with the recovery of the species

There is currently no recovery plan or recommendations for a recovery plan for the White's Seahorse. When this species was initially nominated for listing under the EPBC Act, the Fisheries Scientific Committee had recommended management actions for the 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 (Fisheries) to align with some of the above management recommendations.

Conclusion

White's Seahorse is known to be present in Port Jackson. The study area possesses sub-optimal habitat for the species and it is not known to disperse (either as adults or juveniles) great distances from the birth sites. Potential habitat in the study area occurs as low to medium relief rocky reefs and the submerged sections of the existing artificial structures. The proposal would temporarily remove and permanently shade potential habitat for the species. However, lost potential habitat would be reinstated (in a greater area than that lost) and shaded habitat would still be available and considered a potential area of occupancy. The proposal is unlikely to fragment the population of White's Seahorse in the harbour, disrupt the breeding cycle of the species, introduce or spread invasive species or disease that may adversely impact the species or interfere with any recovery objectives. Thus, the proposal is unlikely to significantly impact White's Seahorse and a referral is not required.



Appendix F

Construction Noise and Vibration Impact Assessment

Noise and Vibration Impact Assessment

Taronga Zoo Wharf Upgrade

AWE200198



Prepared for
Transport for NSW

3 March 2021

Document Information

| | |
|----------------|--------------------------------------|
| Prepared for | Transport for NSW |
| Project Name | Taronga Zoo Wharf Upgrade |
| File Reference | pr_l136_030321_TPZ_01JM_final04.docm |
| Job Reference | AWE200198 |
| Date | March 2021 |

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Document Control

| Version | Effective Date | Description of Revision | Prepared by | Reviewed by |
|---------|----------------|-------------------------|---------------|----------------|
| Rev A | 11 Nov 2020 | Draft for client review | Liam McDonagh | Julie McDonagh |
| Rev B | 13 Dec 2020 | Draft for client review | Liam McDonagh | Julie McDonagh |
| Rev 0 | 03 Mar 2021 | Final | Liam McDonagh | Julie McDonagh |

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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 Taronga Zoo wharf. Taronga Zoo wharf is located approximately three 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:

- > Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- > Removal of existing gangways
- > Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- > Two new transition ramps on the existing pontoon to cater for the new gangways
- > Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- > Construction of a new covered *Disability Standards for Accessible Public Transport* (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- > Removal and relocation of the Transdev office and café on the existing jetty
- > Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- > Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- > Relocation of existing Opal Card readers and Opal top-up machine
- > Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the proposal would include:

- > Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- > Retention of the five existing bicycle parking hoops
- > Retention of the public telephone booth
- > Removal of foreshore vegetation to construct the new accessible ramp.

This assessment has been carried out to determine the predicted noise and vibration impacts associated with the construction of the proposed Taronga Park Zoo wharf Interchange upgrades. Noise modelling has been carried out to determine whether the proposed construction works associated with the project are likely to impact nearby noise sensitive receivers. Potential vibration impacts have also been assessed to the nearest sensitive receivers to the works.

This assessment considers the following impacts on nearby 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:

- > NSW *Interim Construction Noise Guideline* (DECC 2009) (ICNG)
- > NSW *Assessing Vibration – A Technical Guideline* (DEC 2006) (AVATG)
- > NSW *Construction Noise and Vibration Guideline* (RMS 2016) (CNVG).

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. This assessment indicates that there are no sensitive receivers predicted to experience construction noise levels of greater than 75 dB(A).
- > Construction noise levels are predicted to exceed the NSW ICNG noise management levels (NML) for “standard” hours at NCA 3 for standard construction hours for all construction scenarios. Construction noise levels are not predicted to exceed the NMLs at NCA 1 and 2 for works during standard hours.
- > Construction noise levels are predicted to exceed noise management levels for “non-standard” hours of operation for Scenario 4a at the nearby residential receivers in all NCAs, particularly for receivers located on Raglan Street and Wulworra Avenue in NCA 2 and 3 respectively. This is due to the proximity of receivers to the construction works.
- > Predicted levels are expected to be moderately intrusive at a number of receivers in NCA 3 for Scenario 4a for works during the OOHW2 time period. It is understood that no works associated with Scenario 4a will take place during the OOHW1 time period. Construction noise is likely to have the highest impact on and cause sleep disturbance at sensitive receivers located on Raglan Street in NCA 2 and Wulworra Avenue/Cremorne Road in NCA 3, 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 is not likely to be practical for this site given the elevated nature of the surrounding receivers. However, provision of anti-gawk screens with no gaps around the work site may provide some screening to the closest ground level receivers, and should be investigated further as part of the project Construction Noise & Vibration Management Plan (CNVMP) assessment.
- > 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 TfNSW Construction Noise and Vibration Guideline.
- > A detailed construction noise and vibration management plan should 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. |
| 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 Road Noise Policy (DECCW 2011). |
| RTA | NSW Roads and Traffic Authority, now known as the NSW Department of Transport, Roads and Maritime Services |
| 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 |

| Term | Definition |
|--|--|
| | 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 Taronga Zoo wharf .

The Taronga Zoo wharf is located off Athol Wharf Road on the northern side of Sydney Harbour within the suburb of Mosman. The existing wharf consists of a covered walkway down to the café and dual gangways to a floating pontoon, providing access from Athol Wharf Road.

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. Potential vibration impacts have also been assessed to the nearest sensitive receivers to the works.

This assessment considers the following policies and guidelines:

- > NSW *Interim Construction Noise Guideline* (DECC 2009) (ICNG)
- > NSW *Construction Noise and Vibration Guideline* (RMS 2016) (CNVG)
- > NSW *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 various noise sensitive locations near the proposed Taronga Zoo 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

Transport for NSW proposes to construct upgrades to the Taronga Zoo wharf (the proposal) as part of the NSW Government's Transport Access Program (TAP).

The proposal is located within the local government area (LGA) of Mosman Council. Taronga Zoo wharf interchange is positioned near the cul-de-sac at the end of Athol Wharf Road on the northern shore of Sydney Harbour. The wharf is located in close proximity to the southern entry point of Taronga Zoo and Sydney Harbour National Park, and Bradleys Head is located to the east of the wharf.

The wharf is part of the F2 Ferry Service that operates between Circular Quay and Taronga Zoo. The proposal is to improve access to the wharf via a new accessible ramp and the addition of other accessible elements, including longer gangways and modifications to the existing jetty and pontoon to allow for accessible and more efficient passenger services.

The water based features of the proposal would include:

- > Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- > Removal of existing gangways
- > Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- > Two new transition ramps on the existing pontoon to cater for the new gangways
- > Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- > Construction of a new covered *Disability Standards for Accessible Public Transport* (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- > Removal and relocation of the Transdev office and café on the existing jetty
- > Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- > Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- > Relocation of existing Opal Card readers and Opal top-up machine
- > Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the proposal would include:

- > Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- > Retention of the five existing bicycle parking hoops
- > Retention of the public telephone booth
- > Removal of foreshore vegetation to construct the new accessible ramp.

Figure 2-1 shows a visual perspective of the proposal from a waterside perspective.



Figure 2-1 View of the proposal from a waterside perspective looking north-east

Figure 2-2 shows a visual perspective of the proposal from a landside perspective.



Figure 2-2 View of the proposal from a landside perspective looking south-east

Figure 2-3 shows the key features of the proposal including the water-based and land-based components.

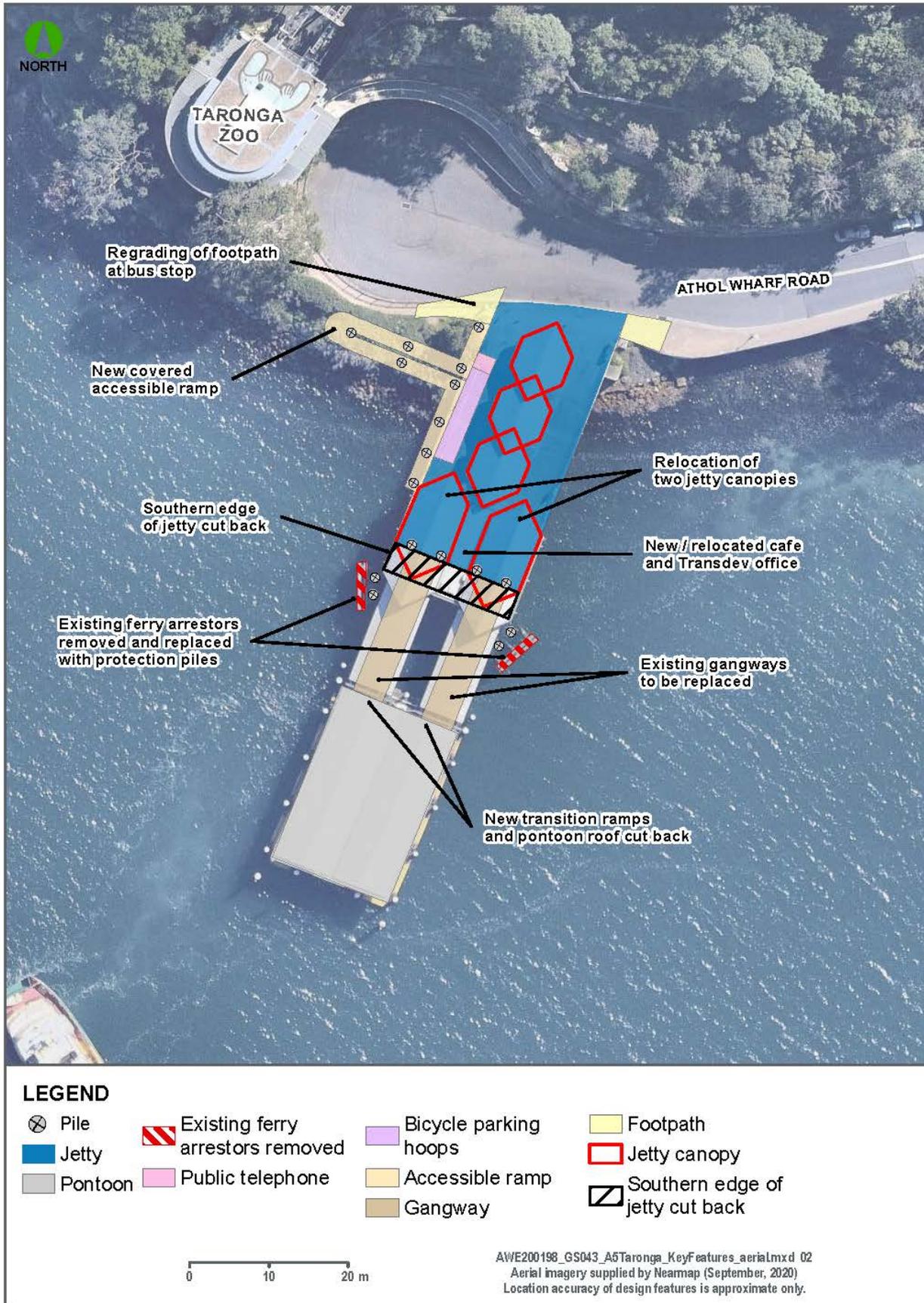


Figure 2-3 Key features of the proposal

2.2 Existing site description

The Taronga Zoo wharf is located on Athol Wharf Road at the southern bank of Taronga Zoo, approximately 445 metres from residential properties located to the north along Whiting Beach Road. The existing wharf is surrounded by a range of noise sensitive receivers, mostly residential and recreational. Non-residential receivers include recreational and commercial areas such as Taronga Zoo, Athol Hall, Sydney Harbour National Park, Cremorne Point Garden and Walk and Cremorne Reserve Parkland.

The assessment area for the proposal, is shown in Figure 2-4 and includes the land uses listed in Table 2-1.

Table 2-1 Existing land uses

| Label | Description | Land Use |
|-------|------------------------------|---------------------------------|
| 1 | Residential North | Residential |
| 2 | Residential Northwest | Residential |
| 3 | Residential West | Residential |
| 4 | Taronga Zoo | Commercial / Passive Recreation |
| 5 | Sydney Harbour National Park | Passive Recreation |
| 6 | Athol Hall | Community Use |
| 7 | Curraghbeena Park | Passive Recreation |
| 8 | Cremorne Reserve Parkland | Passive Recreation |
| 9 | Cremorne Point Garden & Walk | Passive Recreation |
| 10 | Sydney Amateur Sailing Club | Passive Recreation |

The above locations are shown in Figure 2-4.

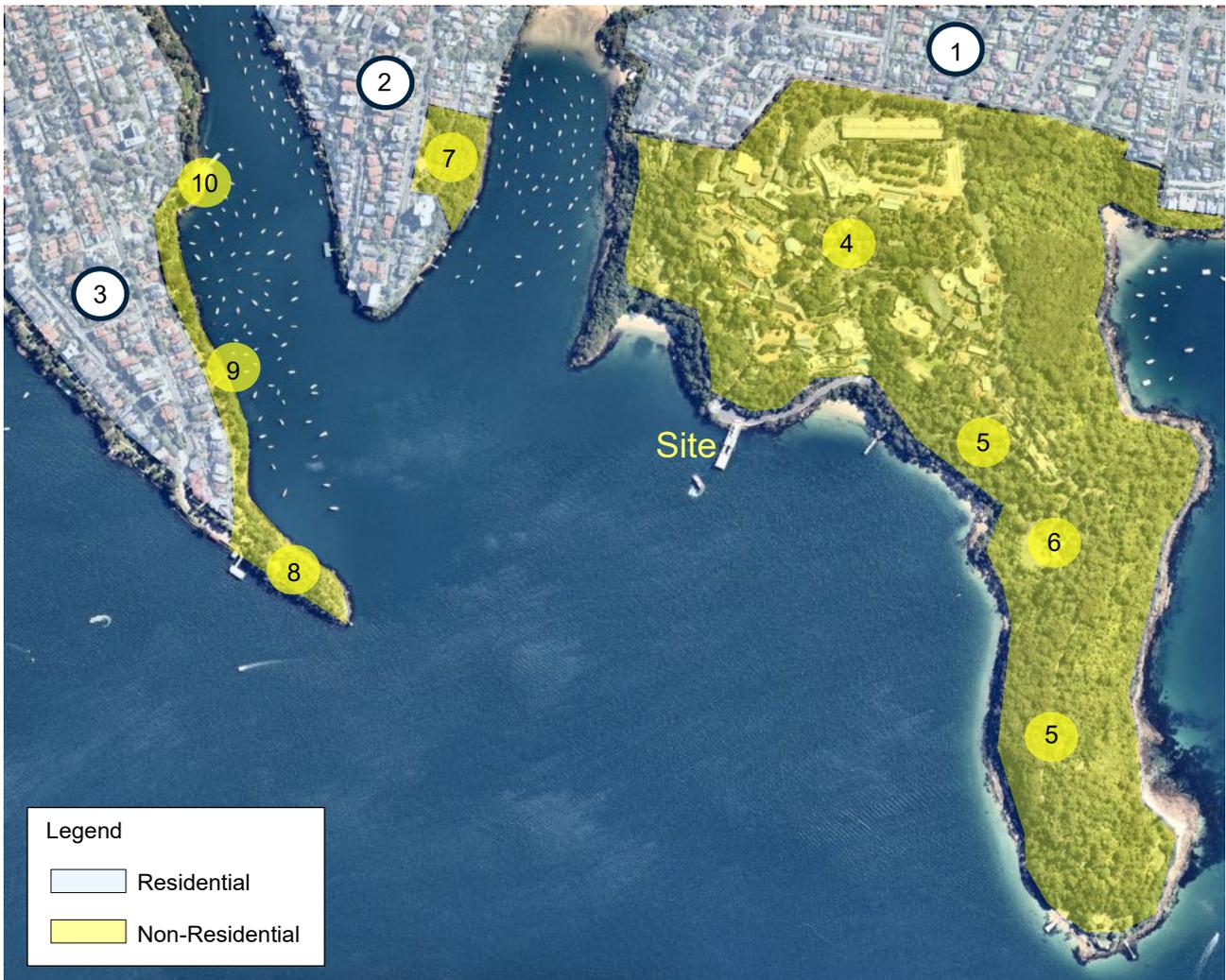


Figure 2-4 Site location and surrounding land uses

2.3 The proposal

The proposed upgrade to the existing Taronga Zoo wharf is a TfNSW initiative to provide a modern and integrated upgrade to transport infrastructure in NSW.

The proposal generally comprises the construction scenarios, onsite activities and timing listed in Table 2-2.

Table 2-2 Construction scenarios

| Activity | Associated work |
|---|---|
| Scenario 1a: Site establishment for land side works | <ul style="list-style-type: none"> ▪ Establishment of a temporary site compound (site offices, amenities and plant/material storage areas, etc.). There is limited space available for these facilities on land, other than parking spaces along the northern side of Athol Wharf (with a narrowing of existing traffic lanes and installation of temporary traffic barriers) or on the existing jetty structure. As such, the main compound area would be installed on a construction barge adjacent to the wharf structure. ▪ Temporary pedestrian paths may need to be installed to maintain safe access past the works. This may require traffic controllers to control pedestrian, vehicle and bus movements. ▪ Traffic control measures (including for vehicles, watercraft, pedestrians and cyclists) would be established in accordance with the traffic |

| Activity | Associated work |
|---|--|
| | <p>management plan. Appropriate wayfinding signage would be installed advising of alternative transport options where necessary.</p> <ul style="list-style-type: none"> ▪ Environmental controls would be established in accordance with the construction environmental management plan (CEMP). |
| <p>Scenario 1b: Site establishment for water side works</p> | <ul style="list-style-type: none"> ▪ Establishment of a construction work area using floating booms to delineate this area. 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. ▪ Environmental controls would be established in accordance with the CEMP. |
| <p>Scenario 2: Construction of a new access ramp</p> | <ul style="list-style-type: none"> ▪ Install temporary footpath diversion to allow construction access. ▪ Clear and excavate for ramp using medium sized excavator (+20 tonne). Note that rock armour has been placed along the water's edge. ▪ Install land side piles (if required) using small excavator mounted piling rig. ▪ Install water side piles using a piling barge. ▪ Install two protection piles (to replace removed ferry arresters). ▪ Install precast concrete headstocks, precast ramps and prefabricated. ▪ Install roof structure by mobile crane located in Athol Wharf cul-de-sac. The works may require the closure of Athol Wharf Road cul-de-sac so may need to be undertaken at night to avoid impacting on bus services. Alternatively, the components could be delivered to site by barge and installed by barge mounted crane. ▪ Connect ramp to existing jetty structure and make good. ▪ Finalisation works (pavements, architectural, finishes, hand rails, etc.). |
| <p>Scenario 3: Demolition</p> | <ul style="list-style-type: none"> ▪ Close the café offices and western gangway. ▪ Demolish the existing café, office, glazing, roof structures and fitments to the extent required. |
| <p>Scenario 4: Installation of protection piles (a) drilling or piling (b) hammering (c) cutting steel)</p> | <ul style="list-style-type: none"> ▪ Demolition of the existing wharf would need to be staged to ensure that one of the western and eastern gantries remains in service at all times. ▪ Demolition of the existing timber ferry arresters would be staged similar to demolition of the existing wharf. |
| <p>Scenario 5: Construction and fit-out work</p> | <ul style="list-style-type: none"> ▪ Establishment of a construction work area using floating booms to delineate this area. 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. |
| <p>Scenario 6: Fencing, Lighting and CCTV installation</p> | <ul style="list-style-type: none"> ▪ Up to three barges (about 20 metres by 30 metres in size) 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. |
| <p>Scenario 7: Precast and roof structure installation</p> | <ul style="list-style-type: none"> ▪ The western side gantry would be closed. ▪ Remove/demolish existing western timber ferry arresters. ▪ Remove the existing western gantry using barge mounted crane and dispose off-site using a barge. ▪ Demolish the western side of the existing jetty to the extent required and make good. ▪ Modify the western side of the existing pontoon to suit new gantry. ▪ The new western gangway would be fabricated off-site and floated to site by barge. The gangway would be lifted into position a large barge mounted crane. |

| Activity | Associated work |
|---------------------------|---|
| | <ul style="list-style-type: none"> ▪ Install new steel protection piles approximately at the location of demolished timber ferry arresters. ▪ The existing western side roof structure would be modified to suit the final arrangement. ▪ Finishing works on the western side would be completed (handrails, finishes, architectural, etc.) and the gantry opened. ▪ The eastern side gantry would be closed. ▪ Remove/demolish existing eastern timber ferry arresters. ▪ Remove the existing eastern gantry using barge mounted crane and dispose off-site using a barge. ▪ Demolish the eastern side of the existing jetty to the extent required and make good. ▪ Modify the western side of the existing pontoon to suit new gantry. ▪ The new eastern gangway would be fabricated off-site and floated to site by barge. The gangway would be lifted into position a large barge mounted crane. ▪ Install new steel protection piles approximately at the location of demolished timber ferry arresters. ▪ The existing eastern side roof structure would be modified to suit the final arrangement. ▪ Finishing works on the eastern side would be completed (handrails, finishes, architectural, etc) and the gantry opened. ▪ New café, office, glazing, roof modifications and other finishing works would be completed. |
| Scenario 8: Site clean-up | <ul style="list-style-type: none"> ▪ The site would be cleaned up and restored to its previous state. ▪ Sedimentation controls and temporary structures would be removed. |

3 Existing noise environment

The existing acoustic environment is generally dominated by road traffic noise on local roads and noise from boats on Sydney Harbour.

3.1 Unattended noise monitoring methodology

Unattended noise monitors were installed at the following three 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 10 and 17 September 2020 for Logger 1, and between the 30 April and 7 May 2020 for Loggers 2 and 3.

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 located approximately 30 metres from 31 Whiting Beach Road and approximately 455 metres north of the Taronga Zoo Wharf pontoon
- > **Logger 2** was approximately 22 metres from 5 Herron Walk and approximately 675 metres northwest of the Taronga Zoo Wharf pontoon
- > **Logger 3** was located approximately 11 metres from 45 Cremorne Road and approximately 930 metres.

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 | 16-306-035 |
| 2 | ARL EL-316 | 16-203-502 |
| 3 | 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

3.3.2 Monitoring period – 10 September to 17 September 2020

- Conditions: Mostly Fine
- Wind: 1 - 13 m/s from a variety of directions
- Humidity: 27 – 99 per cent (%)
- Temperature: 9 – 32°C

Detailed weather information recorded at the site during the monitoring periods are detailed in Appendix A. 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 7 metres above the ground and that the ground level

wind speed is significantly less. Adjustments have been made for this in Appendix A. As shown in Appendix A, 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_{Amax}:** the A-weighted maximum noise level measured during the measurement period
- L_{A1}:** the A-weighted noise level exceeded for 1 per cent (%) of the measurement period
- L_{A10}:** 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_{A90}:** 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_{Aeq}:** 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 factors listed in Table 3-2.

Table 3-2 Observed existing noise environment

| Logger | Location | Observed Noise Environment |
|--------|--------------------|---|
| 1 | Whiting Beach Road | The primary source of noise was from intermittent traffic and nearby waterway vessels. |
| 2 | Musgrave Street | The primary source of noise was from local traffic along Musgrave Street and general noise from nearby waterway vessels. |
| 3 | 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 | Whiting Beach Road | 36 | 37 | 30 |
| 2 | Musgrave Street | 45 | 41 | 38 |
| 3 | 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, Figure 3-3 for logger 2, and Figure 3-4 for logger 3. Full noise charts are displayed in Appendix A.

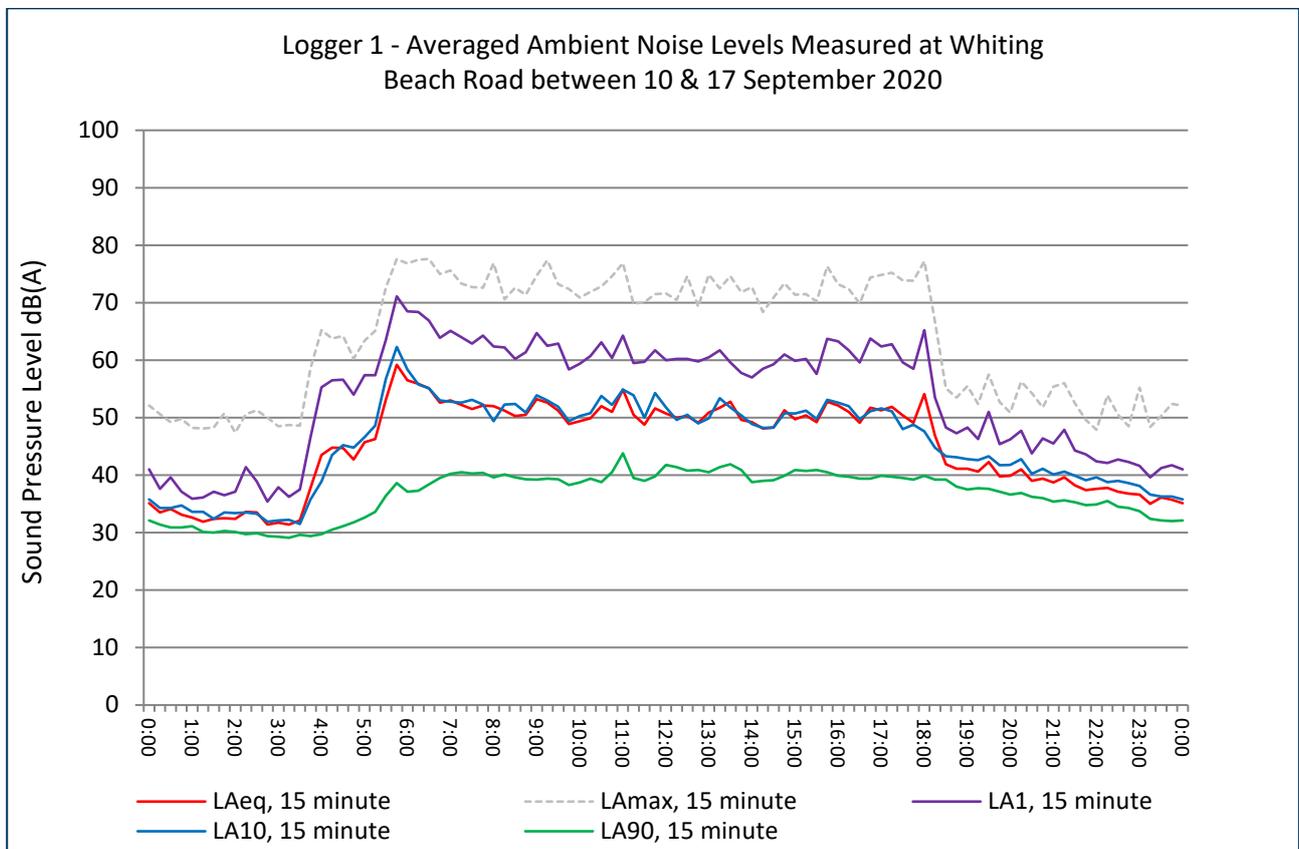


Figure 3-2 Averaged measured noise levels – logger 1

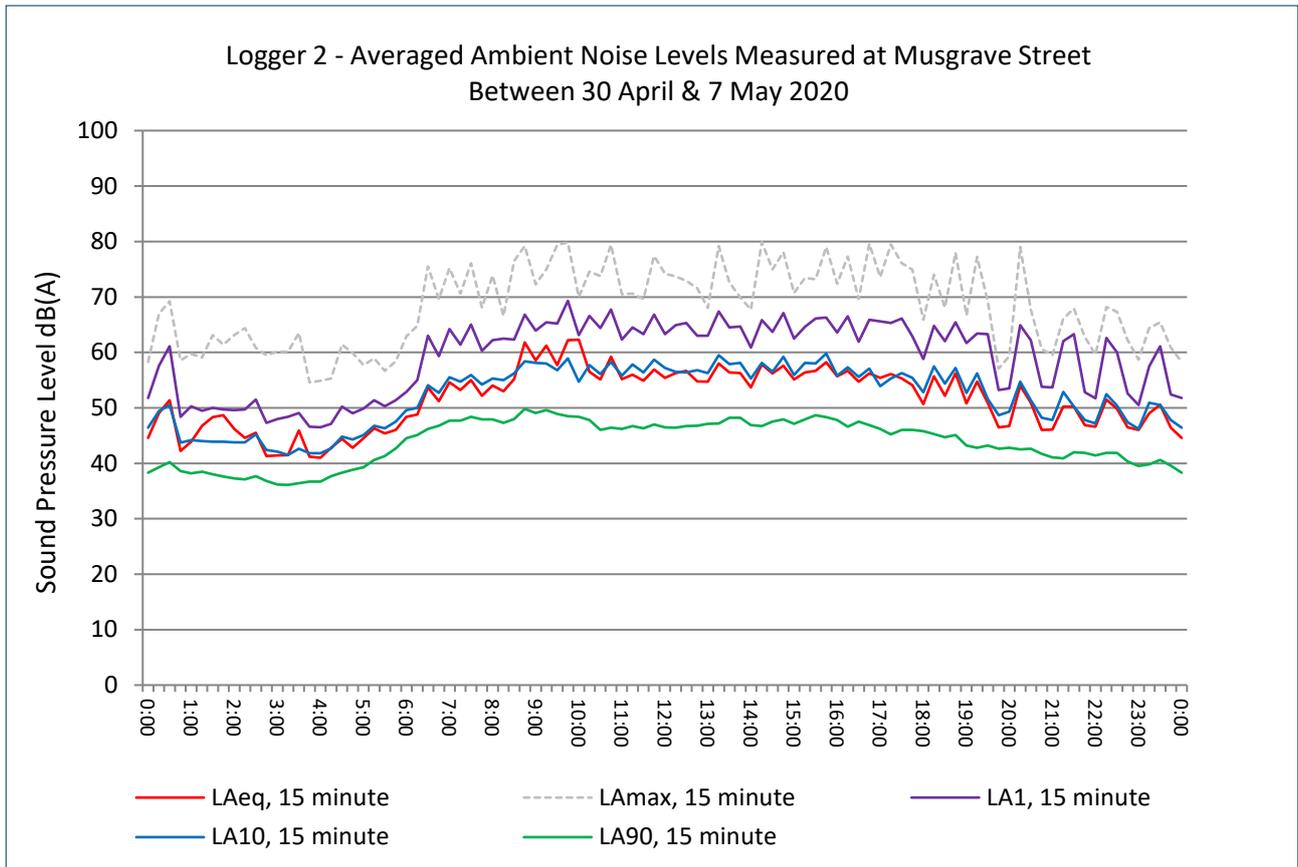


Figure 3-3 Averaged measured noise levels – logger 2

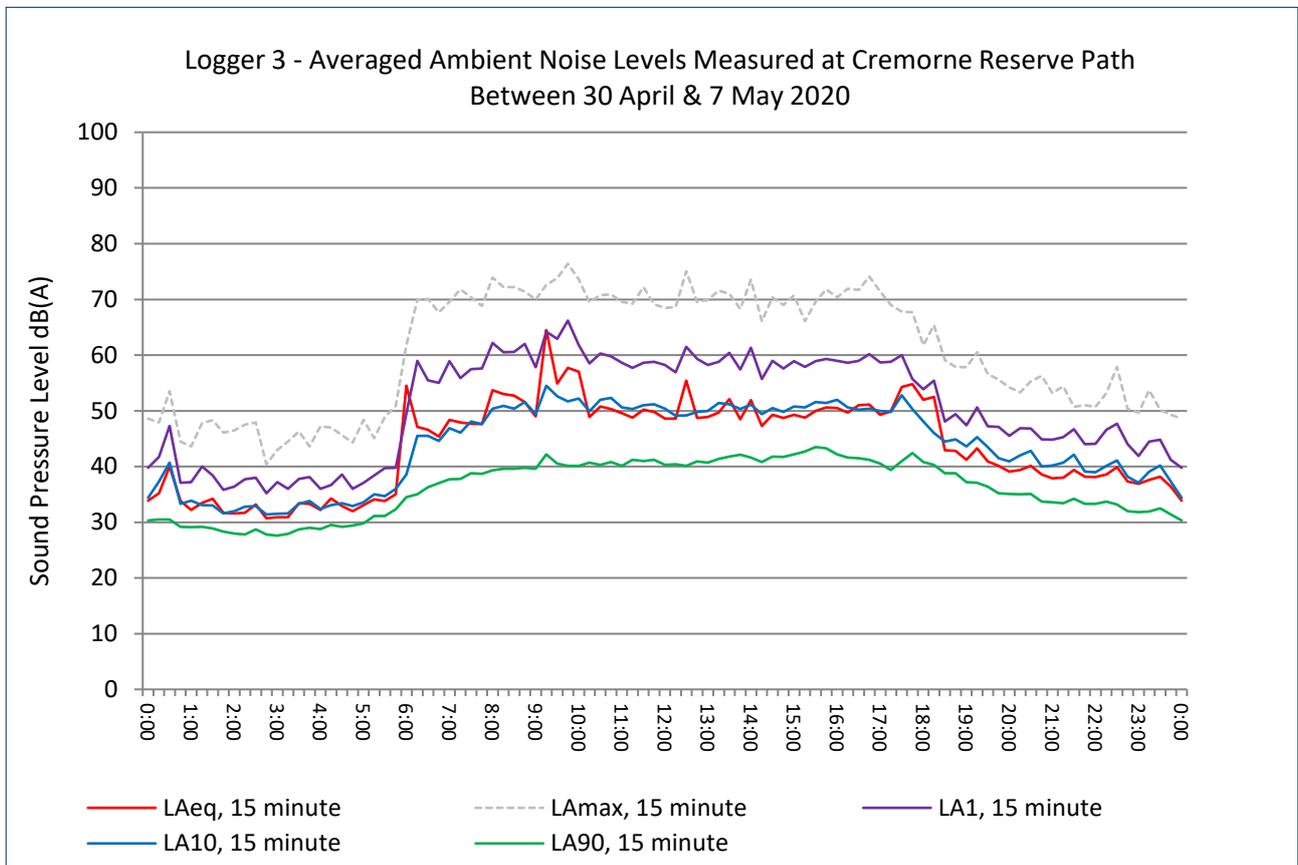


Figure 3-4 Averaged measured noise levels – logger 3

4 Statutory noise and vibration criteria

4.1 Noise criteria

4.1.1 Construction Noise and Vibration Guideline

The Roads and Maritime *Construction Noise and Vibration Guideline* (RMS 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:

- > NSW *Interim Construction Noise Guideline* (DECC 2009) (ICNG)
- > NSW *Assessing Vibration – Technical Guideline* (DEC 2006) (AV:ATG)
- > NSW *Road Noise Policy* (DECC 2011) (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 TfNSW 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

The NSW *Interim Construction Noise Guideline* (DECC, 2009) (ICNG) provides guidance for assessing construction noise impacts.

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 $L_{Aeq(15\ min)^*}$ | 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 $L_{Aeq(15\ min)}$ 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. |
| | Highly noise affected 75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise. |

| Time of day | Management level L_{Aeq} (15 min)* | How to apply |
|------------------------------------|---|--|
| | | <p>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:</p> <p>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)</p> <p>If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</p> |
| Outside recommended standard hours | Noise affected RBL + 5 dB | <p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>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.</p> <p>For guidance on negotiating agreements see section 7.2.2.</p> |

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 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 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 $L_{Aeq, T}$) 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 project 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 ICNG and refers to Section 2.5 of the document *Assessing Vibration: A Technical Guideline (AV:ATG)* issued by DEC (2006).

The 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 that the duration is short, typically less than 2 seconds. | 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 |
|-------------------|--|--|
| 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

Table 7-1 in Section 7.2.2 provides a summary of the minimum working distance for different types of sensitive receivers referenced from the standards described above.

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 project. 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 project 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 $L_{A1, 1 \text{ min}}$ |
|----------------------|--------------|---------------------------------|--|-------|--|
| | | Standard Hours (RBL + 10 dB(A)) | Outside Standard Hours (RBL + 5 dB(A)) | | |
| | | Day | Evening | Night | |
| 1 | 1 | 46 | 42 | 35 | 60 |
| 2 | 2 | 55 | 46 | 43 | 60 |
| 3 | 3 | 48 | 38 | 33 | 60 |

*Sleep disturbance criteria has been calculated based on an assumed typical internal L_{Aeq} 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

Vibration criteria for human comfort that apply to this proposal as shown in Table 5-2.

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 |
| Continuous vibration³ (Weighted RMS Acceleration, m/s^2, 1-80Hz) | | | | | |
| Critical areas ² | 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 |
| Impulsive vibration³ (Weighted RMS Acceleration, m/s^2, 1-80Hz) | | | | | |
| Critical areas ² | 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 |

| Location | Assessment period | Preferred Values | | Maximum Values | |
|--|--|------------------|------------|----------------|------------|
| | | z-axis | x & y axis | z-axis | x & y axis |
| Workshops | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |
| Intermittent vibration⁴ (Vibration Dose Values, VDV, m/s^{1.75}, 1-80Hz) | | | | | |
| Critical areas ² | 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 *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 below in Section 6.6. To provide an indicative assessment of construction noise impact, a noise model was created for each of the construction scenarios (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 |
|-----------------------------|---|
| 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 worst case construction scenarios in Table 6-2 have been modelled for the proposed Taronga Zoo wharf upgrade.

Table 6-2 Modelled construction scenarios

| Scenario No. | Construction Scenario Description |
|--------------|--|
| 1b | Site establishment |
| 3 | Demolition of wharf, ferry arresters, café & roof structures |
| 4a | Installation of protection piles within waterway – drilling or piling (outside of hours – early morning OOHW2) |

| Scenario No. | Construction Scenario Description |
|--------------|--|
| 5 | Construction & fitout work (café, staff office & gangways) |
| 7 | Precast and roof structure installation |

To provide an indicative assessment of construction noise impact, a noise model was created for each of the 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 in Figure 6-1.

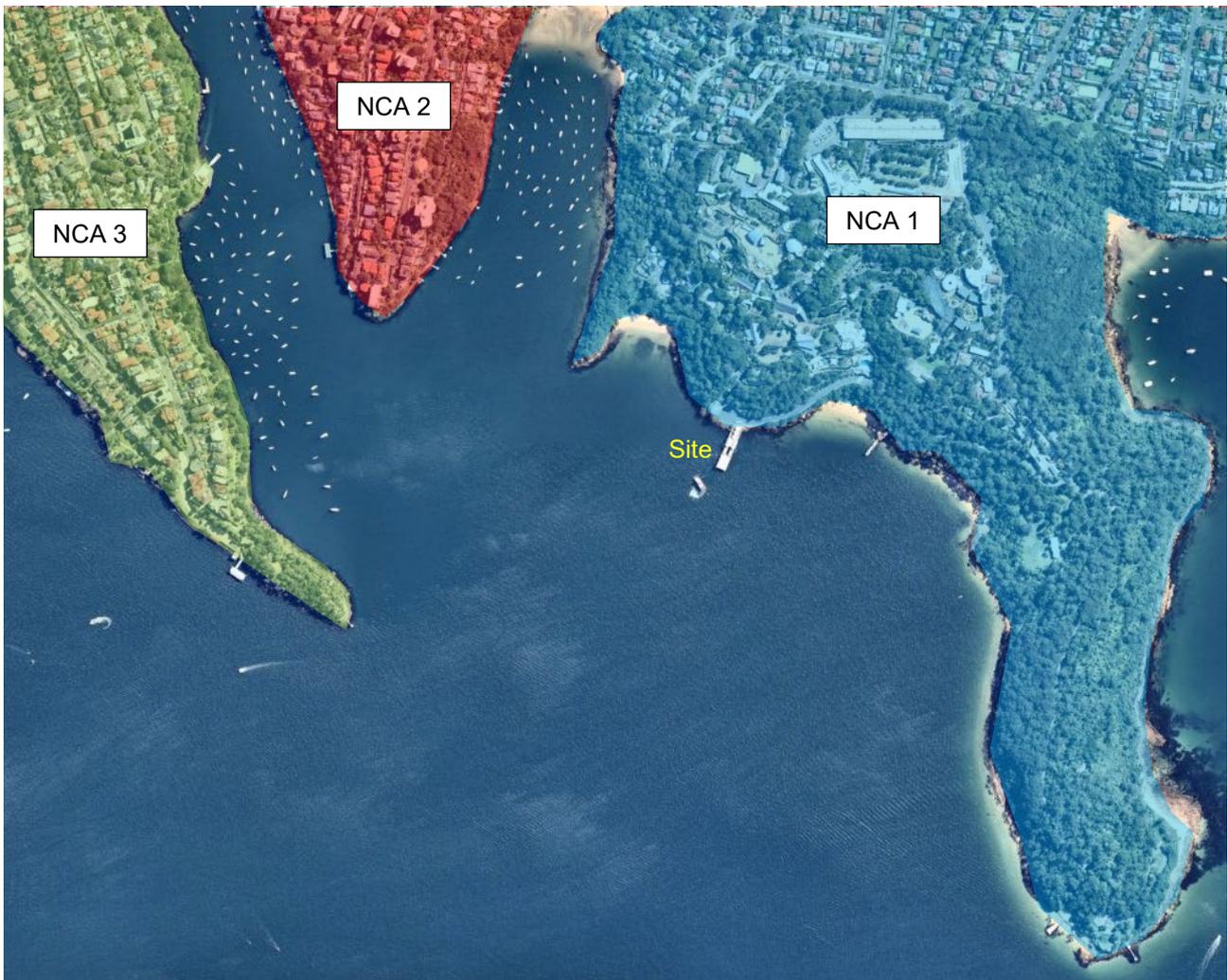


Figure 6-1 Noise catchment areas

Noise contour maps showing the predicted noise levels for the modelled construction works are detailed in Appendix C.

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 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 CNVG, AS2436 and Cardno's measurement library.

Table 6-3 Construction plant sound power levels

| Plant | Number of Plant | Sound Power Level, L _{Aeq} , dB(A) |
|--|------------------------------|---|
| Scenario 1b – Site Establishment | Total L_{Aeq} | 114 |
| Truck (medium rigid) | 1 | 103 |
| Road Truck | 1 | 108 |
| Franna Crane | 1 | 98 |
| EWP | 1 | 98 |
| Floating Boom | 1 | 105 |
| Workboat | 1 | 108 |
| Barge | 1 | 108 |
| Scenario 3 – Demolition of wharf, ferry arresters, café & roof structures | Total L_{Aeq} | 117 |
| Pneumatic Drill | 1 | 115 |
| Franna Crane | 1 | 98 |
| Truck (medium rigid) | 1 | 103 |
| Hand Tools | 1 | 94 |
| Generator | 1 | 98 |
| Workboat | 1 | 108 |
| Barge | 1 | 108 |
| Scenario 4a – Installation of protection piles within waterway – drilling or piling - outside of standard working hours (early morning OOHW2) | Total L_{Aeq} | 119 |
| Rock Drill or Bored Piling | 1 | 112 |
| Truck | 1 | 110 |
| Generator | 1 | 98 |
| Workboat | 1 | 108 |
| Daymaker | 2 | 98 |
| Floating Boom | 1 | 105 |
| Barge Crane | 1 | 110 |
| Pile Hammer | 1 | 116 |
| Scenario 5 – Construction & Fitout Work (Café, Staff Office & Gangways) | Total L_{Aeq} | 111 |
| Barge | 1 | 108 |
| EWP | 1 | 98 |
| Floating Boom | 1 | 105 |
| Hand Tools | 1 | 94 |

| Plant | Number of Plant | Sound Power Level, L _{Aeq} , dB(A) |
|---|------------------------------|---|
| Generator | 1 | 98 |
| Truck (medium rigid) | 1 | 103 |
| Scenario 7 – Precast and Roof Structure Installation | Total L_{Aeq} | 114 |
| Barge | 1 | 108 |
| EWP | 1 | 98 |
| Floating Boom | 1 | 105 |
| Hand Tools | 1 | 94 |
| Generator | 1 | 98 |
| Barge Crane | 1 | 110 |
| Workboat | 1 | 108 |
| Franna Crane | 1 | 98 |

6.7 Predicted construction noise levels

The predicted noise impact from construction activities in the form of noise contour maps is presented in Appendix C with predicted levels at discrete receivers included in Appendix B. Predicted construction noise levels at each modelled NCA for each scenario are shown below in Table 6-4 to Table 6-8. 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.

A full list of predicted noise levels at all modelled receivers is included in Appendix B.

Whilst Taronga Park Zoo falls within NCA 1 specific noise levels have not been predicted at finite points within the zoo as there are no formal NSW criteria for assessment of noise impacts on animals. However, it is noted from the review of the noise contour maps presented in Appendix C, that noise levels of approximately 65 dB(A) are predicted at the nearest animal enclosures to the works for all of the modelled scenarios. These predicted noise impacts higher than the other nominated locations within NCA 1 due to the close proximity of the zoo to the construction works and due the topography of the surrounding area providing screening to other locations within NCA 1.

The predicted reduction of expected construction noise impact with distance is shown on the noise contour maps.

Table 6-4 Predicted construction noise levels – Scenario 1b – site establishment – proposed for standard working hours

| Most Affected Receivers | Obj No. | Floor | Facade Facing | NCA | Predicted Construction Noise Level dB(A), L _{Aeq} 15min | 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) | | | | | | | | | |
| 27 Whiting Beach Road | 20 | GF | E | 1 | 36 | 46 | - | - | - |
| 9 Raglan Street | 48 | L3 | E | 2 | 52 | 55 | - | - | - |
| 3 Wulworra Avenue (3 Cremorne Rd) | 79 | L3 | E | 3 | 50 | 48 | - | 2 | - |

The above results for Scenario 1b indicate noticeable and clearly audible noise levels, and minor exceedances of the ICNG noise management levels during standard work hours for NCA 3.

It is understood that these works would only occur during standard hours. However, 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 3 – demolition of wharf, ferry arresters, café and roof structures – proposed for standard working hours

| Most Affected Receivers | Obj No. | Floor | Facade Facing | NCA | Predicted Construction Noise Level dB(A), L _{Aeq} 15min | 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) | | | | | | | | | |
| 27 Whiting Beach Road | 20 | GF | E | 1 | 40 | 46 | - | 0 | - |
| 10 Raglan Street | 56 | L1 | E | 2 | 55 | 55 | - | 0 | - |
| 3 Wulworra Avenue (3 Cremorne Rd) | 79 | L3 | E | 3 | 54 | 48 | - | 6 | - |

The above results for Scenario 3 indicate clearly audible noise levels for NCA 2 & 3, and minor exceedances of the ICNG noise management levels during standard work hours for NCA 3.

It is understood that these works would only occur during standard hours. However, 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 4a – installation of protection piles within waterway – proposed for outside of standard working hours

| Most Affected Receivers | Obj No. | Floor | Facade Facing | NCA | Predicted Construction Noise Level dB(A), L _{Aeq} 15min | 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) | | | | | | | | | |
| OOHW1 (Evening) - Period 1 - Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Pub Hol (8am – 6pm) | | | | | | | | | |
| OOHW2 (Night) - Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Hol (6pm – 7am) | | | | | | | | | |
| 27 Whiting Beach Road | 20 | GF | E | 1 | 41 | 42 | 35 | - | 6 |
| 10 Raglan Street | 56 | L1 | E | 2 | 58 | 46 | 43 | 12 | 15 |
| 3 Wulworra Avenue (3 Cremorne Rd) | 79 | L3 | E | 3 | 56 | 38 | 33 | 18 | 23 |

The above results for Scenario 4a indicate clearly audible and moderately intrusive noise levels, and exceedances of the ICNG noise management levels for the evening/night time period for all NCAs to varying extents. Properties located on Wulworra Avenue would experience the highest exceedances.

It is understood that Scenario 4a works would take place outside of standard working hours within the OOHW2 time period (early morning), however predictions for OOHW1 have been provided in Table 6-6 for information purposes. Reduced operations are recommended and careful planning would be required for the proposed works to manage potential impacts on all NCAs.

Table 6-7 Predicted construction noise levels – Scenario 5 – construction and fitout work (café, staff office & gangways) – proposed for standard working hours

| Most Affected Receivers | Obj No. | Floor | Facade Facing | NCA | Predicted Construction Noise Level dB(A), L _{Aeq} 15min | 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 St Elmo Street | 75 | GF | S | 1 | 40 | 46 | - | 0 | - |
| 11 Raglan Street | 49 | F3 | E | 2 | 50 | 55 | - | 0 | - |
| 3 Wulworra Avenue | 79 | L3 | E | 3 | 48 | 48 | - | 0 | - |

The above results for Scenario 5 indicate noticeable and clearly audible noise levels, with no exceedances of the ICNG noise management levels during standard work hours for any NCA.

It is understood that these works would only occur during standard hours. However, 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 6-8 Predicted construction noise levels – Scenario 7 – precast and roof structure installation– proposed for standard working hours

| Most Affected Receivers | Obj No. | Floor | Facade Facing | NCA | Predicted Construction Noise Level dB(A), L _{Aeq} 15min | 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) | | | | | | | | | |
| 3 Rickard Avenue | 17 | GF | S | 1 | 43 | 46 | - | - | - |
| 9 Raglan Street | 48 | L3 | E | 2 | 53 | 55 | - | - | - |
| 3 Wulworra Avenue | 79 | L3 | E | 3 | 51 | 48 | - | 3 | - |

The above results for Scenario 7 indicate noticeable and clearly audible noise levels, and minor exceedances of the ICNG noise management levels during standard work hours for NCA 3.

It is understood that these works would only occur during standard hours. However, if night works are considered to be necessary for safety reasons, reduced operations are recommended and careful planning will 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 6-9.

Table 6-9 Predicted number of receivers where NMLs are likely to be exceeded

| Construction Scenario | Standard Hours | Evening | Night | Highly Noise Affected |
|-----------------------|----------------|---------|-------|-----------------------|
| Scenario 1b | 17 | - | - | 0 |
| Scenario 3 | 99 | - | - | 0 |
| Scenario 4a | - | 163 | 235 | 0 |
| Scenario 5 | 6 | - | - | 0 |
| Scenario 7 | 70 | - | - | 0 |

Some receivers are expected to be 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 scenarios 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 Scenario 4a

The most likely source of potential sleep disturbance from outside of construction hours works would be from piling proposed as early morning works (Out of Hours Work Period 2 – OOH2).

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 6-10.

It should be noted that piling would occur intermittently and would not be continuous for the duration of Scenario 4a. Therefore, residents would only experience the noise levels in Table 6-10 intermittently and for short periods.

Table 6-10 Predicted construction maximum (L_{Amax}) noise levels – Scenario 4a

| Receiver | Obj No. | Floor | Facade Facing | NCA | Construction Noise Level dB(A), L_{Amax} Scenario 4a | L_{Amax} Criteria, dB(A) |
|------------------------|---------|-------|---------------|-----|--|----------------------------|
| 31 Whiting Beach Road | 16 | GF | S | 1 | 48 | 60 |
| 29 Whiting Beach Road | 18 | GF | W | 1 | 50 | 60 |
| 27 Whiting Beach Road | 20 | GF | E | 1 | 51 | 60 |
| 25 Whiting Beach Road | 21 | GF | E | 1 | 46 | 60 |
| 25 Rickard Avenue | 28 | GF | SW | 1 | 48 | 60 |
| 28 Rickard Avenue | 14 | GF | SW | 1 | 47 | 60 |
| 28 Rickard Avenue | 14 | F 1 | SW | 1 | 47 | 60 |
| 21 Whiting Beach Road | 23 | GF | E | 1 | 47 | 60 |
| 26a Rickard Avenue | 12 | GF | SW | 1 | 47 | 60 |
| 26a Rickard Avenue | 12 | F 1 | SW | 1 | 47 | 60 |
| 26 Rickard Avenue | 13 | GF | SW | 1 | 47 | 60 |
| 26 Rickard Avenue | 13 | F 1 | SW | 1 | 48 | 60 |
| 24 Rickard Avenue | 11 | GF | SW | 1 | 48 | 60 |
| 24 Rickard Avenue | 11 | F 1 | SW | 1 | 47 | 60 |
| 19 Whiting Beach Road | 26 | GF | E | 1 | 45 | 60 |
| 22 Rickard Avenue | 9 | GF | SW | 1 | 45 | 60 |
| 22 Rickard Avenue | 9 | F 1 | SW | 1 | 48 | 60 |
| 17 Whiting Beach Road | 31 | GF | S | 1 | 48 | 60 |
| 20 Rickard Avenue | 10 | GF | SE | 1 | 46 | 60 |
| 20 Rickard Avenue | 10 | F 1 | SE | 1 | 47 | 60 |
| 18 Rickard Avenue | 8 | GF | SW | 1 | 47 | 60 |
| 18 Rickard Avenue | 8 | F 1 | SW | 1 | 46 | 60 |
| 13A Whiting Beach Road | 33 | GF | S | 1 | 46 | 60 |
| 16 Rickard Avenue | 7 | GF | SE | 1 | 46 | 60 |
| 16 Rickard Avenue | 7 | F 1 | SE | 1 | 47 | 60 |
| 17 Rickard Avenue | 29 | GF | W | 1 | 47 | 60 |
| 17 Rickard Avenue | 29 | F 1 | W | 1 | 47 | 60 |
| 13 Whiting Beach Road | 34 | GF | S | 1 | 47 | 60 |
| 13 Whiting Beach Road | 32 | GF | S | 1 | 48 | 60 |
| 14 Rickard Avenue | 6 | GF | SE | 1 | 46 | 60 |
| 14 Rickard Avenue | 6 | F 1 | SE | 1 | 48 | 60 |
| 15 Rickard Avenue | 30 | GF | S | 1 | 48 | 60 |
| 15 Rickard Avenue | 30 | F 1 | S | 1 | 47 | 60 |
| 11 Whiting Beach Road | 35 | GF | S | 1 | 47 | 60 |
| 13 Rickard Avenue | 25 | GF | W | 1 | 46 | 60 |
| 13 Rickard Avenue | 25 | F 1 | W | 1 | 48 | 60 |
| 9 Whiting Beach Road | 36 | GF | S | 1 | 48 | 60 |
| 11 Rickard Avenue | 24 | GF | W | 1 | 46 | 60 |
| 11 Rickard Avenue | 24 | F 1 | W | 1 | 47 | 60 |
| 10 Rickard Avenue | 5 | GF | SE | 1 | 47 | 60 |
| 10 Rickard Avenue | 5 | F 1 | SE | 1 | 47 | 60 |
| 7 Whiting Beach Road | 37 | GF | S | 1 | 47 | 60 |
| 8 Bradleys Head Road | 78 | GF | E | 1 | 46 | 60 |
| 8 Rickard Avenue | 4 | GF | SE | 1 | 50 | 60 |
| 8 Rickard Avenue | 4 | F 1 | SE | 1 | 50 | 60 |
| 9 Rickard Avenue | 22 | GF | W | 1 | 45 | 60 |
| 9 Rickard Avenue | 22 | F 1 | W | 1 | 46 | 60 |
| 5 Whiting Beach Road | 38 | GF | S | 1 | 47 | 60 |
| 6 Bradleys Head Road | 74 | GF | E | 1 | 47 | 60 |
| 7 Rickard Avenue | 19 | GF | S | 1 | 48 | 60 |
| 7 Rickard Avenue | 19 | F 1 | S | 1 | 48 | 60 |
| 5 Bradleys Head Road | 77 | GF | W | 1 | 46 | 60 |
| 6 Rickard Avenue | 3 | GF | E | 1 | 44 | 60 |
| 6 Rickard Avenue | 3 | F 1 | E | 1 | 47 | 60 |
| 4 Bradleys Head Road | 73 | GF | E | 1 | 47 | 60 |
| 4 Rickard Avenue | 2 | GF | S | 1 | 46 | 60 |
| 4 Rickard Avenue | 2 | F 1 | S | 1 | 45 | 60 |
| 3 Whiting Beach Road | 39 | GF | S | 1 | 50 | 60 |
| 3 Bradleys Head Road | 76 | GF | S | 1 | 50 | 60 |

| Receiver | Obj No. | Floor | Facade Facing | NCA | Construction Noise Level dB(A), L _{AMax} Scenario 4a | L _{Amax} Criteria, dB(A) |
|----------------------|---------|-------|---------------|-----|---|-----------------------------------|
| 3 Rickard Avenue | 17 | GF | S | 1 | 45 | 60 |
| 3 Rickard Avenue | 17 | F 1 | S | 1 | 48 | 60 |
| 2 St Elmos Street | 75 | GF | S | 1 | 48 | 60 |
| 2 Bradleys Head Road | 41 | GF | S | 1 | 47 | 60 |
| 2a Rickard Avenue | 1 | GF | S | 1 | 48 | 60 |
| 2a Rickard Avenue | 1 | F 1 | S | 1 | 48 | 60 |
| 1 Whiting Beach Road | 40 | GF | S | 1 | 45 | 60 |
| 1 Rickard Avenue | 15 | GF | S | 1 | 45 | 60 |
| 1 Rickard Avenue | 15 | F 1 | S | 1 | 48 | 60 |
| 1 Bradleys Head Road | 42 | GF | S | 1 | 49 | 60 |
| 32 Raglan Street | 66 | GF | E | 2 | 63 | 60 |
| 32 Raglan Street | 66 | F 1 | E | 2 | 63 | 60 |
| 30 Raglan Street | 65 | GF | E | 2 | 64 | 60 |
| 30 Raglan Street | 65 | F 1 | E | 2 | 65 | 60 |
| 26 Raglan Street | 64 | GF | E | 2 | 63 | 60 |
| 26 Raglan Street | 64 | F 1 | E | 2 | 64 | 60 |
| 24 Raglan Street | 63 | GF | E | 2 | 64 | 60 |
| 24 Raglan Street | 63 | F 1 | E | 2 | 64 | 60 |
| 22 Raglan Street | 62 | GF | E | 2 | 64 | 60 |
| 22 Raglan Street | 62 | F 1 | E | 2 | 64 | 60 |
| 20 Raglan Street | 61 | GF | E | 2 | 62 | 60 |
| 20 Raglan Street | 61 | F 1 | E | 2 | 65 | 60 |
| 19 Raglan Street | 67 | GF | S | 2 | 62 | 60 |
| 19 Raglan Street | 67 | F 1 | S | 2 | 64 | 60 |
| 18 Raglan Street | 60 | GF | E | 2 | 46 | 60 |
| 18 Raglan Street | 60 | F 1 | E | 2 | 48 | 60 |
| 16 Raglan Street | 59 | GF | E | 2 | 46 | 60 |
| 16 Raglan Street | 59 | F 1 | E | 2 | 48 | 60 |
| 14 Raglan Street | 58 | GF | E | 2 | 58 | 60 |
| 14 Raglan Street | 58 | F 1 | E | 2 | 59 | 60 |
| 17 Raglan Street | 50 | GF | S | 2 | 66 | 60 |
| 17 Raglan Street | 50 | F 1 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 2 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 3 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 4 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 5 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 6 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 7 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 8 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 9 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 10 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 11 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 12 | S | 2 | 67 | 60 |
| 17 Raglan Street | 50 | F 13 | S | 2 | 67 | 60 |
| 12 Raglan Street | 57 | GF | E | 2 | 65 | 60 |
| 12 Raglan Street | 57 | F 1 | E | 2 | 65 | 60 |
| 11 Raglan Street | 49 | GF | E | 2 | 52 | 60 |
| 11 Raglan Street | 49 | F 1 | E | 2 | 56 | 60 |
| 11 Raglan Street | 49 | F 2 | E | 2 | 68 | 60 |
| 11 Raglan Street | 49 | F 3 | E | 2 | 68 | 60 |
| 10 Raglan Street | 56 | GF | E | 2 | 68 | 60 |
| 10 Raglan Street | 56 | F 1 | E | 2 | 68 | 60 |
| 9 Raglan Street | 48 | GF | E | 2 | 59 | 60 |
| 9 Raglan Street | 48 | F 1 | E | 2 | 59 | 60 |
| 9 Raglan Street | 48 | F 2 | E | 2 | 67 | 60 |
| 9 Raglan Street | 48 | F 3 | E | 2 | 67 | 60 |
| 9 Curraghbeena Road | 72 | GF | E | 2 | 67 | 60 |
| 9 Curraghbeena Road | 72 | F 1 | E | 2 | 67 | 60 |
| 8 Raglan Street | 55 | GF | E | 2 | 51 | 60 |
| 8 Raglan Street | 55 | F 1 | E | 2 | 53 | 60 |

| Receiver | Obj No. | Floor | Facade Facing | NCA | Construction Noise Level dB(A), L _{AMax} Scenario 4a | L _{Amax} Criteria, dB(A) |
|---------------------|---------|-------|---------------|-----|---|-----------------------------------|
| 7 Raglan Street | 47 | GF | E | 2 | 67 | 60 |
| 7 Raglan Street | 47 | F 1 | E | 2 | 67 | 60 |
| 7 Raglan Street | 47 | F 2 | E | 2 | 67 | 60 |
| 7 Raglan Street | 47 | F 3 | E | 2 | 67 | 60 |
| 7 Herron Walk | 54 | GF | E | 2 | 55 | 60 |
| 7 Herron Walk | 54 | F 1 | E | 2 | 58 | 60 |
| 7 Herron Walk | 54 | F 2 | E | 2 | 60 | 60 |
| 7 Herron Walk | 54 | F 3 | E | 2 | 62 | 60 |
| 7 Curraghbeena Road | 71 | GF | E | 2 | 59 | 60 |
| 7 Curraghbeena Road | 71 | F 1 | E | 2 | 59 | 60 |
| 5 Curraghbeena Road | 70 | GF | E | 2 | 59 | 60 |
| 5 Curraghbeena Road | 70 | F 1 | E | 2 | 59 | 60 |
| 4-5a Herron Walk | 51 | GF | E | 2 | 52 | 60 |
| 4-5a Herron Walk | 51 | F 1 | E | 2 | 55 | 60 |
| 4-5a Herron Walk | 51 | F 2 | E | 2 | 60 | 60 |
| 4-5a Herron Walk | 51 | F 3 | E | 2 | 65 | 60 |
| 5 Raglan Street | 46 | GF | E | 2 | 67 | 60 |
| 5 Raglan Street | 46 | F 1 | E | 2 | 67 | 60 |
| 5 Raglan Street | 46 | F 2 | E | 2 | 67 | 60 |
| 5 Raglan Street | 46 | F 3 | E | 2 | 67 | 60 |
| 3 Raglan Street | 45 | GF | E | 2 | 67 | 60 |
| 3 Raglan Street | 45 | F 1 | E | 2 | 67 | 60 |
| 3 Raglan Street | 45 | F 2 | E | 2 | 67 | 60 |
| 3 Raglan Street | 45 | F 3 | E | 2 | 67 | 60 |
| 3 Curraghbeena Road | 69 | GF | E | 2 | 60 | 60 |
| 3 Curraghbeena Road | 69 | F 1 | E | 2 | 60 | 60 |
| 3 Herron Walk | 52 | GF | S | 2 | 48 | 60 |
| 3 Herron Walk | 52 | F 1 | S | 2 | 49 | 60 |
| 3 Herron Walk | 52 | F 2 | S | 2 | 46 | 60 |
| 3 Herron Walk | 52 | F 3 | S | 2 | 46 | 60 |
| 2 Raglan Street | 43 | GF | E | 2 | 66 | 60 |
| 2 Raglan Street | 43 | F 1 | E | 2 | 66 | 60 |
| 2 Raglan Street | 43 | F 2 | E | 2 | 66 | 60 |
| 2 Raglan Street | 43 | F 3 | E | 2 | 67 | 60 |
| 2 Raglan Street | 43 | F 4 | E | 2 | 67 | 60 |
| 2 Raglan Street | 43 | F 5 | E | 2 | 67 | 60 |
| 1 Raglan Street | 44 | GF | SE | 2 | 67 | 60 |
| 1 Raglan Street | 44 | F 1 | SE | 2 | 67 | 60 |
| 1 Raglan Street | 44 | F 2 | SE | 2 | 67 | 60 |
| 1 Raglan Street | 44 | F 3 | SE | 2 | 67 | 60 |
| 1 Curraghbeena Road | 68 | GF | S | 2 | 46 | 60 |
| 1 Curraghbeena Road | 68 | F 1 | S | 2 | 46 | 60 |
| 1 Herron Walk | 53 | GF | S | 2 | 46 | 60 |
| 1 Herron Walk | 53 | F 1 | S | 2 | 47 | 60 |
| 1 Herron Walk | 53 | F 2 | S | 2 | 60 | 60 |
| 1 Herron Walk | 53 | F 3 | S | 2 | 60 | 60 |
| 33 Wulworra Avenue | 98 | GF | E | 3 | 62 | 60 |
| 33 Wulworra Avenue | 98 | F 1 | E | 3 | 62 | 60 |
| 33 Wulworra Avenue | 98 | F 2 | E | 3 | 62 | 60 |
| 39 Wulworra Avenue | 99 | GF | E | 3 | 62 | 60 |
| 39 Wulworra Avenue | 99 | F 1 | E | 3 | 62 | 60 |
| 39 Wulworra Avenue | 99 | F 2 | E | 3 | 62 | 60 |
| 51 Wulworra Avenue | 104 | GF | E | 3 | 62 | 60 |
| 51 Wulworra Avenue | 104 | F 1 | E | 3 | 62 | 60 |
| 51 Wulworra Avenue | 104 | F 2 | E | 3 | 62 | 60 |
| 31 Wulworra Avenue | 97 | GF | NE | 3 | 61 | 60 |
| 31 Wulworra Avenue | 97 | F 1 | NE | 3 | 61 | 60 |
| 31 Wulworra Avenue | 97 | F 2 | NE | 3 | 62 | 60 |
| 41 Wulworra Avenue | 100 | GF | E | 3 | 62 | 60 |
| 41 Wulworra Avenue | 100 | F 1 | E | 3 | 62 | 60 |

| Receiver | Obj No. | Floor | Facade Facing | NCA | Construction Noise Level dB(A), L _{AMax} Scenario 4a | L _{Amax} Criteria, dB(A) |
|--------------------|---------|-------|---------------|-----|---|--------------------------------------|
| 41 Wulworra Avenue | 100 | F 2 | E | 3 | 62 | 60 |
| 45 Wulworra Avenue | 102 | GF | E | 3 | 62 | 60 |
| 45 Wulworra Avenue | 102 | F 1 | E | 3 | 62 | 60 |
| 45 Wulworra Avenue | 102 | F 2 | E | 3 | 62 | 60 |
| 49 Wulworra Avenue | 103 | GF | E | 3 | 61 | 60 |
| 49 Wulworra Avenue | 103 | F 1 | E | 3 | 61 | 60 |
| 49 Wulworra Avenue | 103 | F 2 | E | 3 | 62 | 60 |
| 29 Wulworra Avenue | 96 | GF | E | 3 | 62 | 60 |
| 29 Wulworra Avenue | 96 | F 1 | E | 3 | 62 | 60 |
| 29 Wulworra Avenue | 96 | F 2 | E | 3 | 62 | 60 |
| 27 Wulworra Avenue | 95 | GF | E | 3 | 62 | 60 |
| 27 Wulworra Avenue | 95 | F 1 | E | 3 | 62 | 60 |
| 27 Wulworra Avenue | 95 | F 2 | E | 3 | 62 | 60 |
| 25 Wulworra Avenue | 94 | GF | E | 3 | 63 | 60 |
| 25 Wulworra Avenue | 94 | F 1 | E | 3 | 63 | 60 |
| 25 Wulworra Avenue | 94 | F 2 | E | 3 | 63 | 60 |
| 23 Wulworra Avenue | 93 | GF | NE | 3 | 63 | 60 |
| 23 Wulworra Avenue | 93 | F 1 | NE | 3 | 63 | 60 |
| 23 Wulworra Avenue | 93 | F 2 | NE | 3 | 63 | 60 |
| 21 Wulworra Avenue | 92 | GF | E | 3 | 63 | 60 |
| 21 Wulworra Avenue | 92 | F 1 | E | 3 | 63 | 60 |
| 21 Wulworra Avenue | 92 | F 2 | E | 3 | 63 | 60 |
| 17 Wulworra Avenue | 91 | GF | E | 3 | 63 | 60 |
| 17 Wulworra Avenue | 91 | F 1 | E | 3 | 63 | 60 |
| 17 Wulworra Avenue | 91 | F 2 | E | 3 | 63 | 60 |
| 15 Wulworra Avenue | 90 | GF | E | 3 | 63 | 60 |
| 15 Wulworra Avenue | 90 | F 1 | E | 3 | 63 | 60 |
| 15 Wulworra Avenue | 90 | F 2 | E | 3 | 63 | 60 |
| 13 Wulworra Avenue | 89 | GF | E | 3 | 63 | 60 |
| 13 Wulworra Avenue | 89 | F 1 | E | 3 | 63 | 60 |
| 13 Wulworra Avenue | 89 | F 2 | E | 3 | 63 | 60 |
| 11 Wulworra Avenue | 88 | GF | E | 3 | 63 | 60 |
| 11 Wulworra Avenue | 88 | F 1 | E | 3 | 63 | 60 |
| 11 Wulworra Avenue | 88 | F 2 | E | 3 | 63 | 60 |
| 11 Wulworra Avenue | 88 | F 3 | E | 3 | 63 | 60 |
| 9 Wulworra Avenue | 87 | GF | E | 3 | 63 | 60 |
| 9 Wulworra Avenue | 87 | F 1 | E | 3 | 63 | 60 |
| 9 Wulworra Avenue | 87 | F 2 | E | 3 | 63 | 60 |
| 9 Wulworra Avenue | 87 | F 3 | E | 3 | 63 | 60 |
| 7 Wulworra Avenue | 86 | GF | NE | 3 | 63 | 60 |
| 7 Wulworra Avenue | 86 | F 1 | NE | 3 | 63 | 60 |
| 7 Wulworra Avenue | 86 | F 2 | NE | 3 | 64 | 60 |
| 7 Wulworra Avenue | 86 | F 3 | NE | 3 | 64 | 60 |
| 6 Wulworra Avenue | 80 | GF | E | 3 | 64 | 60 |
| 6 Wulworra Avenue | 80 | F 1 | E | 3 | 64 | 60 |
| 6 Wulworra Avenue | 80 | F 2 | E | 3 | 64 | 60 |
| 6 Wulworra Avenue | 80 | F 3 | E | 3 | 66 | 60 |
| 5 Wulworra Avenue | 85 | GF | E | 3 | 64 | 60 |
| 5 Wulworra Avenue | 85 | F 1 | E | 3 | 64 | 60 |
| 5 Wulworra Avenue | 85 | F 2 | E | 3 | 64 | 60 |
| 5 Wulworra Avenue | 85 | F 3 | E | 3 | 64 | 60 |
| 3 Wulworra Avenue | 79 | GF | E | 3 | 66 | 60 |
| 3 Wulworra Avenue | 79 | F 1 | E | 3 | 66 | 60 |
| 3 Wulworra Avenue | 79 | F 2 | E | 3 | 66 | 60 |
| 3 Wulworra Avenue | 79 | F 3 | E | 3 | 66 | 60 |
| 3 Wulworra Avenue | 84 | GF | E | 3 | 64 | 60 |
| 3 Wulworra Avenue | 84 | F 1 | E | 3 | 64 | 60 |
| 3 Wulworra Avenue | 84 | F 2 | E | 3 | 64 | 60 |
| 3 Wulworra Avenue | 84 | F 3 | E | 3 | 64 | 60 |
| 2a Wulworra Avenue | 81 | GF | E | 3 | 64 | 60 |

| Receiver | Obj No. | Floor | Facade Facing | NCA | Construction Noise Level dB(A), L _{AMax} Scenario 4a | L _{AMax} Criteria, dB(A) |
|--------------------|---------|-------|---------------|-----|---|--------------------------------------|
| 2a Wulworra Avenue | 81 | F 1 | E | 3 | 64 | 60 |
| 2a Wulworra Avenue | 81 | F 2 | E | 3 | 65 | 60 |
| 2a Wulworra Avenue | 81 | F 3 | E | 3 | 66 | 60 |
| 2 Wulworra Avenue | 82 | GF | E | 3 | 64 | 60 |
| 2 Wulworra Avenue | 82 | F 1 | E | 3 | 64 | 60 |
| 2 Wulworra Avenue | 82 | F 2 | E | 3 | 65 | 60 |
| 2 Wulworra Avenue | 82 | F 3 | E | 3 | 65 | 60 |
| 1 Wulworra Avenue | 83 | GF | E | 3 | 64 | 60 |
| 1 Wulworra Avenue | 83 | F 1 | E | 3 | 64 | 60 |
| 1 Wulworra Avenue | 83 | F 2 | E | 3 | 64 | 60 |
| 1 Wulworra Avenue | 83 | F 3 | E | 3 | 64 | 60 |

The predicted L_{AMax} results detailed above indicate that maximum construction noise levels are likely to exceed the sleep disturbance criteria for the “outside of standard hours” construction scenario, at some of assessed receivers in NCA 2 and 3. 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 project 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 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
- > Rock hammers
- > Rock drill
- > Truck movements.

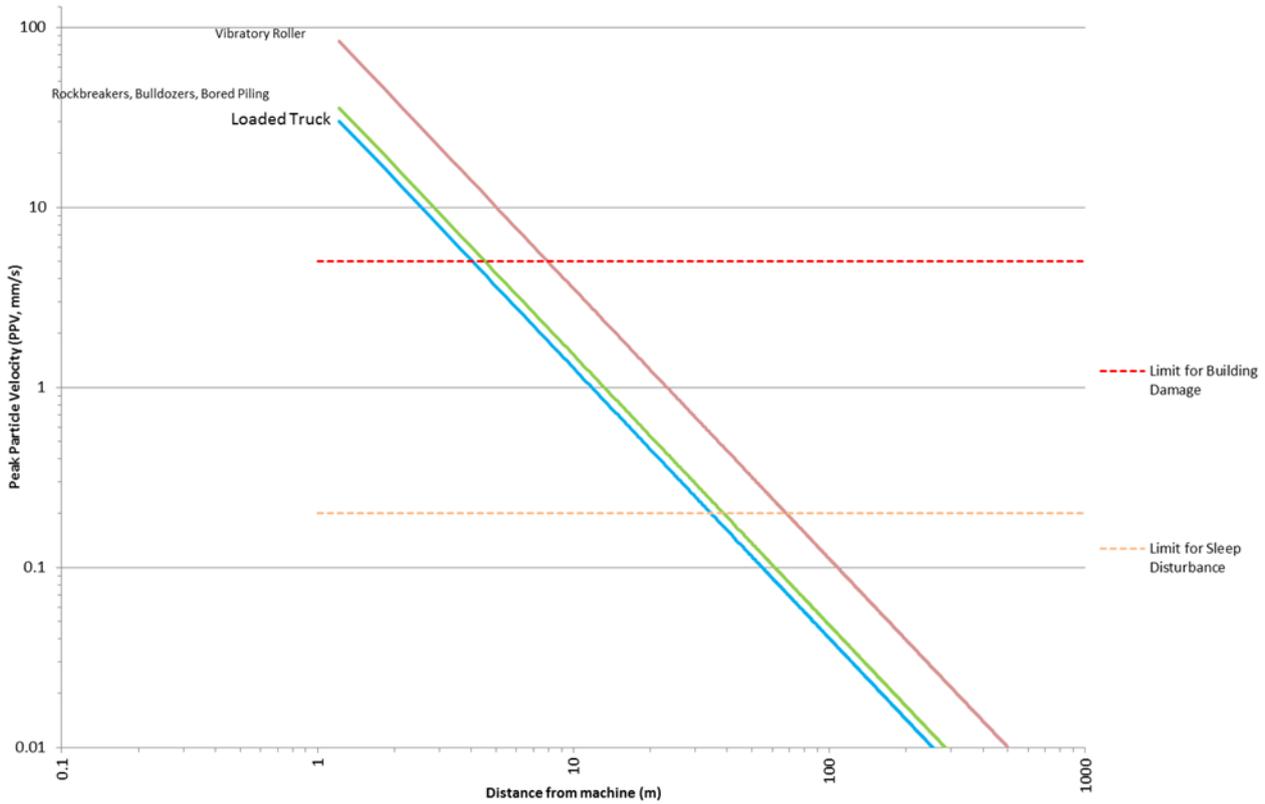
Construction vibration levels vary depending on the distance from the equipment in use, the energy level imparted to the ground by the construction process, and the bedrock type. The highest vibration sources associated with the construction work will be pile hammers and bored piling rigs. It is anticipated 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 Table 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 and hammer piling may be undertaken with a minimum separation distance of 35 metres from the nearest buildings, based on the expected plant to be used for the project 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 for bored piling.

However for rock hammers the minimum required safe working distance is increased as detailed below 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 (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 |

| 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) |
| | < 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 below in Figure 7-2.

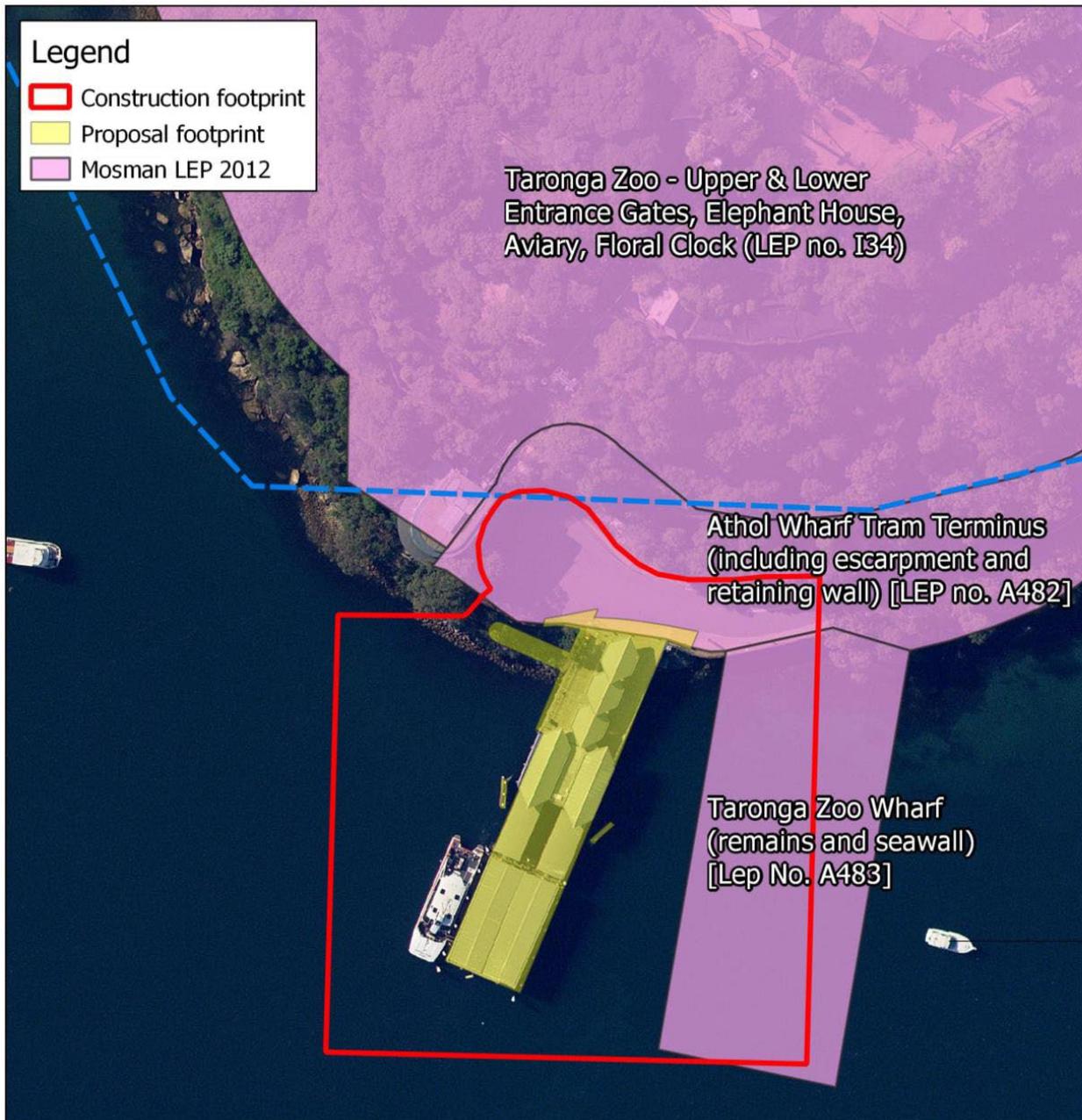


Figure 7-2 Heritage listings located in proximity to the proposal

The closest heritage structures are located at 10, 20 and 30-50 metres from the proposed piling works and include the existing Taronga Zoo wharf remains and seawall, the Athol Wharf Tram Terminus and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (Figure 7-2: LEP No. A483, LEP No. A482 & LEP No. I34 respectively). The proposed works would involve piling and the use of a rock hammer and other vibration intensive plant. These works would be located at less than the minimum safe working distance for cosmetic damage, which is identified in the CNVG and Table 7-1 as 50 metres. Based on Figure 7-1, 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 > 0.5 mm/s could be experienced at the existing Taronga Zoo wharf and seawall which is lower than the limits stated in DIN 4150.3, but would occur at a distance of less than 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 30 metres.

In summary, the proposed works would be located within the minimum safe working distance for cosmetic damage to heritage fabric, which is identified in the CNVG as being within 50m of vibration intensive plant. Therefore, due to the close proximity of the works, the vibrations associated with the piling and additional plant have the potential to cause impacts to the archaeological remains of the former wharf, as well as the extant remains of the sandstone seawall.

However, only a small number of piles are required and 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.

8 Recommended mitigation measures

8.1 ICNG & AS 2436 recommended mitigation measures

8.1.1 General Mitigation Measures

The following best practice construction noise and vibration mitigation measures are based on recommendations provided within the ICNG and Australian Standard AS 2436-1981: *Guide to Noise Control on Construction, Maintenance and Demolition Sites*. The best practice measures provided in Table 8-1 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"> • Plant controls: <ul style="list-style-type: none"> – Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc. – Plant and equipment would be in good working order to prevent excess noise generation. – Locating static sources of noise such as the generators as remotely as possible from noise sensitive receivers – Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations – Use of temporary noise barriers where practical. The height and location of these barriers would 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. – 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 – Acoustic curtains (generally loaded vinyl based products) attached to wire construction fencing or laid over steel scaffold can also provide practical temporary noise barriers. We recommend that this is investigated for stationery plant within the worksites once a detailed schedule of works and plant is available. – Provision of a solid 2 metre high anti-gawk barrier along the site work area boundaries may provide some reduction to nearby receivers, however this is only expected to benefit the lower levels of the nearby receivers. Local barriers will have minimal effects on noise reduction for receivers with multiple levels as there will still be a clear line of sight from the works to the receivers. Inclusion of an angled return at the top of the barrier (if this is practical to construct) may provide increased benefit to multiple storey receivers when the plant is located close to the barrier and is generally stationery. We recommend that this is further investigated once a detailed schedule of works and plant is available. • Management and behavioural controls: <ul style="list-style-type: none"> – Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings – Avoid the need for reversing in the construction area by creating a loop road or similar – Avoid dropping materials from height – Workers should avoid shouting, minimise talking loudly, and avoid slamming vehicle doors. • Allowing construction to occur only during approved construction hours, unless otherwise required as a condition of TfNSW safety requirements • 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. | Contractor | Pre-construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---|--|--------------------|------------------------------------|
| | | <ul style="list-style-type: none"> Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately. Conducting additional monitoring if complaints are received or proposed activities and number of plant exceed those assumed in this assessment. Modifying of work activities where noise or vibration is found to cause unacceptable impact. Implementation of additional mitigation measures in accordance with the CNVG including notification, respite periods and alternate accommodation as reasonable and feasible. | | |
| NV2 | Noise and vibration | <ul style="list-style-type: none"> Carrying out works within standard daytime hours as follows: <ul style="list-style-type: none"> 7:00 am to 6:00 pm Monday to Friday 8:00 am to 1:00 pm Saturdays, no work on Sundays or public holidays. 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 or due to requirements to enable bus access. 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. 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. | Contractor | Construction |
| NV3 | Noise and vibration | <ul style="list-style-type: none"> 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. Notification should be a minimum of 7 calendar days prior to the start of work. A contact telephone number and email address will be available for community feedback | TfNSW / Contractor | Pre-construction |
| B21 | Noise and vibration | Consultation with Taronga Zoo is will be undertaken to determine whether the expected noise and vibration impact from construction are likely to have a detrimental impact on the nearby resident Taronga Zoo fauna to determine suitable mitigation measures to address this if required. | TfNSW / Contractor | Detailed design / 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 (Taronga Zoo Wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. I34)), specialist advice will be sought from an appropriately qualified structural engineer, Transport for NSW Noise and Vibration specialist and Transport for NSW heritage advisor who are 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 | 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 | Contractor | Construction |

| ID | Impact | Environmental safeguards | Responsibility | Timing |
|-----|---------------------|--|----------------|---------------------------------|
| | heritage structures | <p>the sandstone retaining wall in the Taronga Zoo wharf (remains and seawall, LEP No. A438), Athol Wharf Tram Terminus (including escarpment and retaining wall, LEP No. A482) and the Upper and Lower Entrance Gates, Elephant House, Aviary and Floral Clock (LEP No. I34). Assessment and monitoring of vibration impacts should adhere to:</p> <ul style="list-style-type: none"> 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. | | |
| 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 Roads & Maritime Construction Noise and Vibration Guideline 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: |
| All hours | | | | |
| 75dBA or greater | | | N, V, PC, RO | HA |
| Standard Hours: Mon - Fri (7am - 6pm), Sat (8am - 1pm), Sun/Pub Hol (Nil) | | | | |
| 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 |
| OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am & 1pm - 10pm), Sun/Pub Hol (8am - 6pm) | | | | |
| 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 |
| OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6am - 7am) | | | | |
| 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 |
| Notes: | | | | |
| 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 C 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 | 3 |
| (4a) Installation of Protection Piles within Waterway | Period 1 | - | N, R1, DR | V, N, R1, DR |
| | Period 2 | V, N, R2, DR | V, IB, N, PC, SN, R2, DR | 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. This assessment indicates that there are no sensitive receivers predicted to experience construction noise levels of greater than 75 dB(A).
- > Construction noise levels are predicted to exceed the NSW ICNG noise management levels (NML) for “standard” hours at NCA 3 for standard construction hours for all construction stages. Construction noise levels are not predicted to exceed the NMLs at NCA 1 and 2 for works during standard hours.
- > Construction noise levels are predicted to exceed noise management levels for “non-standard” hours of operation for Stage 4a at the nearby residential receivers in all NCAs, particularly for receivers located on Raglan Street and Wulworra Avenue in NCA 2 and 3 respectively. This is due to the proximity of receivers to the construction works.
- > Predicted levels are expected to be moderately intrusive at a number of receivers in NCA 3 for Stages 4a for works during the OOHW2 time period. It is understood that no works associated with Stage 4a will take place during the OOHW1 time period. Construction noise is likely to have the highest impact on and cause sleep disturbance at sensitive receivers located on Raglan Street in NCA 2 and Wulworra Avenue/Cremorne Road in NCA 3, 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 is not likely to be practical for this site given the elevated nature of the surrounding receivers. However, provision of anti-gawk screens with no gaps around the work site may provide some screening to the closest ground level receivers, and should be investigated further as part of the project Construction Noise and Vibration Management Plan (CNVMP) assessment.
- > 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 TfNSW Construction Noise and Vibration Guideline.
- > A detailed construction noise and vibration management plan should 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.

Taronga Zoo
Wharf Upgrade

APPENDIX A
NOISE
MONITORING
CHARTS



Logger 1 - Ambient Noise Levels Measured between 10 September and 17 September 2020

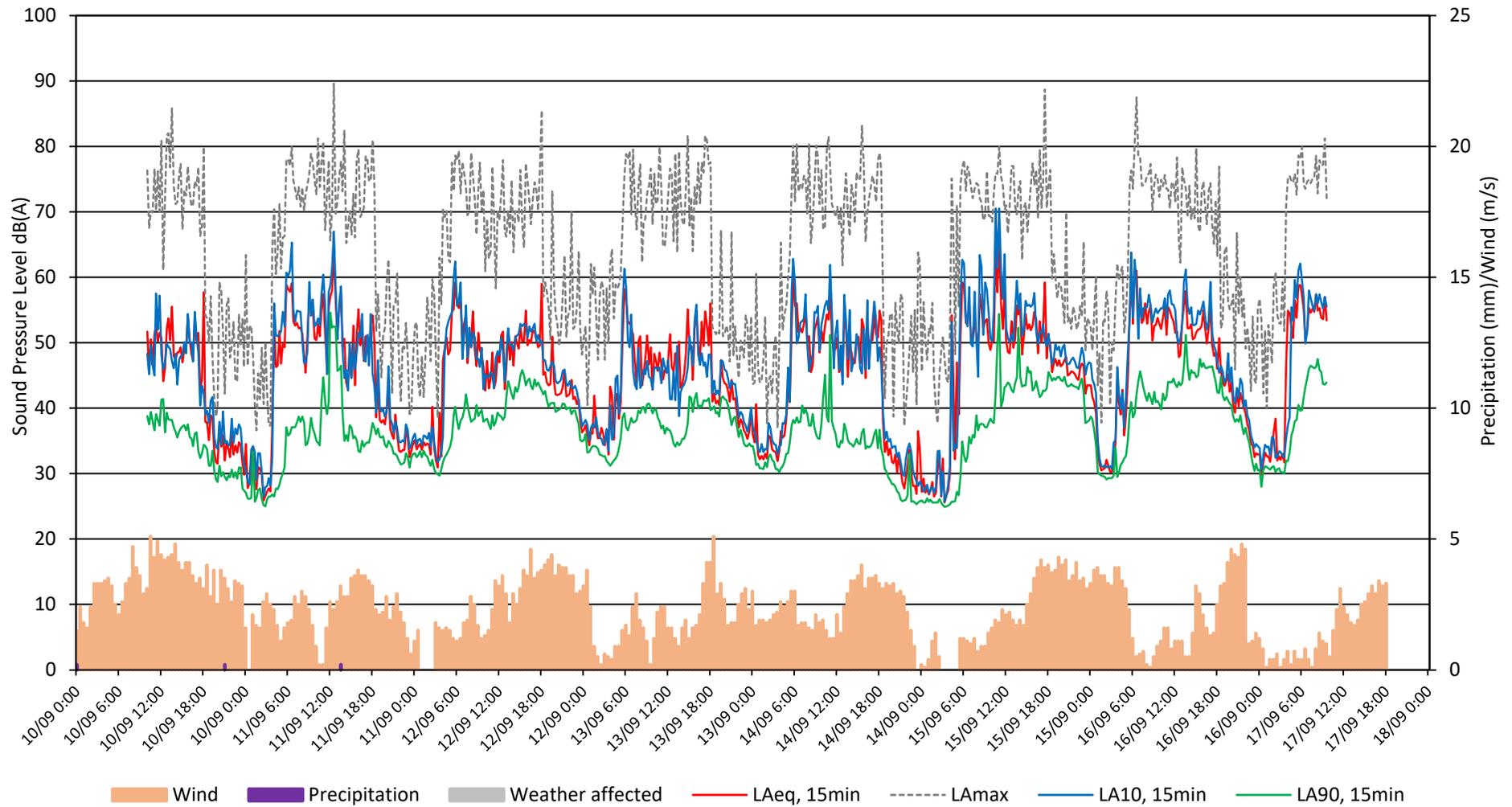


Figure A1 Ambient Noise Levels Measured Between 10 September and 17 September 2020 at Logger Location 1

Logger 2 - Ambient Noise Levels Measured Between 29 April and 6 May 2020

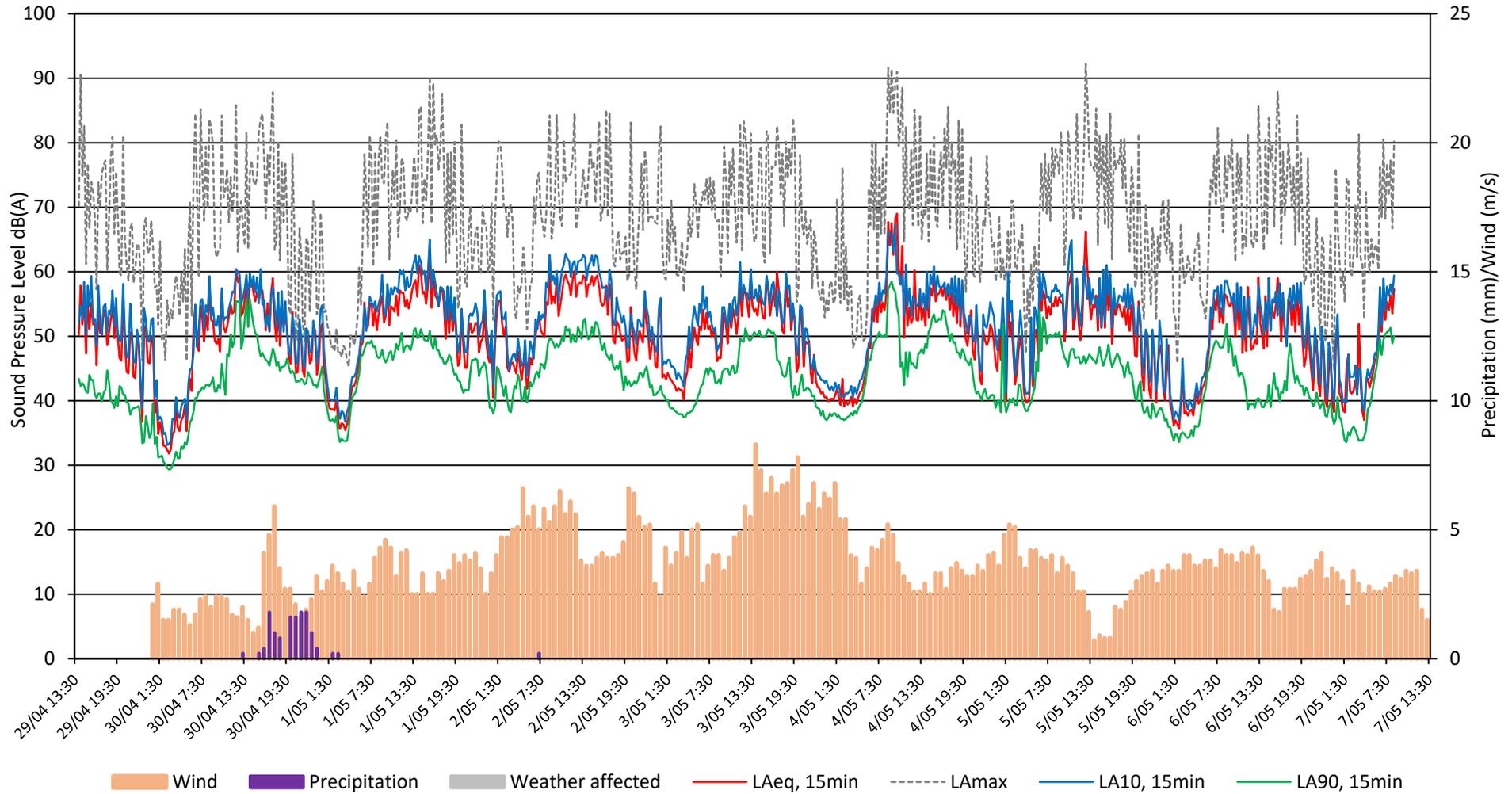


Figure A2 Ambient Noise Levels Measured Between 29 April and 6 May 2020 at Logger Location 2

Logger 3 - Ambient Noise Levels Measured between 29 April and 6 May 2020

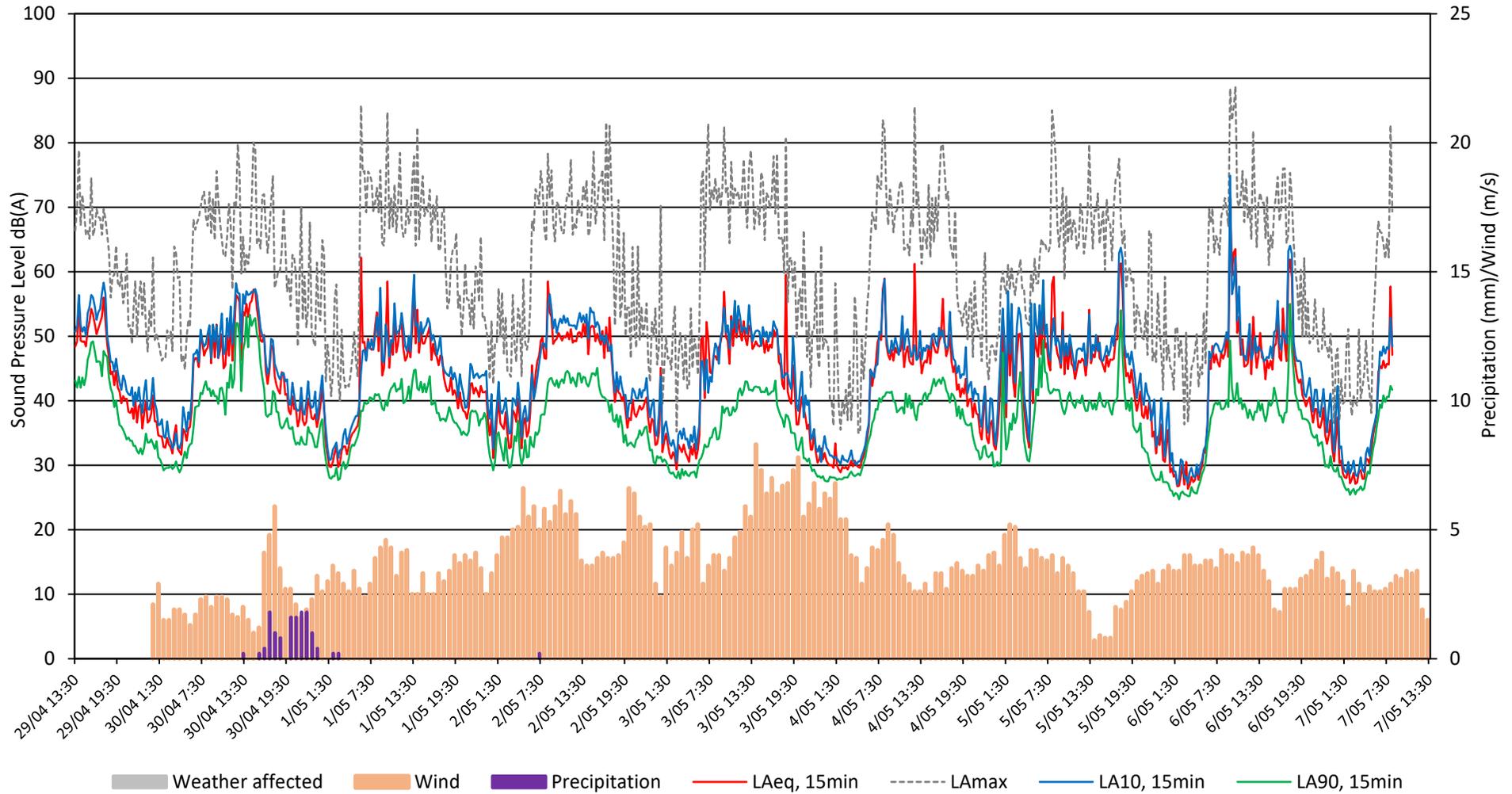


Figure A3 Ambient Noise Levels Measured Between 29 April and 6 May 2020 at Logger Location 3

Taronga Zoo
Wharf
Upgrade

APPENDIX B
PREDICTED
CONSTRUCTION
NOISE LEVELS



Table B1 Predicted Construction LAeq Noise Levels Compared to TfNSW Daytime Noise Impact Categories, dB(A). – NCA 1

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 41-46dB(A) | | | | | | | | | |
| Clearly audible: 46-56 dB(A) | | | | | | | | | |
| Moderately intrusive: 56-66 dB(A) | | | | | | | | | |
| Highly Intrusive: >66 dB(A) | | | | | | | | | |
| 31 Whiting Beach Road | 1 | 16 | GF | S | 32 | 36 | - | 31 | 33 |
| 29 Whiting Beach Road | 1 | 18 | GF | W | 34 | 38 | - | 31 | 34 |
| 27 Whiting Beach Road | 1 | 20 | GF | E | 36 | 40 | - | 34 | 37 |
| 27 Rickard Avenue | 1 | 27 | GF | SE | 30 | 34 | - | 28 | 31 |
| 25 Whiting Beach Road | 1 | 21 | GF | E | 31 | 35 | - | 29 | 32 |
| 25 Rickard Avenue | 1 | 28 | GF | SW | 31 | 35 | - | 29 | 31 |
| 28 Rickard Avenue | 1 | 14 | GF | SW | 30 | 35 | - | 28 | 32 |
| 28 Rickard Avenue | 1 | 14 | F 1 | SW | 30 | 35 | - | 28 | 32 |
| 21 Whiting Beach Road | 1 | 23 | GF | E | 31 | 35 | - | 28 | 32 |
| 26a Rickard Avenue | 1 | 12 | GF | SW | 32 | 35 | - | 28 | 31 |
| 26a Rickard Avenue | 1 | 12 | F 1 | SW | 32 | 35 | - | 29 | 31 |
| 26 Rickard Avenue | 1 | 13 | GF | SW | 30 | 35 | - | 30 | 31 |
| 26 Rickard Avenue | 1 | 13 | F 1 | SW | 30 | 36 | - | 30 | 33 |
| 24 Rickard Avenue | 1 | 11 | GF | SW | 29 | 36 | - | 28 | 33 |
| 24 Rickard Avenue | 1 | 11 | F 1 | SW | 29 | 33 | - | 27 | 30 |
| 19 Whiting Beach Road | 1 | 26 | GF | E | 30 | 33 | - | 27 | 30 |
| 22 Rickard Avenue | 1 | 9 | GF | SW | 32 | 36 | - | 30 | 33 |
| 22 Rickard Avenue | 1 | 9 | F 1 | SW | 32 | 36 | - | 30 | 33 |
| 17 Whiting Beach Road | 1 | 31 | GF | S | 29 | 34 | - | 27 | 31 |
| 20 Rickard Avenue | 1 | 10 | GF | SE | 30 | 35 | - | 28 | 32 |
| 20 Rickard Avenue | 1 | 10 | F 1 | SE | 31 | 36 | - | 28 | 32 |
| 18 Rickard Avenue | 1 | 8 | GF | SW | 29 | 34 | - | 27 | 31 |
| 18 Rickard Avenue | 1 | 8 | F 1 | SW | 29 | 34 | - | 27 | 32 |
| 13A Whiting Beach Road | 1 | 33 | GF | S | 29 | 34 | - | 27 | 32 |
| 16 Rickard Avenue | 1 | 7 | GF | SE | 32 | 35 | - | 28 | 30 |
| 16 Rickard Avenue | 1 | 7 | F 1 | SE | 32 | 35 | - | 28 | 30 |
| 17 Rickard Avenue | 1 | 29 | GF | W | 30 | 34 | - | 29 | 30 |
| 17 Rickard Avenue | 1 | 29 | F 1 | W | 31 | 36 | - | 29 | 33 |
| 13 Whiting Beach Road | 1 | 34 | GF | S | 29 | 36 | - | 27 | 31 |
| 13 Whiting Beach Road | 1 | 32 | GF | S | 31 | 36 | - | 29 | 32 |
| 14 Rickard Avenue | 1 | 6 | GF | SE | 30 | 36 | - | 30 | 33 |
| 14 Rickard Avenue | 1 | 6 | F 1 | SE | 30 | 36 | - | 30 | 33 |
| 15 Rickard Avenue | 1 | 30 | GF | S | 32 | 35 | - | 28 | 32 |
| 15 Rickard Avenue | 1 | 30 | F 1 | S | 32 | 35 | - | 28 | 32 |
| 11 Whiting Beach Road | 1 | 35 | GF | S | 29 | 34 | - | 27 | 30 |
| 13 Rickard Avenue | 1 | 25 | GF | W | 31 | 34 | - | 30 | 32 |
| 13 Rickard Avenue | 1 | 25 | F 1 | W | 31 | 35 | - | 30 | 32 |
| 9 Whiting Beach Road | 1 | 36 | GF | S | 29 | 35 | - | 27 | 30 |
| 11 Rickard Avenue | 1 | 24 | GF | W | 30 | 35 | - | 28 | 30 |
| 11 Rickard Avenue | 1 | 24 | F 1 | W | 30 | 35 | - | 28 | 31 |
| 10 Rickard Avenue | 1 | 5 | GF | SE | 30 | 35 | - | 27 | 31 |
| 10 Rickard Avenue | 1 | 5 | F 1 | SE | 31 | 35 | - | 26 | 29 |
| 7 Whiting Beach Road | 1 | 37 | GF | S | 29 | 32 | - | 28 | 32 |
| 8 Bradleys Head Road | 1 | 78 | GF | E | 28 | 34 | - | 29 | 32 |
| 8 Rickard Avenue | 1 | 4 | GF | SE | 31 | 38 | - | 31 | 34 |
| 8 Rickard Avenue | 1 | 4 | F 1 | SE | 31 | 38 | - | 31 | 34 |
| 9 Rickard Avenue | 1 | 22 | GF | W | 33 | 35 | - | 28 | 32 |
| 9 Rickard Avenue | 1 | 22 | F 1 | W | 33 | 35 | - | 29 | 32 |
| 5 Whiting Beach Road | 1 | 38 | GF | S | 29 | 34 | - | 29 | 32 |
| 6 Bradleys Head Road | 1 | 74 | GF | E | 30 | 36 | - | 27 | 32 |
| 7 Rickard Avenue | 1 | 19 | GF | S | 31 | 36 | - | 30 | 30 |
| 7 Rickard Avenue | 1 | 19 | F 1 | S | 31 | 33 | - | 30 | 31 |

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 41-46dB(A) | | | | | | | | | |
| Clearly audible: 46-56 dB(A) | | | | | | | | | |
| Moderately intrusive: 56-66 dB(A) | | | | | | | | | |
| Highly Intrusive: >66 dB(A) | | | | | | | | | |
| 5 Bradleys Head Road | 1 | 77 | GF | W | 28 | 32 | - | 27 | 30 |
| 6 Rickard Avenue | 1 | 3 | GF | E | 31 | 33 | - | 29 | 32 |
| 6 Rickard Avenue | 1 | 3 | F 1 | E | 31 | 35 | - | 29 | 32 |
| 4 Bradleys Head Road | 1 | 73 | GF | E | 28 | 35 | - | 26 | 30 |
| 4 Rickard Avenue | 1 | 2 | GF | S | 33 | 33 | - | 27 | 30 |
| 4 Rickard Avenue | 1 | 2 | F 1 | S | 33 | 33 | - | 26 | 34 |
| 3 Whiting Beach Road | 1 | 39 | GF | S | 29 | 38 | - | 31 | 34 |
| 3 Bradleys Head Road | 1 | 76 | GF | S | 28 | 38 | - | 31 | 30 |
| 3 Rickard Avenue | 1 | 17 | GF | S | 32 | 34 | - | 30 | 43 |
| 3 Rickard Avenue | 1 | 17 | F 1 | S | 32 | 36 | - | 30 | 33 |
| 2 St Elmos Street | 1 | 75 | GF | S | 31 | 36 | - | 40 | 33 |
| 2 Bradleys Head Road | 1 | 41 | GF | S | 29 | 33 | - | 27 | 30 |
| 2a Rickard Avenue | 1 | 1 | GF | S | 31 | 33 | - | 27 | 30 |
| 2a Rickard Avenue | 1 | 1 | F 1 | S | 31 | 36 | - | 29 | 32 |
| 1 Whiting Beach Road | 1 | 40 | GF | S | 29 | 36 | - | 29 | 33 |
| 1 Rickard Avenue | 1 | 15 | GF | S | 32 | 36 | - | 35 | 37 |
| 1 Rickard Avenue | 1 | 15 | F 1 | S | 32 | 36 | - | 31 | 33 |
| 1 Bradleys Head Road | 1 | 42 | GF | S | 30 | 36 | - | 31 | 33 |

Table B2 Predicted Construction LAeq Noise Levels Compared to TfNSW Daytime Noise Impact Categories, dB(A). – NCA 2

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 50-55 dB(A) | | | | | | | | | |
| Clearly audible: 55-65 dB(A) | | | | | | | | | |
| Moderately intrusive: 65-75 dB(A) | | | | | | | | | |
| Highly Intrusive: >75 dB(A) | | | | | | | | | |
| 32 Raglan Street | 2 | 66 | GF | E | 47 | 49 | - | 46 | 50 |
| 32 Raglan Street | 2 | 66 | F 1 | E | 47 | 50 | - | 46 | 50 |
| 30 Raglan Street | 2 | 65 | GF | E | 47 | 50 | - | 47 | 50 |
| 30 Raglan Street | 2 | 65 | F 1 | E | 47 | 51 | - | 47 | 50 |
| 26 Raglan Street | 2 | 64 | GF | E | 48 | 50 | - | 46 | 50 |
| 26 Raglan Street | 2 | 64 | F 1 | E | 48 | 50 | - | 47 | 51 |
| 24 Raglan Street | 2 | 63 | GF | E | 47 | 50 | - | 46 | 50 |
| 24 Raglan Street | 2 | 63 | F 1 | E | 48 | 50 | - | 46 | 50 |
| 22 Raglan Street | 2 | 62 | GF | E | 47 | 50 | - | 46 | 50 |
| 22 Raglan Street | 2 | 62 | F 1 | E | 48 | 51 | - | 47 | 50 |
| 20 Raglan Street | 2 | 61 | GF | E | 46 | 49 | - | 46 | 50 |
| 20 Raglan Street | 2 | 61 | F 1 | E | 48 | 51 | - | 47 | 50 |
| 19 Raglan Street | 2 | 67 | GF | S | 47 | 50 | - | 46 | 50 |
| 19 Raglan Street | 2 | 67 | F 1 | S | 47 | 50 | - | 46 | 50 |
| 18 Raglan Street | 2 | 60 | GF | E | 29 | 34 | - | 28 | 31 |
| 18 Raglan Street | 2 | 60 | F 1 | E | 29 | 36 | - | 32 | 35 |
| 16 Raglan Street | 2 | 59 | GF | E | 29 | 35 | - | 31 | 34 |
| 16 Raglan Street | 2 | 59 | F 1 | E | 29 | 37 | - | 33 | 36 |
| 14 Raglan Street | 2 | 58 | GF | E | 47 | 47 | - | 44 | 50 |
| 14 Raglan Street | 2 | 58 | F 1 | E | 47 | 47 | - | 44 | 51 |
| 17 Raglan Street | 2 | 50 | GF | S | 50 | 53 | - | 48 | 52 |
| 17 Raglan Street | 2 | 50 | F 1 | S | 50 | 53 | - | 49 | 52 |
| 17 Raglan Street | 2 | 50 | F 2 | S | 50 | 53 | - | 49 | 52 |
| 17 Raglan Street | 2 | 50 | F 3 | S | 50 | 53 | - | 49 | 52 |
| 17 Raglan Street | 2 | 50 | F 4 | S | 50 | 54 | - | 49 | 52 |
| 17 Raglan Street | 2 | 50 | F 5 | S | 50 | 54 | - | 49 | 53 |

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|------|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 50-55 dB(A) | | | | | | | | | |
| Clearly audible: 55-65 dB(A) | | | | | | | | | |
| Moderately intrusive: 65-75 dB(A) | | | | | | | | | |
| Highly Intrusive: >75 dB(A) | | | | | | | | | |
| 17 Raglan Street | 2 | 50 | F 6 | S | 51 | 54 | - | 49 | 53 |
| 17 Raglan Street | 2 | 50 | F 7 | S | 51 | 54 | - | 49 | 53 |
| 17 Raglan Street | 2 | 50 | F 8 | S | 51 | 54 | - | 49 | 53 |
| 17 Raglan Street | 2 | 50 | F 9 | S | 51 | 54 | - | 49 | 53 |
| 17 Raglan Street | 2 | 50 | F 10 | S | 51 | 54 | - | 49 | 53 |
| 17 Raglan Street | 2 | 50 | F 11 | S | 51 | 55 | - | 49 | 53 |
| 17 Raglan Street | 2 | 50 | F 12 | S | 51 | 55 | - | 49 | 53 |
| 17 Raglan Street | 2 | 50 | F 13 | S | 51 | 55 | - | 49 | 53 |
| 12 Raglan Street | 2 | 57 | GF | E | 46 | 51 | - | 46 | 47 |
| 12 Raglan Street | 2 | 57 | F 1 | E | 46 | 52 | - | 47 | 48 |
| 11 Raglan Street | 2 | 49 | GF | E | 51 | 34 | - | 50 | 53 |
| 11 Raglan Street | 2 | 49 | F 1 | E | 51 | 37 | - | 50 | 53 |
| 11 Raglan Street | 2 | 49 | F 2 | E | 51 | 55 | - | 50 | 53 |
| 11 Raglan Street | 2 | 49 | F 3 | E | 51 | 55 | - | 50 | 53 |
| 10 Raglan Street | 2 | 56 | GF | E | 29 | 55 | - | 29 | 32 |
| 10 Raglan Street | 2 | 56 | F 1 | E | 30 | 55 | - | 33 | 36 |
| 9 Raglan Street | 2 | 48 | GF | E | 51 | 54 | - | 49 | 53 |
| 9 Raglan Street | 2 | 48 | F 1 | E | 51 | 54 | - | 49 | 53 |
| 9 Raglan Street | 2 | 48 | F 2 | E | 51 | 54 | - | 50 | 53 |
| 9 Raglan Street | 2 | 48 | F 3 | E | 52 | 55 | - | 50 | 53 |
| 9 Curraghbeena Road | 2 | 72 | GF | E | 45 | 44 | - | 45 | 49 |
| 9 Curraghbeena Road | 2 | 72 | F 1 | E | 45 | 45 | - | 45 | 49 |
| 8 Raglan Street | 2 | 55 | GF | E | 33 | 47 | - | 41 | 38 |
| 8 Raglan Street | 2 | 55 | F 1 | E | 35 | 47 | - | 42 | 40 |
| 7 Raglan Street | 2 | 47 | GF | E | 50 | 54 | - | 49 | 52 |
| 7 Raglan Street | 2 | 47 | F 1 | E | 51 | 54 | - | 49 | 52 |
| 7 Raglan Street | 2 | 47 | F 2 | E | 51 | 54 | - | 49 | 52 |
| 7 Raglan Street | 2 | 47 | F 3 | E | 51 | 54 | - | 49 | 53 |
| 7 Herron Walk | 2 | 54 | GF | E | 39 | 41 | - | 37 | 41 |
| 7 Herron Walk | 2 | 54 | F 1 | E | 41 | 44 | - | 40 | 44 |
| 7 Herron Walk | 2 | 54 | F 2 | E | 43 | 46 | - | 42 | 46 |
| 7 Herron Walk | 2 | 54 | F 3 | E | 46 | 48 | - | 44 | 48 |
| 7 Curraghbeena Road | 2 | 71 | GF | E | 45 | 48 | - | 45 | 49 |
| 7 Curraghbeena Road | 2 | 71 | F 1 | E | 45 | 48 | - | 45 | 49 |
| 5 Curraghbeena Road | 2 | 70 | GF | E | 45 | 54 | - | 49 | 52 |
| 5 Curraghbeena Road | 2 | 70 | F 1 | E | 46 | 54 | - | 49 | 52 |
| 4-5a Herron Walk | 2 | 51 | GF | E | 43 | 54 | - | 49 | 53 |
| 4-5a Herron Walk | 2 | 51 | F 1 | E | 44 | 54 | - | 49 | 53 |
| 4-5a Herron Walk | 2 | 51 | F 2 | E | 46 | 48 | - | 45 | 49 |
| 4-5a Herron Walk | 2 | 51 | F 3 | E | 49 | 48 | - | 45 | 49 |
| 5 Raglan Street | 2 | 46 | GF | E | 51 | 45 | - | 41 | 47 |
| 5 Raglan Street | 2 | 46 | F 1 | E | 51 | 46 | - | 42 | 47 |
| 5 Raglan Street | 2 | 46 | F 2 | E | 51 | 48 | - | 44 | 49 |
| 5 Raglan Street | 2 | 46 | F 3 | E | 51 | 52 | - | 48 | 52 |
| 3 Raglan Street | 2 | 45 | GF | E | 51 | 54 | - | 49 | 52 |
| 3 Raglan Street | 2 | 45 | F 1 | E | 51 | 54 | - | 49 | 53 |
| 3 Raglan Street | 2 | 45 | F 2 | E | 51 | 55 | - | 49 | 53 |
| 3 Raglan Street | 2 | 45 | F 3 | E | 51 | 55 | - | 49 | 53 |
| 3 Curraghbeena Road | 2 | 69 | GF | E | 46 | 36 | - | 45 | 33 |
| 3 Curraghbeena Road | 2 | 69 | F 1 | E | 46 | 36 | - | 45 | 34 |
| 3 Herron Walk | 2 | 52 | GF | S | 32 | 34 | - | 30 | 31 |
| 3 Herron Walk | 2 | 52 | F 1 | S | 33 | 34 | - | 31 | 31 |
| 3 Herron Walk | 2 | 52 | F 2 | S | 30 | 48 | - | 28 | 49 |
| 3 Herron Walk | 2 | 52 | F 3 | S | 30 | 48 | - | 29 | 49 |

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 50-55 dB(A) | | | | | | | | | |
| Clearly audible: 55-65 dB(A) | | | | | | | | | |
| Moderately intrusive: 65-75 dB(A) | | | | | | | | | |
| Highly Intrusive: >75 dB(A) | | | | | | | | | |
| 2 Raglan Street | 2 | 43 | GF | E | 50 | 54 | - | 48 | 52 |
| 2 Raglan Street | 2 | 43 | F 1 | E | 50 | 54 | - | 48 | 52 |
| 2 Raglan Street | 2 | 43 | F 2 | E | 50 | 54 | - | 48 | 52 |
| 2 Raglan Street | 2 | 43 | F 3 | E | 50 | 54 | - | 48 | 52 |
| 2 Raglan Street | 2 | 43 | F 4 | E | 50 | 55 | - | 49 | 52 |
| 2 Raglan Street | 2 | 43 | F 5 | E | 50 | 55 | - | 49 | 52 |
| 1 Raglan Street | 2 | 44 | GF | SE | 51 | 54 | - | 49 | 52 |
| 1 Raglan Street | 2 | 44 | F 1 | SE | 51 | 54 | - | 49 | 52 |
| 1 Raglan Street | 2 | 44 | F 2 | SE | 51 | 55 | - | 49 | 52 |
| 1 Raglan Street | 2 | 44 | F 3 | SE | 51 | 55 | - | 49 | 53 |
| 1 Curraghbeena Road | 2 | 68 | GF | S | 46 | 34 | - | 28 | 31 |
| 1 Curraghbeena Road | 2 | 68 | F 1 | S | 46 | 34 | - | 28 | 31 |
| 1 Herron Walk | 2 | 53 | GF | S | 30 | 34 | - | 28 | 31 |
| 1 Herron Walk | 2 | 53 | F 1 | S | 30 | 34 | - | 29 | 32 |
| 1 Herron Walk | 2 | 53 | F 2 | S | 30 | 49 | - | 45 | 50 |
| 1 Herron Walk | 2 | 53 | F 3 | S | 31 | 49 | - | 45 | 50 |

Table B3 Predicted Construction LAeq Noise Levels Compared to TfNSW Daytime Noise Impact Categories, dB(A). – NCA 3

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 43-48 dB(A) | | | | | | | | | |
| Clearly audible: 48-58 dB(A) | | | | | | | | | |
| Moderately intrusive: 58-68 dB(A) | | | | | | | | | |
| Highly Intrusive: >68 dB(A) | | | | | | | | | |
| 33 Wolworra Avenue | 3 | 98 | GF | E | 46 | 50 | - | 43 | 47 |
| 33 Wolworra Avenue | 3 | 98 | F 1 | E | 46 | 50 | - | 43 | 47 |
| 33 Wolworra Avenue | 3 | 98 | F 2 | E | 46 | 50 | - | 43 | 47 |
| 39 Wolworra Avenue | 3 | 99 | GF | E | 46 | 50 | - | 44 | 47 |
| 39 Wolworra Avenue | 3 | 99 | F 1 | E | 46 | 50 | - | 44 | 47 |
| 39 Wolworra Avenue | 3 | 99 | F 2 | E | 46 | 50 | - | 44 | 47 |
| 51 Wolworra Avenue | 3 | 104 | GF | E | 45 | 50 | - | 44 | 48 |
| 51 Wolworra Avenue | 3 | 104 | F 1 | E | 45 | 50 | - | 44 | 48 |
| 51 Wolworra Avenue | 3 | 104 | F 2 | E | 45 | 50 | - | 44 | 48 |
| 31 Wolworra Avenue | 3 | 97 | GF | NE | 46 | 50 | - | 43 | 47 |
| 31 Wolworra Avenue | 3 | 97 | F 1 | NE | 46 | 50 | - | 43 | 47 |
| 31 Wolworra Avenue | 3 | 97 | F 2 | NE | 46 | 50 | - | 43 | 47 |
| 41 Wolworra Avenue | 3 | 100 | GF | E | 46 | 50 | - | 44 | 47 |
| 41 Wolworra Avenue | 3 | 100 | F 1 | E | 46 | 50 | - | 44 | 47 |
| 41 Wolworra Avenue | 3 | 100 | F 2 | E | 46 | 50 | - | 44 | 47 |
| 45 Wolworra Avenue | 3 | 102 | GF | E | 45 | 50 | - | 44 | 47 |
| 45 Wolworra Avenue | 3 | 102 | F 1 | E | 45 | 50 | - | 44 | 47 |
| 45 Wolworra Avenue | 3 | 102 | F 2 | E | 45 | 50 | - | 44 | 47 |
| 49 Wolworra Avenue | 3 | 103 | GF | E | 45 | 50 | - | 44 | 48 |
| 49 Wolworra Avenue | 3 | 103 | F 1 | E | 45 | 50 | - | 44 | 48 |
| 49 Wolworra Avenue | 3 | 103 | F 2 | E | 45 | 50 | - | 44 | 48 |
| 29 Wolworra Avenue | 3 | 96 | GF | E | 46 | 50 | - | 44 | 48 |
| 29 Wolworra Avenue | 3 | 96 | F 1 | E | 46 | 50 | - | 44 | 48 |
| 29 Wolworra Avenue | 3 | 96 | F 2 | E | 46 | 50 | - | 44 | 48 |
| 27 Wolworra Avenue | 3 | 95 | GF | E | 46 | 50 | - | 44 | 48 |
| 27 Wolworra Avenue | 3 | 95 | F 1 | E | 46 | 50 | - | 44 | 48 |
| 27 Wolworra Avenue | 3 | 95 | F 2 | E | 46 | 50 | - | 44 | 48 |
| 25 Wolworra Avenue | 3 | 94 | GF | E | 46 | 51 | - | 44 | 48 |
| 25 Wolworra Avenue | 3 | 94 | F 1 | E | 46 | 51 | - | 45 | 48 |

| Receiver | NCA | Obj.- No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|--------------|-----|-----|----------------|---------------|----------------|---------------|---------------|
| Noticeable: 43-48 dB(A) | | | | | | | | | |
| Clearly audible: 48-58 dB(A) | | | | | | | | | |
| Moderately intrusive: 58-68 dB(A) | | | | | | | | | |
| Highly Intrusive: >68 dB(A) | | | | | | | | | |
| 25 Wulworra Avenue | 3 | 94 | F 2 | E | 46 | 51 | - | 45 | 48 |
| 23 Wulworra Avenue | 3 | 93 | GF | NE | 46 | 51 | - | 45 | 48 |
| 23 Wulworra Avenue | 3 | 93 | F 1 | NE | 46 | 51 | - | 45 | 48 |
| 23 Wulworra Avenue | 3 | 93 | F 2 | NE | 47 | 51 | - | 45 | 48 |
| 21 Wulworra Avenue | 3 | 92 | GF | E | 47 | 51 | - | 45 | 48 |
| 21 Wulworra Avenue | 3 | 92 | F 1 | E | 47 | 51 | - | 45 | 48 |
| 21 Wulworra Avenue | 3 | 92 | F 2 | E | 47 | 51 | - | 45 | 48 |
| 17 Wulworra Avenue | 3 | 91 | GF | E | 47 | 51 | - | 45 | 48 |
| 17 Wulworra Avenue | 3 | 91 | F 1 | E | 47 | 51 | - | 45 | 48 |
| 17 Wulworra Avenue | 3 | 91 | F 2 | E | 47 | 51 | - | 45 | 48 |
| 15 Wulworra Avenue | 3 | 90 | GF | E | 47 | 51 | - | 45 | 48 |
| 15 Wulworra Avenue | 3 | 90 | F 1 | E | 47 | 51 | - | 45 | 48 |
| 15 Wulworra Avenue | 3 | 90 | F 2 | E | 47 | 51 | - | 45 | 48 |
| 13 Wulworra Avenue | 3 | 89 | GF | E | 47 | 51 | - | 45 | 48 |
| 13 Wulworra Avenue | 3 | 89 | F 1 | E | 47 | 51 | - | 45 | 48 |
| 13 Wulworra Avenue | 3 | 89 | F 2 | E | 47 | 51 | - | 45 | 49 |
| 11 Wulworra Avenue | 3 | 88 | GF | E | 47 | 51 | - | 45 | 49 |
| 11 Wulworra Avenue | 3 | 88 | F 1 | E | 47 | 51 | - | 45 | 49 |
| 11 Wulworra Avenue | 3 | 88 | F 2 | E | 47 | 51 | - | 45 | 49 |
| 11 Wulworra Avenue | 3 | 88 | F 3 | E | 47 | 51 | - | 45 | 49 |
| 9 Wulworra Avenue | 3 | 87 | GF | E | 47 | 51 | - | 45 | 48 |
| 9 Wulworra Avenue | 3 | 87 | F 1 | E | 47 | 51 | - | 45 | 49 |
| 9 Wulworra Avenue | 3 | 87 | F 2 | E | 47 | 51 | - | 45 | 49 |
| 9 Wulworra Avenue | 3 | 87 | F 3 | E | 47 | 52 | - | 45 | 49 |
| 7 Wulworra Avenue | 3 | 86 | GF | NE | 47 | 51 | - | 45 | 49 |
| 7 Wulworra Avenue | 3 | 86 | F 1 | NE | 47 | 52 | - | 45 | 49 |
| 7 Wulworra Avenue | 3 | 86 | F 2 | NE | 47 | 52 | - | 45 | 49 |
| 7 Wulworra Avenue | 3 | 86 | F 3 | NE | 47 | 52 | - | 45 | 49 |
| 6 Wulworra Avenue | 3 | 80 | GF | E | 47 | 52 | - | 45 | 49 |
| 6 Wulworra Avenue | 3 | 80 | F 1 | E | 47 | 52 | - | 45 | 49 |
| 6 Wulworra Avenue | 3 | 80 | F 2 | E | 48 | 52 | - | 46 | 50 |
| 6 Wulworra Avenue | 3 | 80 | F 3 | E | 49 | 54 | - | 48 | 51 |
| 5 Wulworra Avenue | 3 | 85 | GF | E | 47 | 52 | - | 45 | 49 |
| 5 Wulworra Avenue | 3 | 85 | F 1 | E | 47 | 52 | - | 45 | 49 |
| 5 Wulworra Avenue | 3 | 85 | F 2 | E | 47 | 52 | - | 45 | 49 |
| 5 Wulworra Avenue | 3 | 85 | F 3 | E | 47 | 52 | - | 45 | 49 |
| 3 Wulworra Avenue | 3 | 79 | GF | E | 50 | 54 | - | 48 | 51 |
| 3 Wulworra Avenue | 3 | 79 | F 1 | E | 50 | 54 | - | 48 | 51 |
| 3 Wulworra Avenue | 3 | 79 | F 2 | E | 50 | 54 | - | 48 | 51 |
| 3 Wulworra Avenue | 3 | 79 | F 3 | E | 50 | 54 | - | 48 | 51 |
| 3 Wulworra Avenue | 3 | 84 | GF | E | 47 | 52 | - | 45 | 49 |
| 3 Wulworra Avenue | 3 | 84 | F 1 | E | 47 | 52 | - | 45 | 49 |
| 3 Wulworra Avenue | 3 | 84 | F 2 | E | 47 | 52 | - | 45 | 49 |
| 3 Wulworra Avenue | 3 | 84 | F 3 | E | 47 | 52 | - | 45 | 49 |
| 2a Wulworra Avenue | 3 | 81 | GF | E | 47 | 52 | - | 47 | 50 |
| 2a Wulworra Avenue | 3 | 81 | F 1 | E | 48 | 52 | - | 47 | 50 |
| 2a Wulworra Avenue | 3 | 81 | F 2 | E | 49 | 53 | - | 47 | 51 |
| 2a Wulworra Avenue | 3 | 81 | F 3 | E | 49 | 54 | - | 48 | 51 |
| 2 Wulworra Avenue | 3 | 82 | GF | E | 48 | 52 | - | 46 | 51 |
| 2 Wulworra Avenue | 3 | 82 | F 1 | E | 48 | 53 | - | 46 | 51 |
| 2 Wulworra Avenue | 3 | 82 | F 2 | E | 49 | 53 | - | 46 | 51 |
| 2 Wulworra Avenue | 3 | 82 | F 3 | E | 49 | 53 | - | 46 | 51 |
| 1 Wulworra Avenue | 3 | 83 | GF | E | 48 | 52 | - | 47 | 50 |
| 1 Wulworra Avenue | 3 | 83 | F 1 | E | 48 | 53 | - | 47 | 50 |

| Receiver | NCA | Obj.- No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|--------------|-----|-----|----------------|---------------|----------------|---------------|---------------|
| Noticeable: 43-48 dB(A) | | | | | | | | | |
| Clearly audible: 48-58 dB(A) | | | | | | | | | |
| Moderately intrusive: 58-68 dB(A) | | | | | | | | | |
| Highly Intrusive: >68 dB(A) | | | | | | | | | |
| 1 Wulworra Avenue | 3 | 83 | F 2 | E | 48 | 53 | - | 47 | 50 |
| 1 Wulworra Avenue | 3 | 83 | F 3 | E | 49 | 53 | - | 47 | 50 |

Table B4 Predicted Construction LAeq Noise Levels Compared to TfNSW Night-time (OOHW2) Worst Case Noise Impact Categories, dB(A) – NCA 1

| Receiver | NCA | Obj.- No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|--------------|-----|-----|----------------|---------------|----------------|---------------|---------------|
| Noticeable: 35-40 dB(A) | | | | | | | | | |
| Clearly audible: 40-50 dB(A) | | | | | | | | | |
| Moderately intrusive: 50-60 dB(A) | | | | | | | | | |
| Highly Intrusive: >60 dB(A) | | | | | | | | | |
| 31 Whiting Beach Road | 1 | 16 | GF | S | - | - | 38 | - | - |
| 29 Whiting Beach Road | 1 | 18 | GF | W | - | - | 40 | - | - |
| 27 Whiting Beach Road | 1 | 20 | GF | E | - | - | 41 | - | - |
| 27 Rickard Avenue | 1 | 27 | GF | SE | - | - | 36 | - | - |
| 25 Whiting Beach Road | 1 | 21 | GF | E | - | - | 38 | - | - |
| 25 Rickard Avenue | 1 | 28 | GF | SW | - | - | 37 | - | - |
| 28 Rickard Avenue | 1 | 14 | GF | SW | - | - | 37 | - | - |
| 28 Rickard Avenue | 1 | 14 | F 1 | SW | - | - | 37 | - | - |
| 21 Whiting Beach Road | 1 | 23 | GF | E | - | - | 37 | - | - |
| 26a Rickard Avenue | 1 | 12 | GF | SW | - | - | 37 | - | - |
| 26a Rickard Avenue | 1 | 12 | F 1 | SW | - | - | 37 | - | - |
| 26 Rickard Avenue | 1 | 13 | GF | SW | - | - | 38 | - | - |
| 26 Rickard Avenue | 1 | 13 | F 1 | SW | - | - | 38 | - | - |
| 24 Rickard Avenue | 1 | 11 | GF | SW | - | - | 37 | - | - |
| 24 Rickard Avenue | 1 | 11 | F 1 | SW | - | - | 35 | - | - |
| 19 Whiting Beach Road | 1 | 26 | GF | E | - | - | 35 | - | - |
| 22 Rickard Avenue | 1 | 9 | GF | SW | - | - | 38 | - | - |
| 22 Rickard Avenue | 1 | 9 | F 1 | SW | - | - | 38 | - | - |
| 17 Whiting Beach Road | 1 | 31 | GF | S | - | - | 36 | - | - |
| 20 Rickard Avenue | 1 | 10 | GF | SE | - | - | 37 | - | - |
| 20 Rickard Avenue | 1 | 10 | F 1 | SE | - | - | 37 | - | - |
| 18 Rickard Avenue | 1 | 8 | GF | SW | - | - | 36 | - | - |
| 18 Rickard Avenue | 1 | 8 | F 1 | SW | - | - | 36 | - | - |
| 13A Whiting Beach Road | 1 | 33 | GF | S | - | - | 36 | - | - |
| 16 Rickard Avenue | 1 | 7 | GF | SE | - | - | 37 | - | - |
| 16 Rickard Avenue | 1 | 7 | F 1 | SE | - | - | 37 | - | - |
| 17 Rickard Avenue | 1 | 29 | GF | W | - | - | 37 | - | - |
| 17 Rickard Avenue | 1 | 29 | F 1 | W | - | - | 37 | - | - |
| 13 Whiting Beach Road | 1 | 34 | GF | S | - | - | 38 | - | - |
| 13 Whiting Beach Road | 1 | 32 | GF | S | - | - | 36 | - | - |
| 14 Rickard Avenue | 1 | 6 | GF | SE | - | - | 38 | - | - |
| 14 Rickard Avenue | 1 | 6 | F 1 | SE | - | - | 38 | - | - |
| 15 Rickard Avenue | 1 | 30 | GF | S | - | - | 37 | - | - |
| 15 Rickard Avenue | 1 | 30 | F 1 | S | - | - | 37 | - | - |
| 11 Whiting Beach Road | 1 | 35 | GF | S | - | - | 36 | - | - |
| 13 Rickard Avenue | 1 | 25 | GF | W | - | - | 38 | - | - |
| 13 Rickard Avenue | 1 | 25 | F 1 | W | - | - | 38 | - | - |
| 9 Whiting Beach Road | 1 | 36 | GF | S | - | - | 36 | - | - |
| 11 Rickard Avenue | 1 | 24 | GF | W | - | - | 37 | - | - |
| 11 Rickard Avenue | 1 | 24 | F 1 | W | - | - | 37 | - | - |
| 10 Rickard Avenue | 1 | 5 | GF | SE | - | - | 37 | - | - |
| 10 Rickard Avenue | 1 | 5 | F 1 | SE | - | - | 37 | - | - |

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 35-40 dB(A) | | | | | | | | | |
| Clearly audible: 40-50 dB(A) | | | | | | | | | |
| Moderately intrusive: 50-60 dB(A) | | | | | | | | | |
| Highly Intrusive: >60 dB(A) | | | | | | | | | |
| 7 Whiting Beach Road | 1 | 37 | GF | S | - | - | 36 | - | - |
| 8 Bradleys Head Road | 1 | 78 | GF | E | - | - | 40 | - | - |
| 8 Rickard Avenue | 1 | 4 | GF | SE | - | - | 40 | - | - |
| 8 Rickard Avenue | 1 | 4 | F 1 | SE | - | - | 35 | - | - |
| 9 Rickard Avenue | 1 | 22 | GF | W | - | - | 36 | - | - |
| 9 Rickard Avenue | 1 | 22 | F 1 | W | - | - | 37 | - | - |
| 5 Whiting Beach Road | 1 | 38 | GF | S | - | - | 37 | - | - |
| 6 Bradleys Head Road | 1 | 74 | GF | E | - | - | 38 | - | - |
| 7 Rickard Avenue | 1 | 19 | GF | S | - | - | 38 | - | - |
| 7 Rickard Avenue | 1 | 19 | F 1 | S | - | - | 36 | - | - |
| 5 Bradleys Head Road | 1 | 77 | GF | W | - | - | 34 | - | - |
| 6 Rickard Avenue | 1 | 3 | GF | E | - | - | 37 | - | - |
| 6 Rickard Avenue | 1 | 3 | F 1 | E | - | - | 37 | - | - |
| 4 Bradleys Head Road | 1 | 73 | GF | E | - | - | 36 | - | - |
| 4 Rickard Avenue | 1 | 2 | GF | S | - | - | 35 | - | - |
| 4 Rickard Avenue | 1 | 2 | F 1 | S | - | - | 40 | - | - |
| 3 Whiting Beach Road | 1 | 39 | GF | S | - | - | 40 | - | - |
| 3 Bradleys Head Road | 1 | 76 | GF | S | - | - | 35 | - | - |
| 3 Rickard Avenue | 1 | 17 | GF | S | - | - | 38 | - | - |
| 3 Rickard Avenue | 1 | 17 | F 1 | S | - | - | 38 | - | - |
| 2 St Elmos Street | 1 | 75 | GF | S | - | - | 37 | - | - |
| 2 Bradleys Head Road | 1 | 41 | GF | S | - | - | 38 | - | - |
| 2a Rickard Avenue | 1 | 1 | GF | S | - | - | 38 | - | - |
| 2a Rickard Avenue | 1 | 1 | F 1 | S | - | - | 35 | - | - |
| 1 Whiting Beach Road | 1 | 40 | GF | S | - | - | 35 | - | - |
| 1 Rickard Avenue | 1 | 15 | GF | S | - | - | 38 | - | - |
| 1 Rickard Avenue | 1 | 15 | F 1 | S | - | - | 39 | - | - |
| 1 Bradleys Head Road | 1 | 42 | GF | S | - | - | 39 | - | - |

Table B5 Predicted Construction LAeq Noise Levels Compared to TfNSW Night (OOHW2) Worst Case Noise Impact Categories, dB(A) – NCA 2

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 43-48 dB(A) | | | | | | | | | |
| Clearly audible: 48-58 dB(A) | | | | | | | | | |
| Moderately intrusive: 58-68 dB(A) | | | | | | | | | |
| Highly Intrusive: >68 dB(A) | | | | | | | | | |
| 32 Raglan Street | 2 | 66 | GF | E | - | - | 53 | - | - |
| 32 Raglan Street | 2 | 66 | F 1 | E | - | - | 53 | - | - |
| 30 Raglan Street | 2 | 65 | GF | E | - | - | 54 | - | - |
| 30 Raglan Street | 2 | 65 | F 1 | E | - | - | 55 | - | - |
| 26 Raglan Street | 2 | 64 | GF | E | - | - | 53 | - | - |
| 26 Raglan Street | 2 | 64 | F 1 | E | - | - | 54 | - | - |
| 24 Raglan Street | 2 | 63 | GF | E | - | - | 54 | - | - |
| 24 Raglan Street | 2 | 63 | F 1 | E | - | - | 54 | - | - |
| 22 Raglan Street | 2 | 62 | GF | E | - | - | 54 | - | - |
| 22 Raglan Street | 2 | 62 | F 1 | E | - | - | 54 | - | - |
| 20 Raglan Street | 2 | 61 | GF | E | - | - | 52 | - | - |
| 20 Raglan Street | 2 | 61 | F 1 | E | - | - | 55 | - | - |
| 19 Raglan Street | 2 | 67 | GF | S | - | - | 52 | - | - |
| 19 Raglan Street | 2 | 67 | F 1 | S | - | - | 54 | - | - |
| 18 Raglan Street | 2 | 60 | GF | E | - | - | 36 | - | - |
| 18 Raglan Street | 2 | 60 | F 1 | E | - | - | 38 | - | - |

| Receiver | NCA | Obj.- No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|--------------|------|-----|----------------|---------------|----------------|---------------|---------------|
| Noticeable: 43-48 dB(A) | | | | | | | | | |
| Clearly audible: 48-58 dB(A) | | | | | | | | | |
| Moderately intrusive: 58-68 dB(A) | | | | | | | | | |
| Highly Intrusive: >68 dB(A) | | | | | | | | | |
| 16 Raglan Street | 2 | 59 | GF | E | - | - | 36 | - | - |
| 16 Raglan Street | 2 | 59 | F 1 | E | - | - | 38 | - | - |
| 14 Raglan Street | 2 | 58 | GF | E | - | - | 48 | - | - |
| 14 Raglan Street | 2 | 58 | F 1 | E | - | - | 49 | - | - |
| 17 Raglan Street | 2 | 50 | GF | S | - | - | 56 | - | - |
| 17 Raglan Street | 2 | 50 | F 1 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 2 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 3 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 4 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 5 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 6 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 7 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 8 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 9 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 10 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 11 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 12 | S | - | - | 57 | - | - |
| 17 Raglan Street | 2 | 50 | F 13 | S | - | - | 57 | - | - |
| 12 Raglan Street | 2 | 57 | GF | E | - | - | 55 | - | - |
| 12 Raglan Street | 2 | 57 | F 1 | E | - | - | 55 | - | - |
| 11 Raglan Street | 2 | 49 | GF | E | - | - | 42 | - | - |
| 11 Raglan Street | 2 | 49 | F 1 | E | - | - | 46 | - | - |
| 11 Raglan Street | 2 | 49 | F 2 | E | - | - | 58 | - | - |
| 11 Raglan Street | 2 | 49 | F 3 | E | - | - | 58 | - | - |
| 10 Raglan Street | 2 | 56 | GF | E | - | - | 58 | - | - |
| 10 Raglan Street | 2 | 56 | F 1 | E | - | - | 58 | - | - |
| 9 Raglan Street | 2 | 48 | GF | E | - | - | 49 | - | - |
| 9 Raglan Street | 2 | 48 | F 1 | E | - | - | 49 | - | - |
| 9 Raglan Street | 2 | 48 | F 2 | E | - | - | 57 | - | - |
| 9 Raglan Street | 2 | 48 | F 3 | E | - | - | 57 | - | - |
| 9 Curraghbeena Road | 2 | 72 | GF | E | - | - | 57 | - | - |
| 9 Curraghbeena Road | 2 | 72 | F 1 | E | - | - | 57 | - | - |
| 8 Raglan Street | 2 | 55 | GF | E | - | - | 41 | - | - |
| 8 Raglan Street | 2 | 55 | F 1 | E | - | - | 43 | - | - |
| 7 Raglan Street | 2 | 47 | GF | E | - | - | 57 | - | - |
| 7 Raglan Street | 2 | 47 | F 1 | E | - | - | 57 | - | - |
| 7 Raglan Street | 2 | 47 | F 2 | E | - | - | 57 | - | - |
| 7 Raglan Street | 2 | 47 | F 3 | E | - | - | 57 | - | - |
| 7 Herron Walk | 2 | 54 | GF | E | - | - | 45 | - | - |
| 7 Herron Walk | 2 | 54 | F 1 | E | - | - | 48 | - | - |
| 7 Herron Walk | 2 | 54 | F 2 | E | - | - | 50 | - | - |
| 7 Herron Walk | 2 | 54 | F 3 | E | - | - | 52 | - | - |
| 7 Curraghbeena Road | 2 | 71 | GF | E | - | - | 49 | - | - |
| 7 Curraghbeena Road | 2 | 71 | F 1 | E | - | - | 49 | - | - |
| 5 Curraghbeena Road | 2 | 70 | GF | E | - | - | 49 | - | - |
| 5 Curraghbeena Road | 2 | 70 | F 1 | E | - | - | 49 | - | - |
| 4-5a Herron Walk | 2 | 51 | GF | E | - | - | 42 | - | - |
| 4-5a Herron Walk | 2 | 51 | F 1 | E | - | - | 45 | - | - |
| 4-5a Herron Walk | 2 | 51 | F 2 | E | - | - | 50 | - | - |
| 4-5a Herron Walk | 2 | 51 | F 3 | E | - | - | 55 | - | - |
| 5 Raglan Street | 2 | 46 | GF | E | - | - | 57 | - | - |
| 5 Raglan Street | 2 | 46 | F 1 | E | - | - | 57 | - | - |
| 5 Raglan Street | 2 | 46 | F 2 | E | - | - | 57 | - | - |
| 5 Raglan Street | 2 | 46 | F 3 | E | - | - | 57 | - | - |

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 43-48 dB(A) | | | | | | | | | |
| Clearly audible: 48-58 dB(A) | | | | | | | | | |
| Moderately intrusive: 58-68 dB(A) | | | | | | | | | |
| Highly Intrusive: >68 dB(A) | | | | | | | | | |
| 3 Raglan Street | 2 | 45 | GF | E | - | - | 57 | - | - |
| 3 Raglan Street | 2 | 45 | F 1 | E | - | - | 57 | - | - |
| 3 Raglan Street | 2 | 45 | F 2 | E | - | - | 57 | - | - |
| 3 Raglan Street | 2 | 45 | F 3 | E | - | - | 57 | - | - |
| 3 Curraghbeena Road | 2 | 69 | GF | E | - | - | 50 | - | - |
| 3 Curraghbeena Road | 2 | 69 | F 1 | E | - | - | 50 | - | - |
| 3 Herron Walk | 2 | 52 | GF | S | - | - | 38 | - | - |
| 3 Herron Walk | 2 | 52 | F 1 | S | - | - | 39 | - | - |
| 3 Herron Walk | 2 | 52 | F 2 | S | - | - | 36 | - | - |
| 3 Herron Walk | 2 | 52 | F 3 | S | - | - | 36 | - | - |
| 2 Raglan Street | 2 | 43 | GF | E | - | - | 56 | - | - |
| 2 Raglan Street | 2 | 43 | F 1 | E | - | - | 56 | - | - |
| 2 Raglan Street | 2 | 43 | F 2 | E | - | - | 56 | - | - |
| 2 Raglan Street | 2 | 43 | F 3 | E | - | - | 57 | - | - |
| 2 Raglan Street | 2 | 43 | F 4 | E | - | - | 57 | - | - |
| 2 Raglan Street | 2 | 43 | F 5 | E | - | - | 57 | - | - |
| 1 Raglan Street | 2 | 44 | GF | SE | - | - | 57 | - | - |
| 1 Raglan Street | 2 | 44 | F 1 | SE | - | - | 57 | - | - |
| 1 Raglan Street | 2 | 44 | F 2 | SE | - | - | 57 | - | - |
| 1 Raglan Street | 2 | 44 | F 3 | SE | - | - | 57 | - | - |
| 1 Curraghbeena Road | 2 | 68 | GF | S | - | - | 36 | - | - |
| 1 Curraghbeena Road | 2 | 68 | F 1 | S | - | - | 36 | - | - |
| 1 Herron Walk | 2 | 53 | GF | S | - | - | 36 | - | - |
| 1 Herron Walk | 2 | 53 | F 1 | S | - | - | 37 | - | - |
| 1 Herron Walk | 2 | 53 | F 2 | S | - | - | 50 | - | - |
| 1 Herron Walk | 2 | 53 | F 3 | S | - | - | 50 | - | - |

Table B6 Predicted Construction LAeq Noise Levels Compared to TfNSW Night (OOHW2) Worst Case Noise Impact Categories, dB(A) – NCA 3

| Receiver | NCA | Obj.-No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|----------|-----|-----|-------------|------------|-------------|------------|------------|
| Noticeable: 33-38 dB(A) | | | | | | | | | |
| Clearly audible: 38-48 dB(A) | | | | | | | | | |
| Moderately intrusive: 48-58 dB(A) | | | | | | | | | |
| Highly Intrusive: >58 dB(A) | | | | | | | | | |
| 33 Wolworra Avenue | 3 | 98 | GF | E | - | - | 52 | - | - |
| 33 Wolworra Avenue | 3 | 98 | F 1 | E | - | - | 52 | - | - |
| 33 Wolworra Avenue | 3 | 98 | F 2 | E | - | - | 52 | - | - |
| 39 Wolworra Avenue | 3 | 99 | GF | E | - | - | 52 | - | - |
| 39 Wolworra Avenue | 3 | 99 | F 1 | E | - | - | 52 | - | - |
| 39 Wolworra Avenue | 3 | 99 | F 2 | E | - | - | 52 | - | - |
| 51 Wolworra Avenue | 3 | 104 | GF | E | - | - | 52 | - | - |
| 51 Wolworra Avenue | 3 | 104 | F 1 | E | - | - | 52 | - | - |
| 51 Wolworra Avenue | 3 | 104 | F 2 | E | - | - | 52 | - | - |
| 31 Wolworra Avenue | 3 | 97 | GF | NE | - | - | 51 | - | - |
| 31 Wolworra Avenue | 3 | 97 | F 1 | NE | - | - | 51 | - | - |
| 31 Wolworra Avenue | 3 | 97 | F 2 | NE | - | - | 52 | - | - |
| 41 Wolworra Avenue | 3 | 100 | GF | E | - | - | 52 | - | - |
| 41 Wolworra Avenue | 3 | 100 | F 1 | E | - | - | 52 | - | - |
| 41 Wolworra Avenue | 3 | 100 | F 2 | E | - | - | 52 | - | - |
| 45 Wolworra Avenue | 3 | 102 | GF | E | - | - | 52 | - | - |
| 45 Wolworra Avenue | 3 | 102 | F 1 | E | - | - | 52 | - | - |
| 45 Wolworra Avenue | 3 | 102 | F 2 | E | - | - | 52 | - | - |

| Receiver | NCA | Obj.- No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|--------------|-----|-----|----------------|---------------|----------------|---------------|---------------|
| Noticeable: 33-38 dB(A) | | | | | | | | | |
| Clearly audible: 38-48 dB(A) | | | | | | | | | |
| Moderately intrusive: 48-58 dB(A) | | | | | | | | | |
| Highly Intrusive: >58 dB(A) | | | | | | | | | |
| 49 Wulworra Avenue | 3 | 103 | GF | E | - | - | 51 | - | - |
| 49 Wulworra Avenue | 3 | 103 | F 1 | E | - | - | 51 | - | - |
| 49 Wulworra Avenue | 3 | 103 | F 2 | E | - | - | 52 | - | - |
| 29 Wulworra Avenue | 3 | 96 | GF | E | - | - | 52 | - | - |
| 29 Wulworra Avenue | 3 | 96 | F 1 | E | - | - | 52 | - | - |
| 29 Wulworra Avenue | 3 | 96 | F 2 | E | - | - | 52 | - | - |
| 27 Wulworra Avenue | 3 | 95 | GF | E | - | - | 52 | - | - |
| 27 Wulworra Avenue | 3 | 95 | F 1 | E | - | - | 52 | - | - |
| 27 Wulworra Avenue | 3 | 95 | F 2 | E | - | - | 52 | - | - |
| 25 Wulworra Avenue | 3 | 94 | GF | E | - | - | 53 | - | - |
| 25 Wulworra Avenue | 3 | 94 | F 1 | E | - | - | 53 | - | - |
| 25 Wulworra Avenue | 3 | 94 | F 2 | E | - | - | 53 | - | - |
| 23 Wulworra Avenue | 3 | 93 | GF | NE | - | - | 53 | - | - |
| 23 Wulworra Avenue | 3 | 93 | F 1 | NE | - | - | 53 | - | - |
| 23 Wulworra Avenue | 3 | 93 | F 2 | NE | - | - | 53 | - | - |
| 21 Wulworra Avenue | 3 | 92 | GF | E | - | - | 53 | - | - |
| 21 Wulworra Avenue | 3 | 92 | F 1 | E | - | - | 53 | - | - |
| 21 Wulworra Avenue | 3 | 92 | F 2 | E | - | - | 53 | - | - |
| 17 Wulworra Avenue | 3 | 91 | GF | E | - | - | 53 | - | - |
| 17 Wulworra Avenue | 3 | 91 | F 1 | E | - | - | 53 | - | - |
| 17 Wulworra Avenue | 3 | 91 | F 2 | E | - | - | 53 | - | - |
| 15 Wulworra Avenue | 3 | 90 | GF | E | - | - | 53 | - | - |
| 15 Wulworra Avenue | 3 | 90 | F 1 | E | - | - | 53 | - | - |
| 15 Wulworra Avenue | 3 | 90 | F 2 | E | - | - | 53 | - | - |
| 13 Wulworra Avenue | 3 | 89 | GF | E | - | - | 53 | - | - |
| 13 Wulworra Avenue | 3 | 89 | F 1 | E | - | - | 53 | - | - |
| 13 Wulworra Avenue | 3 | 89 | F 2 | E | - | - | 53 | - | - |
| 11 Wulworra Avenue | 3 | 88 | GF | E | - | - | 53 | - | - |
| 11 Wulworra Avenue | 3 | 88 | F 1 | E | - | - | 53 | - | - |
| 11 Wulworra Avenue | 3 | 88 | F 2 | E | - | - | 53 | - | - |
| 11 Wulworra Avenue | 3 | 88 | F 3 | E | - | - | 53 | - | - |
| 9 Wulworra Avenue | 3 | 87 | GF | E | - | - | 53 | - | - |
| 9 Wulworra Avenue | 3 | 87 | F 1 | E | - | - | 53 | - | - |
| 9 Wulworra Avenue | 3 | 87 | F 2 | E | - | - | 53 | - | - |
| 9 Wulworra Avenue | 3 | 87 | F 3 | E | - | - | 53 | - | - |
| 7 Wulworra Avenue | 3 | 86 | GF | NE | - | - | 53 | - | - |
| 7 Wulworra Avenue | 3 | 86 | F 1 | NE | - | - | 53 | - | - |
| 7 Wulworra Avenue | 3 | 86 | F 2 | NE | - | - | 54 | - | - |
| 7 Wulworra Avenue | 3 | 86 | F 3 | NE | - | - | 54 | - | - |
| 6 Wulworra Avenue | 3 | 80 | GF | E | - | - | 54 | - | - |
| 6 Wulworra Avenue | 3 | 80 | F 1 | E | - | - | 54 | - | - |
| 6 Wulworra Avenue | 3 | 80 | F 2 | E | - | - | 54 | - | - |
| 6 Wulworra Avenue | 3 | 80 | F 3 | E | - | - | 56 | - | - |
| 5 Wulworra Avenue | 3 | 85 | GF | E | - | - | 54 | - | - |
| 5 Wulworra Avenue | 3 | 85 | F 1 | E | - | - | 54 | - | - |
| 5 Wulworra Avenue | 3 | 85 | F 2 | E | - | - | 54 | - | - |
| 5 Wulworra Avenue | 3 | 85 | F 3 | E | - | - | 54 | - | - |
| 3 Wulworra Avenue | 3 | 79 | GF | E | - | - | 56 | - | - |
| 3 Wulworra Avenue | 3 | 79 | F 1 | E | - | - | 56 | - | - |
| 3 Wulworra Avenue | 3 | 79 | F 2 | E | - | - | 56 | - | - |
| 3 Wulworra Avenue | 3 | 79 | F 3 | E | - | - | 56 | - | - |
| 3 Wulworra Avenue | 3 | 84 | GF | E | - | - | 54 | - | - |
| 3 Wulworra Avenue | 3 | 84 | F 1 | E | - | - | 54 | - | - |
| 3 Wulworra Avenue | 3 | 84 | F 2 | E | - | - | 54 | - | - |

| Receiver | NCA | Obj.- No. | Fl | Dir | Scenario 1b | Scenario 3 | Scenario 4a | Scenario 5 | Scenario 7 |
|-----------------------------------|-----|--------------|-----|-----|----------------|---------------|----------------|---------------|---------------|
| Noticeable: 33-38 dB(A) | | | | | | | | | |
| Clearly audible: 38-48 dB(A) | | | | | | | | | |
| Moderately intrusive: 48-58 dB(A) | | | | | | | | | |
| Highly Intrusive: >58 dB(A) | | | | | | | | | |
| 3 Wulworra Avenue | 3 | 84 | F 3 | E | - | - | 54 | - | - |
| 2a Wulworra Avenue | 3 | 81 | GF | E | - | - | 54 | - | - |
| 2a Wulworra Avenue | 3 | 81 | F 1 | E | - | - | 54 | - | - |
| 2a Wulworra Avenue | 3 | 81 | F 2 | E | - | - | 55 | - | - |
| 2a Wulworra Avenue | 3 | 81 | F 3 | E | - | - | 56 | - | - |
| 2 Wulworra Avenue | 3 | 82 | GF | E | - | - | 54 | - | - |
| 2 Wulworra Avenue | 3 | 82 | F 1 | E | - | - | 54 | - | - |
| 2 Wulworra Avenue | 3 | 82 | F 2 | E | - | - | 55 | - | - |
| 2 Wulworra Avenue | 3 | 82 | F 3 | E | - | - | 55 | - | - |
| 1 Wulworra Avenue | 3 | 83 | GF | E | - | - | 54 | - | - |
| 1 Wulworra Avenue | 3 | 83 | F 1 | E | - | - | 54 | - | - |
| 1 Wulworra Avenue | 3 | 83 | F 2 | E | - | - | 54 | - | - |
| 1 Wulworra Avenue | 3 | 83 | F 3 | E | - | - | 54 | - | - |

Taronga Zoo Wharf
Upgrade

APPENDIX C
PREDICTED
CONSTRUCTION
NOISE IMPACTS –
NOISE CONTOUR
MAPS



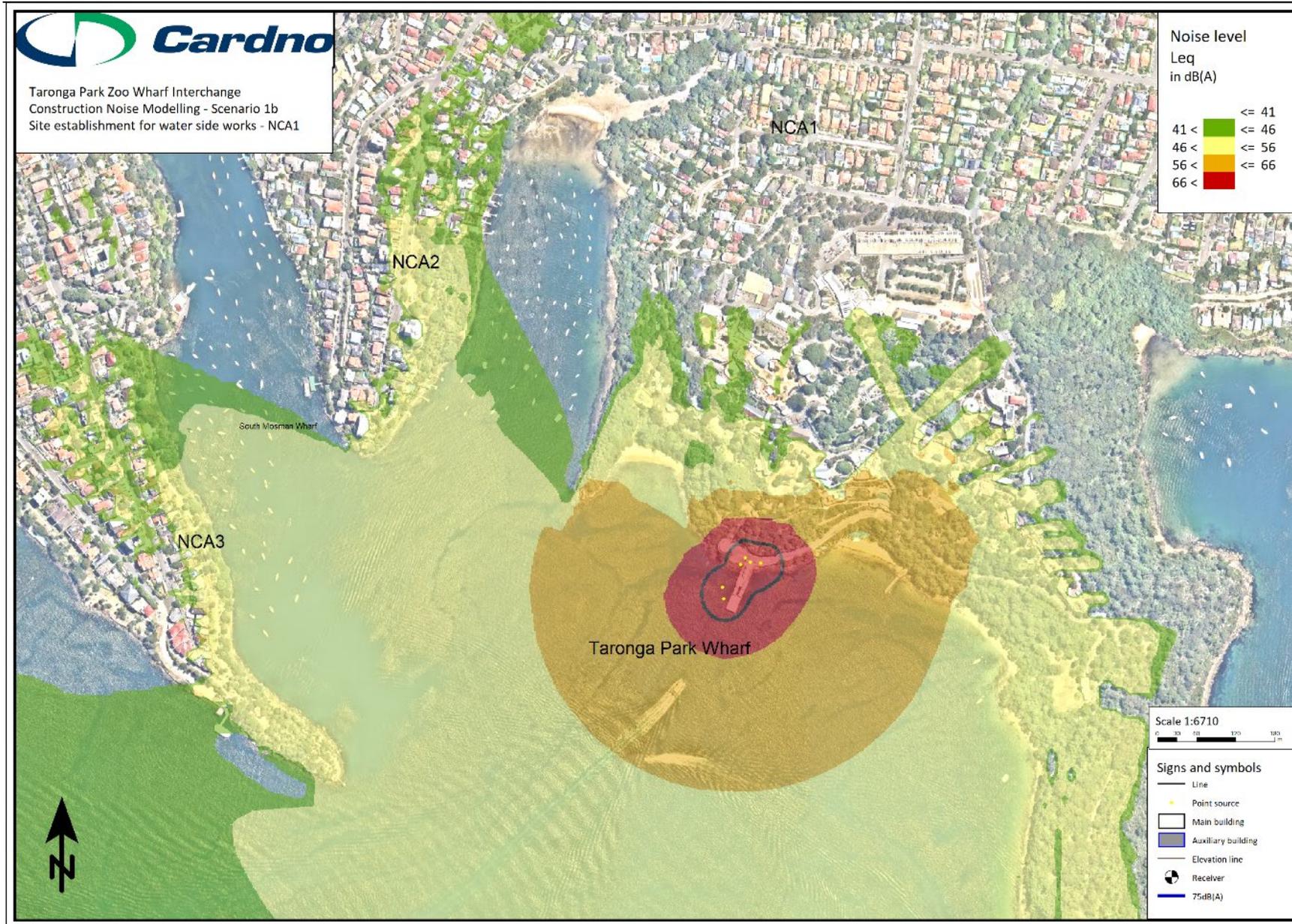


Figure C1 Predicted Construction Noise Scenario 1b – Site Establishment, NCA1 Ground Level – Standard Hours



Figure C2 Predicted Construction Noise Scenario 1b – Site Establishment, NCA2 Ground Level – Standard Hours

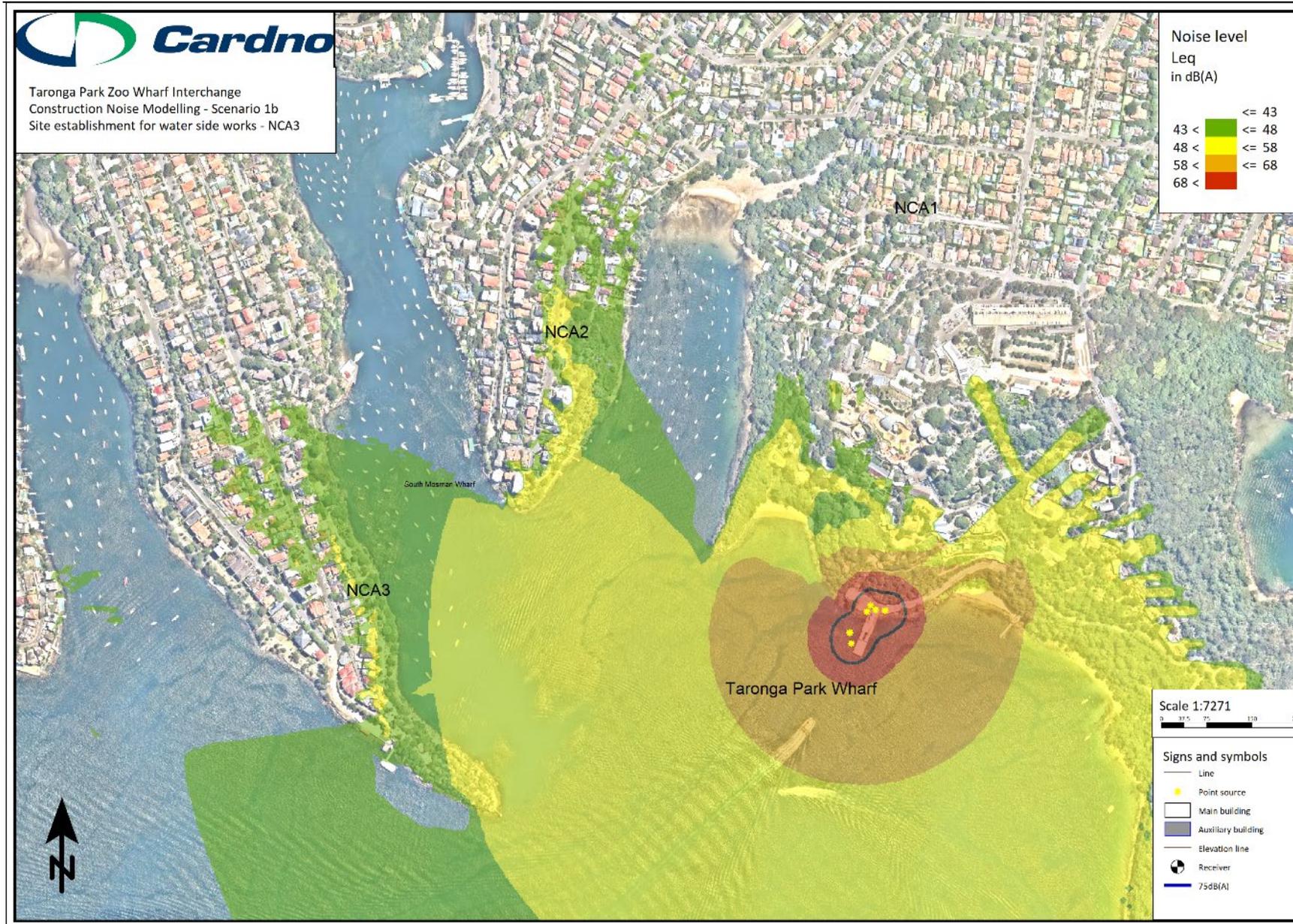


Figure C3 Predicted Construction Noise Scenario 1b – Site Establishment, NCA3 Ground Level – Standard Hours

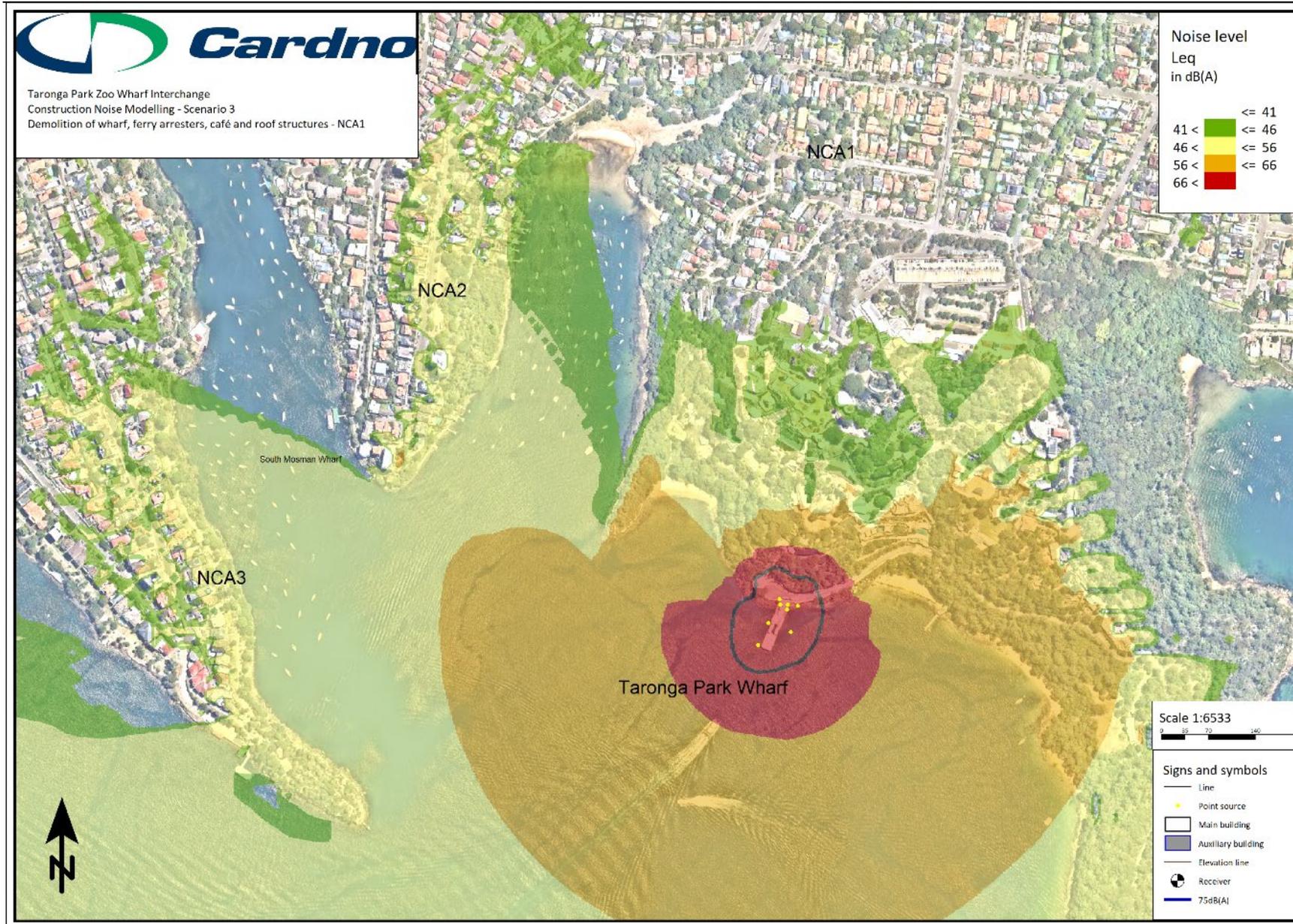


Figure C4 Predicted Construction Noise Scenario 3 – Demolition of wharf, ferry arresters, café & roof structure NCA1 Ground Level – Standard Hours

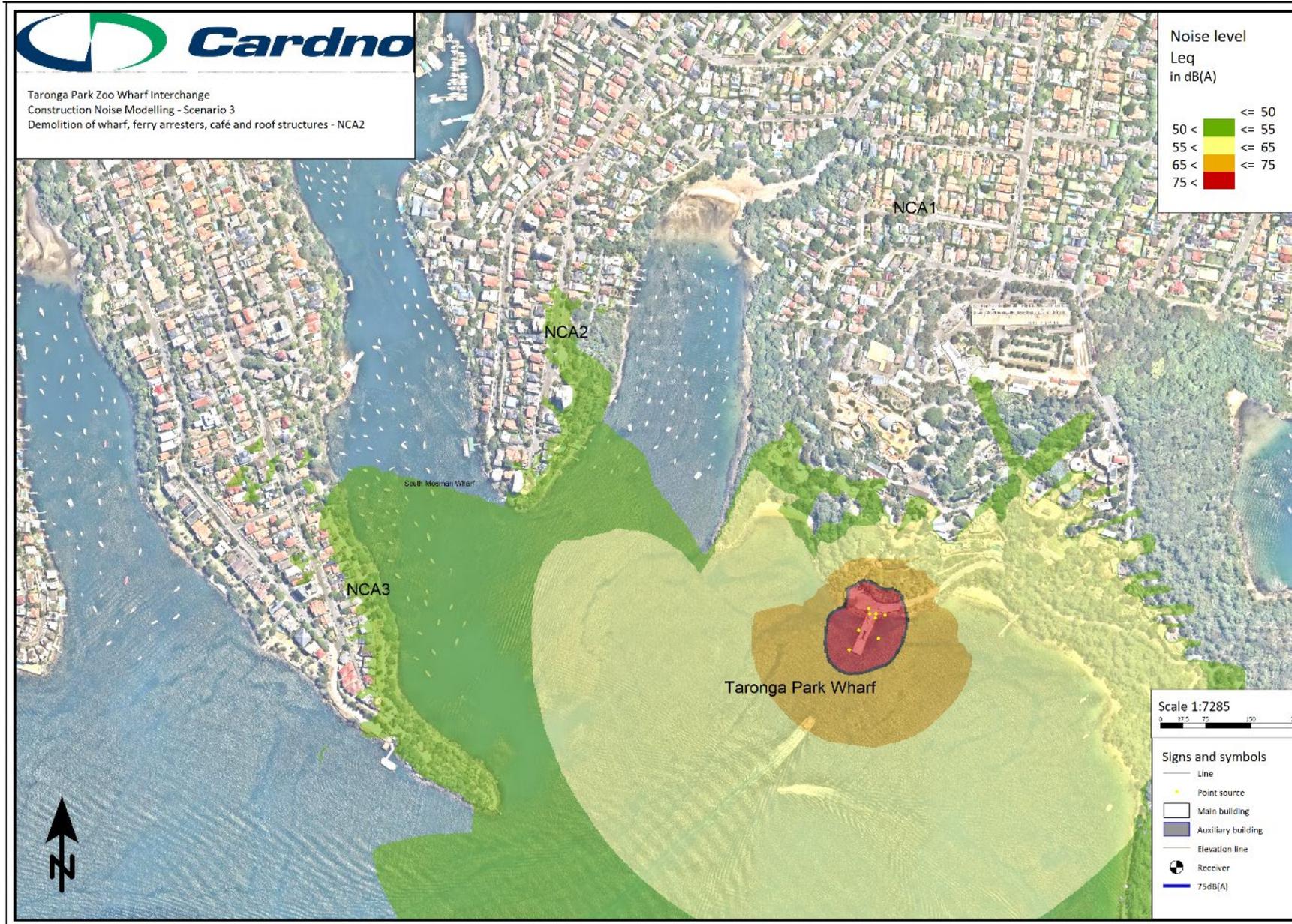


Figure C5 Predicted Construction Noise Scenario 3 – Demolition of wharf, ferry arresters, café & roof structure NCA2 Ground Level – Standard Hours

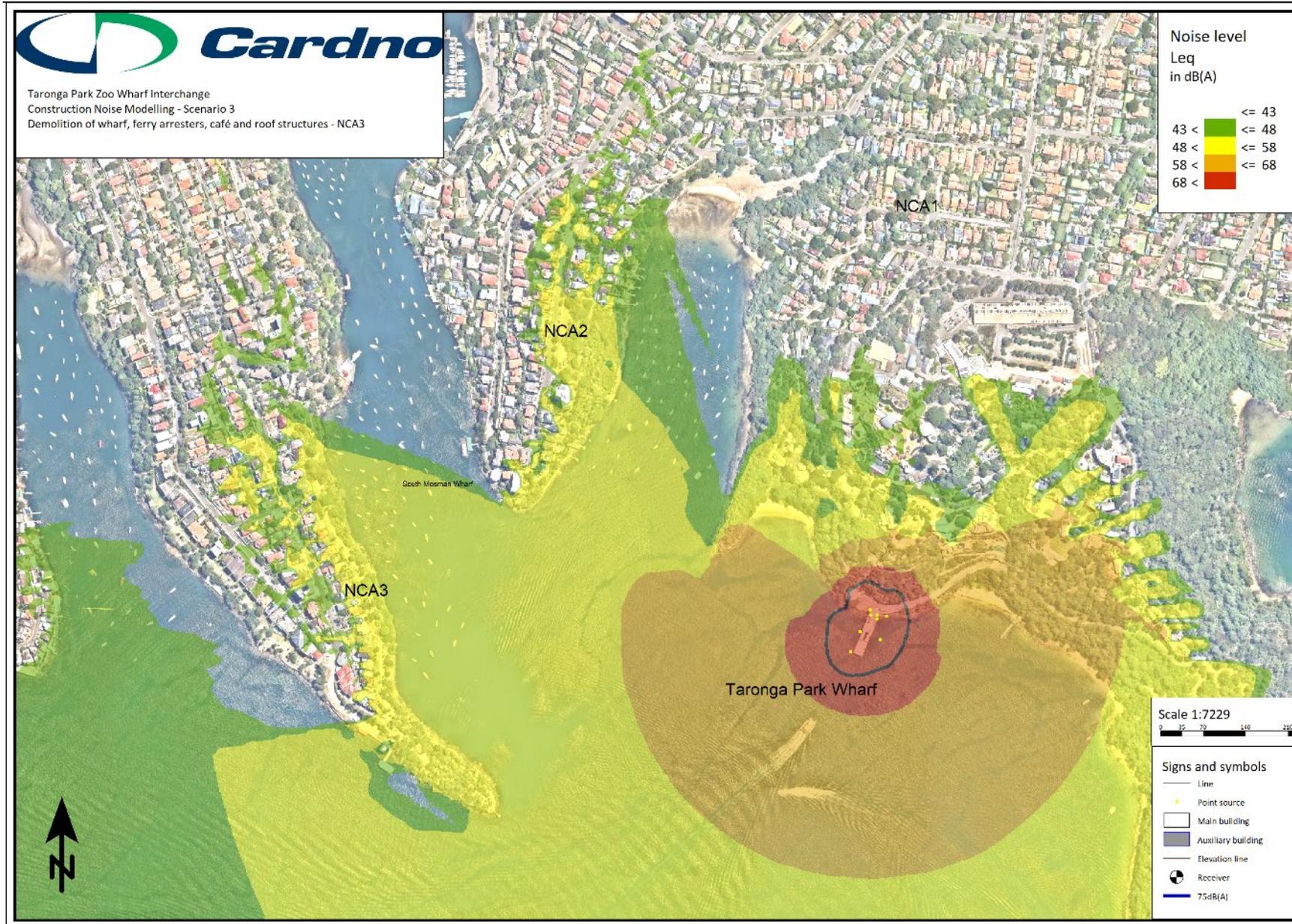


Figure C6 Predicted Construction Noise Scenario 3 – Demolition of wharf, ferry arresters, café & roof structure NCA3 Ground Level – Standard Hours

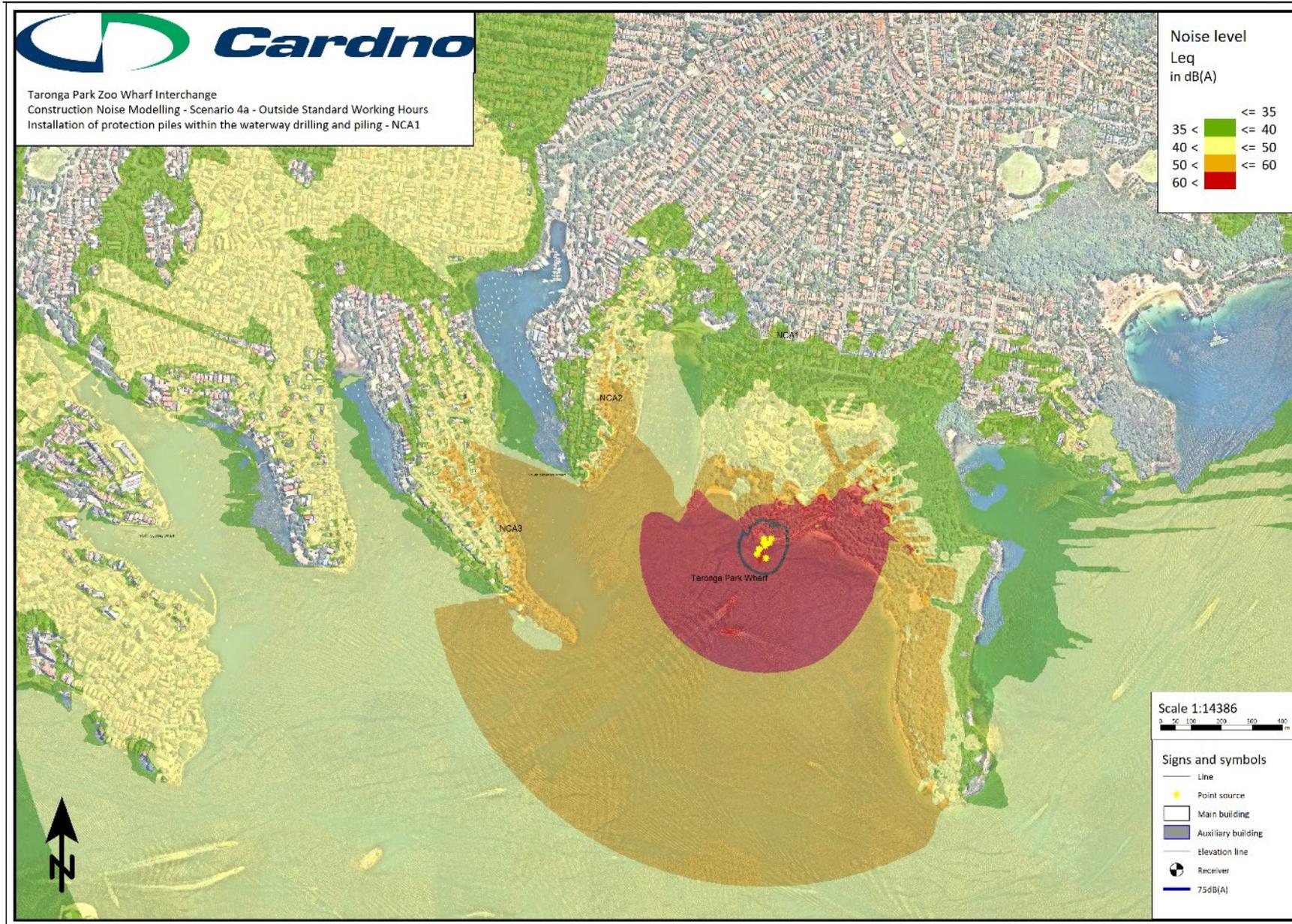


Figure C7 Predicted Construction Noise Scenario 4A – Installation of protection piles, NCA1 Ground Level – Non-Standard Hours (OOHW2)

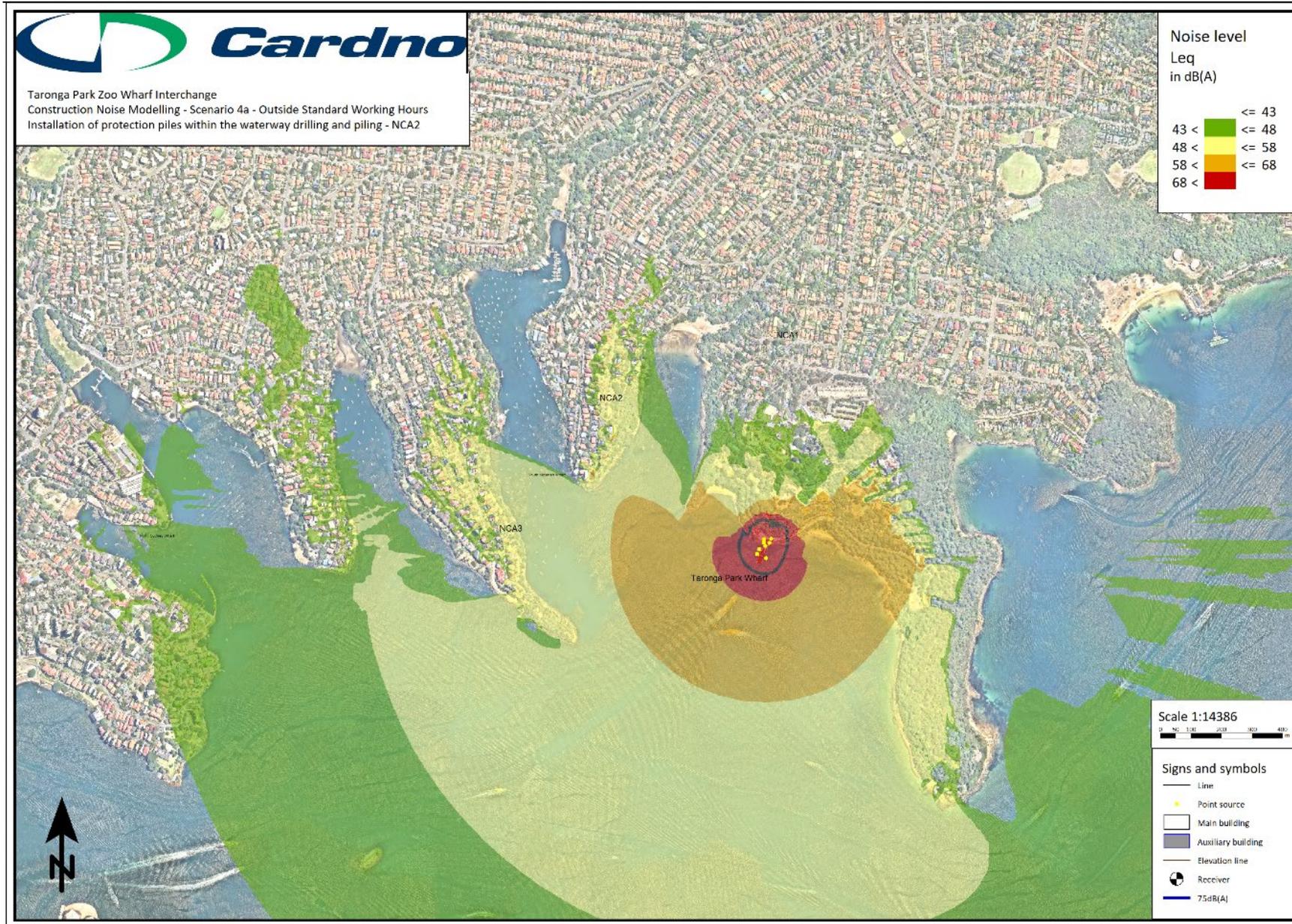


Figure C8 Predicted Construction Noise Scenario 4A – Installation of protection piles, NCA2 Ground Level – Non-Standard Hours (OOHW2)

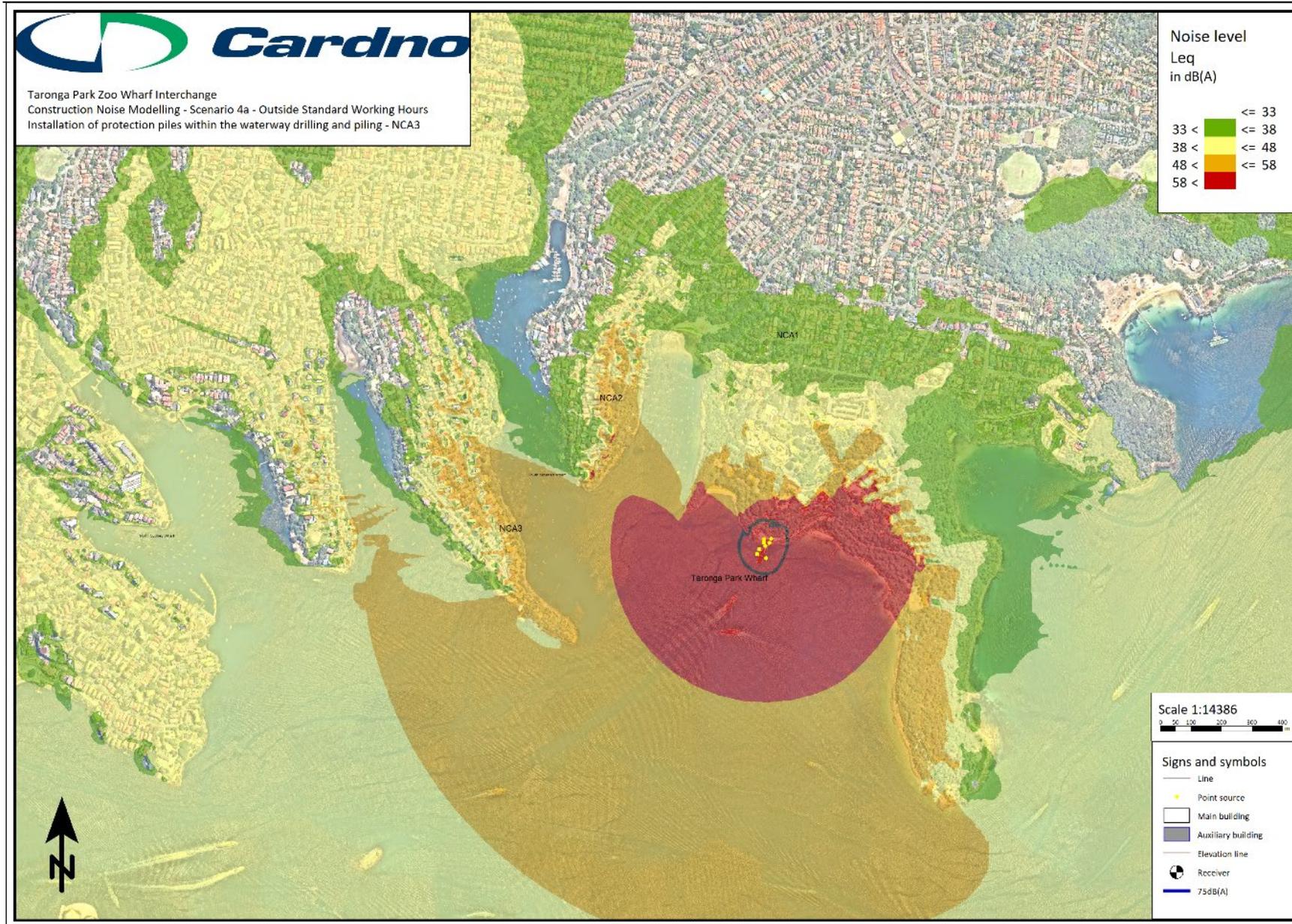


Figure C9 Predicted Construction Noise Scenario 4A – Installation of protection piles, NCA3 Ground Level – Non-Standard Hours (OOHW2)

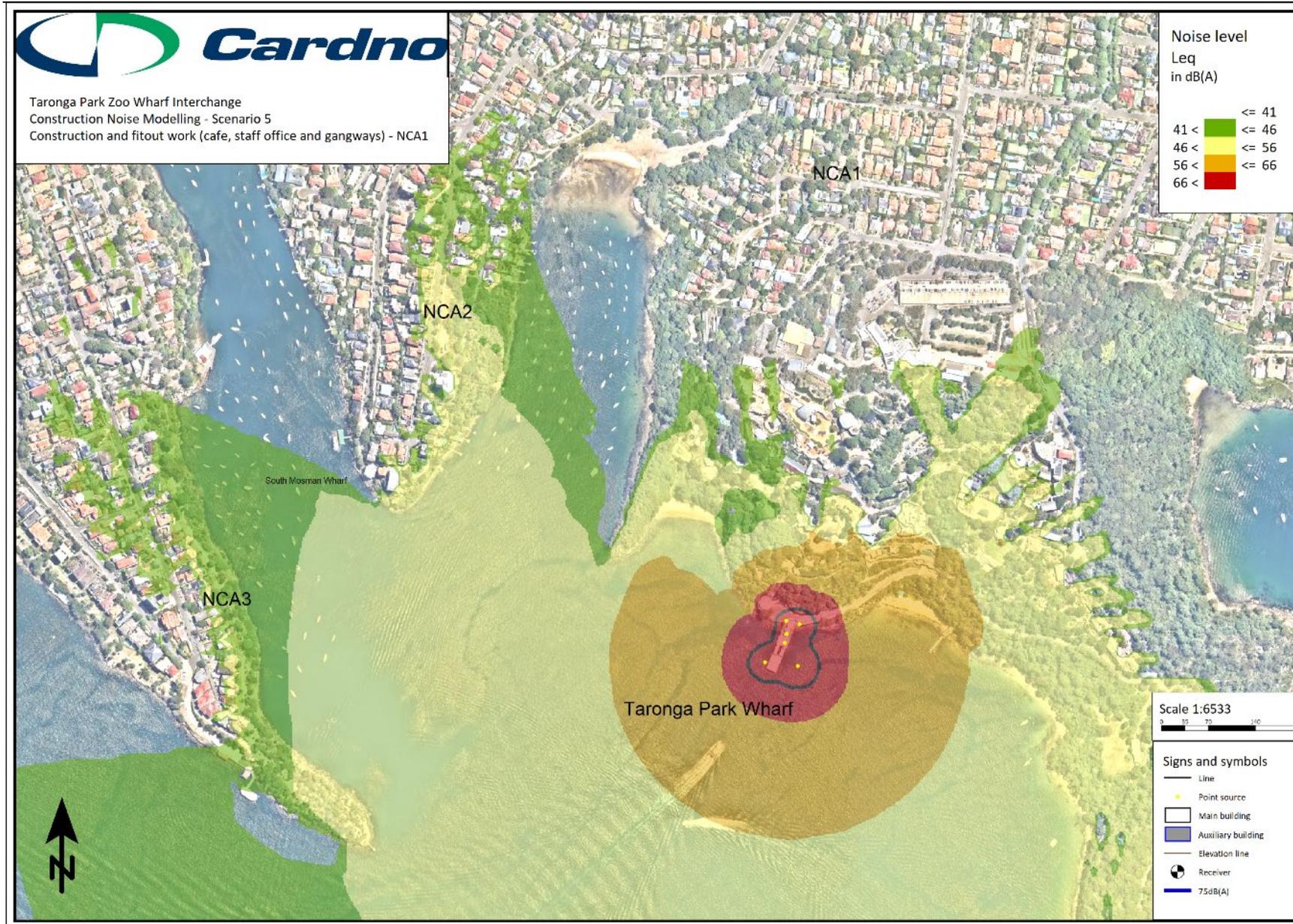


Figure C10 Predicted Construction Noise Scenario 5 – Construction & fitout work, NCA1 Ground Level – Standard Hours

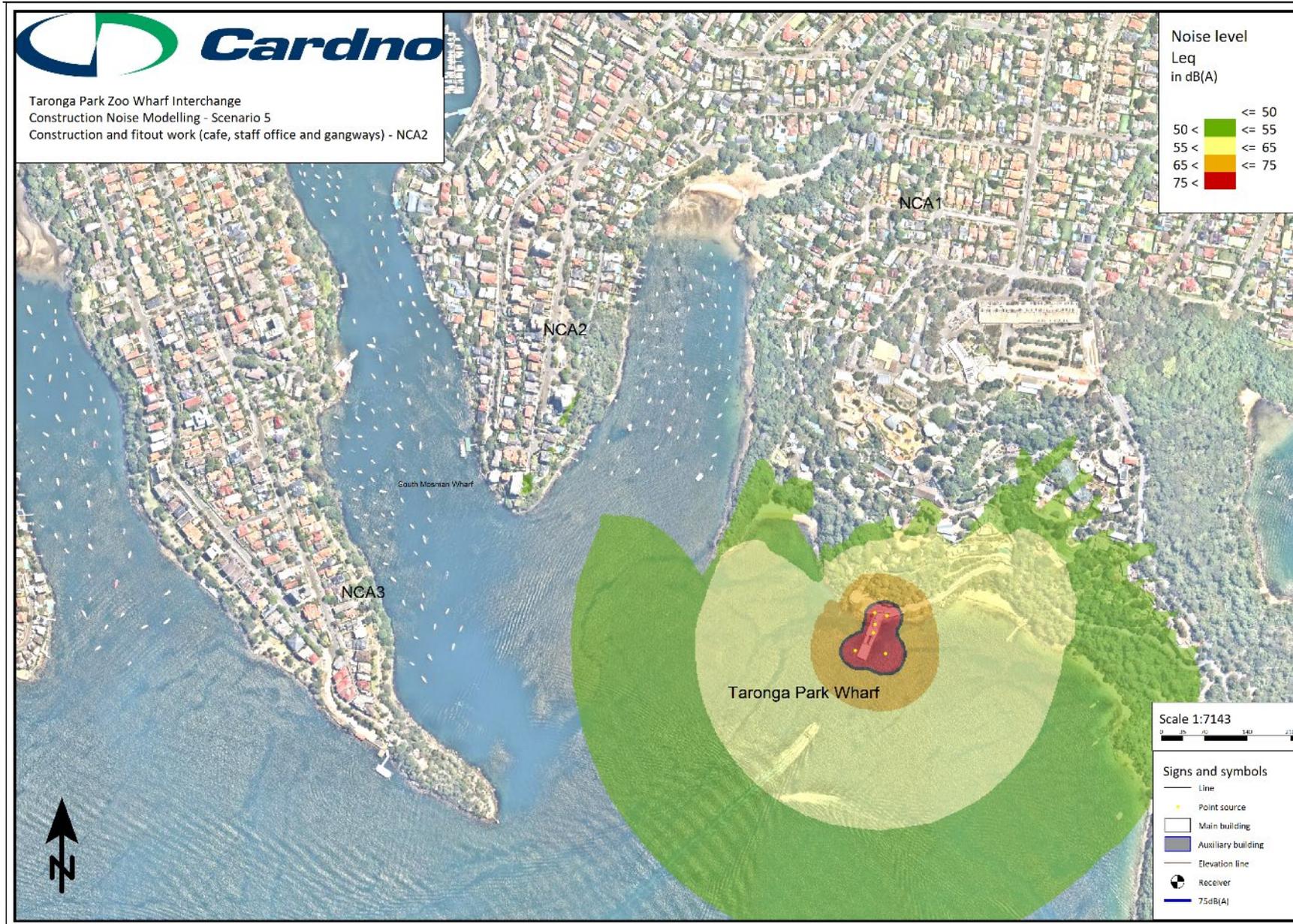


Figure C11 Predicted Construction Noise Scenario 5 – Construction & fitout work, NCA2 Ground Level – Standard Hours

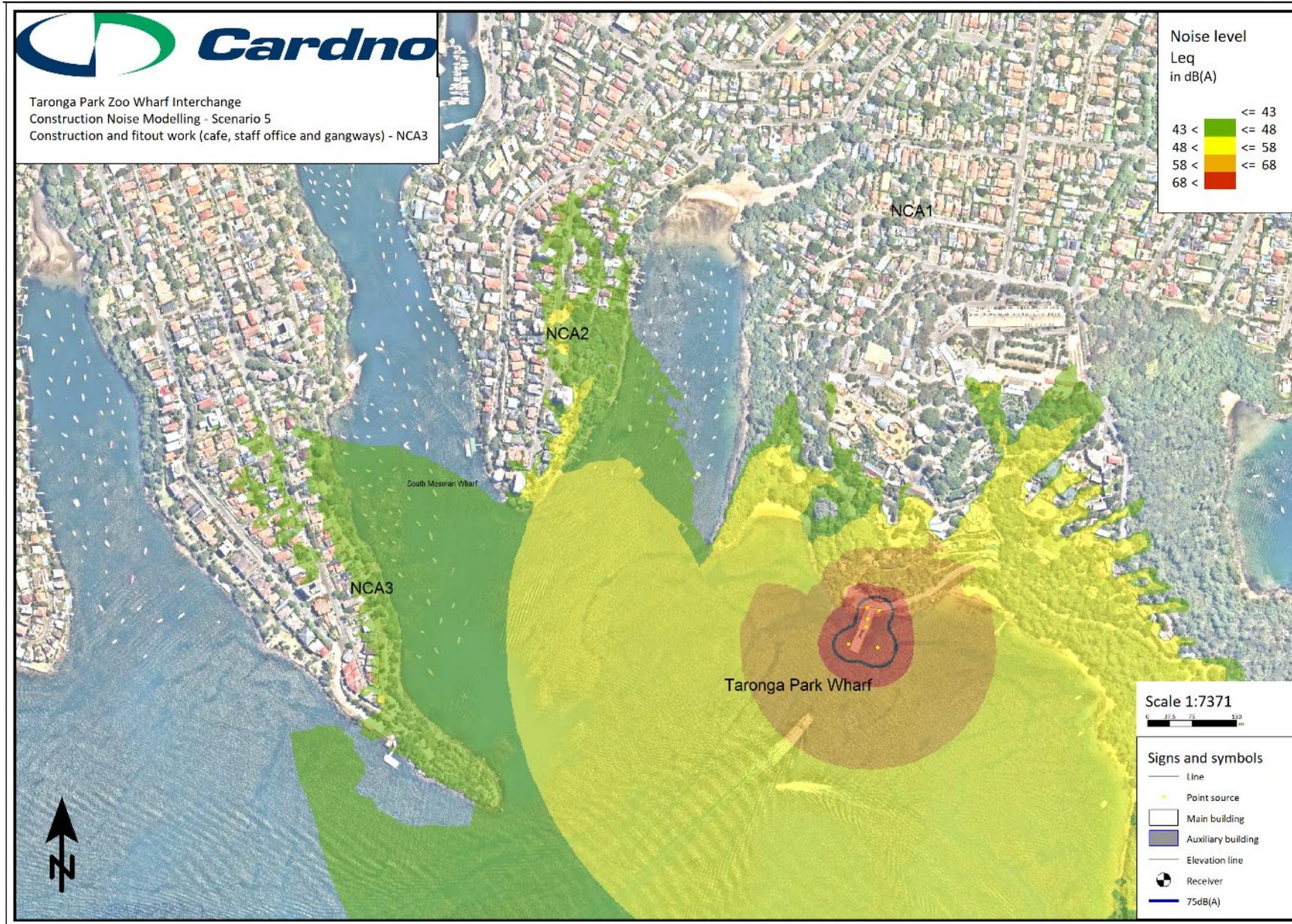


Figure C12 Predicted Construction Noise Scenario 5 – Construction & fitout work, NCA3 Ground Level – Standard Hours

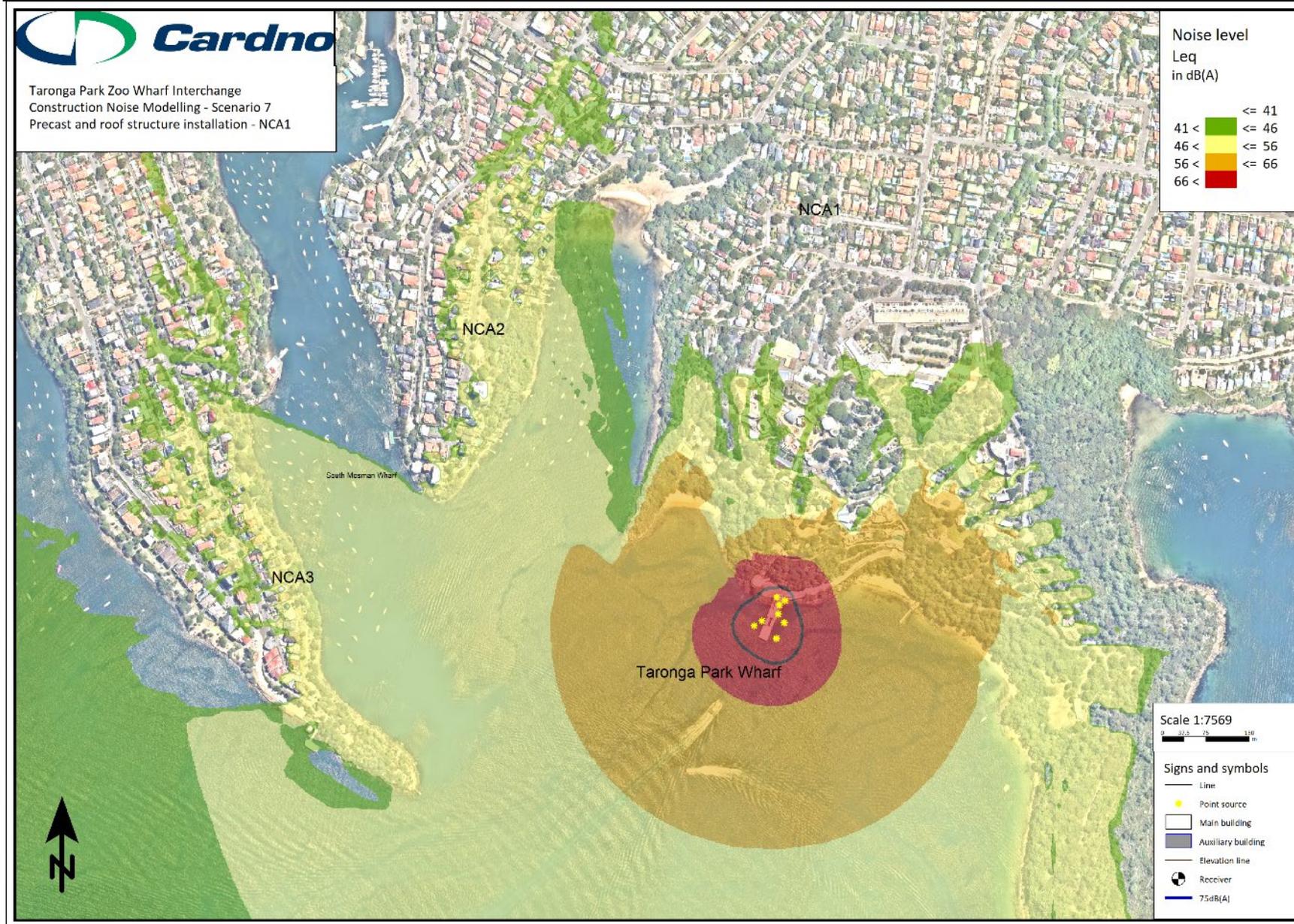


Figure C13 Predicted Construction Noise Scenario 7 – Precast and roof structure installation, NCA1 Ground Level – Standard Hours

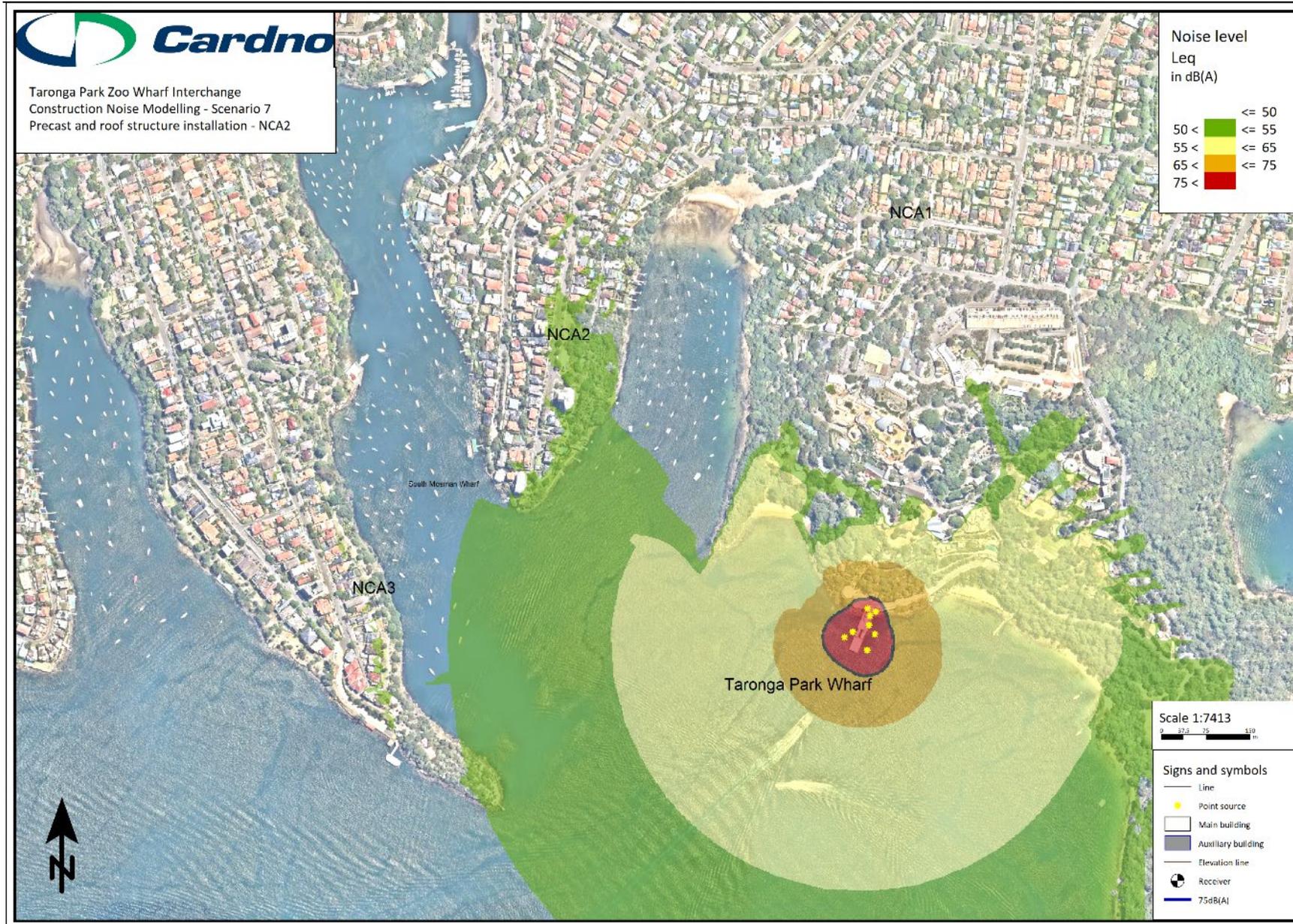


Figure C14 Predicted Construction Noise Scenario 7 – Precast and roof structure installation, NCA2 Ground Level – Standard Hours

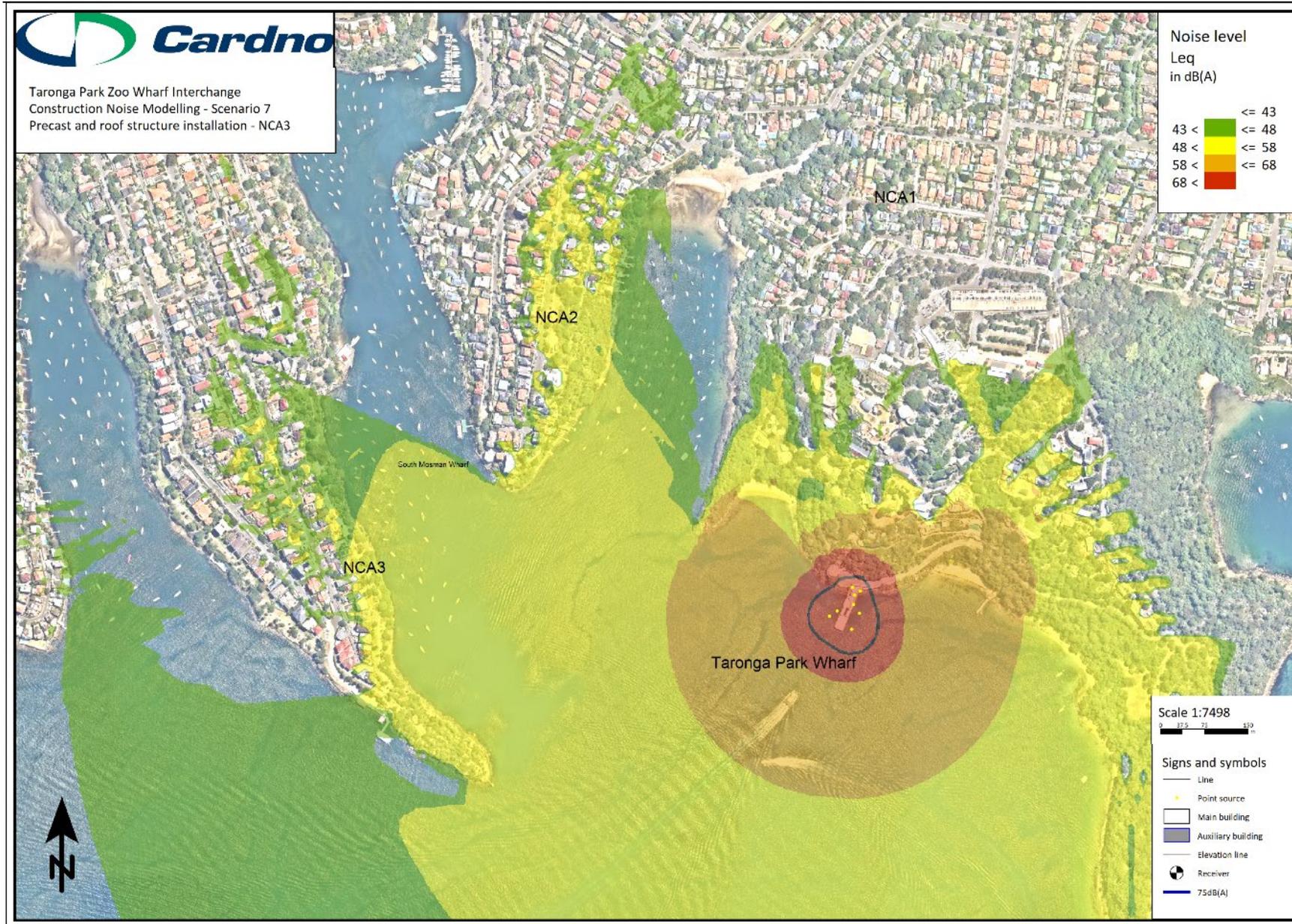


Figure C15 Predicted Construction Noise Scenario 7 – Precast and roof structure installation, NCA3 Ground Level – Standard Hours

Appendix G

Landscape Character and Visual Impact Assessment

Landscape Character and Visual Impact Assessment

Taronga Zoo Wharf Upgrade

AWE200198



Prepared for
Transport for NSW

21 December 2020

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Document Information

| | |
|----------------|--|
| Prepared for | Transport for NSW |
| Project Name | Taronga Zoo Wharf Upgrade |
| File Reference | AWE200198_R206_Rev 0_Taronga_LCVIA.docx |
| Job Reference | AWE200198 |
| Date | 21 December 2020 |
| Version Number | Rev 0 |

Effective Date 21/12/2020

Date Approved 21/12/2020

Document History

| Version | Effective Date | Description of Revision | Prepared by | Reviewed by |
|---------|------------------|-------------------------|-------------|-------------|
| Rev A | 22 October 2020 | Draft for client review | KP | JOG |
| Rev B | 11 December 2020 | Final Draft | KP | NP |
| Rev 0 | 21 December 2020 | Final | KP | NP |

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1 Introduction

Transport for NSW (TfNSW) has engaged Cardno to undertake an environmental assessment to upgrade the Taronga Zoo 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* (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 (REF) for the Taronga Zoo Wharf upgrade. The purposes of this report are:

- > To inform the design of the wharf so the proposal can avoid and minimise impacts on local landscape character and views from surrounding areas and properties
- > To undertake a view analysis to and from the site from adjoining properties, key vintage points and streetscape locations, 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 *Environmental Impact Assessment Practice Note EIA-NO4 – Guideline for landscape character and visual assessment* (RMS, 2020). 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 Taronga Zoo Wharf is to facilitate a development outcome that:

- > Ensures the proposal is compatible with the existing built and natural environments
- > Contributes to the landscape character of the area
- > Protects key elements and features of the local landscape character
- > Safeguards key and significant viewpoints to and from the site
- > Enhances the overall visual and landscape quality of the public domain for the community and park users
- > Upgrades facilities to meet current standards and improve visual and landscape amenity.

2.2 The proposal

2.2.1 Waterside design

The water based features of the proposal would include:

- > Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- > Removal of existing gangways
- > Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- > Two new transition ramps on the existing pontoon to cater for the new gangways
- > Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- > Construction of a new covered *Disability Standards for Accessible Public Transport (DSAPT)* compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- > Removal and relocation of the Transdev office and café on the existing jetty
- > Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- > Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- > Relocation of existing Opal Card readers and Opal top-up machine
- > Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

2.2.2 Landside design

The land based features of the proposal would include:

- > Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- > Retention of the five existing bicycle parking hoops
- > Retention of the public telephone booth
- > Removal of foreshore vegetation to construct the new accessible ramp.

Key features of the proposal including the water-based and land-based features are shown on Figure 2-1.

2.3 Study Area

Figure 2-2 identifies the Study Area of the LCVIA.

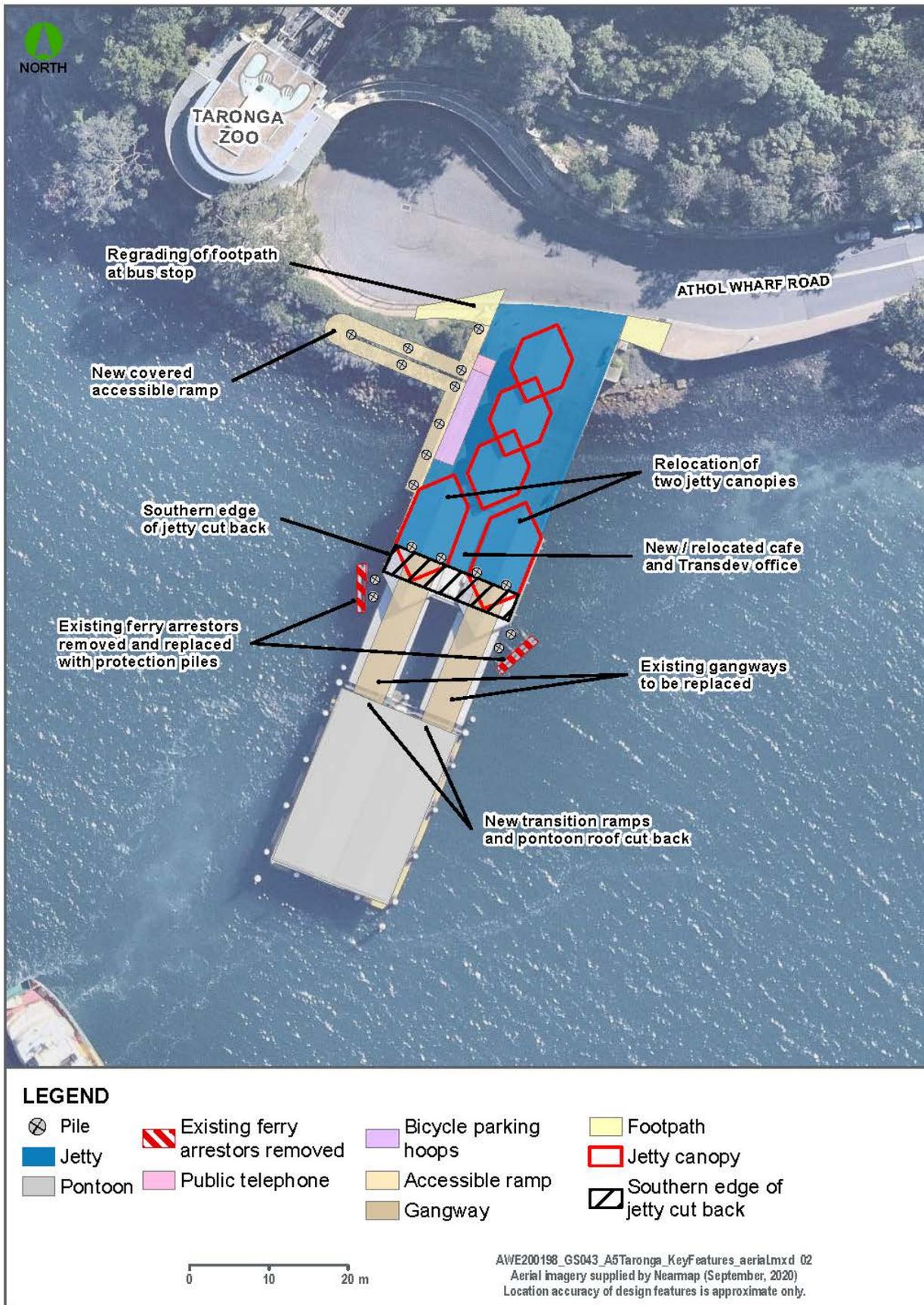


Figure 2-1 Key features of the proposal



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 W1 Maritime Waters and W2 Environmental Protection. The objectives of the W1 zone are:

- > 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
- > 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
- > To promote equitable use of the waterway, including use by passive recreation craft.

The objectives of the W2 zone are:

- > To protect the natural and cultural values of waters in this zone
- > To prevent damage or the possibility of longer term detrimental impacts to the natural and cultural values of waters in this zone and adjoining foreshores
- > To give preference to enhancing and rehabilitating the natural and cultural values of waters in this zone and adjoining foreshores
- > To provide for the long-term management of the natural and cultural values of waters in this zone and adjoining foreshores.

Additionally, the Study Area is located within the Foreshores and Waterways Area and Wetland Protection Areas.

3.1.2 Sydney Harbour Foreshore Area Development Control Plan

The *Sydney Harbour Foreshore Area Development Control Plan* (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 Taronga Zoo wharf is identified as Landscape Character Type 8 and the Statement of Character and Intent is 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

| Performance Criteria | Comments |
|---|--|
| Vegetation is integrated with land-based development to minimise the contrast between natural and built elements. | Where practicable, any vegetation removed should be replaced with locally indigenous species of trees and shrubs planted in appropriate locations. |
| 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 compatible with surrounding land uses. The wharf structure upgrades are of contemporary design which is considered to complement and improve the visual character of its locality. |

| Performance Criteria | Comments |
|---|---|
| <p>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.</p> | <p>The Taronga Zoo wharf upgrade would preserve the maritime uses on the Harbour.</p> |
| <p>Remaining natural features that are significant along the foreshore are preserved and views of these features are maintained.</p> | <p>The inclusion of the accessible ramp would involve some removal of trees and would change the view of the foreshore behind the existing wharf. The visual impact of the proposal would be mitigated by the low key, contemporary form and finishes to the upgraded wharf.</p> <p>Replanting of indigenous trees and shrubs in appropriate locations would also mitigate the impact of the proposal. With these measures in place, the proposal is considered to have an acceptable visual impact on natural features of the foreshore.</p> |

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* (Mosman LEP) is required.

3.1.3.1 Zoning

The land based portion of the Study Area is zoned as SP2 – Infrastructure under the Mosman LEP as shown on Figure 3-1. The objectives of the SP2 zone are as follows:

- > To provide for infrastructure and related uses.
- > To prevent development that is not compatible with or that may detract from the provision of infrastructure.



Figure 3-1 Extract *Mosman Local Environmental Plan 2012* – Land Zoning Map (Sheet LZN-003)

The proposal would be consistent with the objectives of the zone and with the adjoining zones that are relevant to landscape character or visual amenity.

3.1.3.2 Heritage conservation

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

- > Athol Wharf Tram Terminus (including escarpment and retaining wall) (Item no. A482)
- > Taronga Zoo Wharf (remains and sea wall) (Item no. A483)
- > “Rainforest Aviary”, “Elephant House”, bus shelter and office, floral clock and upper and lower entrance gates (Item no. I34).

The locations of the heritage items are shown on Figure 3-2.

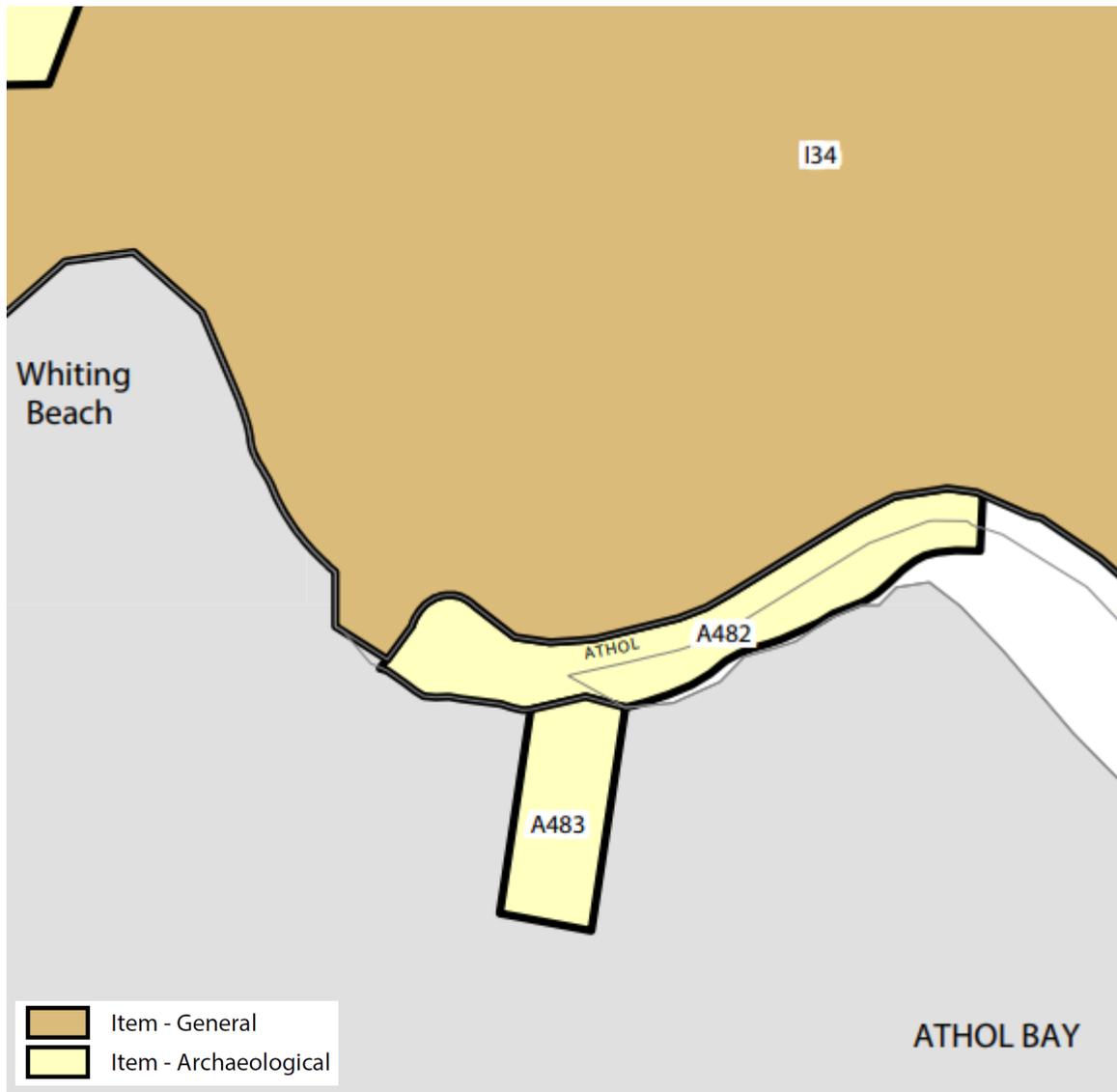


Figure 3-2 Extract Mosman Local Environmental Plan 2012 – Heritage Map (Sheet HER-003)

3.1.3.3 Scenic protection areas

Cl.6.4 of the Mosman LEP 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.

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 adjacent to 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 LEP.

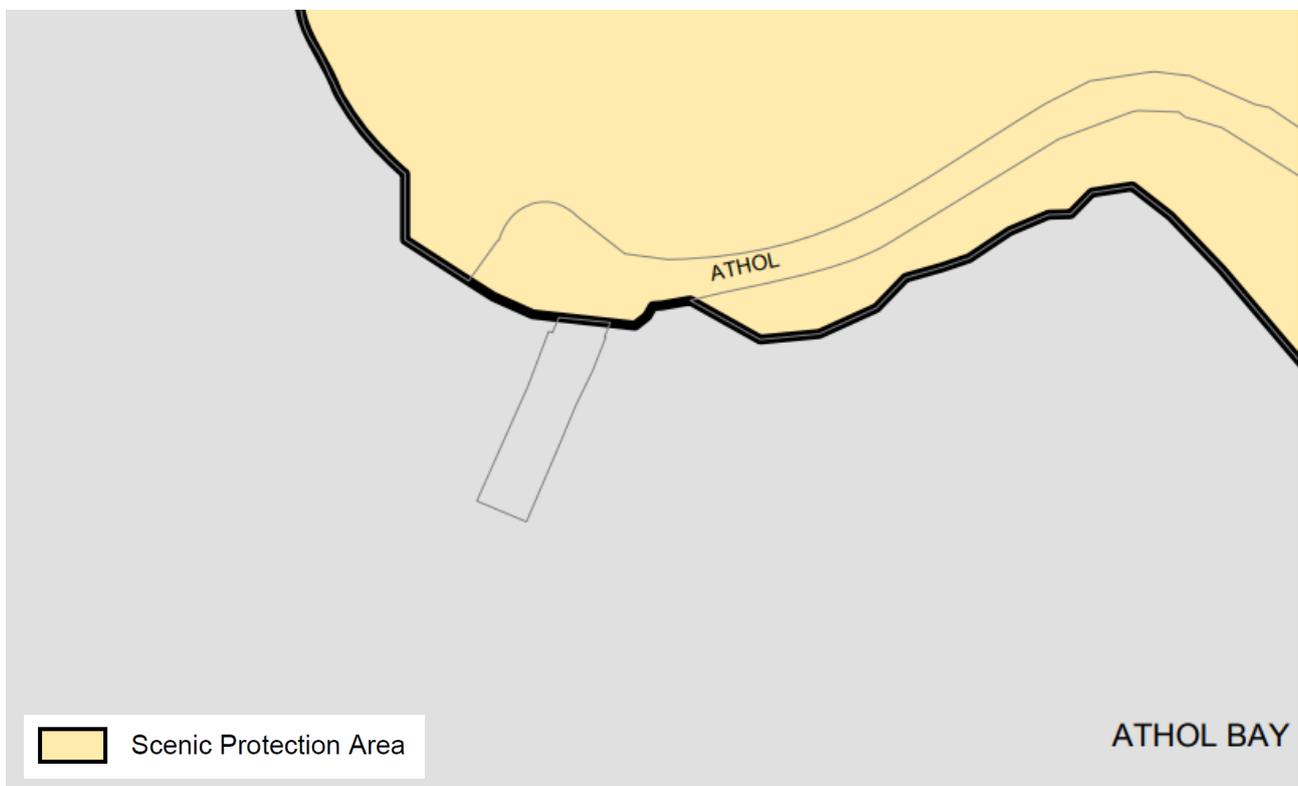


Figure 3-3 Extract Mosman Local Environmental Plan 2012 - Scenic Protection Area Map (Sheet SCP_003)

4 Existing context

4.1 Location

Taronga Zoo wharf is positioned near the cul-de-sac at the end of Athol Wharf Road on the northern shore of Sydney Harbour. The wharf is located in close proximity to the southern entry point of Taronga Zoo and Sydney Harbour National Park, and Bradleys Head is located to the east of the wharf. The location of the wharf is shown in Figure 4-1 and Figure 4-2.

The wharf is situated 3.4 kilometres (by water) and 10.1 kilometres (by road) from the Sydney CBD.

The wharf is situated on the F2 Sydney Ferry Network Loop, which provides connections to Circular Quay and other northern harbour locations.

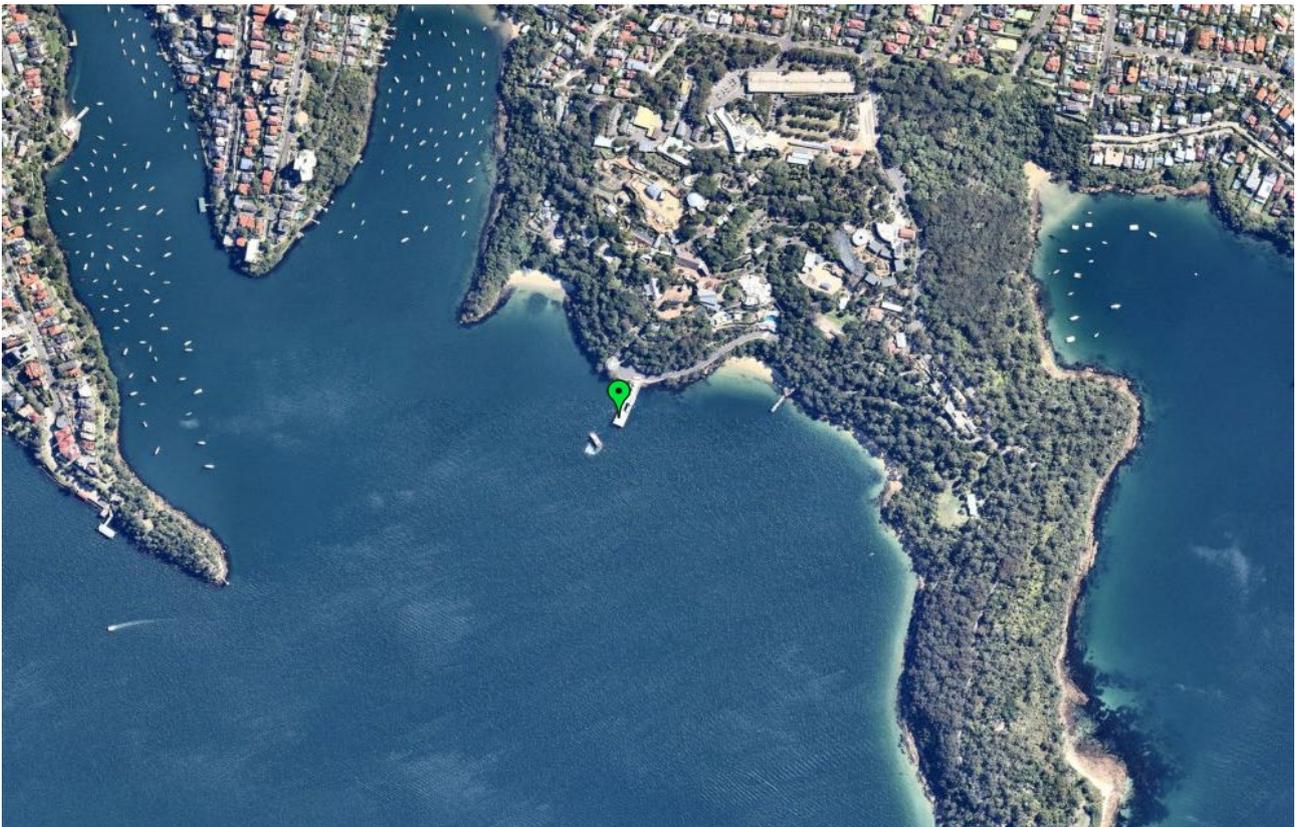


Figure 4-1 Location of Taronga Zoo wharf (Source: NearMap)



Figure 4-2 Perspective view of Taronga Zoo wharf (Source: Google Map)

4.2 Landscape and urban context

The existing Taronga Zoo wharf is connected to the foreshore incorporating a concrete jetty with dual-berthing, canopy cover and two-lane gangways. Paths connect the jetty to the bus interchange on Athol Wharf Road and the entrance to Taronga Zoo.

The wharf provides the southern entry point to Taronga Zoo and Sydney Harbour National Park, with the foreshore landscape being significantly vegetated with native tree species along rock and sandstone cliff. The character of the foreshore area north and into Taronga Zoo is essentially dominated by natural features (vegetated hillsides) with built form (buildings and structures associated with the operations of the Zoo) being a recessive element.

Broadly, the wharf site is located between Whiting Beach to the west (accessible via Curlew Camp Artist's Walk) and Bradleys Head to the east.

5 Landscape character assessment

5.1 Landscape character

The *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4* (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 Taronga Zoo 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 Taronga Zoo 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 |

5.2.1 Landscape character impact assessment

For this assessment, the magnitude rating for the landscape character impact is categorised in Table 5-2.

Table 5-2 Magnitude rating for landscape character

| 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

To determine the Taronga Zoo wharf impact, the broader 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.

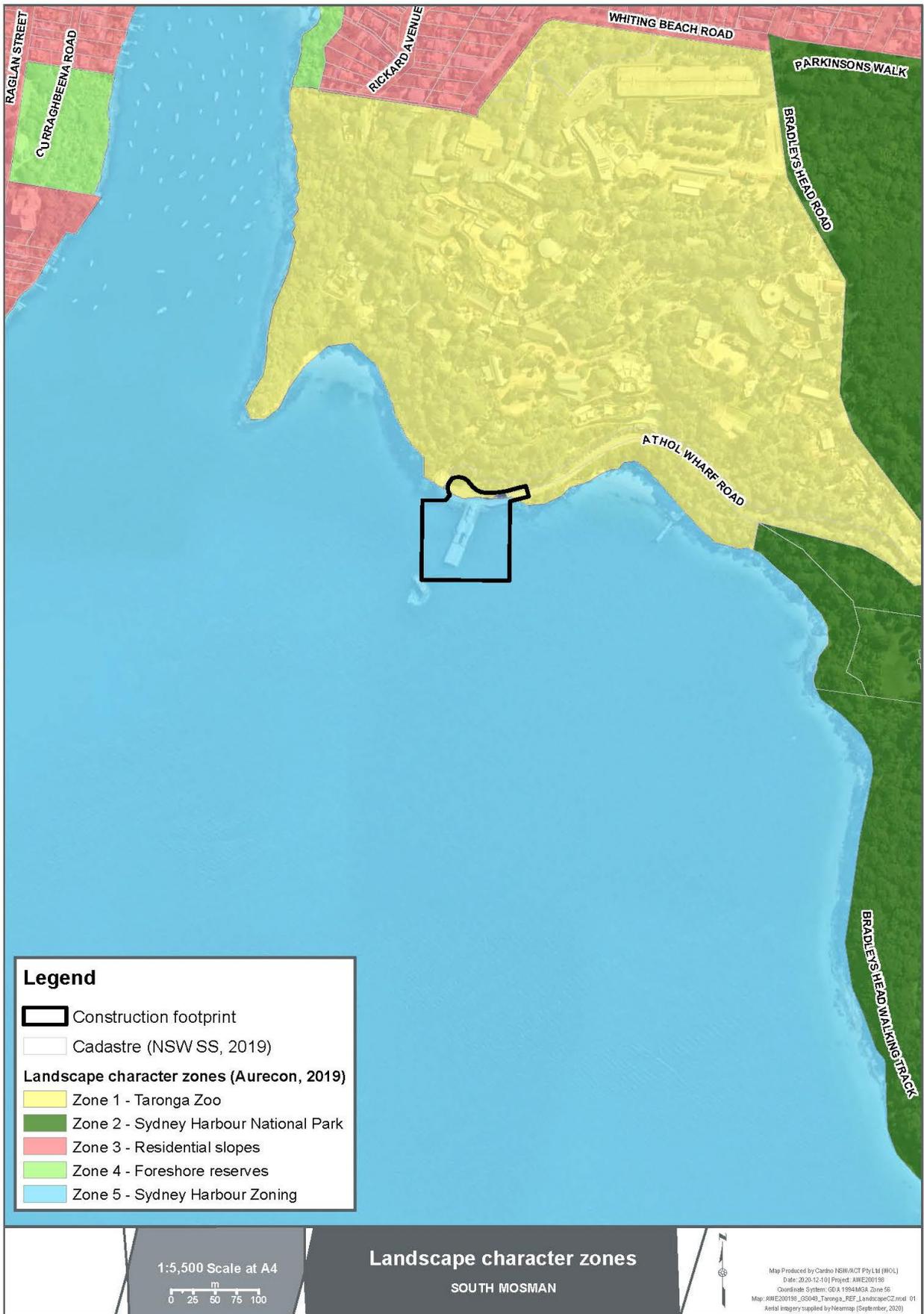


Figure 5-1 Landscape character zones

Table 5-3 Landscape character assessment

| Landscape Character Precinct | Description | Sensitivity | Magnitude | Landscape Character Impact |
|------------------------------|---|--|--|--|
| Taronga Zoo | <p>Taronga Zoo is located on the shores of Sydney Harbour, within the suburb of Mosman. The zoo is an iconic tourist attraction on Sydney Harbour and boasts striking views of Sydney Harbour.</p> <p>The area is characterised by significant vegetation in a garden setting that stretches up from the foreshore to the ridgeline. A wide variety of buildings are scattered throughout the area taking on a wide variety of built forms from traditional to contemporary architectural types, which have been developed over the last 100 years, to cater for the vast array of animals that reside at the zoo.</p> <p>The zoo also includes a large cable car which stretches from the southern portion of the zoo to the main entry point.</p> | <p>Moderate</p> <ul style="list-style-type: none"> > The area boasts views of Sydney Harbour and slopes down within a significantly vegetated landscape. > Highly patronised tourist attraction. | <p>Moderate</p> <ul style="list-style-type: none"> > Design would increase overall size however the materials and structure would be similar form to existing wharf. | <p>Moderate</p> <ul style="list-style-type: none"> > Taronga Zoo is a top tourist attraction within Sydney Harbour with an array of wildlife that are cared for and visited by many tourists. The zoo does however include a number of different large structures including the cable car and wharf structure, demonstrating that the site has been prone to change over the years. > The proposed design of Taronga Zoo wharf consists of an additional ramped structure to the western side of the existing wharf and replacement of the existing gangways. Some vegetation clearing would be required for the proposed ramp however this is considered to be minor. |
| Sydney Harbour National Park | <p>Sydney Harbour National Park comprises parts of Port Jackson, Sydney and its foreshores and various islands. Bradleys Head is part of the Sydney Harbour National Park which extends into Sydney Harbour. Bradleys Head is located to the east of the proposed design.</p> <p>The National Park is a prominent bushland area which wraps</p> | <p>High</p> <ul style="list-style-type: none"> > Uninterrupted scenic views from the National Park extend across the Harbour from existing walking tracks. | <p>Low</p> <ul style="list-style-type: none"> > The proposed works retain the existing structure with significant works occurring only on the western extent of the wharf structure. | <p>Moderate</p> <ul style="list-style-type: none"> > The National Park is a prominent bushland area which stretches out towards Bradleys Head and further east towards Georges Head lookout. > The proposed design is relatively distant from the character zone which is located on the western extent of the existing wharf and |

| Landscape Character Precinct | Description | Sensitivity | Magnitude | Landscape Character Impact |
|------------------------------|--|--|---|---|
| | <p>around the foreshore and Bradleys Head. A gentle bush walk weaves around the harbour headland providing scenic views of the Harbour which stretch back towards the Sydney Opera House and Sydney Harbour Bridge.</p> | | | <p>would not present a contrast to the existing wharf structure.</p> |
| <p>Residential Slopes</p> | <p>This zone is characterised by a mix of 2 to 3 storey residential dwellings and 4 to 8 storey residential flat buildings. Architectural styles and buildings vary from traditional architectural styles such as Victorian and Federation dwellings, to more contemporary styles incorporating traditional architectural elements.</p> <p>The terrain generally slopes down from ridgelines towards the harbour and foreshore areas.</p> <p>Tree lined streets and mature vegetation is interspersed through the residential areas which form a significant part of the appearance of the zone.</p> | <p>Moderate</p> <ul style="list-style-type: none"> > The residential slopes zone exhibits a very broad variety of building forms, masses, heights, materials and setbacks. | <p>Low</p> <ul style="list-style-type: none"> > The proposed ferry wharf upgrade is generally recognised as an extension to the existing wharf and whilst it would increase the overall size of the structure, it would not contribute to a significant contrast to the existing landscape. | <p>Low-Moderate</p> <ul style="list-style-type: none"> > The interspersed mature vegetation is quite evident in this area. > The residential zone is also relatively distant to the proposed design resulting in a low magnitude. |
| <p>Foreshore Reserves</p> | <p>Grassed recreational spaces and vegetated foreshores are prominent within the landscape character of the northern shore of Sydney Harbour. Bushland and large mature trees are particularly evident in these areas and break</p> | <p>High</p> <ul style="list-style-type: none"> > Recreational and vegetated foreshore areas offer highly sensitive significant views towards the harbour, foreshore and Bay areas. | <p>Negligible</p> <ul style="list-style-type: none"> > The proposed design is distant from the character zone which is not recognised to present a contrast against the existing wharf structure. | <p>Negligible</p> <ul style="list-style-type: none"> > The area is predominately bushland with a visible tree canopy when viewed from the harbour. > The character zone is distant from the proposed design and |

| Landscape Character Precinct | Description | Sensitivity | Magnitude | Landscape Character Impact |
|------------------------------|---|---|---|---|
| | <p>up the built elements from adjoining land uses.</p> <p>These areas are publicly available recreational spaces and environmental conservation zones adjacent to the Sydney Harbour.</p> | | | <p>separated by an existing ridgeline.</p> |
| <p>Sydney Harbour</p> | <p>Sydney Harbour is a large body of water, which formed from a flooded river estuary.</p> <p>The landform around the harbour includes peninsulas with steep slopes rising to ridgelines.</p> <p>Natural sandstone outcrops and manmade sandstone walls can be seen lining parts of the Harbour foreshore.</p> <p>Much of the foreshore surrounding the harbour is vegetated recreational areas, and residential dwellings.</p> <p>Visually, parts of the harbour also include moored yachts flanking the foreshores and industrial waterside work areas.</p> | <p>High</p> <p>> The wharf boasts significant views of the Harbour's foreshore areas consisting of iconic landmarks, vegetated reserves and exclusive residencies.</p> | <p>Low</p> <p>> The proposed design is recognised as an extension to the existing wharf structure with the inclusion of a ramped pathway to the western side of the wharf. This would increase the overall size of the wharf structure, however, it would not be a significant contrast to the wharf and foreshore area.</p> | <p>Moderate</p> <p>> Sydney Harbour is one of the more scenic harbours in the world, and in proximity to the existing wharf contains minimal marine structures and a heavily vegetated foreshore associated with Taronga Zoo and the Sydney Harbour National Park.</p> |

5.4 Overall sensitivity – high to moderate

Taronga Zoo is an iconic tourist attraction to Sydney Harbour which is exposed to a large number of visitors and visual receivers. The area is set within a vegetated/garden landscape and boasts significant views of the harbour. The area does however contain large structures and buildings including the cable car.

Sydney Harbour National Park consists of sensitive bushland areas on the foreshores of Sydney Harbour. Part of the National Park extends along Bradleys Head towards the headland and includes uninterrupted scenic views from the walking tracks across the harbour. The sensitivity of this zone is considered high for this reason.

The residential slopes character zone contains a wide variety of building forms, height, masses and setbacks. However, given the distance of this zone from the proposed design, the sensitivity is considered moderate.

The foreshore reserve contains recreational and vegetated public spaces which are prominent to the foreshore of Sydney Harbour which breaks up the urban development of the foreshore. However, given the distance of this zone from the proposed design, the sensitivity is considered moderate.

Sydney Harbour is recognised as having a mix of recreational and maritime uses, which brings a mix of landscape characters. Views from the harbour towards the existing wharf consist predominately of vegetated foreshore area's interspersed with mature trees which is characteristic of the north shore. As such, the sensitivity of Sydney Harbour was considered high.

It is considered that the general sensitivity of the surrounding character zones is high to moderate for this reason.

5.5 Overall magnitude – low

The existing Taronga Zoo wharf would be upgraded improving accessibility and customer experience. The design is identified as an upgrade to the existing wharf structure with an additional ramped structure proposed along the western side of the wharf.

The magnitude of the proposal is highest from viewpoints south of Taronga Zoo and Sydney Harbour, however, the overall magnitude for the landscape character is considered low as the impact is considered to have a minor contrast to what is existing at the current wharf site. Some vegetation clearing would be required to accommodate the proposed ramped structure, however this is considered to be minor.

5.6 Overall landscape character impact - moderate to low

The landscape character impact of the proposed Taronga Zoo wharf, extending from existing wharf, is considered to be moderate to low on the surrounding character zones.

The proposed design is located within a sensitive area on the northern foreshore of Sydney Harbour. The landscape consists of a relatively vegetated foreshore area in proximity to Taronga Zoo, Sydney Harbour National Park lands and Sydney Harbour.

The proposed design, however, is essentially an extension to the existing wharf structure with an additional ramped structure proposed along the western side of the wharf. The design is not considered to have a significant contrast to the existing wharf area and is relatively distant from some sensitive landscape character zones. Some vegetation clearing is required to accommodate the ramped structure, however, this is considered to have a minor impact on the landscape. The additional structures would increase the overall size of the existing wharf however would not have a significant impact to the existing landscape character zones.

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 Taronga Zoo 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 Taronga Zoo 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 rating for the visual impact is categorised in Table 6-3.

Table 6-3 Visual impact rating description

| Visual Impact 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 maybe 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. |

6.2.4 Key view points

In consultation with TfNSW, viewpoints within a reasonable distance and visual catchment of the Taronga Zoo wharf have been identified (Figure 6-1). The figure outlines the position and direction of the key viewpoints that are likely to be impacted by the proposed works/structures.

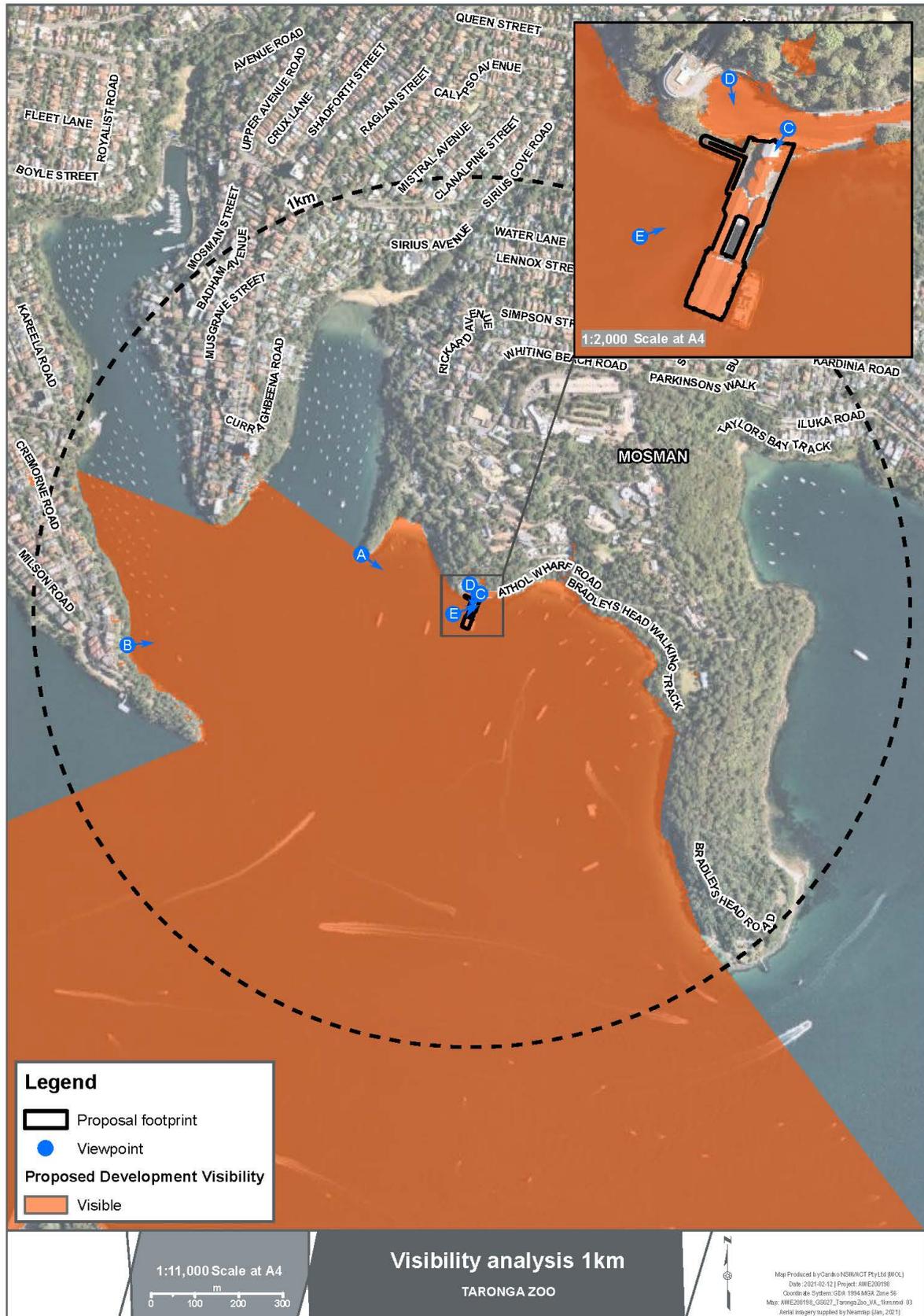


Figure 6-1 Visibility analysis and key viewpoints

6.2.5 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 – 250 metres from the viewer
- > Middle ground zone (MZ): 250 – 500 metres from the viewer
- > Background zone (BZ): 500 meters or greater from the viewer.

6.2.6 Photomontages

Photomontages have been developed to illustrate proposed changes and to determine the likely visual impact generated by the proposed Taronga Zoo wharf. Photomontages in the broader study area have been prepared from the following five viewpoints.

- > Viewpoint A – Little Sirius Point/Whiting Beach headland looking south-east toward wharf
- > Viewpoint B – Cremorne Reserve Path looking north-east toward wharf
- > Viewpoint C – Athol Wharf Road pathway looking south toward wharf
- > Viewpoint D – Sydney Harbour looking north-east toward wharf
- > Viewpoint E – Taronga Zoo pathway at end of Athol Wharf Road looking south-east toward wharf.

Figure 6-2 to Figure 6-11 have been selected to identify the different aspects of the proposal and determine the magnitude of the proposed works/structures from critical viewpoints in the proximity of the study area.

6.2.7 Viewpoint assessment

6.2.7.1 Viewpoint A – Little Sirius Point/Whiting Beach headland looking south-east toward wharf



Figure 6-2 Viewpoint A – existing view (Source: Urbaine, 2020)



Figure 6-3 Viewpoint A – photomontage (Source: Urbaine, 2020)

6.2.7.1.2 Viewpoint A - description

Viewpoint A is located at Little Sirius Point to the east of Whiting Beach, approximately 260 metres north-east of the wharf. The view includes the Sydney Harbour waterway, Taronga Zoo foreshore along Curlew Camp Artist’s Walk, and Bradleys Head in the distance. Horizon views are primarily vegetation associated with Bradleys Head (also a Scenic Protection Area) and the southern foreshore of Sydney Harbour. The existing Taronga Zoo wharf forms a small component of this broad view. It is recessive against the backdrop of Bradleys Head.

6.2.7.1.3 Viewpoint A – visual impact assessment

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|---|-------------|-----------|---------------|----------------|--|
| Wharf platform and roof, gangway platform and roof. | H | L | MZ | L-M | Viewpoint A is representative of moderately distant, elevated views from Little Sirius Point towards the proposal site. The sensitivity of Viewpoint A is high for the following reasons: <ul style="list-style-type: none"> > The central location of the wharf complex in the view |

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|------------------|-------------|-----------|---------------|----------------|--|
| | | | | | <ul style="list-style-type: none"> > Medium views of Taronga Zoo vegetation > The view is in the direction of the Scenic Protection Area > Viewers would be expected to be highly sensitive to changes to these views across the harbour towards the relatively natural foreshore of the Taronga Zoo complex. > The quality of the view is, however, moderated by the presence of built form of variable visual quality (including the existing wharf). <p>The magnitude of impact on the view of the new wharf complex is considered low as the proposal would introduce minimal change to the existing view.</p> |

6.2.7.2 Viewpoint B – Cremorne Reserve Path looking north-east toward wharf



Figure 6-4 Viewpoint B – existing view (Source: Urbaine, 2020)



Figure 6-5 Viewpoint B – photomontage (Source: TfNSW)

6.2.7.2.2 Viewpoint B - description

Viewpoint B is located along Cremorne Reserve Path, approximately 780 metres south-west of the wharf. The view includes the Sydney Harbour waterway, Taronga Zoo foreshore and Athol Beach. Horizon views are dominated by vegetation associated with Taronga Zoo (also a Scenic Protection Area). The existing Taronga Zoo wharf forms a small component of this broad view. It is recessive against the backdrop of Taronga Zoo.

6.2.7.2.3 Viewpoint B – visual impact assessment

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|---|-------------|-----------|---------------|----------------|--|
| Ramped pathway, wharf platform and roof, gangway platform and roof. | H | L | BZ | L | <p>Viewpoint B is representative of distant perspective views from Cremorne Point of the new infrastructure associated with the wharf upgrade proposal.</p> <p>The sensitivity of Viewpoint B is high for the following reasons:</p> <ul style="list-style-type: none"> > The central location of the wharf complex in the view > Medium views of Taronga Zoo vegetation > Visibility of the Scenic Protection Area > The quality of the view is moderated by the presence of built form of variable visual quality (including the existing wharf). <p>The magnitude of impact on the view of the new wharf complex is considered low as viewers would be highly sensitive to changes to the view however the design would introduce minimal change.</p> |

6.2.7.3 Viewpoint C – Athol Wharf Road pathway looking south toward wharf



Figure 6-6 Viewpoint C – existing view (Source: Urbaine, 2020)



Figure 6-7 Viewpoint C – photomontage (Source: Urbaine, 2020)

6.2.7.3.2 Viewpoint C - description

Viewpoint C is located at the entrance to the wharf, directly adjacent to the bus stop toward the end of the Athol Wharf Road cul-de-sac. The viewpoint is elevated slightly above the site due to the landform and incorporates views of Sydney Harbour and the southern foreshore of Sydney Harbour in the distant horizon.

6.2.7.3.3 Viewpoint C – visual impact assessment

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|---|-------------|-----------|---------------|----------------|---|
| <p>Ramped pathway, wharf platform and roof, gangway platform and roof.</p> <p>Removed trees are also a significant element of the changed view.</p> | M | H | FZ | M-H | <p>Viewpoint C is representative of close views from Athol Wharf Road of the new infrastructure associated with the wharf upgrade proposal.</p> <p>The sensitivity of Viewpoint C is moderate for the following reasons:</p> <ul style="list-style-type: none"> > The central location of the wharf complex in the view > Visibility of the Scenic Protection Area > The quality of the view is moderated by the presence of built form of variable visual quality (including the existing wharf). <p>The magnitude of impact on the view of the new wharf complex is considered high as it involves moderately substantial new built form of the path and removal of some trees, offset by an improved quality of built form and finishes.</p> |

6.2.7.4 Viewpoint D – Sydney Harbour looking north-east toward wharf



Figure 6-8 Viewpoint D – existing view (Source: Urbaine, 2020)



Figure 6-9 Viewpoint D – photomontage (Source: Urbaine, 2020)

6.2.7.4.2 Viewpoint D - description

Viewpoint D is located in the Harbour, approaching the wharf from the south-west. The viewpoint includes the elevated highly vegetated landscape of Taronga Zoo, signage associated with Athol Wharf Road, and rocky and moderately vegetated foreshore.

6.2.7.4.3 Viewpoint D - Visual impact assessment

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|---|-------------|-----------|---------------|----------------|--|
| Ramped pathway, wharf platform and roof, gangway platform and roof. Removed trees are also a significant | H | M | FZ | M | Viewpoint D is representative of close views from Sydney Harbour adjacent to the wharf of the new infrastructure associated with the wharf upgrade proposal. The sensitivity of Viewpoint D is high for the following reasons: > The relatively well vegetated foreshore |

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|------------------------------|-------------|-----------|---------------|----------------|---|
| element of the changed view. | | | | | <ul style="list-style-type: none"> > Natural backdrop including visually high quality substantial vegetation > Visibility of the Scenic Protection Area > Close proximity to the wharf > The quality of the view is moderated by the presence of built form of variable visual quality (including the existing wharf). <p>The magnitude of impact on the view of the new wharf complex is considered moderate as it involves moderately substantial new built form of the path and removal of some trees, offset by an improved quality of built form and finishes.</p> |

6.2.7.5 Viewpoint E – Taronga Zoo pathway at end of Athol Wharf Road looking south-east toward wharf



Figure 6-10 Viewpoint E – existing view (Source: Urbaine, 2020)



Figure 6-11 Viewpoint E – photomontage (Source: Urbaine, 2020)

6.2.7.5.2 Viewpoint E - description

Viewpoint E is located on the Taronga Zoo entrance pathway at the end of Athol Wharf Road in the cul-de-sac. The viewpoint is elevated above the site of the existing wharf and incorporates views of Sydney Harbour, Bradleys Head and the southern foreshore of Sydney Harbour in the distant horizon.

6.2.7.5.3 Viewpoint E - visual impact assessment

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|---|-------------|-----------|---------------|----------------|--|
| Ramped pathway, wharf platform and roof, gangway platform and roof. | M | M | FZ | M | Viewpoint E is representative of close higher perspective views from the Taronga Zoo pathway of the new infrastructure associated with the wharf upgrade proposal. |

| Visible Elements | Sensitivity | Magnitude | Distance Zone | Overall Rating | Comment |
|---|-------------|-----------|---------------|----------------|---|
| Removed trees are also a significant element of the changed view. | | | | | <p>The sensitivity of Viewpoint E is moderate for the following reasons:</p> <ul style="list-style-type: none"> > The central location of the wharf complex in the view > Distant views of Bradleys Head and Point Piper > Visibility of the Scenic Protection Area > 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). <p>The magnitude of impact on the view of the new wharf complex is considered moderate as it involves moderately substantial new built form of the path and removal of some trees, offset by an improved quality of built form and finishes.</p> |

6.3 Overall visual impact assessment - moderate

The overall visual impact of the proposed concept design for Taronga Zoo wharf, is considered moderate following the assessment of the viewpoints. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site.

The Taronga Zoo wharf and access infrastructure is located adjacent to the Scenic Protection Area and a number of local heritage items under the Mosman LEP. 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.

The proposed design is seen as an extension to the existing wharf structure which is of a notably large size in comparison to other ferry wharves within Sydney Harbour. The ramped pathway in particular would increase the overall size of the wharf structure due to the switchback in the pathway. Some minor vegetation clearing would be required to accommodate the proposed ramped pathway; however, this is considered to have a minor impact on the overall visual context of the locality. Visually, the design is considered to be relatively in context with the existing wharf.

Ferry patrons and visitors to the zoo are expected to be the most affected by the proposed design from a visual perspective; however, it should be noted that the proposed design is provided to benefit and improve the experience of patrons making the wharf interchange more accessible for ferry users and zoo visitors. As such, the visual impact for the proposed is considered reasonable given the intended aim of the proposed design.

7 Summary of urban design concept and mitigation strategy

7.1 Summary of urban design concept and mitigation strategy

The proposed upgrades to Taronga wharf have 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 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 accessible ramp. 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 offset the tree loss that would result from the proposal
- > 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 we consider that the wharf upgrade 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.

7.2 Conclusion

The assessment of the impacts of the proposed Taronga Zoo Wharf upgrades 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 landscape character impact of the proposed Taronga Zoo wharf, extending from existing wharf, is considered to be moderate to low on the surrounding character zones as the proposed design is essentially an extension to the existing wharf structure with an additional ramped structure proposed along the western side of the wharf. The design is not considered to have a significant contrast to the existing wharf area and is relatively distant from some sensitive landscape character zones.

The overall visual impact of the proposed concept design for Taronga Zoo wharf, is considered moderate following the assessment of the viewpoints. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site, however with the proposed design being an extension to the existing wharf structure which is of a notably large size in comparison to other ferry wharves within Sydney Harbour, the design is considered to be relatively in context with the existing wharf.

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.

Appendix H

Statement of Heritage Impact

Ferry Wharf Upgrade Program 3, Taronga Zoo Wharf

Statement of Heritage Impact

Report to Cardno

December 2020



 artefact

Artefact Heritage

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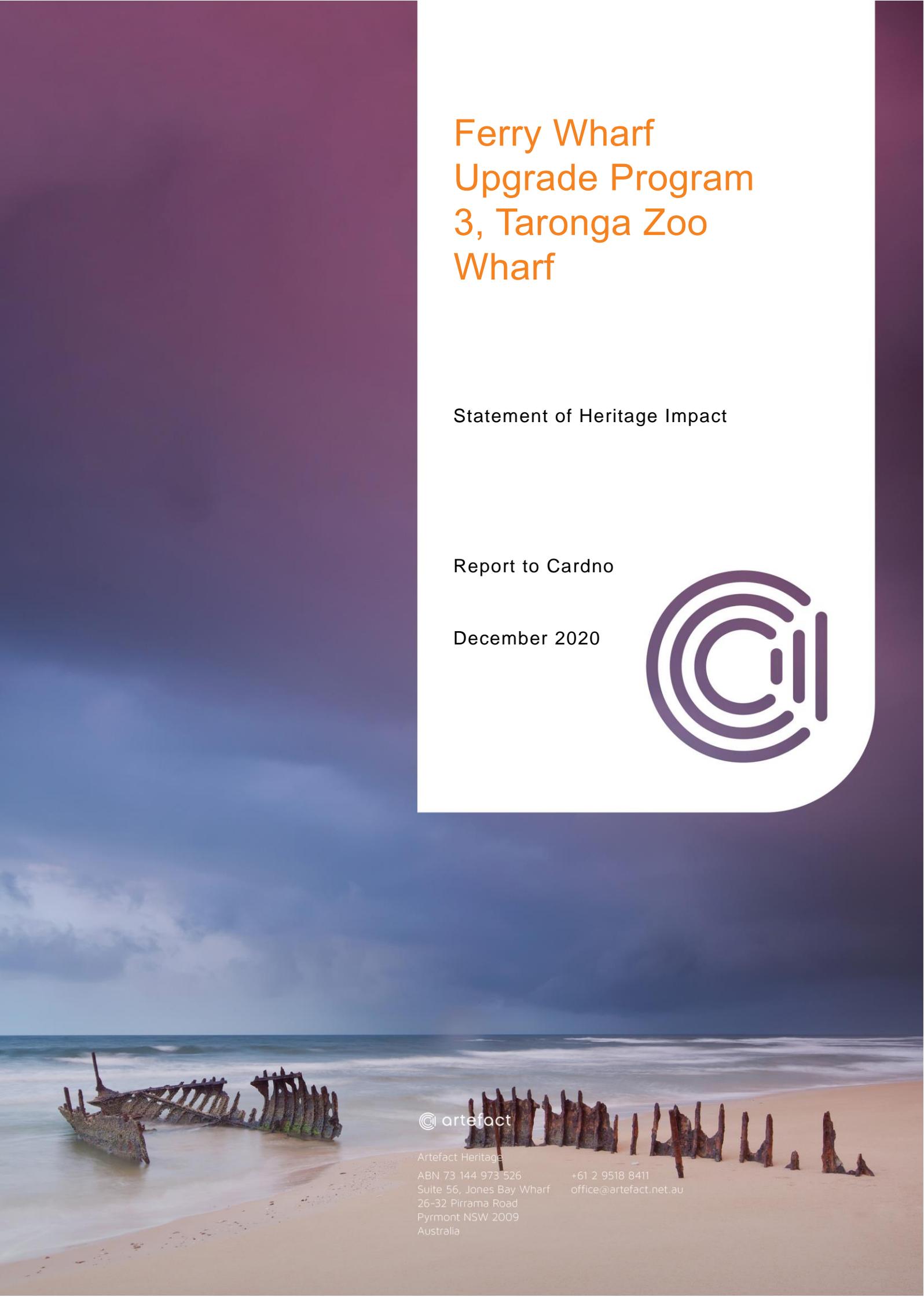
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Document history and status

| Revision | Date issued | Reviewed by | Approved by | Date approved | Revision type |
|----------|------------------|-----------------------------------|-----------------------------------|------------------|---------------|
| 1 | 27 October 2020 | Josh Symons | Josh Symons | 27 October 2020 | First draft |
| 2 | 15 December 2020 | Belinda Crichton James Paddock | Belinda Crichton James Paddock | 15 December 2020 | Client review |
| 3 | 21 December 2020 | Josh Symons | Josh Symons | 21 December 2020 | Second draft |
| 4 | 21 December 2020 | Josh Symons | Josh Symons | 21 December 2020 | Final |

| | |
|------------------------------|--|
| Last saved: | 21/12/2020 |
| File name: | DRAFT FWUP3 Seven Wharves Upgrade - Taronga Zoo Wharf SoHI October2020 |
| Project name: | Ferry Wharf Upgrade Program, Seven Wharves |
| Author: | Jessica Horton, Sarah Hawkins, Jayden van Beek, Josh Symons |
| Project manager: | Jayden van Beek |
| Project number: | 20035 |
| Name of organisation: | Artefact Heritage |
| Document version: | Final |

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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 Taronga Zoo Wharf as part of Ferry Wharf Upgrade Program 3 (FWUP3). FWUP3 aims to upgrade ferry wharves in Sydney Harbour as part of the Transport Access Program (TAP), which is 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 within the package.

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 Taronga Zoo 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 Taronga Zoo Wharf compliant with the requirements of the DDA
- The construction footprint is located within the curtilage of two heritage items listed on the Mosman Local Environmental Plan (LEP) 2012:
 - Taronga Zoo Wharf (remains and seawall) [LEP no. A438]
 - Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482]
- The construction footprint is located adjacent to the curtilages of one heritage item listed on the Mosman LEP 2012:
 - Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34)
- The visual buffer zone for the construction site also includes:
 - The visual buffer zone of one heritage item listed on the World Heritage List (WHL):
 - Sydney Opera House (buffer zone) [WHL 166rev]
 - One heritage item listed on the State Heritage Register (SHR):
 - Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials (SHR no. 01838)
 - Ten items listed on the Mosman LEP 2012, North Sydney LEP 2013 and Sydney LEP 2012
- A preliminary archaeological assessment has determined that the construction footprint has nil to low potential to contain non-significant archaeological remains associated with Phase 1 (1788-

1912 Informal use, land grants and military reserve), and moderate to high potential to contain locally significant archaeological remains associated with Phase 2 (1912-1959 Establishment of Taronga Zoo), including evidence of the former tram line and terminus, tracks and timber slats associated with the tram line construction, and evidence of the former Taronga Zoo Wharf, including timber piles, timber planks and ramp structure. However, based on the preliminary archaeological assessment the areas of significant archaeological potential are located outside of the proposal footprint, and earthworks associated with the proposal (limited to the footpath regrading) are unlikely to cause 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 impact on the identified heritage items resulting from the proposed works are summarised in the table below.

| Heritage Item | Direct | Potential direct | Indirect (visual) | Archaeological |
|--|---------|------------------|-------------------|----------------|
| Taronga Zoo Wharf (remains and seawall) | Neutral | Negligible | Negligible | Neutral |
| Athol Wharf Tram Terminus (including escarpment and retaining wall) | Neutral | Negligible | Negligible | Neutral |
| Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock | Neutral | Negligible | Negligible | Neutral |
| Sydney Opera House (buffer zone) | Neutral | Neutral | Neutral | Neutral |
| Ashton Park | Neutral | Neutral | Neutral | Neutral |
| Athol Gardens Dance Hall and Wharf Remains | Neutral | Neutral | Neutral | Neutral |
| Group of 4 houses | Neutral | Neutral | Neutral | Neutral |
| "The Castle", flats | Neutral | Neutral | Neutral | Neutral |
| Divided Road | Neutral | Neutral | Neutral | Neutral |
| Cremorne Point Conservation Area | Neutral | Neutral | Neutral | Neutral |
| Cremorne Reserve (including Robertsons Point) | Neutral | Neutral | Neutral | Neutral |
| Site of Cremorne Smelter | Neutral | Neutral | Neutral | Neutral |
| Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials | 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 items. 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 records
- In accordance with the sustainability requirements for the project, opportunities for the implementation of heritage interpretation should be investigated during detailed design. It is recommended that a Heritage Interpretation Strategy (HIS) be prepared for the proposal. The HIS would discuss the various media for heritage interpretation appropriate to the location and heritage significance of the Taronga Zoo Wharf
- The preliminary archaeological assessment has identified that there is moderate to high potential for archaeological remains of local significance to be present within the construction footprint. However, as the areas of significant archaeology associated with Phase 2 (evidence of the former Taronga Zoo Wharf and Athol Wharf Road Tram Terminus) are located outside of the proposal footprint, significant archaeology would not be impacted. Furthermore, the preliminary archaeological assessment has found that the potential archaeological remains in the construction footprint would likely be limited to 'works'. As a result, an exception under Section 139 (4) of the *Heritage Act 1977* (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 archaeological 'works' such as evidence of the former tramline and terminus are unexpectedly encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts
- If unexpected 'relics' are encountered during excavation, a s146 relics notification would be forwarded to Heritage NSW, Department of Premier and Cabinet (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 design changes result in additional earthworks and impacts to archaeological remains within the Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] or Taronga Zoo Wharf (remains and seawall) [LEP no. A438] heritage items, further archaeological assessment and management would be required. If underwater excavations are proposed in the curtilage of Taronga Zoo Wharf (remains and seawall) [LEP no. A438], then a maritime archaeological assessment should be undertaken to assess the potential for impacts to maritime archaeological remains of the former wharf

- 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
- It is unlikely that the vibrations associated with the proposed works would result in direct impacts to the sandstone retaining wall within the Taronga Zoo Wharf (remains and seawall) [LEP no. A438] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items or the buildings in Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34). However, a structural engineer should assess this to confirm if there are potential risks of vibration impacts. During 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 sandstone retaining wall in the Taronga Zoo Wharf (remains and seawall) [LEP no. A438] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items, and the buildings in Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34). 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 the Taronga Zoo Wharf (remains and seawall) [LEP no. A438] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items or the buildings in Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34), 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 road and footpath surfaces must be reinstated as near as possible to their original state following the completion of works
- Any project 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) is the delivery agency for the upgrade of the Sydney ferry wharves within the TAP program (known as Ferry Wharf Upgrade Program 3 [FWUP3]).

The objectives of FWUP3 are:

- Achieve one hundred per cent compliance with the *Disability Standards for Accessible Public Transport 2002* (DSAPT)¹ for all 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 equable access to ferry services and as such do not meet the DSAPT or DDA requirements. The upgrade works associated with FWUP3 would include activities such as the installation of a combination of new jetty's/gangways, and footpath regrading and modifications to provide greater access. As part of FWUP3, Cardno, on behalf of Transport for NSW, is preparing a REF for each wharf upgrade within the package.

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 works at Taronga Zoo 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 The DSAPT is an instrument of the *Disability Discrimination Act 1992 (the Act)* (Commonwealth).

1.2 Project location

For the purposes of this assessment, the construction footprint of the Taronga Zoo 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 (Figure 1).

The construction footprint includes the Taronga Zoo Wharf, at Athol Wharf Road, within the suburb of Mosman. A portion of Athol Wharf Road is also within the construction footprint. The construction footprint is located on the south side of Bradley's Head, although it is not located with any lot boundaries. The construction footprint is overlooked by Taronga Zoo, Mosman. 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 Bradley's Head, Sirius Cove, and part of Sydney Harbour has been assessed for visual impacts associated with the proposed works at Taronga Zoo 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 subject site is illustrated in Figure 1 and Figure 2, and the visual buffer zone assessed in this SoHI is illustrated in Figure 3 and Figure 4.

1.3 The proposal

The proposal is to upgrade the Taronga Zoo Wharf as part of the TAP.

- The water-based features of the proposal would include:
- Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5m
- Removal of existing gangways
- Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- Two new transition ramps on the existing pontoon to cater for the new gangways
- Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- Construction of a new covered DSAPT compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- Removal and relocation of the Transdev office and café on the existing jetty
- Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- Relocation of existing Opal Card readers and Opal top-up machine

- Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land-based features of the proposal would include:

- Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- Retention of the five existing bicycle parking hoops
- Retention of the public telephone booth
- Removal of foreshore vegetation to construct the new accessible ramp.

The construction footprint and key features of the proposal are illustrated in Figure 49.



 **Construction footprint** Scale: 1:1600
20035 Seven Wharves Upgrades - Taronga Zoo Size: A4
LGA: Mosman Date: 16-12-2020

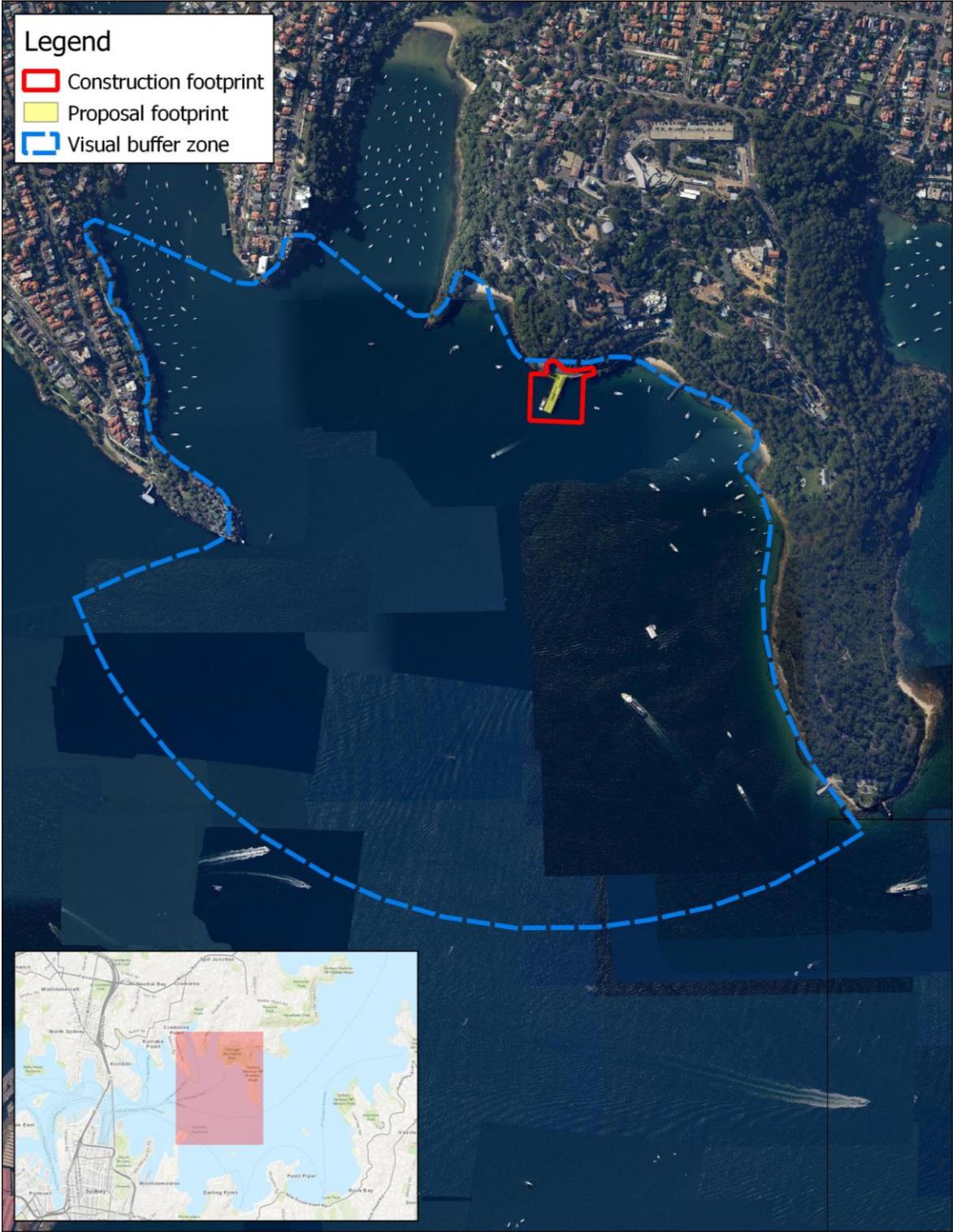
0 30 60 m



Figure 1: Location of the construction and proposal footprints



Figure 2: Proposal footprint and construction footprint (provided by Cardno)



 **Construction footprint and visual buffer zone**
20035 Seven Wharves Upgrades - Taronga Zoo
LGA: Mosman

Scale: 1:11500
Size: A4
Date: 16-12-2020

0 200 400 m



Figure 3: Location of the construction footprint and the wider visual buffer zone

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*.² 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*.³ 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 as a relic 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.⁴

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.

² Heritage Office and Department of Urban Affairs and Planning, "Statements of Heritage Impact," 2002, <https://www.heritage.nsw.gov.au/assets/Uploads/a-z-publications/s-u/Statements-of-Heritage-Impact.pdf>.

³ NSW Heritage Council, "Archaeological Assessment Guidelines," in *NSW Heritage Manual* (New South Wales: Heritage Office, 1996).

⁴ This section is an extract based on the Heritage Office Assessing Significance for Historical Archaeological Sites and Relics 2009:6.

Table 1: NSW heritage significance assessment criteria

| Criterion | Explanation |
|-------------------------------------|--|
| A – Historical Significance | 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 – Associative Significance | 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) |
| C – Aesthetic Significance | 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) |
| D – Social Significance | 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 |
| E – Research Potential | 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) |
| F – Rarity | 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) |
| G – Representative | 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 2.⁵ 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.

⁵ 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 |
|-------------------|---|
| Major | <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> |
| Moderate | <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> |
| Minor | <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> |
| Negligible | <p>Actions that would results in very minor changes to heritage items</p> |
| Neutral | <p>Actions that would have no heritage impact</p> |

1.4.3 Assessment of visual impacts 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.⁶ 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 5 and Figure 6, 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:⁷

- 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.

⁶ Cardno, 'Landscape Character and Visual Impact Assessment: Taronga Zoo Wharf Upgrade'. Report to Transport for NSW, 2020.

⁷ Cardno, 'Landscape Character and Visual Impact Assessment: Taronga Zoo Wharf Upgrade'. 20.



Figure 4: Visibility analysis prepared by Cardno (provided by Cardno 2020)⁸

⁸ Cardno, 'Landscape Character and Visual Impact Assessment: Taronga Zoo Wharf Upgrade'.

In order to assess potential direct impacts, the guidelines provided in the 2016 Roads and Maritime *Construction Noise and Vibration Guideline* are followed.⁹ 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 plant¹⁰

| 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.

⁹ Roads and Maritime, 'Construction Noise and Vibration Guideline'. Roads and Maritime, 2016. 71.

¹⁰ 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*¹¹ and the Heritage Branch (now Heritage NSW, DPC) issued the 2009 *Assessing Significance for Historical Archaeological Sites and 'Relics'*.¹² 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 |
|-----------------|--|
| Nil | No evidence of historical development or use, or where previous impacts such as deep basement structures would have removed all archaeological potential |
| Low | 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 |
| Moderate | Analysis demonstrates known historical development and some previous impacts, but it is likely that archaeological remains survive with some localised truncation and disturbance |
| High | Evidence of multiple phases of historical development and structures with minimal or localised 20th century development impacts, and it is likely the archaeological resource would be largely intact. |

¹¹ NSW Heritage Council, "Archaeological Assessment Guidelines".

¹² NSW Heritage Branch, *Assessing Significance for Historical Archaeological Sites and 'Relics'*.

1.4.5 Archaeological significance

The *NSW Heritage Manual* provides the framework for the significance assessment of the construction footprint. These guidelines incorporate the aspects of cultural heritage value identified in the *Burra Charter* (Australia ICOMOS 2013). The Heritage Council also issued the 1996 *Archaeological Assessment Guidelines* and the Heritage Branch (now Heritage, DPC) issued the 2009 *Assessing Significance for Historical Archaeological Sites and 'Relics'*.¹³ The assessment of historical archaeological sites requires a specialised framework in order to consider the range of values of an archaeological site.

Heritage significance is assessed in accordance with the criteria outlined in the significance assessment guidelines provided by Heritage NSW, DPC. 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 (Table 1). The heritage assessment guidelines also include two thresholds (State or local) for assessing the relative level of significance of heritage items.

Table 5. NSW heritage significance assessment criteria

| Criterion | Explanation |
|-------------------------------------|--|
| A – Historical Significance | 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 – Associative Significance | 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) |
| C – Aesthetic Significance | 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) |
| D – Social Significance | 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 |
| E – Research Potential | 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) |
| F – Rarity | 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) |
| G – Representative | 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) |

1.4.6 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 6 could potentially have views to the new development, it is expected that these items are located at a sufficient distance

¹³ NSW Heritage Council 1996. *Archaeological Assessment Guidelines*; NSW Heritage Branch (now Heritage, DPC) and Department of Planning (now Department of Planning, Industry and Environment), 2009. *Assessing Significance for Historical Archaeological Sites and Relics*. *Heritage publications*. Accessed online 4/5/2020 at: <https://www.environment.nsw.gov.au/Heritage/publications/index.htm>.

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), Jessica Horton (Heritage Consultant) and Jayden van Beek (Senior Heritage Consultant) with management input and review by Josh Symons (Principal) 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 in the vicinity of the project footprint were identified through a search of the relevant state and federal statutory and non-statutory heritage registers 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.

The construction footprint is located about 600m from the edge of the visual buffer zone of the Sydney Opera House (WHL 166rev) [Figure 6]. The visual buffer zone assessed in this SoHI overlaps the visual buffer zone of the Sydney Opera House (WHL 166rev).

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 manage 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:

...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.

A relic has been further defined as:

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).¹⁴

Excavation permits are issued by the Heritage Council of NSW, or its delegate, under Section 140 of the Heritage Act for relics outside SHR curtilage 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

¹⁴ Heritage Branch, 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 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*¹⁵ or in accordance with agency specific exemptions. 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 immediate vicinity of the construction footprint listed on the SHR.

There is one heritage item listed on the SHR within the visual buffer zone:

- Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials (SHR no. 01838).

2.4.4 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.

¹⁵ Heritage Council of New South Wales, 2009. *Standard Exemptions for Works Requiring Heritage Council Approval*.

2.4.5 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 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 Heritage Council. These principles serve to protect and conserve the heritage significance of items and are based on NSW heritage legislation and guidelines.

There are no items within or in the immediate vicinity of the construction footprint listed on s170 heritage and conservation registers. There are no s170 items in the visual buffer zone.

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 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 Council 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:

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

There are three heritage items listed on the Mosman LEP 2012 that are located within or in the immediate vicinity of the construction footprint:

- Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482]
- Taronga Zoo Wharf (remains and seawall) [LEP no. A483]
- Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34).

There are six heritage items listed on the Mosman LEP 2012 within the visual buffer zone, three heritage items and heritage conservation areas listed on the North Sydney LEP 2013 and one heritage item listed on the City of Sydney LEP 2012 (Table 6).

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:

*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.*¹⁶

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.

2.6.1 State Environmental Planning Policy No. 56 – Sydney Harbour Foreshores and Tributaries

The construction footprint falls within the boundary of *State Environmental Planning Policy (SEPP) No. 56 – Sydney Harbour Foreshores and Tributaries* on which the Taronga Zoological Gardens are listed as Schedule 1 No. 13. The aim of the policy is to co-ordinate the planning and development of land comprising the foreshores of Sydney Harbour and its tributaries.

2.6.2 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

There is one heritage item within the visual buffer zone listed on the *Sydney Regional Environmental Plan (SREP) [Sydney Harbour Catchment] 2005* Schedule 4 Part 2. The plan outlines development in relation to heritage under Part 2 and Part 5; and identifies heritage items under Schedule 4.

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 of 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 five heritage items listed on non-statutory registers within the visual buffer zone.

¹⁶ ISEPP Clause 14. Accessed 19 October 2020. http://www7.austlii.edu.au/cgi-bin/viewdoc/au/legis/nsw/consol_reg/sepp2007541/s14.html.

2.8 Heritage registers search

A search of all relevant registers was undertaken on 14 October 2020. The results are displayed below in Table 6. A map of the curtilages of the relevant heritage items is provided in Figure 5 and Figure 6.

Table 6: Heritage listed items within and nearby the construction footprint

| Item | Address | Significance | Listing | Distance from construction footprint |
|--|--|--------------|---|--------------------------------------|
| Athol Wharf Tram Terminus (including escarpment and retaining wall) | Athol Wharf Road, Mosman | Local | Mosman LEP 2012 no. A482 | Within |
| Taronga Zoo Wharf (remains and seawall) | Athol Wharf Road, Mosman | Local | Mosman LEP 2012 no. A483 | Within |
| Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock | Mosman | Local | Mosman LEP 2012 no. I34 SEPP No. 56 – Schedule 1 No. 13 | Adjacent |
| Sydney Opera House (buffer zone) | 2 Circular Quay East, Sydney (buffer zone extends to Argyle Street and Fitzroy Street) | World | WHL 166rev NHL ID 105738 SHR no. 01685 City of Sydney LEP 2012 no. I1712 RNE ID 2353 RNTA 6088 | Visual buffer zone (600m south-west) |
| Ashton Park | Sydney Harbour National Park Bradleys Head Road | Local | Mosman LEP 2012 no. I458 RNE ID 2874 | Visual buffer zone (280m south-east) |
| Athol Gardens Dance Hall and Wharf Remains | Sydney Harbour National Park Bradleys Head Road | Local | Mosman LEP 2012 no. I459 | Visual buffer zone (410m south-east) |
| Group of 4 houses | 5–11 Raglan Street, Mosman | Local | Mosman LEP 2012 no. I230 RNE ID 103679 | Visual buffer zone (500m north-west) |
| “The Castle”, flats | 3 Raglan Street, Mosman | Local | Mosman LEP 2012 no. I229 | Visual buffer zone (520m north-west) |
| Divided road | Raglan Street, Mosman | Local | Mosman LEP 2012 no. I435 | Visual buffer zone (540m north-west) |
| Cremorne Point Conservation Area | Cremorne Point | Local | North Sydney LEP 2013 no. CA06 RNE ID 100862, 100861 | Visual buffer zone (600m west) |
| Cremorne Reserve (including Robertsons Point) | Cremorne Point | Local | North Sydney LEP 2013 no. I0136 | Visual buffer zone (600m west) |

| Item | Address | Significance | Listing | Distance from construction footprint |
|---|--|--------------|---|--------------------------------------|
| Site of Cremorne Smelter | Cremorne Reserve, east of 5 Green Street, Cremorne Point | Local | North Sydney LEP 2013 no. I0102 | Visual buffer zone (740m west) |
| Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials | Sydney Harbour National Park Bradleys Head Road | State | SHR no. 01838 Mosman LEP 2012 no. I460 SREP Part 2 item no. 25 RNE ID 2875, 2869, 2877, 2875 RNTA | Visual buffer zone (900m south-east) |



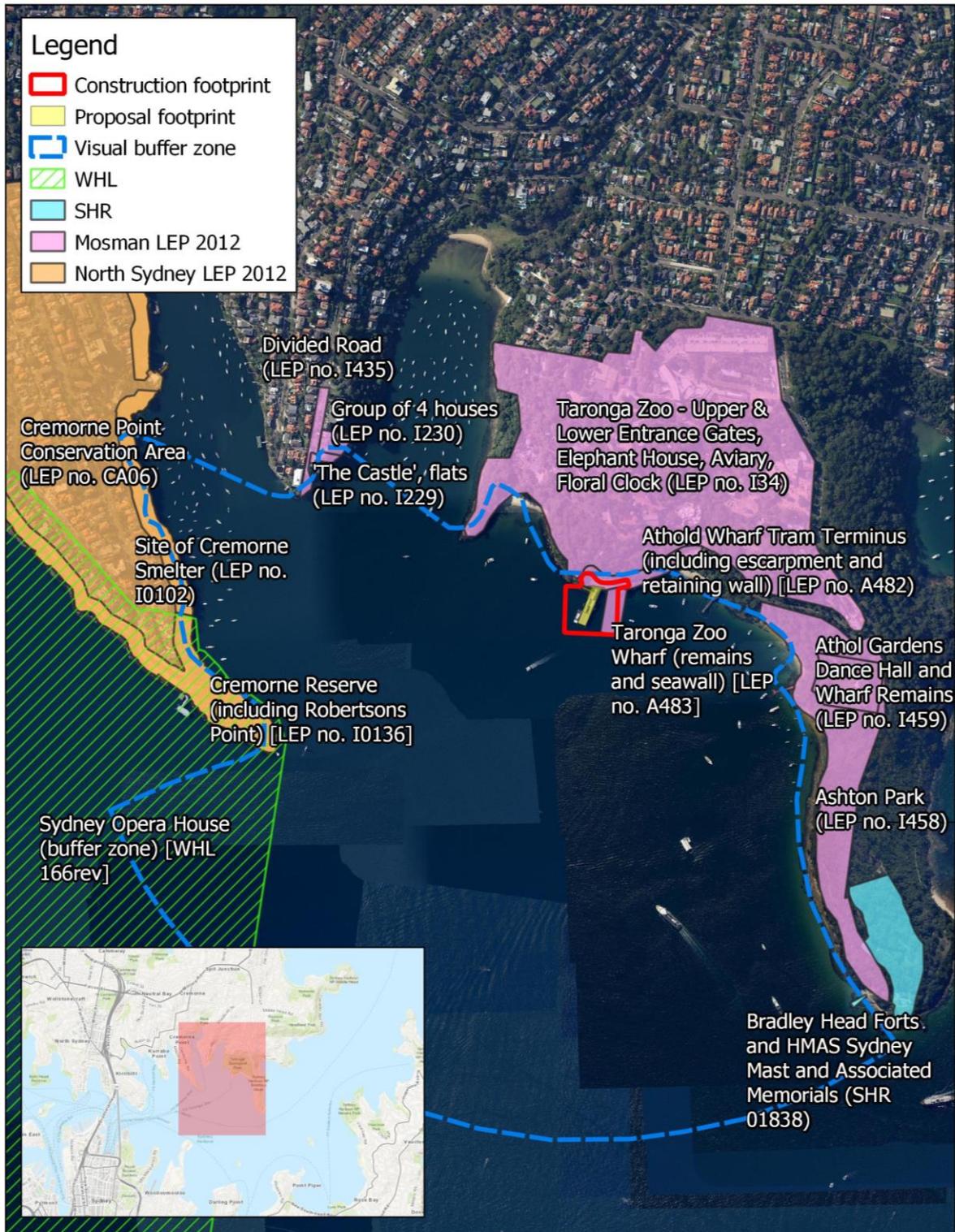
Source: C:\Users\JHorton\Box\Projects\2020\02 Active Projects\20035 Seven Wharves Upgrades\3. Mapping\3.1 GIS\Taronga\QGIS\Taronga.qgz

Heritage items near construction footprint
 20035 Seven Wharves Upgrades - Taronga Zoo
 LGA: Mosman

Scale: 1:1400
 Size: A4
 Date: 16-12-2020

0 200 400 m

Figure 5: Heritage listings within and in close proximity to the construction footprint



Heritage items in visual buffer zone
20035 Seven Wharves Upgrades - Taronga Zoo
 LGA: Mosman

Scale: 1:11500
 Size: A4
 Date: 16-12-2020

0 200 400 m

artefact

Figure 6: Heritage items within the visual buffer zone

3.0 HISTORICAL CONTEXT

3.1 Early non-Aboriginal settlement in Mosman

3.1.1 Early settlement in Mosman

As early as 28 January 1788, Lieutenant William Bradley, a naval officer, described what is now known as Bradley's Head within his journals. Located to the south-east of the construction footprint, Bradley's Point was originally known as Borogegy by the local Aboriginal people of the area, the Borogegal.¹⁷ Formal settlement in Mosman and North Sydney, to the west of the construction footprint, began to occur from the 1820s, however settlement did not extend to Bradley's Head and the surrounding area for several years. Some informal timber getting was undertaken near the construction footprint, and in the 1820s an orchard was established at Chowder Bay to the east.

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.¹⁸ 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*.¹⁹ 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.

In the 1830s a whaling station was established at Mosman Bay by Archibald Mosman, and subsequently, a series of whaling allotments were sold throughout North Sydney and Mosman, further increasing residential and industrial growth in the area. Additional land grants in the surrounding Mosman area were granted as a whaling allotment scheme, while other grants were purchased by relatively well to do colonists who constructed bush retreat villas.²⁰ 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, east of the construction footprint.

In 1831 Robert Millard and Richard Linley, two shipwrights, were granted four acres of land in Sandy Bay. This bay later became known as Athol Bay following the construction of a substantial stone house, named Athol, by Mary Anne Ferrier in 1837. In the 1840s a convict stockade and battery was constructed at Bradleys Head, which was then armed in 1846 as part of an inner harbour fortification system. By the 1850s, the construction footprint and surrounding Taronga Zoo site was part of four land grants owned by Charles Jenkins and J. Holt. During the 1850s Athol was leased to various tenants by Ferrier and was converted into a hotel and pleasure ground by 1863. Mosman and the surrounding areas became popular for day trips for picnics and camping throughout the mid-1800s, with the nearby Mosman waterfalls also a popular day trip location. A wharf was constructed at Athol Bay to transport the day-trippers.

The battery and stockade at Bradleys Head were dedicated as a military reserve following its closure in 1861, and in the 1870s a government road was built to the point, where a larger battery was

¹⁷ Carment, D., 2011. 'Bradleys Head.' *Dictionary of Sydney*. Accessed online 14 October 2020, https://dictionaryofsydney.org/entry/bradleys_head.

¹⁸ Stephen, M.D., 1967. 'Mosman, Archibald (1799-1863)'. *Australian Dictionary of Biography*. Accessed online 14 October 2020, <http://adb.anu.edu.au/biography/mosman-archibald-2485>.

¹⁹ Stephen, M.D., 1967. 'Mosman, Archibald (1799-1863)'. *Australian Dictionary of Biography*.

²⁰ Mosman Council, n.d. 'A Brief History of Mosman.' *Mosman Council*. Accessed online 14 October 2020, <https://mosman.nsw.gov.au/mosman/history/a-brief-history-of-mosman>.

constructed. The existing land grants on the peninsula, including in the location of Taronga Zoo, were resumed and came under military ownership.

In 1879 two sites were reserved for quarantining of imports at Bradleys Head, one located at Athol Wharf, and the other at Whiting Beach. The Athol site featured a tramway and several buildings. Each site was incorporated into Taronga Zoo in the early 1900s. Following Federation in 1901, the military land was absorbed by the Commonwealth, although by 1908 the NSW State Government had reclaimed ownership of Bradleys Head. The area was then gazetted as Ashton Park.

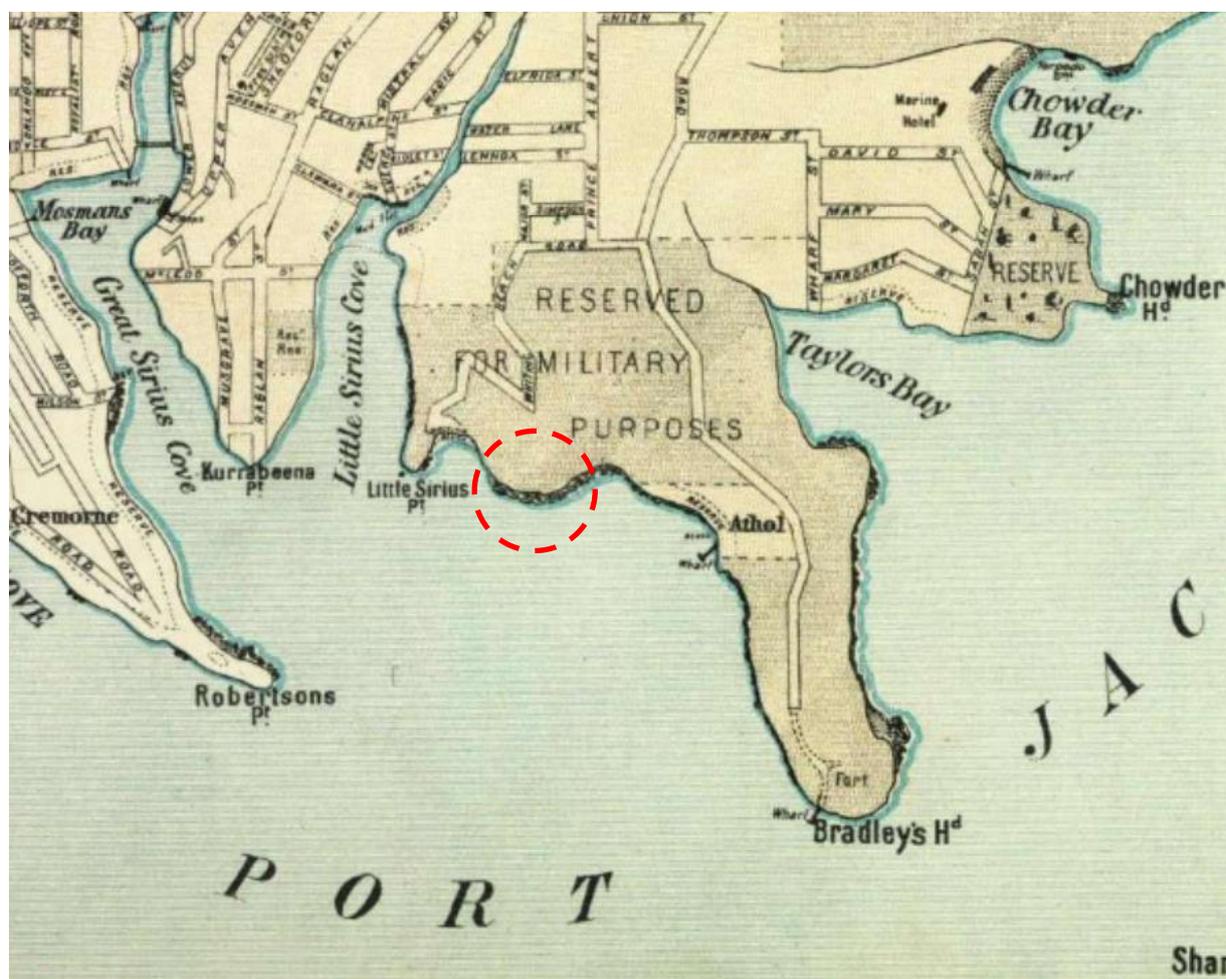


Figure 7: Parish of Willoughby map showing Bradleys Head Military Land and Athol gardens, n.d. (construction footprint indicated in red)²¹

3.1.2 Sydney's early zoological history

From c.1850 collections of 'exotic' animals were shown in Sydney. The first were owned by the Australian Museum and displayed in Hyde Park, including a tiger.²² Shortly after, Australian Museum executives proposed the establishment of a public zoological park in Sydney, which was supported by Henry Parkes and other notable Sydney residents.²³ A menagerie developed in the Botanic Gardens, which already included a large aviary and deer. By 1880, approval had been granted to lease Billy

²¹ Land Registry Services, n.d. 'Parish of Willoughby'. *Historical Land Records Viewer*. Accessed online 15 October 2020, <https://hlrv.nswlrs.com.au/>.

²² Lennon, T., 2015. 'Colonial Sydney went wild for first zoos at Hyde Park and Botany.' *The Daily Telegraph*. Accessed online 14 October 2020, <https://www.dailytelegraph.com.au/news/today-in-history/colonial-sydney-went-wild-for-first-zoos-at-hyde-park-and-botany/news-story/8998900af0f15cd6bb67f75723442987>.

²³ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 18.

Goat Swamp in Moore Park.²⁴ The zoo covered 15 acres, and included bird aviaries, a zookeeper house, and over 60 species of mammals, including an orangutan, two polar bears, lions, tigers, pumas, hyenas, jackals and dingos; in addition to two Indian Elephants named Jumbo and Jessie who offered patrons rides around the zoo. . In 1907 it was determined that a new site would be required, as expansion at Moore Park was rejected.²⁵ In 1909 the Royal NSW Zoological Society inspected several sites, including Ashton Park. In the following year, the Society applied for purchase of Ashton Park with the NSW Government. In 1912 this was approved, and Ashton Park was gazetted for rezoning for a zoological park.²⁶



Figure 8: Moore Park Zoo, c.1885²⁷

²⁴ Taronga Zoo, n.d. 'Taronga Zoo Sydney 1916 to now.' *Taronga Conservation Society Australia*. Accessed online 14 October 2020, <https://taronga.org.au/about/history-and-culture/sydney#:~:text=Taronga%20Zoo%20Sydney%20was%20officially,the%20Tiger%20Pits%20in%201939>.

²⁵ Horvath, C., 2018. 'Moore Park Zoo's colourful history.' *Centennial Parklands*. Accessed online 14 October 2020, <https://www.centennialparklands.com.au/stories/2018/moore-park-zoo%E2%80%99s-colourful-history>.

²⁶ Taronga Zoo

²⁷ Author unknown, c1885. 'Moore Park Zoo'. *Centennial Parklands*. Accessed online 15 October 2020, <https://www.centennialparklands.com.au/stories/2018/moore-park-zoo%E2%80%99s-colourful-history>.



Figure 9: Joyce Denis & Florence with an Indian Elephant at Moore Park Zoo, 1900²⁸

3.1.3 Establishment of Taronga Zoo

From May 1912 workers began clearing Ashton Park for the construction of the zoo. By October the site was cleared and the name of Taronga Zoological Park was chosen. Several ornamental plantings were made. The steep topography of the zoo required division into three levels, the top of which would comprise recreational grounds and the entrance, while the lower two levels would be for zoological exhibits.²⁹ A ring road was established for vehicles around the outside of the park, with internal access primarily footpaths.³⁰

In October of 1916 the zoo was officially opened, with 177 animals and over 320 birds transferred from Moore Park.³¹ Jessie the elephant, one of the oldest and largest of the zoo's inhabitants, was walked along Anzac Parade to Circular Quay and transported across to Mosman on the ferry.³² Over the next two decades, several enclosures were added, with baboons, chimpanzees, giraffes, polar bears, hippopotamuses and several big cats within the park by 1925.³³ Additional elephant enclosures

²⁸ Arthur Allen, 1900. 'Joyce Denise & Florence had a ride on the elephant, who was afterwards rewarded with biscuits'. *Museum of Sydney*. Accessed online 15 October 2020, <https://sydneylivingmuseums.com.au/stories/edwardian-summer-sydney-through-lens-arthur-wigram-allen>.

²⁹ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 21.

³⁰ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 22-3.

³¹ Taronga Conservation Society, n.d. 'Taronga Zoo Sydney.' *Taronga Conservation Society*.

³² Caroline Mackaness, 2010. 'An Edwardian Summer: Sydney and Beyond through the Lens of Arthur Wigram Allen'. *Sydney Living Museums*. Accessed online October 15 2020, <https://sydneylivingmuseums.com.au/stories/edwardian-summer-sydney-through-lens-arthur-wigram-allen>.

³³ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 28.

and an aquarium were subsequently constructed.³⁴ A miniature train and merry ground were established, and additional administrative buildings were created.

Original transportation to the zoo was by tram, however in the 1950s these were phased out of Sydney's public transport system. The trams were replaced by buses, which required the construction of a turning circle at the base of Athol Wharf Road, where the lower entrance to the park was located.

From the 1970s Taronga Zoo upgraded several exhibits and opened their first environmental exhibit in 1976, reflecting changes attitudes towards animal conservation.³⁵ This was the African Swamp exhibit, which featured a natural waterhole setting in an attempt to create a more natural 'wild' experience for the animals and visitors. In 1978 the Veterinary Centre opened with an operating theatre, laboratory and pathology centre.³⁶ The environmental exhibit treatment was extended to the giraffe and chimpanzee enclosures in 1980.

In 1987 the Taronga Aerial Cabin Ride opened, in which a cable car system was constructed from the lower level of the zoo adjacent to the wharf, which travelled to the top level and main entrance.³⁷ In 1989 the Taronga Zoo Conservation and Research Centre opened and was one of the first zoological conservation facilities in the world. Throughout the 1990s and 2000s several enclosures continued to be refurbished to reflect changing developments in animal conservation and welfare. The zoo continued to revamp its public programs and add new exhibits, including reptile exhibits, bird shows, a conservation theatre, and the Nightzoo program.³⁸



Figure 10: Elephant rides at Taronga Zoo, 1925³⁹

³⁴ Taronga Conservation Society, n.d. 'Taronga Zoo Sydney.'

³⁵ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 36.

³⁶ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 36.

³⁷ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 39.

³⁸ GML Heritage, 2002. *Taronga Zoo – Conservation Strategy*, 43-4.

³⁹ Author unknown, 1925. 'Group of dreadnought boys sitting on an elephant at Taronga Zoo'. *National Library of Australia*. Accessed online 15 October 2020, <https://nla.gov.au/nla.obj-162082651/view>



Figure 11: Upper level of Taronga Zoo, c.1920s-50s⁴⁰



Figure 12: Floral clock and view over Sydney Harbour, c.1930s-1950s⁴¹

⁴⁰ Frank Hurley, between 1910-1962. 'Seal Pool, Taronga Zoo'. *National Library of Australia*. Accessed online 15 October 2020, <https://nla.gov.au/nla.obj-160111449/view>

⁴¹ Frank Hurley, between 1910-1962. 'Floral Clock, Taronga Zoo'. *National Library of Australia*. Accessed online 15 October 2020, <https://nla.gov.au/nla.obj-160111046/view>.



Figure 13: 'The Neck-romancer', Taronga Zoo, 1932⁴²

⁴² Harold Cazneaux, 1932. 'The neckromancer, Taronga Zoo'. *National Library of Australia*. Accessed online 15 October 2020, <https://nla.gov.au/nla.obj-140229156/view>

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 European history. Prior to European colonisation, the Eora people of various groups around Sydney Harbour and the Parramatta River utilised the harbour for transportation and food supply, as discussed in Section 3.1. From the arrival of the First Fleet at Port Jackson/Sydney Cove (now Circular Quay) in 1788, European 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).⁴³ 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, about 80% of Sydney's population lived within walking distance of the harbour.⁴⁴

In 1861 the North Shore Ferry Company was established and operated the first commuter-style ferry across the harbour.⁴⁵ 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 1901.⁴⁶ Early ferries on the harbour were purpose built steam paddlers, many of which were constructed at Morts Dock in Balmain in the early 1900s.⁴⁷

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.⁴⁸

Following the construction of the Sydney Harbour Bridge, which opened in 1932, ferry patronage dropped significantly. The bridge and the train network allowed faster travel and prevented the need for multiple modes of transport. Ferry services were overall halved.⁴⁹ Vehicular ferries had also been common throughout the early twentieth century, however these services were entirely eradicated following the opening of the harbour Bridge.⁵⁰ In the late 1800s and early 1900s 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.⁵¹

Following financial hardship among private ferry operators in the mid-1900s, many of the ferry services were acquired by the State Government in 1951. The Manly ferry services were purchased

⁴³ Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*. Accessed online 14 October 2020, <https://dictionaryofsydney.org/entry/ferries>.

⁴⁴ Karskens, G., 2014. 'Harbour life: tracing early Sydney's watery history.' *The Conversation*. Accessed online 14 October 2020, <http://theconversation.com/harbour-life-tracing-early-sydneys-watery-history-21892>.

⁴⁵ Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

⁴⁶ Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

⁴⁷ Australian National Maritime Museum, 2018. 'The Manly Ferry.' Accessed online 14 October 2020, <http://arhv.anmm.gov.au/en/collections/details/34289/the-manly-ferry>.

⁴⁸ Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

⁴⁹ Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

⁵⁰ Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*.

⁵¹ Australian National Maritime Museum, 2018. 'The Manly Ferry.'

by the government in 1974, although today the privately owned Manly Fast Ferry provides transport between the inner harbour and Manly.⁵² 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.

3.2.2 Taronga Zoo Wharf

In 1864 a wharf was established below Athol House at Bradleys Head, where a steep path provided access to the house and neighbouring inn. The wharf was constructed to serve the ‘pleasure grounds’ of the Athol Garden Hotel, which had one of the most popular picnic grounds on Sydney Harbour, especially on public holidays. Extra ferries were frequently required to transport the many visitors. The wharf was purchased by Sydney Ferries Ltd. in 1906 and various upgrades were undertaken. New pathways were constructed throughout the Athol Gardens and a new pavilion was constructed in 1908, remaining extant as Athol Hall – the only extant feature of the Athol Gardens at their peak.

After the announcement that the Taronga Zoological Park would be opened at Ashton Park, the land was sold to the Taronga Park trustees. The Athol Gardens Wharf remained in use and extant, however, in 1916 a new wharf was constructed for the grand opening of Taronga Park on the southern foreshore of Ashton Park. Historical plans show the Athol Wharf located below Athol Hall on the eastern foreshore of Bradley’s Head, about 400m south-east of the new Taronga Zoo Wharf (which also shared the name of ‘Athol Wharf’ at times) (Figure 14). Subdivision plans of Mosman from 1903-1915 do not show the Taronga Zoo Wharf or any other structures in the area. Plans for the new wharf are marked on a plan from 1912, which indicates the proposed location of the wharf and roadway (Figure 15). The 1916 subdivision plans show the wharf jutting out from the southern foreshore beneath the zoological park in a T-formation, and with the tram line established along the southern boundary of the zoo. Athol Wharf Road had not been established at this point.

The first Taronga Zoo Wharf was located about 15m to the east of the existing wharf structure and was constructed between 1912 and 1916 for the opening of the Zoo. This structure was a flat timber square shaped wharf on several timber piles and piers. Figure 16 shows the T-shape of the wharf, with a narrow ramp/gangway descending from the foreshore and seawall to the larger timber pontoon. The pontoon was enclosed with a low fence of horizontal beams, likely constructed of timber rather than metal. The pontoon appears to have been supported beneath and made stationary by timber piling, rather than being a floating structure encircled by piling. Figure 20 shows that ferries would moor at the southern face of the jetty and that a gate could swing open to provide access onto the wharf. A timber awning structure was present over the ramp and Athol Wharf Road then led to the lower zoo entrance. Photographs show that the foreshore to the west of the wharf was largely retained, however to the east a formal stone sea wall was established.

Prior to the construction of the Sydney Harbour Bridge, and despite its opening in 1932, animals were transported to Taronga Zoo by water on several occasions. Elephants, panthers and other species were landed at the wharf on several occasions, including in 1935.⁵³ The wharf appears to have been suitable for various types of animals with the exception of giraffes, who on account of their height would not fit under the timber structures at Taronga and instead were taken to the Mosman Bay Wharf.⁵⁴ The Taronga Zoo Wharf also featured several small stores appealing to visitors, including a

⁵² Wotherspoon, G., 2008. ‘Ferries.’ *Dictionary of Sydney*.

⁵³ *The Daily Telegraph*, 1 Nov 1935. ‘New Taronga Residents.’ Accessed online 14 October 2020, <https://trove.nla.gov.au/newspaper/article/246575750>

⁵⁴ *The Daily Telegraph*, 1 Nov 1935. ‘New Taronga Residents.’

bookstall,⁵⁵ a confectionary shop,⁵⁶ and refreshment room.⁵⁷ By the mid-1930s the Taronga Zoo Wharf was being reported as the 'most robbed place in Australia' with a minimum number of forty robberies since its opening.⁵⁸ Despite the installation of security systems, the wharf appears to have been an easy target due to the lack of security at the wharf itself, the distance of the wharf from the watchtowers within the Zoo grounds, and the presence of hiding places and an easy getaway into the bushland nearby.⁵⁹

By the mid-1920s the wharf had been expanded.⁶⁰ A new timber waiting shed structure, which featured a parapet roof with a gabled section in the centre, was constructed at the northern end of the pontoon. To the south a new pontoon was added to the wharf structure, while the original gangway and pontoon were covered by timber waiting sheds. Figure 23 shows the small timber structure on the gangway, with the larger structure on the northern pontoon, and with the open-air pontoon at the south. Figure 24 also shows the descent down to the wharf from the main portion of the zoological park, following the tram line. By the 1940s it appears that the wharf was somewhat dilapidated, with state government funding provided to the Taronga Park Trustees for the 'removing and reconditioning' of the pontoon and to rent a 'substitute pontoon'.⁶¹ This record suggests that the southern pontoon was replaced in the mid-1940s while the original structures were retained.

In 1959 the former tramline which ran along Athol Wharf Road to the Taronga Zoo Wharf was decommissioned, to be replaced with a bus route and sealed road. In 1960 the extant bus turning circle was constructed in the location of the two-track system (Figure 26). The aerial imagery from the 1950s and 1960s indicates that to accommodate the width of the turning circle the construction included cutting back the stone escarpment along the north side of the road and reclaiming land on the south side (Figure 30 and Figure 31). However, the area of the former tram terminus at the far eastern end of the road appears to still have been present. By 1960, the southern pontoon had also been provided with a roof (Figure 31). Photographs from the 1980s show that this pontoon was partially enclosed with paned windows at the southern end, while the eastern and western sides were open (Figure 28).

The wharf remained in use until the mid-1980s (Figure 28), when it was demolished, and the existing Taronga Zoo Wharf was constructed to the west. This modern wharf is constructed on timber piles and does not appear to have been heavily modified since construction. Around the same time the gondola lift and building providing access from the wharf to the zoo was installed at the end of the road.

⁵⁵ *Smith's Weekly*, 7 Dec 1935. 'Taronga Zoo Wharf Most Robbed Place in Australia.' Accessed online 14 October 2020, <https://trove.nla.gov.au/newspaper/article/234613681>.

⁵⁶ *Evening News*, 1927. 'Window Smashed.' Accessed online 14 October 2020, <https://trove.nla.gov.au/newspaper/article/117696628>.

⁵⁷ *Evening News*, 1924. 'At Zoo Wharf.' Accessed online 14 October 2020, <https://trove.nla.gov.au/newspaper/article/119201707>.

⁵⁸ *Evening News*, 1924. 'At Zoo Wharf.'

⁵⁹ *Evening News*, 1924. 'At Zoo Wharf.'

⁶⁰ *The Labor Daily*, 1 Oct 1925. 'Bigger Wharf for the Zoo.' Accessed online 14 October 2020, <https://trove.nla.gov.au/newspaper/article/238114702>.

⁶¹ *The Sun*, 28 December 1943. 'Zoo Wharf Costs.' Accessed online 14 October 2020, <https://trove.nla.gov.au/newspaper/article/231608672>.

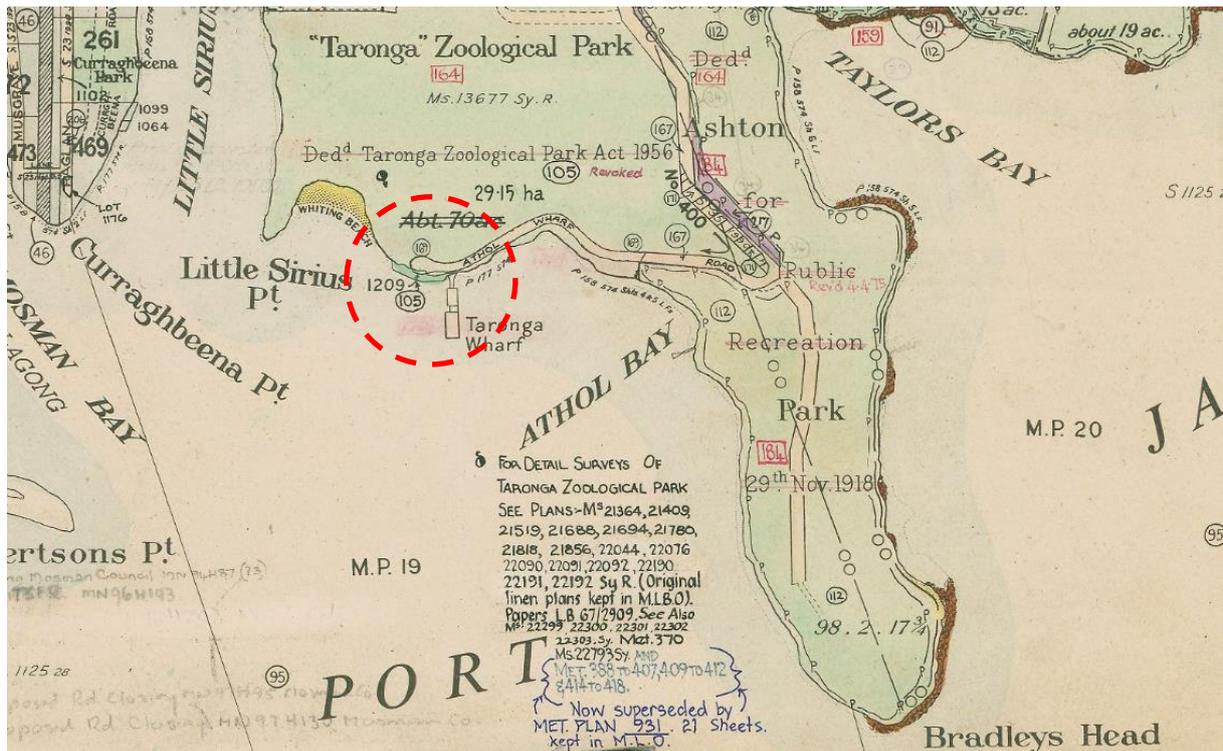


Figure 14: Athol Wharf and Taronga Wharf locations on map of Mosman (construction footprint indicated in red)⁶²

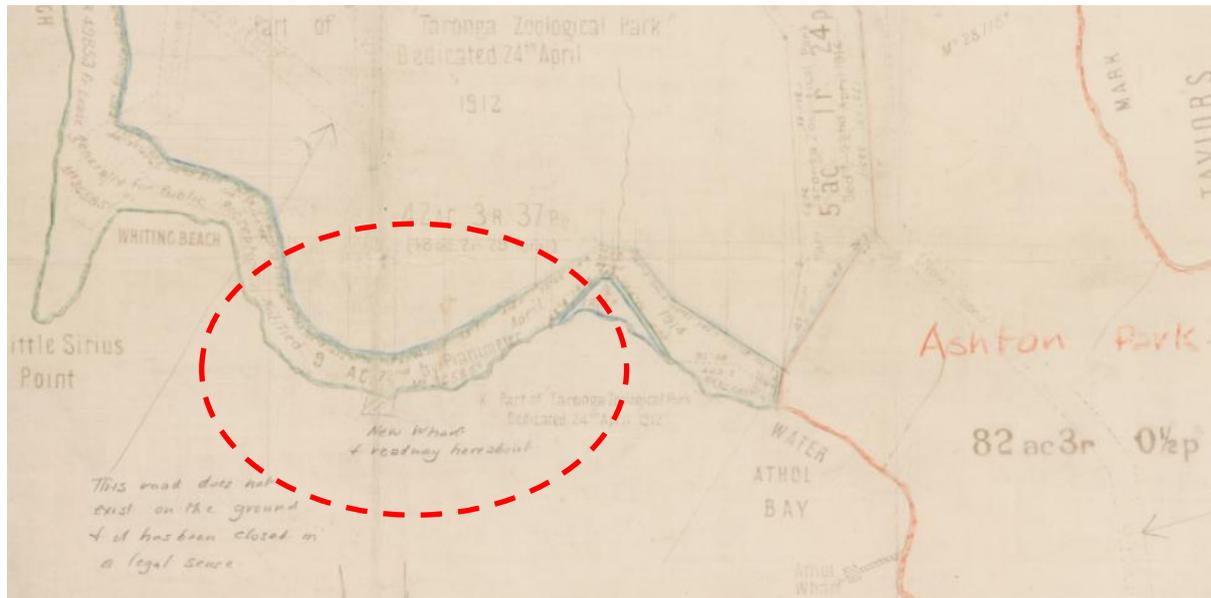


Figure 15: Proposed location of the Taronga Zoo Wharf and roadway, 1912 (construction footprint indicated in red)⁶³

⁶² Lands Registry Services, n.d. 'Parish of Willoughby'. Accessed online 15 October 2020, <https://hlrv.nswlrs.com.au/>.

⁶³ Metropolitan Land District Land Board – District of Sydney, 1912. '306 – Z/SP/M26/318 – Plan of Ashton Park – Whiting Beach Rd, Major St, Prince Albert St, Bradleys Head Rd, St Elmo St, Buena Vista Ave, Wharf St [1912].' State Library of New South Wales. Call No. Z/SP/M26 IE9044080 FL9044080. Accessed online 14 October 2020, http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?dps_pid=IE9044080&change_lng=.



Figure 16: Taronga Zoo Wharf on district plan, 1916 (construction footprint indicated in red).⁶⁴

⁶⁴ State Archives & Records NSW, 1916. 'Locality Plan of Taronga Zoological Park'. Accessed online 15 October 2020, <https://www.records.nsw.gov.au/archives/collections-and-research/guides-and-indexes/stories/taronga-zoo-centenary#>

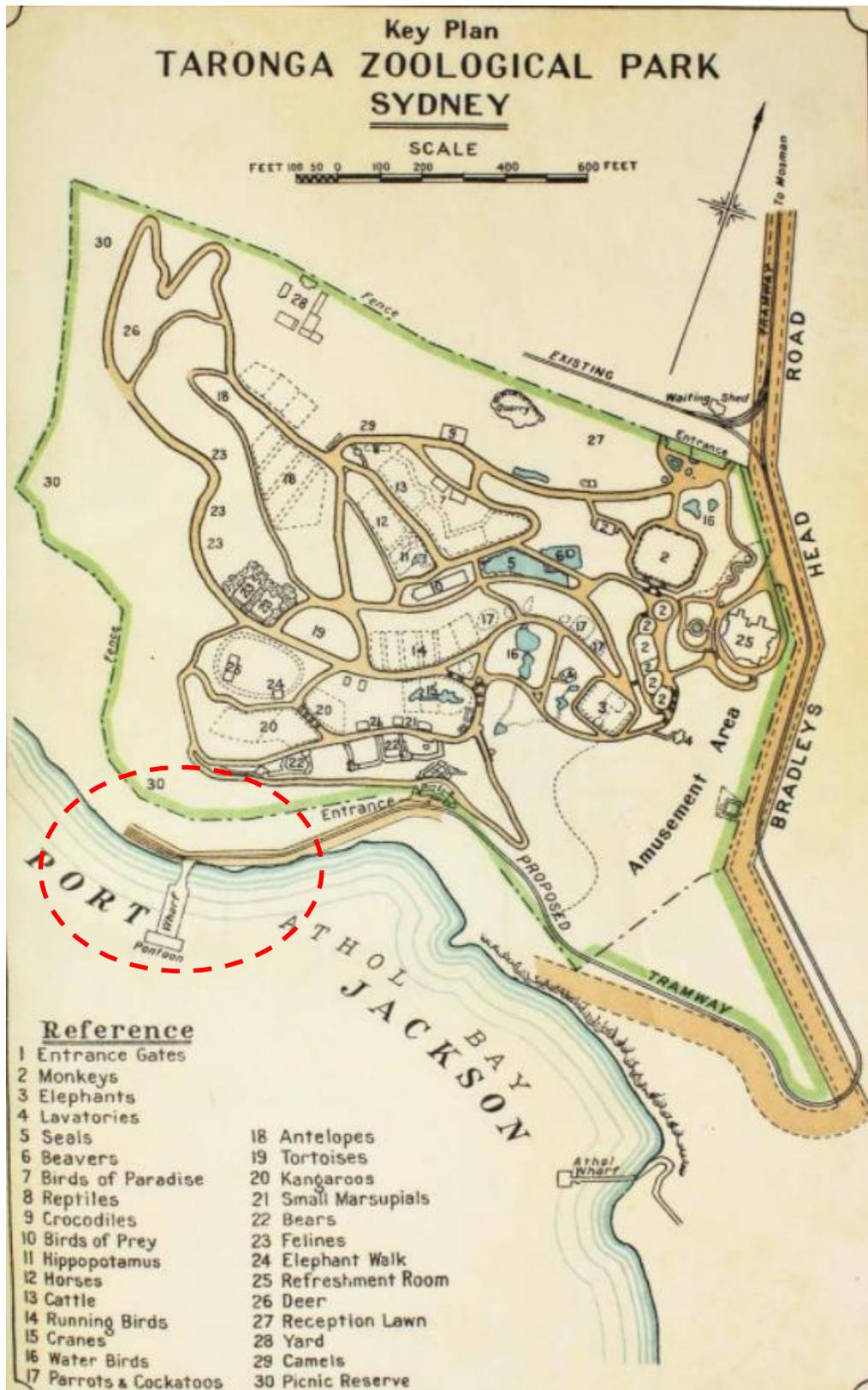


Figure 17: Taronga Zoo Wharf on district plan, 1916 (construction footprint indicated in red).⁶⁵

⁶⁵ State Archives & Records NSW, 1916. 'Locality Plan of Taronga Zoological Park'. Accessed online 15 October 2020, <https://www.records.nsw.gov.au/archives/collections-and-research/guides-and-indexes/stories/taronga-zoo-centenary#>

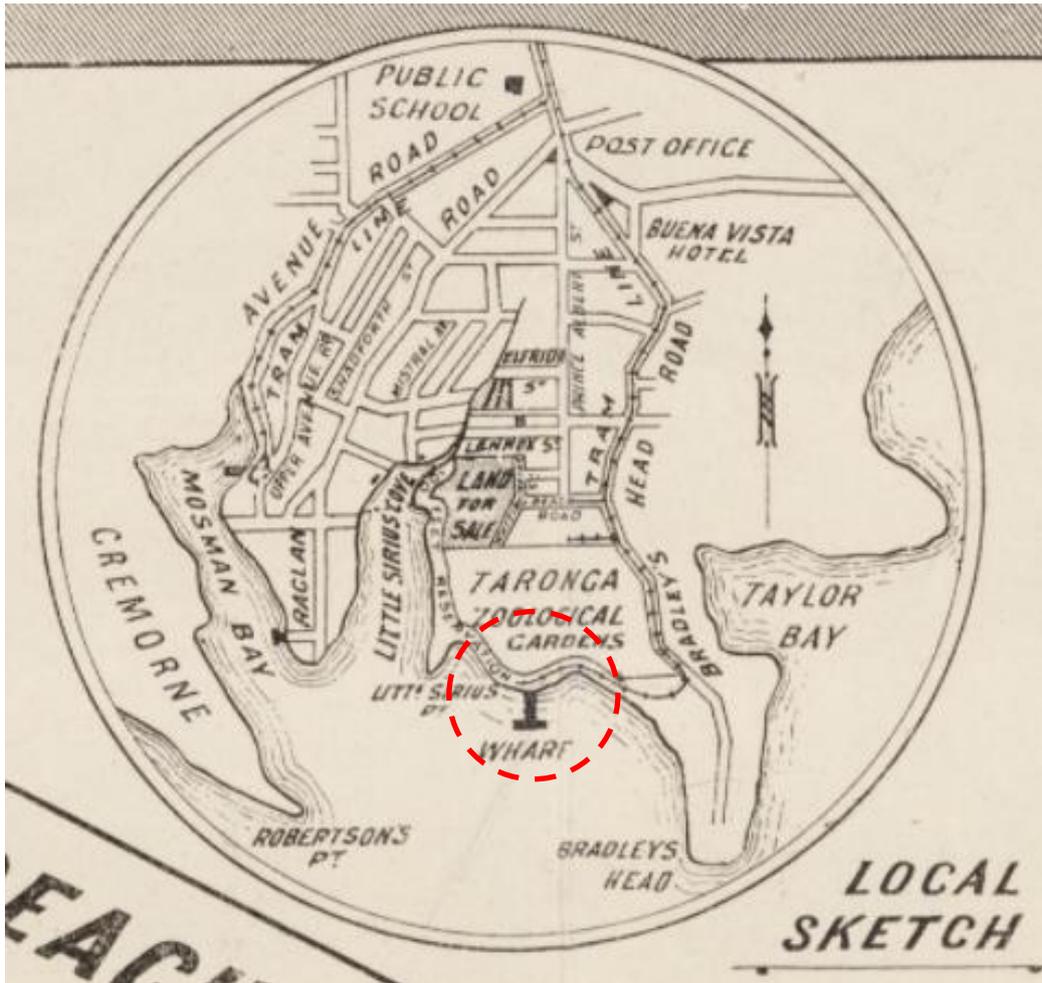


Figure 18: Location of the Taronga Zoo Wharf on subdivision plan of Mosman, 1918 (construction footprint indicated in red).⁶⁶

⁶⁶ Arthur Rickard & Co., 1918. '115 – Z/SP/M26/117 – Sirius Beach Estate no. 2, Mosman – Lennox St, Major Beach Rd, Rickard Ave, Whiting Beach Rd, Simpson St, [1918].' *State Library of New South Wales*. Call No. Z/SP/M26 IE9039287 FL9039293. Accessed online 14 October 2020, http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?dps_pid=IE9039287&change_lng=



Figure 19: Taronga Park Ferry jetty, c.1916.⁶⁷



Figure 20: Passengers disembarking at Taronga Park Wharf, n.d.⁶⁸

⁶⁷ Government Printing Office, c.1916. 'Taronga Park Ferry jetty.' *State Library of New South Wales*. Accessed online 14 October 2020, http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE1911486&_ga=2.259341578.1016274055.1586129098-706910494.1581896604.

⁶⁸ Government Printing Office, n.d. 'Passengers disembarking at Taronga Park Wharf.' *State Library of New South Wales*. Accessed online 14 October 2020, http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE1872561&_ga=2.259341578.1016274055.1586129098-706910494.1581896604.



Figure 21: Crowd at the wharf, 1917⁶⁹

⁶⁹ *Sydney Mail*, Wed. 19 September 1917. 'Loyalists at Taronga Park'. Accessed online 14 October 2020, <https://trove.nla.gov.au/newspaper/article/160629908?searchTerm=taronga%20zoo%20wharf>

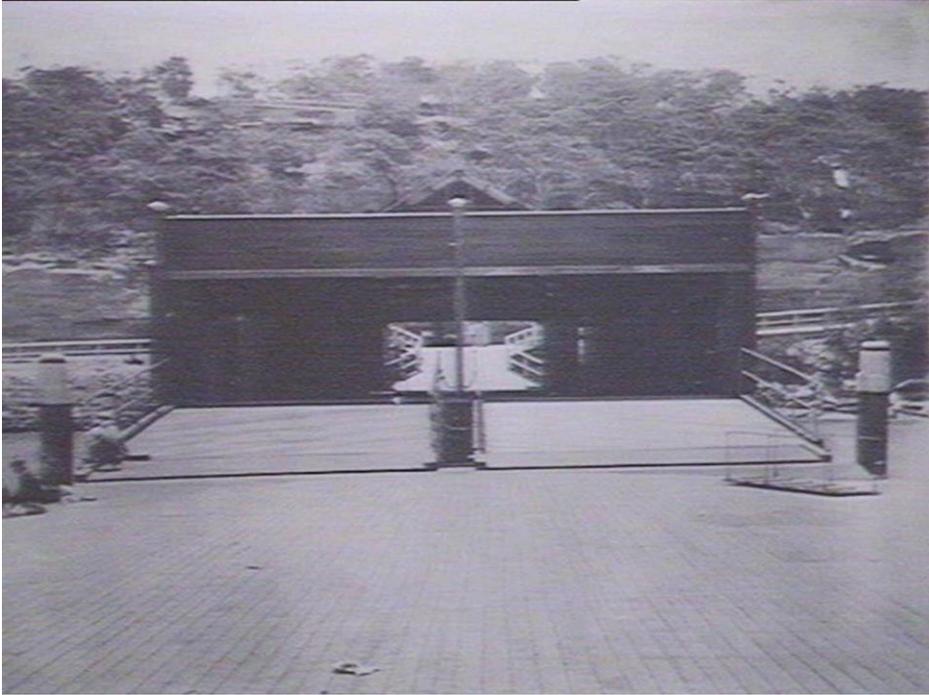


Figure 22: Ramp and entrance structure at Taronga Zoo Wharf, n.d⁷⁰



Figure 23: Taronga Zoo Wharf, n.d⁷¹

⁷⁰ Government Printing Office, n.d. 'Ramps on Taronga Park Jetty.' *State Library of New South Wales*. Accessed online 14 October 2020, digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE1843616&_ga=2.201145774.1016274055.1586129098-706910494.1581896604.

⁷¹ Author unknown, n.d. 'Taronga Zoo Wharf'. *State Library NSW*. Accessed online 15 October 2020, <http://archival.sl.nsw.gov.au/Details/archive/110111735>



Figure 24: View towards Taronga Zoo Wharf, showing trams running along Athol Wharf Road, c1930⁷²

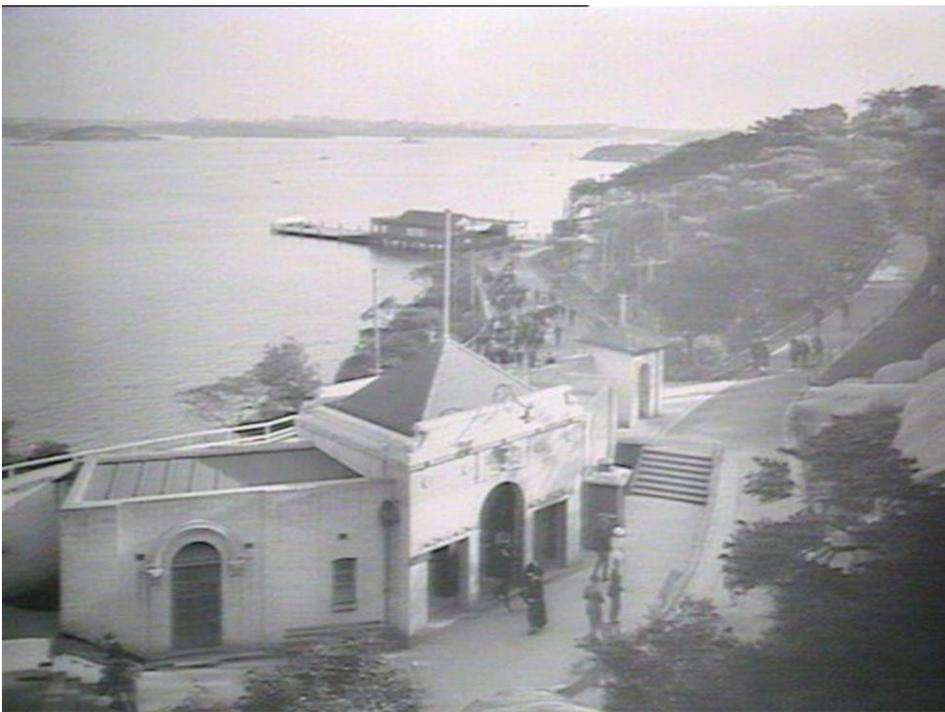


Figure 25. Lower Taronga Zoo entrance with wharf in background⁷³

⁷² Government Printing Office, c1930. 'Taronga Zoo Wharf'. *State Library NSW*. Accessed online 15 October 2020, <http://archival.sl.nsw.gov.au/Details/archive/110117474>

⁷³ Government Printing Office, n.d. 'Entrance from water side, Taronga Park Zoo.' *State Library of New South Wales*. Accessed online 14 October 2020, http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE1795859&_ga=2.201145774.1016274055.1586129098-706910494.1581896604.



Figure 26: End of the tram line at Athol Wharf Road, showing the alignment of the tramline, 1952⁷⁴

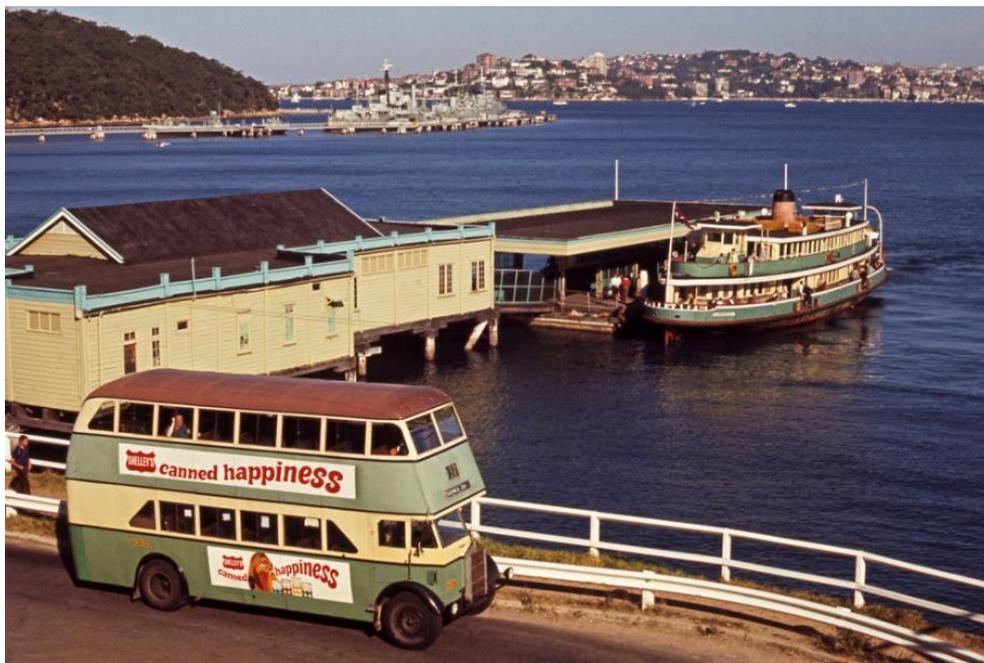


Figure 27: Taronga Zoo Wharf, 1970⁷⁵

⁷⁴ Caroline Simpson Library & Research Collection, 1952. 'End of the line'. Accessed 15 October 2020, <http://collection.hht.net.au/firsthttpictures/fullRecordPicture.jsp?recoListAttr=recoListRI&reco=56058>

⁷⁵ John Ward, 1970. 'Taronga Zoo Wharf'. *City of Sydney Archives*. Accessed online 20 October 2020, <https://archives.cityofsydney.nsw.gov.au/nodes/view/1865118?keywords=taronga%20wharf&highlights=WyJ0YXJkbmdhliwid2hhcmYiXQ==>.



Figure 28: Photograph of the original Taronga Zoo Wharf, c1981, prior to its removal⁷⁶

⁷⁶ Author unknown, 1981. 'Taronga Zoo Wharf'. *Fairfax Media Archives*. Accessed online 20 October 2020, <https://www.gettyimages.ca/detail/news-photo/pics-of-the-old-amp-the-new-wharfs-at-taronga-park-the-old-news-photo/1080661492>.



Figure 29: 1943 aerial imagery showing first Taronga Zoo Wharf



Figure 30: c1950s aerial imagery showing first Taronga Zoo Wharf



Figure 31: c1960s aerial imagery showing first Taronga Zoo Wharf, tram line and bus turning circle

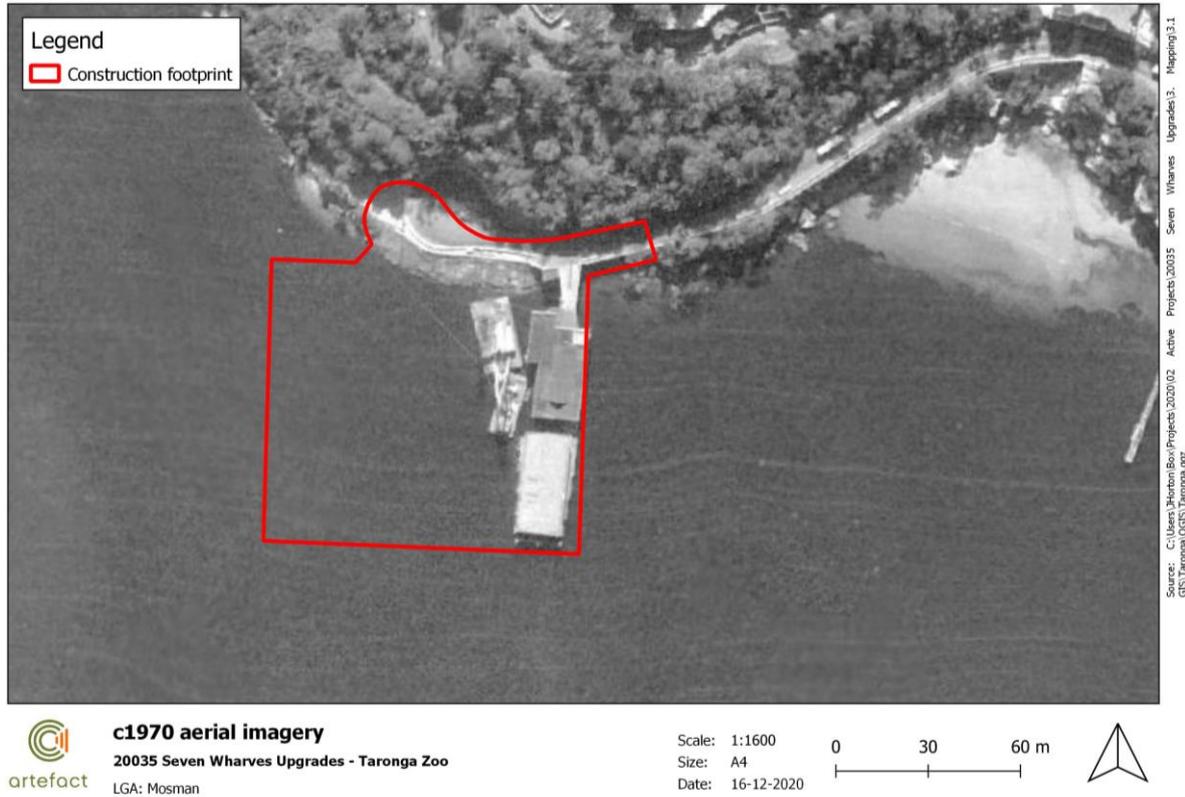


Figure 32: c1970s aerial imagery showing first Taronga Zoo Wharf, tram line and bus turning circle



Figure 33: c1980s aerial imagery showing existing Taronga Zoo Wharf

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 Taronga Zoo Wharf project team. The aim of the site inspection was to inspect the area of proposed impacts to inform the specialist studies for the FWUP3 REF, including to inform a preliminary assessment of archaeological potential and to identify heritage items in the vicinity of the site 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

Taronga Zoo Wharf is located at the end of Athol Wharf Road in the suburb of Mosman on the northern side of Sydney Harbour. Athol Wharf Road is primarily orientated east to west down towards Taronga Zoo Wharf, with the sandstone sea wall present along the south side of the road and the cut rock escarpment climbing to the north (Figure 41). The road ends in a wide turning circle where the existing wharf is located (Figure 43). The LEP listed Taonga Zoo (LEP no. I34) encompasses the entire area to the north of the wharf and is heavily vegetated, with stairs and lifts at the end of Athol Wharf Road providing access from the wharf to the zoo (Figure 43). Due to thick vegetation and steep slope, there is generally no direct view to any of the animal enclosures from the wharf. To the east across Athol Bay is Athol Beach and Bradley's Head, while to the west the Curlew Camp Artist's Walk from the wharf leads around to Whiting Beach and Little Sirius Point. To the west of the wharf the rocky embankment is formed by irregularly shaped sandstone rubble that is vegetated on top, while to the east the road is bounded by the dressed sandstone blocks of the seawall.

Taonga Zoo Wharf protrudes out from the road at an angle, with both the jetty and the floating pontoon oriented north-east to south-west (Figure 34 to Figure 38). The wharf is relatively wide compared to other North Shore ferry wharves such as North Sydney Wharf and South Mosman Wharf, and is comprised of three components: a concrete jetty that connects to the land, the floating pontoon where passengers board the ferries, and the metal gangway that connects them (Figure 36). All three components are covered, with the jetty being covered by partially overlapping gable roofs. The jetty features benches and small tables that are used for the café located at the southern end of the jetty (Figure 35 and Figure 37). The gangway is separated into four ramps, with entry and exit ramps on both sides of the wharf. Additional benches are located on the pontoon.

To the west Taronga Zoo Wharf has clear views towards Little Sirius Point, Curraghbeena Point on the other side of Little Sirius Cove, and Robertsons Point across Athol Bay in the suburb of Cremorne Point. To the east the wharf has unobstructed views of the west side of Bradley's Head. The wharf also has clear views across Sydney Harbour and to the south-west the Sydney Opera House and Sydney Harbour Bridge are both visible in the background.

With the exception of the excavated escarpment to the north of the road there is no visible evidence of the former Athol Wharf Tram Terminus (LEP no. A482) located within the road reserve. Furthermore, with the exception of the sandstone sea wall there was also little to no evidence of the former Taronga Zoo Wharf (LEP no. A483), such as timber posts, visible on the surface in the area at the time of the inspection.



Figure 34: South-west view towards Taronga Zoo Wharf from Athol Wharf Road



Figure 35: North-east view within Taronga Zoo Wharf showing existing amenities



Figure 36: North-east view of gangways from Taronga Zoo Wharf showing existing configuration



Figure 37: South-west view along Taronga Zoo Wharf showing café, Opal Card readers and Top Up machines, and gangways



Figure 38: South-west view of Taronga Zoo Wharf showing existing configuration and view towards the Sydney CBD



Figure 39: Northern view from Taronga Zoo Wharf showing existing steel and timber piles (foreground) and cable car station (background)



Figure 40: North-east view from Taronga Zoo Wharf showing existing steel and timber piles (foreground) and sandstone retaining wall

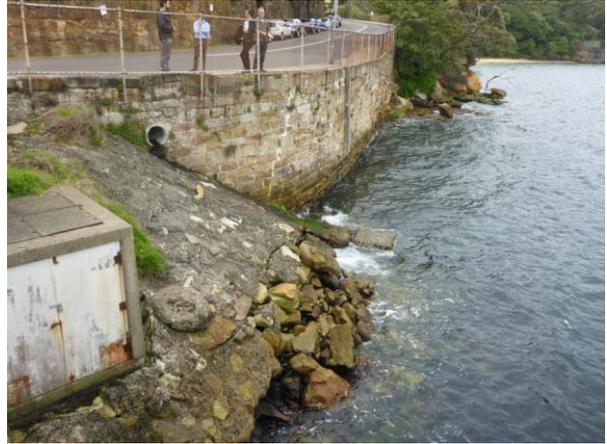


Figure 41: North-east facing detail view of sandstone retaining wall along Athol Wharf Road



Figure 42: Eastern view along Athol Wharf Road showing existing bus terminal



Figure 43: North-west view of existing bus turning circle along Athol Wharf Road



Figure 44: South-west view from Taronga Zoo Wharf showing view line to Sydney CBD



Figure 45: South-west view along Taronga Zoo Wharf showing existing configuration and view line to Sydney CBD



Figure 46: View south-west along Athol Wharf Road towards Taronga Zoo Wharf. The original tramline would have followed this road alignment



Figure 47: View south-west at end of Athol Wharf Road showing former location of the tramline terminus

5.0 HERITAGE SIGNIFICANCE

5.1 Introduction

This section outlines the significance assessments and statements of significance for the listed heritage items within or immediately adjacent to the construction footprint. The significance of the heritage items has been assessed against the NSW heritage significance criteria outlined in Table 5. The significance assessments and statements of significance for the remaining heritage items which have been identified in Table 6 as being within the visual buffer zone have not been identified.

5.2 Taronga Zoo Wharf (remains and seawall) (LEP no. A483)

5.2.1 Significance assessment

The SHI entries for Taronga Zoo Wharf (remains and seawall) [LEP no. A483] do not contain a complete significance assessment for the item.⁷⁷ As a result, a significance assessment has been prepared by Artefact Heritage as part of this SoHI and is detailed in Table 7.

Table 7: Significance assessment for Taronga Zoo Wharf (remains and seawall) [LEP no. A483]

| Criterion | Explanation |
|--|---|
| A – Historical Significance | <p>Taronga Zoo Wharf (remains and seawall) is of historical significance as remnants of an early passenger ferry wharf on the northern side of Sydney Harbour. It is representative of the first generation of European land / water transport interchanges in Sydney Harbour, where the wharf provided transportation prior to the construction of the Sydney Harbour Bridge.</p> <p>Taronga Zoo Wharf (remains and seawall) has local significance under this criterion</p> |
| B – Associative Significance | <p>The Taronga Zoo Wharf (remains and seawall) is not associated with any persons or events of note.</p> <p>Taronga Zoo Wharf (remains and seawall) does not reach the threshold of local significance under this criterion</p> |
| C – Aesthetic or Technical Significance | <p>The Taronga Zoo Wharf (remains and seawall), as an archaeological feature, is not expected to reveal aesthetic qualities reaching the threshold for local significance. However, the sandstone seawall adjacent to the present Taronga Zoo Wharf expresses the long period of use of the site for ferry services and is aesthetically consistent with the surrounding character of Mosman.</p> <p>Taronga Zoo Wharf (remains and seawall) has local significance under this criterion</p> |
| D – Social Significance | <p>The Taronga Zoo Wharf (remains and seawall) may be of interest to residents and history groups within the Mosman area. The former passenger wharf served as an important transportation route for residents of the area and facilitated recreational trips, although the wharf has since been demolished, the site has been in continued use for over 100 years, providing a ferry service. Remains of the former wharf may contribute to residents understanding of place and Mosman's interaction with Sydney Harbour.</p> <p>Taronga Zoo Wharf (remains and seawall) has local significance under this criterion</p> |

⁷⁷ Heritage NSW, DCP, 2016. 'Taronga Zoo Wharf (remains and seawall)'. *State Heritage Inventory*. Accessed online 20 October 2020, <https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=2060061>.

| Criterion | Explanation |
|-------------------------------|--|
| E – Research Potential | <p>Archaeological remains of the Taronga Wharf (remains and seawall) may be able to demonstrate the construction style and layout of the former wharf structure. However, the location and style of the structure is 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>Taronga Zoo Wharf (remains and seawall) does not reach the threshold of local significance under this criterion</p> |
| F – Rarity | <p>The Taronga Wharf (remains and seawall) 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 wharves 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>Taronga Zoo Wharf (remains and seawall) does not reach the threshold of local significance under this criterion</p> |
| G – Representativeness | <p>Photographs of the former wharf indicate that it was representative of early 20th century wharves in the Mosman LGA and surrounding area, which played an important role in transportation for local residents. Although the sandstone seawall is largely intact, 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>Taronga Zoo Wharf (remains and seawall) site does not reach the threshold of local significance under this criterion</p> |

5.2.2 Statement of significance

Taronga Zoo Wharf (remains and seawall) [LEP no. A483] is of local heritage significance.

The following statement of significance has been extracted, and edited where relevant, from the SHI entry for the Taronga Zoo Wharf (remains and seawall) [LEP no. A483]:

The Taronga Zoo Wharf site is of historical and social significance as an early passenger wharf on the northern side of the harbour, facilitating recreational trips to Taronga Zoo. Although the wharf has since been demolished, the site has been in continued use for over a century, providing a major access point to Mosman. It is among a collection of ferry wharves which are representative of the first generation of European land / water transport interchanges in Sydney Harbour, where transportation was provided across the harbour prior to the construction of the Sydney Harbour Bridge.⁷⁸

⁷⁸ Heritage NSW, DCP, 2016. 'Taronga Zoo Wharf (remains and seawall)'.

5.3 Athol Wharf Tram Terminus (including escarpment and retaining wall) (LEP no. A482)

5.3.1 Significance assessment

The SHI entry for Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] does not contain a complete significance assessment for the item.⁷⁹ As a result, a significance assessment has been prepared by Artefact Heritage as part of this SoHI and is detailed in Table 8.

Table 8: Significance Assessment for Athol Wharf Tram Terminus (LEP no. A482)

| Criterion | Explanation |
|--|--|
| A – Historical Significance | <p>The Athol Wharf Tram Terminus (including escarpment and retaining wall) is of historical significance as remains of a major form of transportation providing access from Taronga Zoo Wharf into the zoo, established to coincide with the grand opening in 1916. It is representative of the first generation of European land / water transport interchanges in Sydney Harbour, and although the tram terminus has been removed, the route is in continued use via bus along Athol Wharf Road.</p> <p>Athol Wharf Tram Terminus (including escarpment and retaining wall) has local significance under this criterion</p> |
| B – Associative Significance | <p>The Athol Wharf Tram Terminus (including escarpment and retaining wall) is not associated with any persons or events of note.</p> <p>Athol Wharf Tram Terminus (including escarpment and retaining wall) does not reach the threshold for local significance under this criterion</p> |
| C – Aesthetic or Technical Significance | <p>The Athol Wharf Tram Terminus (including escarpment and retaining wall), as an archaeological feature, is not expected to reveal aesthetic qualities reaching the threshold for local significance. However, the sandstone seawall within the Athol Wharf Tram Terminus heritage item curtilage expresses the long period of use of the site for ferry services and is aesthetically consistent with the surrounding character of Mosman.</p> <p>Athol Wharf Tram Terminus (including escarpment and retaining wall) has local significance under this criterion</p> |
| D – Social Significance | <p>The Athol Wharf Tram Terminus (including escarpment and retaining wall) may be of interest to residents and history groups within the Mosman area. The former tram terminus served as an important transportation route for residents and visitors of the area and facilitated recreational trips, although the tramline and terminus has since been demolished / asphalted over, the route along Athol Wharf Road has been in continued use for over 100 years, now with the use of a bus. Remains of the former tram terminus and line may contribute to residents understanding of place and Mosman’s interaction with Sydney Harbour.</p> <p>Athol Wharf Tram Terminus (including escarpment and retaining wall) has local significance under this criterion</p> |

⁷⁹ Heritage NSW, DCP, 2016. 'Athol Wharf Tram Terminus (including escarpment and retaining wall)'. *State Heritage Inventory*. Accessed online 20 October 2020, <https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=2060059>.

| Criterion | Explanation |
|-------------------------------|--|
| E – Research Potential | <p>Archaeological remains of the Athol Wharf Tram Terminus (including escarpment and retaining wall) may be able to demonstrate the construction style and layout of the former tramline. However, the location and style of the structure is 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>Athol Wharf Tram Terminus (including escarpment and retaining wall) does not reach the threshold for local significance under this criterion</p> |
| F – Rarity | <p>Archaeological remains of the Athol Wharf Tram Terminus (including escarpment and retaining wall) including tramline are not considered rare within Sydney. A number of remains linked to Sydney’s former tram network have been uncovered and are well documented.</p> <p>Athol Wharf Tram Terminus (including escarpment and retaining wall) does not reach the threshold for local significance under this criterion</p> |
| G – Representativeness | <p>Photographs of the former tram terminus indicate that it was representative of the 20th century tram network in the Mosman LGA and surrounding area, which played an important role in transportation for local residents.</p> <p>Athol Wharf Tram Terminus (including escarpment and retaining wall) has local significance under this criterion</p> |

5.3.2 Statement of significance

Athol Wharf Tram Terminus (LEP no. A482) is of local heritage significance.

The following statement of significance has been extracted, and edited where relevant, from the SHI entry for the Athol Wharf Tram Terminus (LEP no. A482):

The Athol Wharf Tram Terminus remains are of historical and social significance as a significant form of transportation from the Taronga Zoo Wharf to into the zoo, established to coincide with the grand opening in 1916. This item records the presence and operation of tram services to the Taronga Zoo Wharf and provides evidence of the technology and techniques employed. It forms part of a collection of harbourside wharf / tram connection nodes which were critical elements in the development of the city, especially the North Shore.⁸⁰

5.4 Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34)

5.4.1 Significance assessment

The SHI entry for Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34) does not contain a complete significance assessment for the item.⁸¹ As a result,

⁸⁰ Heritage NSW, DCP, 2016. ‘Athol Wharf Tram Terminus’.

⁸¹ Heritage NSW, DCP, n.d. ‘Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock’. *State Heritage Inventory*. Accessed online 20 October 2020, <https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=2060062>.

the significance assessment in Table 9 has been supplemented by the assessment undertaken by GML in 2002⁸² and further assessment undertaken by Artefact Heritage as part of this SoHI.

Table 9: Significance Assessment for Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34)

| Criterion | Explanation |
|--|--|
| A – Historical Significance | <p>Taronga Zoo is of historical significance as a place of recreation and conservation in operation for over a century. Taronga Zoo is a place of national significance as an urban zoo with unique physical and associative attributes, including links with early modern zoo philosophy, a unique and powerful cultural landscape and a wide range of landscape elements, architectural styles and enclosure designs evidencing the development of zoos in Australia.</p> <p>Taronga Zoo has local significance under this criterion</p> |
| B – Associative Significance | <p>Taronga Zoo is not associated with any persons or events of note.</p> <p>Taronga Zoo does not reach the threshold of local significance under this criterion</p> |
| C – Aesthetic or Technical Significance | <p>Taronga Zoo is a landmark within Sydney Harbour, holding significant aesthetic qualities. Features that contribute to Taronga’s aesthetic and cultural landscape include the steeply sloping topography of the site, its location on the northern foreshore of Sydney Harbour, the exploitation of the natural stone landforms and complementary faux rock formations; the circulation layout associated staircases and seating the exotic and grand built elements used for public buildings and animal enclosures; the native and introduced vegetation on the site, the internal visual corridors within the site and expansive views from the site across Sydney Harbour to the city skyline.</p> <p>Taronga Zoo has local significance under this criterion</p> |
| D – Social Significance | <p>As an educational, entertainment and recreational facility, Taronga is a highly revered institution within Sydney’s social fabric, evoking memories across generations of visitors. The zoo is also an important keystone in distinguishing Sydney’s sense of place. For the zoological community, Taronga is internationally recognised as a leading centre of biodiversity conservation and for the zoo’s educational focus.</p> <p>Taronga Zoo has local significance under this criterion</p> |
| E – Research Potential | <p>Taronga’s archaeological resource has some potential to provide information about the Aboriginal community, the early use of the site as a quarantine station and the development of the zoo. In combination, the extensive archive collection, built structures, landscape features and archaeological features at Taronga have great potential for research and community education.</p> <p>Taronga Zoo has local significance under this criterion</p> |
| F – Rarity | <p>Taronga Zoo is considered nationally rare as one of the oldest and consistently operational zoos in Australia.</p> <p>Taronga Zoo has local significance under this criterion</p> |
| G – Representativeness | <p>Taronga Zoo is considered representative as one of the oldest and consistently operational zoos in Australia.</p> <p>Taronga Zoo has local significance under this criterion</p> |

⁸² GML, 2002. *Conservation Strategy – Taronga Zoo*. Report to Zoological Parks Board of NSW. Heritage Council Endorsed, July 2002.

5.4.2 Statement of significance

Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34) is of local heritage significance.

The following statement of significance has been extracted, in full, from the Conservation Strategy prepared by GML in 2002:

Taronga Zoo is a place of national significance as an urban zoo with unique physical and associative attributes, including links with early modern zoo philosophy, a unique and powerful cultural landscape and a wide range of landscape elements, architectural styles and enclosure designs evidencing the development of zoos in Australia.

Features that contribute to Taronga's cultural landscape include the steeply sloping topography of the site, its location on the northern foreshore of Sydney Harbour, the exploitation of the natural stone landforms and complementary faux rock formations; the circulation layout associated staircases and seating the exotic and grand built elements used for public buildings and animal enclosures; the native and introduced vegetation on the site, the internal visual corridors within the site and expansive views from the site across Sydney Harbour to the city skyline.

The original fabric at Taronga demonstrates the earliest example in Australia of Carl Hagenbeck's and early twentieth century European zoological philosophies. In the differing design and approaches to the animal enclosures and aviaries, Taronga also evidences key aspects of international zoological philosophy that have influenced the zoo's development throughout the twentieth century.

As an educational, entertainment and recreational facility. Taronga is a highly revered institution within Sydney's social fabric, evoking memories across generations of visitors. The zoo is also an important keystone in distinguishing Sydney's sense of place. For the zoological community, Taronga is internationally recognised as a leading centre of biodiversity conservation and for the zoo's educational focus.

Taronga's archaeological resource has some potential to provide information about the Aboriginal community, the early use of the site as a quarantine station and the development of the zoo. In combination, the extensive archive collection, built structures, landscape features and archaeological features at Taronga have great potential for research and community education.⁸³

⁸³ GML, 2002. *Conservation Strategy – Taronga Zoo*.

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 potential significant archaeological remains are illustrated in Figure 48.

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 (1788-1912): Informal use, land grants and military reserve

During Phase 1 the construction footprint may have been used for informal land use recorded in the Mosman and Little Sirius Cove area, notably including timber getting. The construction footprint then formed part of a 20-acre grant given to C.H. Jenkins, however, there is no written documentation of any structures being built on the grant, or within the construction footprint. The construction footprint and much of Bradley's Head was resumed for a military reserve. No known structures were built within the construction footprint.

6.2.2 Phase 2 (1912-1959): Establishment of Taronga Zoo

Following the purchase of the construction footprint by the Royal Zoological Society, development of Taronga Zoo began. The first Taronga Zoo Wharf (also known as Athol Wharf) was built, located at the far eastern boundary of the construction footprint. The wharf was constructed of timber planks on piling, accessed with a ramp. Athol Wharf Road was established at this time to provide access to the wharf, along with the extant seawall and the former tram tracks. The location of the former tram tracks is located within the construction footprint.

6.2.3 Phase 3 (1960-present): Modernisation of Taronga Zoo

In 1959 the tram tracks were decommissioned, and Athol Wharf Road was sealed. A bus turning circle was constructed at the western extent of the construction footprint, with aerial imagery showing that clearance of mature vegetation, cutting of the rock escarpment, and minor land reclamation was required for the extension of the road. In c.1980 the first wharf was demolished, and the second Taronga Zoo Wharf (extant) was built, also on timber piles. The extant cable car building was also built immediately adjacent to the construction footprint during this period. The existing footpath established in this period alongside the extant wharf appears to have been largely located on the portion of land that was reclaimed as part of the construction of the bus turning circle. It is likely that modern utilities were installed during this period to service the extant wharf and cable car building.

6.3 Preliminary assessment of archaeological potential

6.3.1 Phase 1 (1788-1912): Informal use, land grants and military reserve

Historical records do not attest to the presence of built structures within the construction footprint, and it is unlikely that undocumented structures would be present within the construction footprint associated with Charles Jenkins land grant or the military reserve. While land clearance or minor landscape modification may have occurred during this phase, it has likely been disturbed and impacted by the subsequent phases of activity.

Overall, there is **nil to low** archaeological potential associated with Phase 1.

6.3.2 Phase 2 (1912-1959): Establishment of Taronga Zoo

Potential archaeological remains associated with Phase 2 may include evidence of the former Taronga Zoo Wharf (Athol Wharf). Archaeological remains may include timber planking, timber piles, or remnant postholes. Remains associated with the original Taronga Zoo Wharf are known to be present, having been previously identified by Austral Archaeology during an archaeological study undertaken from 2015 - 2017.⁸⁴ As a result, there is **high** potential for archaeological remains associated with the original wharf to be present within the area. It is noted that though these remains are located within the far eastern portion of the construction footprint and are not expected to be found within the proposal footprint.

During phase 2 major works were undertaken as part of the construction of Taronga Zoo and associated transportation networks. Potential archaeological remains associated with the establishment of Athol Wharf Road and the tram line and terminus along the road may include evidence of the earlier road construction, including earlier gravel or asphalt road surfaces, kerbing, drainage and postholes from road boundary fences, as well as the I-bar metal tram tracks themselves and timber slats located beneath the beams. In addition, construction cut and fill soil deposits may be present. Evidence of the former road surface may have been partially truncated or completely removed in areas by subsequent developments including modern road upgrades and utilities, the construction of the turning circle and the establishment of the extant wharf and cable car structures. However, evidence of the former road surfaces may have survived in localised pockets. Archaeological remains of the former metal tram tracks also tend to be more robust and therefore are more likely to have survived. As such, there is **moderate** potential for archaeological remains associated with the establishment of Athol Wharf Road and the former tramline to be present within the construction footprint. However, while it is noted that these remains are located within the far northern portion of the construction footprint, they are not expected to be found within the proposal footprint which is limited to the current footpath.

Overall, there is **moderate to high** potential for archaeological remains associated with Phase 2 to be present within the construction footprint. However, the areas of archaeological potential are generally located outside of the proposal footprint.

6.3.3 Phase 3 (1960-present): Modernisation of Taronga Zoo

Material remains associated with Phase 3 are above ground features which remain extant, and as such, would not be considered archaeological. Therefore, there is **nil** archaeological potential associated with Phase 3.

⁸⁴ Austral Archaeology, 2017. *Archaeological Significance Assessment: Archaeological Sites Listed in Mosman LEP Final Report*. Report to Mosman Municipal Council.

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 early land grants to C.H. Jenkins and military land resumptions. However, there is no documentary evidence to suggest that the construction footprint was developed during this period as part of either land ownership. As a result, archaeological remains from this phase would likely be limited to ephemeral evidence of informal land use and land clearing. Archaeological remains of this type contribute little to no significant information relating to the development of Mosman and are of no research value. As a result, archaeological remains from Phase 1 would not reach the threshold of local significance.

Potential archaeological remains from Phase 2 may include evidence of the former Taronga Zoo Wharf (also known as Athol Wharf) and associated infrastructure such as the original seawall, and the former Athol Wharf Tram Terminus on Athol Wharf Road. Archaeological remains of these developments would be directly associated with the locally significant Taronga Zoo Wharf (remains and seawall) [LEP no. A483] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items, and therefore be significant for their historical and social values. The potential archaeological remains from Phase 2 would be significant for their association with the development of transportation routes in Mosman and the development of the local area. These transportation routes all helped to provide access to Taronga Zoo, which was, and remains, a popular recreational destination for both local residents and visitors.

Potential archaeological remains from Phase 2 may also include evidence of the initial establishment of Athol Wharf Road alongside the tram line in the early twentieth century, such as a former gravel or asphalt road surface. However, the significance of Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] is primarily associated with the remains of the former tram tracks and terminus itself rather than evidence of the road in general. As a result, Phase 2 archaeological remains of the establishment of Athol Wharf Road would not reach the threshold of local significance.

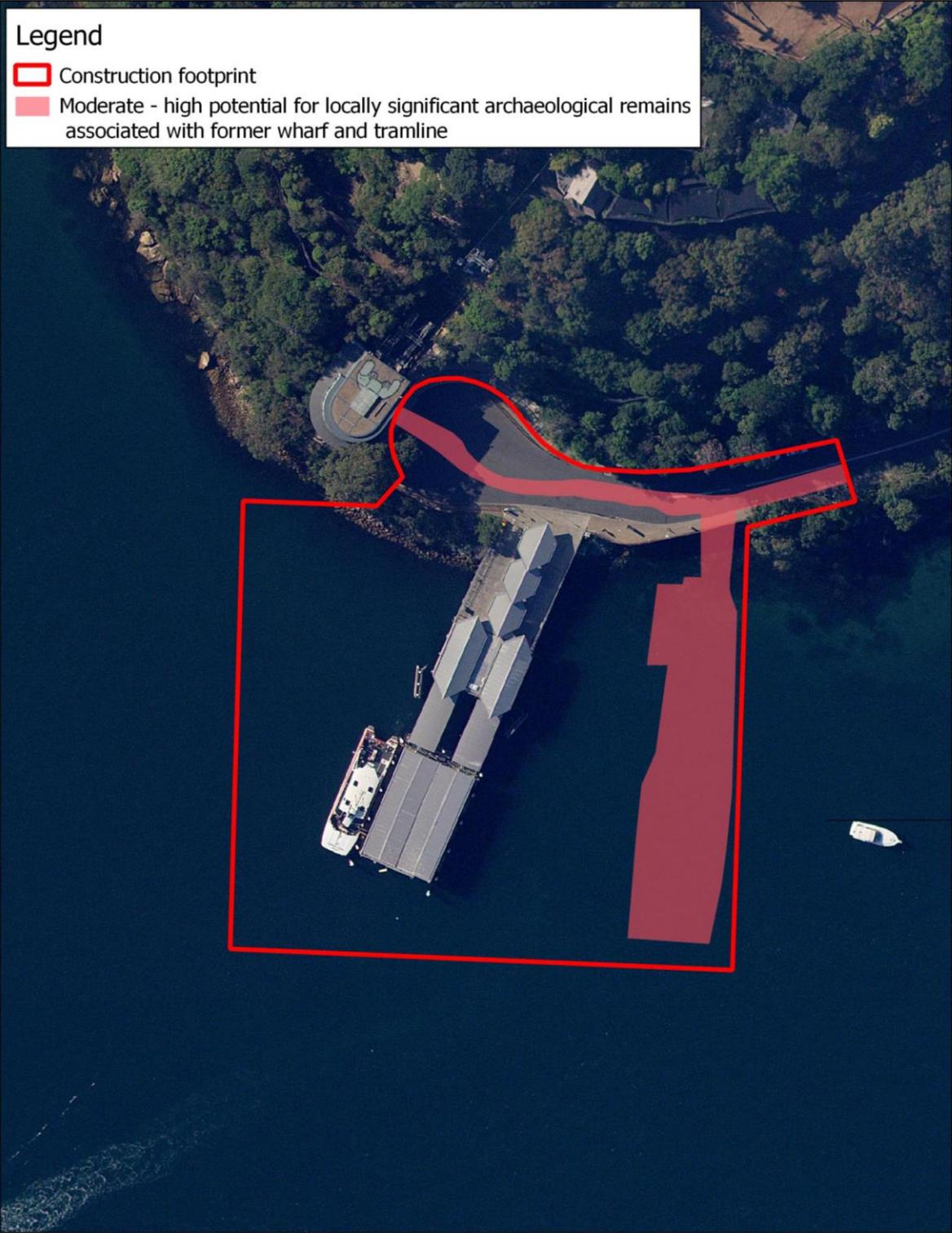
Overall, the preliminary archaeological assessment has identified that the construction footprint has potential to contain archaeological remains of local significance, largely associated with the development of the original Taronga Zoo Wharf and the former tramline. However, these archaeological remains are unlikely to be found in association with *in situ* artefact bearing deposits, such as intact occupation 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 10. Areas of archaeological significance are illustrated in Figure 48.

Table 10: Summary of archaeological potential and significance

| Phase | Potential Remains | Potential | Significance |
|--------------------------|---|------------|---|
| Phase 1 (1788-1912) | Evidence of informal land use, land clearance | Nil to low | Would not reach the threshold of local significance |
| Phase 2 (1912-1959) | Evidence of the former Taronga Zoo Wharf (Athol Wharf), including timber piles, timber planks, ramp structure | High | Local (works) |
| | Evidence of the former Athol Wharf Road tram line and terminus, including tracks, timber slats, cut and fill construction deposits | Moderate | Local (works) |
| | Evidence of the initial establishment of Athol Wharf Road, such as former gravelled or asphalted road surfaces, kerbing and drainage, and postholes | Moderate | Would not reach the threshold of local significance |
| Phase 3 (c.1959-present) | Nil | Nil | N/a |



Archaeological potential
20035 Seven Wharves
Upgrades - Taronga Zoo
LGA: Mosman

Scale: 1:1200
Size: A4
Date: 17-12-2020

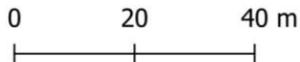


Figure 48: Areas of significant potential archaeological remains

7.0 PROPOSED WORKS

7.1 Introduction

This section describes the main design features of the proposal and outlines the associated construction activities at Taronga Zoo Wharf.

7.2 The proposal

7.2.1 Major water-based features

7.2.1.1 Fixed accessible ramp

A new fixed accessible ramp would be built on the western side of the existing wharf structure. The ramp would provide a path of DSAPT-compliant grade to connect the existing footpath to the southern end of the jetty before the gangways. The ramp would consist of a concrete deck slab supported by concrete headstocks on steel piles. Metal handrails would be provided either side of the ramp. The ramp would be about 60m long and 2.2m wide. The ramp would be covered with a steel framed canopy with composite cladding and metal roofing supported on steel columns. The style of the roof would complement the angular appearance of the existing jetty canopies to be retained.

7.2.1.2 Gangways

The two existing 16m long dual gangways would be replaced with two 18m long and 3.5m wide, dual-lane aluminium gangways which would connect the fixed jetty structure to the pontoon. The gangway gradient would vary according to the tides to be almost horizontal at high tide, and a maximum grade of one in 14 or 80 per cent of the tide levels.

The new gangways would be installed at the same location as the existing, with the connection points at the pontoon unchanged.

To accommodate the additional gangway length, the existing fixed jetty structure would be cut back about 3.5m. To support each gangway, two piles and headstock would be installed, this would be connected to the existing wharf through a new concrete deck about 1.4m wide.

7.2.1.3 Modification to existing jetty

The existing jetty would also be modified to comply with DSAPT requirements and provide an accessible pathway from the accessible ramp to the gangways and around the wharf facilities including the Transdev office / toilet and café.

The existing Transdev office / toilet and Taronga Zoo Kiosk would be demolished and relocated in the jetty. The existing kerb in front of the current position of the café would be removed to allow a level two circulation zone.

The Transdev office and toilet would be replaced in a similar location to its current position on the jetty between the two gangways. The office would be around 2.5m by 2m with a 1m by 2m toilet. The café space would be around 5m by 3m, with a separate café store. The existing distribution board would also be rehoused as part of this building structure.

Two of the jetty canopies would be replaced to accommodate the change in size of the jetty.

7.2.1.4 Modifications to the existing pontoon

Minor modifications to the existing pontoon are proposed at each gangway connection point to accommodate the new gangway and its landings. This includes relocation of glass partitions, the cutting back of the pontoon roof and installation of transition ramps at the end of the gangways. The

transition ramps would be 1:14 ramps (about 4m long) and would be the same width as the gangways. A central balustrade would be constructed in the middle of the ramp that would run along with the centre posts of the gangway.

Tactile Ground Surface Indicators (TGSIs) would be installed at appropriate locations on the pontoon to comply with DSAPT requirements.

7.2.2 Major land-based features

7.2.2.1 Pedestrian access

There would be two methods of access to the wharf from street level as part of the proposed upgrade:

- New accessible ramp
- Through the existing jetty.

The accessible ramp would be constructed on the west side of the existing jetty, connecting the jetty to the Mosman Council (Council) footpath at the bus stop. A small part of the existing fence would need to be removed to connect the existing footpath to the accessible ramp. The entry to the new ramp would be flat to allow people to wait undercover for the bus. The existing Council footpath at the entry to the wharf would be widened to provide DSAPT-compliant grades suitable for wheelchairs accessing the new ramp from the bus stop or Athol Wharf Road cul-de-sac.

7.2.2.2 Bus facilities

There is an existing bus interchange at the wharf entrance on Athol Wharf Road. It is proposed to re-grade and extend the Council footpath to provide an accessible connection to the bus stop for DSAPT compliance.

The covered jetty is located a few metres away from the bus stop, where patrons can wait for buses. The jetty would remain a covered structure to continue to provide shelter to patrons.

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
- 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.

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 works start, detailed design requirements, 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 Earthworks

There would be limited earthworks associated with the proposal. A small amount of seabed sediment would be disturbed during the piling work; however, no sediment would be removed. Earthworks during construction of the land-based elements would include earthworks for the construction of the new access ramp and regrading of the footpath at the bus stop.

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

7.2.6 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 11.

Table 11: Planned construction activities

| Activity | Associated work |
|---|---|
| Site establishment for land slide works | <ul style="list-style-type: none"> Establishment of a temporary site compound (site offices, amenities and plant/material storage areas, etc). There is limited space available for these facilities on land, other than parking spaces along the northern side of Athol Wharf (with a narrowing of existing traffic lanes and installation of temporary traffic barriers) or on the existing jetty structure. As such, the compound area would be installed on a construction barge adjacent to the wharf structure Temporary pedestrian paths may need to be installed to maintain safe access past the works. This may require traffic controllers to control pedestrian, vehicle and bus movements 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 Environmental controls would be established in accordance with the construction environmental management plan |
| Site establishment for water side works | <ul style="list-style-type: none"> Establishment of a construction work area using floating booms to delineate this area. 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 |

| Activity | Associated work |
|--|--|
| Construction of a new access ramp | <ul style="list-style-type: none"> • Environmental controls would be established in accordance with the construction environmental management plan. <hr/> <ul style="list-style-type: none"> • Install temporary footpath diversion to allow construction access • Clear and excavate for ramp using medium sized excavator (+20 tonne). Note that rock armour has been placed along the water's edge • Install land side piles (if required) using small excavator mounted piling rig • Install water side piles using a piling barge • Install two protection piles (to replace removed ferry arresters) • Install precast concrete headstocks, precast ramps and prefabricated • Install roof structure by mobile crane located in Athol Wharf cul-de-sac. The works may require the closure of Athol Wharf Road cul-de-sac so may need to be undertaken at night to avoid impacting on bus services. Alternatively, the components could be delivered to site by barge and installed by barge mounted crane • Connect ramp to existing jetty structure and make good • Finalisation works (pavements, architectural, finishes, hand-rails, etc). |
| Installation of new gangways and jetty fit out | <ul style="list-style-type: none"> • Close the café offices and western gangway • Demolish the existing café, office, glazing, roof structures and fitments to the extent required • Demolition of the existing wharf would need to be staged to ensure that one of the western and eastern gantries remains in service at all times • Demolition of the existing timber ferry arresters would be staged similar to demolition of the existing wharf • Establishment of a construction work area using floating booms to delineate this area. 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 • Up to three barges (about 20m by 30m in size) 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 • The western side gantry would be closed • Remove/demolish existing western timber ferry arresters • Remove the existing western gantry using barge mounted crane and dispose off-site using a barge • Demolish the western side of the existing jetty to the extent required and make good • Modify the western side of the existing pontoon to suit new gantry • The new western gangway would be fabricated off-site and floated to site by barge. The gangway would be lifted into position a large barge mounted crane • Install new steel protection piles approximately at the location of demolished timber ferry arresters • The existing western side roof structure would be modified to suit the final arrangement • Finishing works on the western side would be completed (handrails, finishes, architectural, etc) and the gantry opened • The eastern side gantry would be closed • Remove/demolish existing eastern timber ferry arresters • Remove the existing eastern gantry using barge mounted crane and dispose off-site using a barge • Demolish the eastern side of the existing jetty to the extent required and make good • Modify the western side of the existing pontoon to suit new gantry |

| Activity | Associated work |
|---------------|--|
| | <ul style="list-style-type: none">• The new eastern gangway would be fabricated off-site and floated to site by barge. The gangway would be lifted into position a large barge mounted crane• Install new steel protection piles approximately at the location of demolished timber ferry arresters• The existing eastern side roof structure would be modified to suit the final arrangement• Finishing works on the eastern side would be completed (handrails, finishes, architectural, etc) and the gantry opened• New café, office, glazing, roof modifications and other finishing works would be completed. |
| Site clean-up | <ul style="list-style-type: none">• The site would be cleaned up and restored to its previous state• Sedimentation controls and temporary structures would be removed. |

Key features of the proposal are illustrated in Figure 49 and virtual renders of the design are illustrated in Figure 50 to Figure 52.

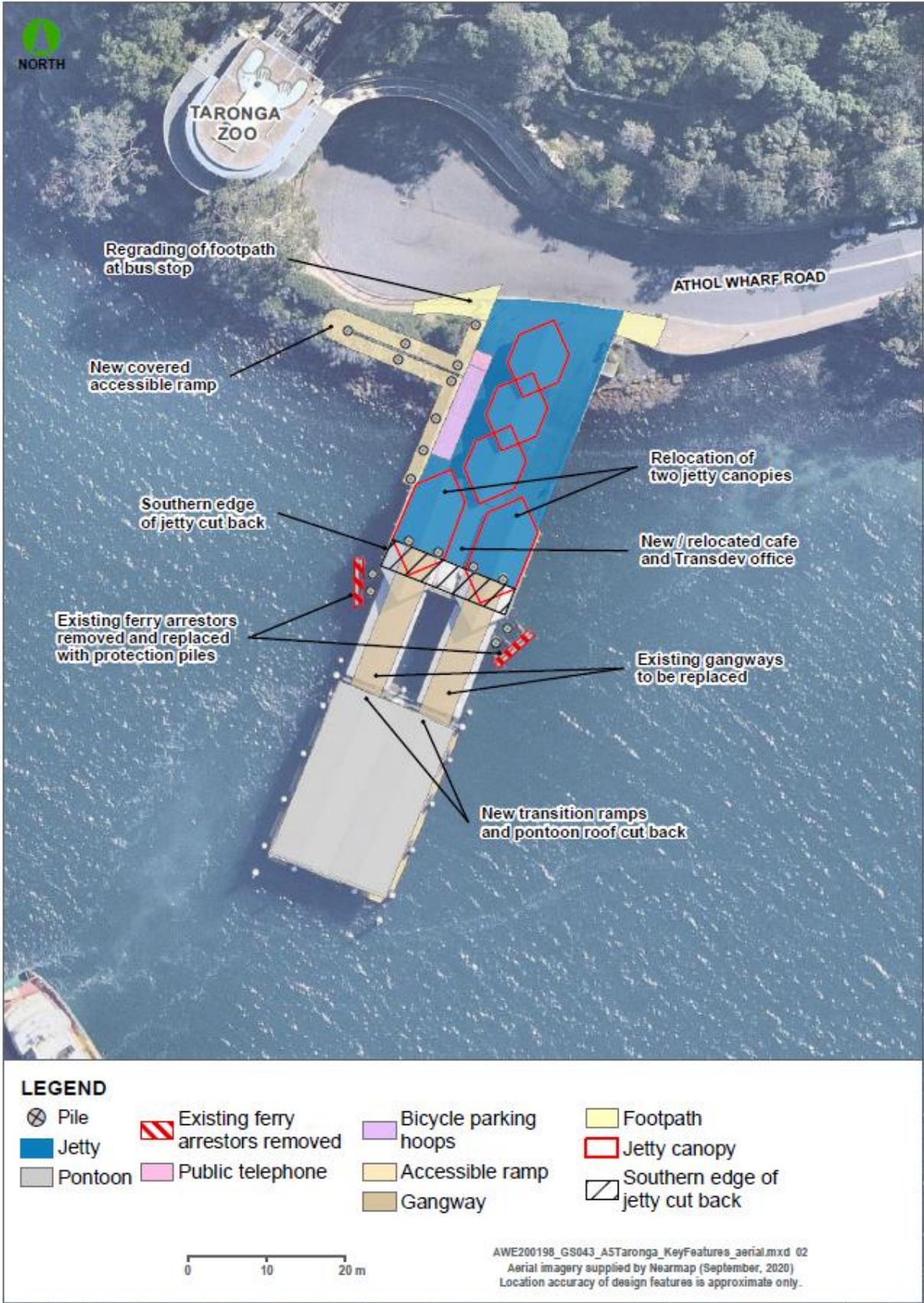


Figure 49: Key features of the proposal (provided by Cardno)



Figure 50: Render of the proposed wharf design from landside perspective, Athol Wharf Road, view south-east (provided by Transport for NSW)



Figure 51: Render of the proposed wharf design from landside perspective, Athol Wharf Road, view south-west (provided by Transport for NSW)



Figure 52: Render of the proposed wharf from waterside perspective, view north-east (provided by Transport for NSW)

8.0 HERITAGE IMPACT ASSESSMENT

8.1 Taronga Zoo Wharf (remains and seawall) [LEP no. A483]

8.1.1 Direct and potential direct (physical) heritage impacts

Although the Taronga Zoo Wharf (remains and seawall) [LEP no. A438] heritage item is located within the proposed construction footprint, it is not located within the proposal footprint. As a result, there would be no direct impact to the heritage item.

The proposed works would involve piling and the use of other vibration intensive plant. These works would be located within the minimum safe working distance for cosmetic damage to heritage fabric, which is identified in the 2016 Roads and Maritime *Construction Noise and Vibration Guideline* as being within 68m of vibration intensive plant (Table 3).⁸⁵ Therefore, due to the close proximity of the works the vibrations associated with the piling and additional plant have the potential to cause impacts to the archaeological remains of the former wharf, as well as the extant remains of the sandstone seawall. However, only a small number of piles are required and 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, the proposed works would result in a **neutral** direct and **negligible** potential direct impact to Taronga Zoo Wharf (remains and seawall) [LEP no. A483].

8.1.2 Indirect (visual) heritage impacts

The proposed works at Taronga Zoo Wharf are relatively minor and do not involve replacing the existing wharf. Instead the existing wharf structure would be upgraded, with the largest new addition being the proposed access ramp. The new access ramp and other upgrades to the existing wharf structure would be located outside of the curtilage of Taronga Zoo Wharf (remains and seawall) [LEP no. A483], however they would be located directly adjacent to the item. This would introduce a new visually intrusive element within sight of the heritage item.

The new access ramp has been designed however to reduce the visual imprint of the new feature. It has been designed to be relatively small in size and consistent with the existing wharf structure, utilising lightweight and consistent materials, simple lines, and muted colours. The new ramp would be located on the opposite side of the existing wharf, which would help to screen it from view. The proposed upgrades to the existing wharf structure itself are also relatively minor in nature and are consistent with the existing design of the wharf. As a result, the changes to the wharf structure would result in little to no change to the visual setting of the area. Although the new features would be visible from Taronga Zoo Wharf (remains and seawall) [LEP no. A483], views to and from the heritage item would not be more obstructed than they currently are, and views of the seawall and views to Sydney Harbour would be retained.

Overall, the proposed works would result in a **negligible** visual impact to the Taronga Zoo Wharf (remains and seawall) [LEP no. A483].

⁸⁵ Roads and Maritime Services, 'Construction Noise and Vibration Guideline'. Roads and Maritime Services, 2016. 71.

8.2 Athol Wharf Tram Terminus (including escarpment and retaining wall) (A482)

8.2.1 Direct and potential direct (physical heritage impacts)

Although Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] extends into the construction footprint, only a very small portion of the heritage item is within the proposal footprint. The proposed works within this small portion of the heritage item would be limited to the regrading and widening of the existing footpath. This work would not impact the significant escarpment that forms part of the heritage item. It would however be undertaken in close proximity to the sandstone retaining wall that forms the southern boundary of the heritage item and is located underneath the existing footpath. As a result, excavations within the footpath could potentially damage the underlying fabric of the retaining wall. However, the footpath works are relatively minor in nature and would not involve substantial excavations, and the proposed works would not involve the direct modification of the retaining wall itself. Furthermore, the proposal footprint would only be located within a small portion of the larger heritage item, therefore impacts to the overall heritage item would be minimal. As a result, direct impacts to Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] would be **negligible**.

The proposed works would be located within the curtilage of Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] and therefore the vibrations associated with the proposed works could result in potential direct impacts. In particular, the proposed piling is located within 15m of the significant sandstone retaining wall and 20m of the rockface of the escarpment. This could potentially cause blocks within the retaining wall to be displaced or could cause cracking in the rockface of the escarpment. However, only a small number of piles are required, and both the retaining wall and the escarpment are robust features, therefore it is unlikely that the relatively minor works would cause substantial structural issues. The vibrations resulting from the proposed works could also potentially cause impacts to archaeological remains of the former tramline. However, the expected archaeological remains would likely consist of steel tracks, which were constructed to support the weight and vibrations associated with the former trams. As a result, it is unlikely that the vibrations associated with the proposed works would impact the archaeological remains of the former tramline, and it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, there would be a **negligible** direct and potential direct impacts to Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482].

8.2.2 Indirect (visual) heritage impacts

As noted previously the proposed works are relatively minor and do not involve replacing the existing wharf. The new access ramp would be located directly adjacent to Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] and would be visible from it, and therefore would introduce new intrusive visual elements. However, the access ramp has been designed to reduce the visual imprint by being small in size and by utilising lightweight and consistent materials, simple lines, and muted colours. The ramp would not obscure views of the significant retaining wall and escarpment, views to Sydney Harbour would be retained, and the ramp would primarily only be visible at the western end of the heritage item. Furthermore, the modifications to the existing wharf structure itself are minor in nature and would generally be consistent with the existing structure.

Overall, the proposed works would result in a **negligible** visual impact to Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482].

8.3 Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34)

8.3.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34). As a result, there would be no direct impact to the heritage item. Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34) is located 20m north-west from the nearest proposed work (piling) however. 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, namely to the cable car station building. However, only a very small area of the much larger heritage item would potentially be affected by the vibrations, and the cable car station building is not considered to be an element that substantially contributes to the significance of the heritage item. As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposed works would result in a **neutral** direct and **negligible** potential direct impact to Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34).

8.3.2 Indirect (visual) heritage impacts

The upgrade of the Taronga Zoo Wharf would introduce new visually intrusive elements within sight of the Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34) heritage item, namely the construction of the proposed access ramp. However, the ramp has been designed to be less obtrusive through the use of lightweight and consistent materials, simple lines, and muted colours. The ramp and wharf upgrades would only be visible from a very small portion of the much larger heritage item, with the dense vegetation and steep landform context bordering Athol Wharf Road minimising direct views to the new elements from the zoo. The upgrades would not restrict views to Sydney Harbour from the cable car station building. 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 Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34).

8.4 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 12.

Table 12: Heritage items within the MZ of the visual buffer zone

| Item | Address | Significance | Listing | Distance from construction footprint |
|---|---|--------------|--|---|
| Ashton Park | Sydney Harbour National Park Bradleys Head Road | Local | Mosman LEP 2012 I458 RNE ID 2874 | Visual buffer zone (280m southeast) |
| Athol Gardens Dance Hall and Wharf Remains | Sydney Harbour National Park Bradleys Head Road | Local | Mosman LEP 2012 I459 | Visual buffer zone (410m southeast) |
| Group of 4 houses | 5–11 Raglan Street, Mosman | Local | Mosman LEP 2012 I230 RNE ID 103679 | Visual buffer zone (500m northwest) |

The proposed upgrade of the Taronga Zoo Wharf 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 present to and from each of these heritage items, they are located at a sufficient distance so that the wharf would not interrupt prominent views and would generally only be partially visible in the background. At that distance the minor modifications to the existing wharf structure would not be discernible, and elements such as the regarded footpath would be low to the ground and would be hidden from view. The main new element would be access ramp. However, the ramp would not be visible to heritage items to the east as it would be screened from view by the existing wharf structure, and it would not be visible from Group of 4 houses (LEP no. I230) as it would be largely blocked from view by the landform of Little Sirius Point. Furthermore, the new access ramp would not obstruct views towards these items from the existing wharf.

There may be some temporary visual impacts while the works are undertaken as a result of the establishment of the site compound and the presence of machinery, however, this would be relatively minimal and would be fully removed following completion of the works.

Overall, the proposed works would have a **neutral** visual impact to the heritage items listed in Table 12.

8.5 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 13.

Table 13: Heritage items within the BZ of the visual buffer zone

| Item | Address | Significance | Listing | Distance from construction footprint |
|----------------------------------|---|--------------|---|--|
| Sydney Opera House (buffer zone) | 2 Circular Quay East, Sydney (buffer zone extends to Argyle Street and Fitzroy Street) | World | WHL 166rev NHL ID 105738 SHR no. 01685 City of Sydney LEP 2020 no. I1712 RNE ID 2353 RNTA 6088 | Visual buffer zone (600m south-west) |

| Item | Address | Significance | Listing | Distance from construction footprint |
|---|--|--------------|---|--------------------------------------|
| "The Castle", flats | 3 Raglan Street, Mosman | Local | Mosman LEP 2012 I229 | Visual buffer zone (520m northwest) |
| Divided Road | Raglan Street, Mosman | Local | Mosman LEP 2012 I435 | Visual buffer zone (540m northwest) |
| Cremorne Point Conservation Area | Cremorne Point | Local | North Sydney LEP 2013 CA06 RNE ID 100862, 100861 | Visual buffer zone (600m west) |
| Cremorne Reserve (including Robertsons Point) | Cremorne Point | Local | North Sydney LEP 2013 I0136 | Visual buffer zone (600m west) |
| Site of Cremorne Smelter | Cremorne Reserve, east of 5 Green Street, Cremorne Point | Local | North Sydney LEP 2013 I0102 | Visual buffer zone (740m west) |
| Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials | Sydney Harbour National Park Bradleys Head Road | State | SHR 01838 Mosman LEP 2012 I460 SREP Part 2 item no. 25 RNE ID 2875, 2869, 2877, 2875 RNTA | Visual buffer zone (900m southeast) |

The proposed upgrade of the Taronga Zoo Wharf would introduce new intrusive elements within sight of the heritage items listed above. Although the heritage items would have views towards the construction footprint, the distance to the construction footprint would be sufficient enough that the new access ramp would not introduce adverse visual impacts to the area or obstruct any significant view lines to or from the heritage items.

Overall, the proposed works would result in a **neutral** visual impact to the heritage items listed in Table 13.

The proposed work would not result in a visual impact to Sydney Opera House (WHL 166rev). Although the visual buffer zone of the Sydney Opera House does extend into the BZ, the new access ramp and upgraded wharf would not have any sightlines to the Sydney Opera House itself. Furthermore, at that distance the new access ramp would not be discernible from the existing wharf behind it. As a result, the proposed works would result in a **neutral** visual impact to the Sydney Opera House and buffer zone (WHL 166rev).

8.6 Impacts to archaeological resources

The proposed works within the construction footprint would require limited earthworks including piling work, which is expected to disturb a small amount of seabed, and excavations to a depth of up to 300mm for the regrading of the footpath. Based on the preliminary archaeological assessment, however, only the minor excavations within the footpath would be located in proximity to areas of archaeological potential. The proposed construction compound on Athol Wharf Road would be located in the vicinity of the archaeological remains of the former tram line, however, activities within

the compound would be limited surface works and would not involve any excavations. Furthermore, the portion of the footpath within the proposal footprint largely appears to be located on land that was reclaimed as part of the construction of the bus turning circle in the 1970s and does not include the areas of significant archaeology.

The preliminary archaeological assessment has identified that the construction footprint has generally moderate to high potential to contain locally significant archaeological remains associated with the Taronga Zoo Wharf (remains and seawall) [LEP no. A483] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items. This may include evidence of the former wharf structure and the former tram line. However, historical overlays indicate that although the former wharf structure was located on the eastern edge of the construction footprint, it was outside of the proposal footprint. Therefore, no excavations would be undertaken within the footprint of the former wharf and there would be **nil** archaeological impacts to Taronga Zoo Wharf (remains and seawall) [LEP no. A438].

Although archaeological evidence of the former tram line and terminus may survive within the construction footprint, historical overlays indicate that the former tram tracks themselves were located to the north of the existing footpath and therefore outside of the proposal footprint. As a result, the remains of the former tram line also would not be impacted. While a small portion of the proposal footprint within the curtilage of Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] may contain evidence of the former road surface of Athol Wharf Road, it has been assessed that archaeological remains of this would not reach the threshold of local significance. As a result, there would be **nil** archaeological impacts to significant remains of Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482].

Overall, it is assessed that the proposed works would result in **nil** impacts to archaeological remains of local significance. As a result, it is not expected that detailed archaeological management and investigation would be required. Furthermore, the preliminary archaeological assessment has identified that the potential archaeological remains within the construction footprint would likely be limited to 'works'. As a result, the proposed works would not result in impacts to significant archaeological 'relics'.

8.7 Summary of impacts to heritage items

A summary of impacts to relevant heritage items is provided in Table 14.

Table 14: Summary of impacts to heritage items

| Heritage Item | Direct | Potential direct | Indirect (visual) | Archaeological |
|--|---------|------------------|-------------------|----------------|
| Taronga Zoo Wharf (remains and seawall) | Neutral | Negligible | Negligible | Neutral |
| Athol Wharf Tram Terminus (including escarpment and retaining wall) | Neutral | Negligible | Negligible | Neutral |
| Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock | Neutral | Negligible | Negligible | Neutral |
| Sydney Opera House (buffer zone) | Neutral | Neutral | Neutral | Neutral |
| Ashton Park | Neutral | Neutral | Neutral | Neutral |

| Heritage Item | Direct | Potential direct | Indirect (visual) | Archaeological |
|---|---------|------------------|-------------------|----------------|
| Athol Gardens Dance Hall and Wharf Remains | Neutral | Neutral | Neutral | Neutral |
| Group of 4 houses | Neutral | Neutral | Neutral | Neutral |
| “The Castle”, flats | Neutral | Neutral | Neutral | Neutral |
| Divided Road | Neutral | Neutral | Neutral | Neutral |
| Cremorne Point Conservation Area | Neutral | Neutral | Neutral | Neutral |
| Cremorne Reserve (including Robertsons Point) | Neutral | Neutral | Neutral | Neutral |
| Site of Cremorne Smelter | Neutral | Neutral | Neutral | Neutral |
| Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials | Neutral | Neutral | Neutral | Neutral |

8.8 Statement of heritage impact

A statement of heritage impact has been prepared according to NSW Heritage Office guidelines in Table 15 below.

Table 15: Statement of Heritage Impact for the proposal

| Development | Discussion |
|--|--|
| What aspects of the Proposal respect or enhance the heritage significance of the construction footprint? | <p>The proposed works are largely located outside the curtilage of heritage listed items, with only small portions of the construction footprint extending into Taronga Zoo Wharf (remains and seawall) [LEP no. A483] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482]. The proposed works would avoid impacts to significant archaeological remains associated with each of these items, which historical imagery has indicated would be located outside of the proposal footprint. As a result, there would be no impacts to significant archaeological remains.</p> <p>The upgrading of Taronga Zoo Wharf would introduce new intrusive visual elements in the area. However, the wharf would maintain its historical use within the area and the design has largely been limited to the establishment of a new access ramp to minimise the introduction of intrusive visual elements. The proposal would allow for 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 construction footprint? | <p>Vibrations associated with the proposed works have the potential to result in structural impacts to the sandstone retaining wall listed as part of the Taronga Zoo Wharf (remains and seawall) [LEP no. A483] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items. However, the risk of potential indirect impacts could be largely mitigated through control measures.</p> <p>The proposed works would introduce new intrusive visual elements in the vicinity of listed heritage items. However, the existing wharf is not being replaced, with only minor modifications proposed that would not drastically alter the aesthetics of the structure. The main intrusive visual</p> |

element proposed to be installed is the new access ramp. However, the access ramp would be consistent with those found at other Sydney ferry wharves and has been designed to be consistent with the aesthetics of the existing ferry wharf, utilising lightweight and consistent materials, simple lines, and muted colours. As a result, the proposed works would have minimal visual impact to the listed heritage items in the area.

In addition, the visual impact has been assessed as being neutral across all heritage items within the 1-kilometre visual buffer zone and would not impact to the overall setting and character of these items or their overall heritage significance.

Have more sympathetic options been considered and discounted?

Three options were assessed as part of the concept design. Options 1 proposed an accessible ramp on the western side of the jetty, whilst Option 3 proposed the demolition of the existing wharf and construction of a new wharf. Both options would have resulted in a greater visual impact and would have extended further into heritage curtilage. These options were discounted in favour of Option 2 (the current design) which proposed a simpler upgrade of the existing Taronga Zoo Wharf.

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 Taronga Zoo Wharf compliant with the requirements of the DDA
- The construction footprint is located within the curtilage of two heritage items listed on the Mosman LEP 2012:
 - Taronga Zoo Wharf (remains and seawall) [LEP no. A438]
 - Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482]
- The construction footprint is located adjacent to the curtilages of one heritage item listed on the Mosman LEP 2012:
 - Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34)
- The visual buffer zone for the construction site also includes:
 - The visual buffer zone of one heritage item listed on the World Heritage List (WHL):
 - Sydney Opera House (buffer zone) [WHL 166rev]
 - One heritage item listed on the State Heritage Register (SHR):
 - Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials (SHR no. 01838)
 - Ten items listed on the Mosman LEP 2012, North Sydney LEP 2013 and Sydney LEP 2012
- A preliminary archaeological assessment has determined that the construction footprint has nil to low potential to contain non-significant archaeological remains associated with Phase 1 (1788-1912 Informal use, land grants and military reserve), and moderate to high potential to contain locally significant archaeological remains associated with Phase 2 (1912-1959 Establishment of Taronga Zoo), including evidence of the former tram line and terminus, tracks and timber slats associated with the tram line construction, and evidence of the former Taronga Zoo Wharf, including timber piles, timber planks and ramp structure. However, based on the preliminary archaeological assessment the areas of significant archaeological potential are located outside of the proposal footprint, and earthworks associated with the proposal (limited to the footpath regrading) are unlikely to cause 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 impact on the identified heritage items resulting from the proposed works are summarised in the table below.

| Heritage Item | Direct | Potential direct | Indirect (visual) | Archaeological |
|--|---------|------------------|-------------------|----------------|
| Taronga Zoo Wharf (remains and seawall) | Neutral | Negligible | Negligible | Neutral |
| Athol Wharf Tram Terminus (including escarpment and retaining wall) | Neutral | Negligible | Negligible | Neutral |
| Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock | Neutral | Negligible | Negligible | Neutral |
| Sydney Opera House (buffer zone) | Neutral | Neutral | Neutral | Neutral |
| Ashton Park | Neutral | Neutral | Neutral | Neutral |
| Athol Gardens Dance Hall and Wharf Remains | Neutral | Neutral | Neutral | Neutral |
| Group of 4 houses | Neutral | Neutral | Neutral | Neutral |
| “The Castle”, flats | Neutral | Neutral | Neutral | Neutral |
| Divided Road | Neutral | Neutral | Neutral | Neutral |
| Cremorne Point Conservation Area | Neutral | Neutral | Neutral | Neutral |
| Cremorne Reserve (including Robertsons Point) | Neutral | Neutral | Neutral | Neutral |
| Site of Cremorne Smelter | Neutral | Neutral | Neutral | Neutral |
| Bradleys Head Forts and HMAS Sydney 1 Mast and Associated Memorials | 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 items. As a result, the proposal is consistent with the general requirements for exempt development under Section 20 of the 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 records
- In accordance with the sustainability requirements for the project, opportunities for the implementation of heritage interpretation should be investigated during detailed design. It is recommended that a Heritage Interpretation Strategy (HIS) be prepared for the proposal. The HIS would discuss the various media for heritage interpretation appropriate to the location and heritage significance of the Taronga Zoo Wharf
- The preliminary archaeological assessment has identified that there is moderate to high potential for archaeological remains of local significance to be present within the construction footprint. However, as the areas of significant archaeology associated with Phase 2 (evidence of the former

Taronga Zoo Wharf and Athol Wharf Road Tram Terminus) are located outside of the proposal footprint, significant archaeology would not be impacted. Furthermore, the preliminary archaeological assessment has found that the potential archaeological remains in the construction footprint 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 archaeological 'works' such as evidence of the former tramline and terminus are unexpectedly encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts
- 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 design changes result in additional earthworks and impacts to archaeological remains within the Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] or Taronga Zoo Wharf (remains and seawall) [LEP no. A438] heritage items, further archaeological assessment and management would be required. If underwater excavations are proposed in the curtilage of Taronga Zoo Wharf (remains and seawall) [LEP no. A438], then a maritime archaeological assessment should be undertaken to assess the potential for impacts to maritime archaeological remains of the former wharf
- 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
- It is unlikely that the vibrations associated with the proposed works would result in direct impacts to the sandstone retaining wall within the Taronga Zoo Wharf (remains and seawall) [LEP no. A438] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items or the buildings in Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34). However, a structural engineer should assess this to confirm if there are potential risks of vibration impacts. During 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 sandstone retaining wall in the Taronga Zoo Wharf (remains and seawall) [LEP no. A438] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items, and the buildings in Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34). 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 the Taronga Zoo Wharf (remains and seawall) [LEP no. A438] and Athol Wharf Tram Terminus (including escarpment and retaining wall) [LEP no. A482] heritage items or the buildings in Taronga Zoo – Upper & Lower Entrance Gates, Elephant House, Aviary, Floral Clock (LEP no. I34), 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 road and footpath surfaces must be reinstated as near as possible to their original state following the completion of works
- Any project redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to this SoHI.

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Appendix I

Procedure for Aboriginal Cultural Heritage Consultation and Investigation



4/06/2020

Rebecca Murray
Environment Officer
Environment Officer | Greater Sydney Project Office

Dear Rebecca

Re: Preliminary assessment results for the Taronga Zoo Ferry Wharf Upgrade *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

A handwritten signature in black ink that reads 'M. Lester'.

Mark Lester
Aboriginal Cultural Heritage Officer – Sydney Region
27-31 Argyle St Parramatta NSW 2150
Phone - 02 8849 2583 Mobile – 0448 731 510

Appendix J

Socio-economic Impact Assessment

Socio-economic Impact Assessment

Taronga Zoo Wharf Upgrade

AWE200198



Prepared for
Transport for NSW

21 December 2020

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Document Information

Prepared for Transport for NSW

Project Name Taronga Zoo Wharf Upgrade

File Reference AWE200198_R207_Rev 0_Taronga Zoo_SEIA.docx

Job Reference AWE200198

Date 21 December 2020

Version Number Rev 0

Effective Date 21/12/2020

Date Approved 21/12/2020

Document History

| Version | Effective Date | Description of Revision | Prepared by | Reviewed by |
|---------|----------------|---------------------------|--------------------|-----------------|
| V01 | 13/10/2020 | Draft for internal review | Naveena Wijesekara | Tanja Mackenzie |
| Rev A | 16/10/2020 | Draft for client review | Naveena Wijesekara | Tanja Mackenzie |
| Rev B | 16/11/2020 | Draft for client review | Naveena Wijesekara | Tanja Mackenzie |
| Rev 0 | 21/12/2020 | Final for client | Naveena Wijesekara | Tanja Mackenzie |

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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 improve the wharf interchange at Taronga Zoo (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).

Taronga Zoo wharf (the wharf) interchange is located near the cul-de-sac at the end of Athol Wharf Road on the northern shore of Sydney Harbour. The wharf is located in close proximity to the southern entry point of Taronga Zoo and near Sydney Harbour National Park, and Bradleys Head is located to the east of the wharf. Taronga Zoo wharf provides a starting point to the Balmoral Beach to Taronga Zoo foreshore walk and the coastal walk to Sirius Cove. Figure 1-1 and Figure 1-2 show the regional and local setting respectively.

Taronga Zoo wharf is a commuter wharf and a destination wharf for the neighbouring zoo, located about two kilometres south from the local centre along Military Road. The wharf is part of the F2 Ferry Service that operates between Circular Quay and Taronga Zoo.

The Proposal is to improve access to the wharf via a new accessible ramp and the addition of other accessible elements, including longer gangways and modifications to the existing jetty and pontoon to allow for accessible and more efficient passenger services.

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:

- > Retention of most of the existing jetty and covered pontoon. However, to accommodate the new longer gangways the existing jetty structure and pontoon roof structure would be cut back by about 3.5 metres
- > Removal of existing gangways
- > Installation of two new covered aluminium 18 metre dual-lane gangways between the cut back jetty and pontoon. Each gangway would be held in place by two new piles (four in total)
- > Two new transition ramps on the existing pontoon to cater for the new gangways
- > Replacement of two of the existing jetty canopies to accommodate the change in jetty size
- > Construction of a new covered Disability Standards for Accessible Public Transport (DSAPT) compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. The ramp would be held in place by nine new piles (three waterside and six landside)
- > Removal and relocation of the Transdev office and café on the existing jetty
- > Removal of the existing ferry arrestors on each side of the wharf to allow space for construction activities. Ferry arrestors would be replaced with two protection piles on each side of the wharf (four in total)
- > Changes to steel fencing on the pontoon to cater for changes in customer flows due to new gangways
- > Relocation of existing Opal Card readers and Opal top-up machine
- > Upgrade (where required) of safety and security features including lighting, closed circuit television (CCTV) security cameras, ladders to the water and tactile ground surface indicators, if required.

The land based features of the proposal would include:

- > Regrading of the footpath and bus stop to achieve DSAPT compliance to the new accessible ramp
- > Retention of the five existing bicycle parking hoops
- > Retention of the public telephone booth
- > Removal of foreshore vegetation to construct the new accessible ramp.

The proposal would be built over a duration of up to five months starting in late 2021. During construction the wharf would remain operational, however the café would be closed.

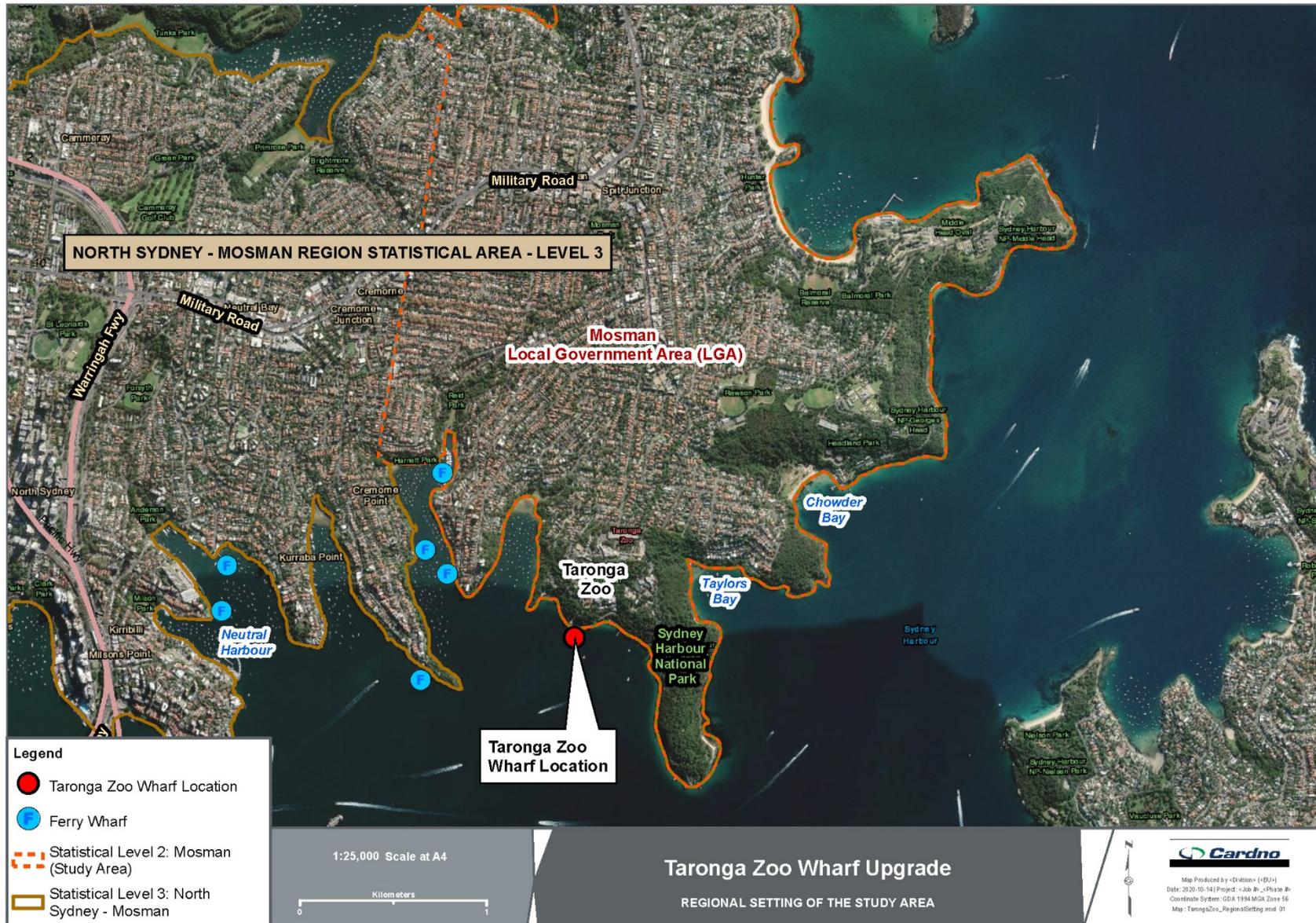


Figure 1-1 Regional setting of the Taronga Zoo wharf



Figure 1-2 Taronga Zoo wharf location and local setting

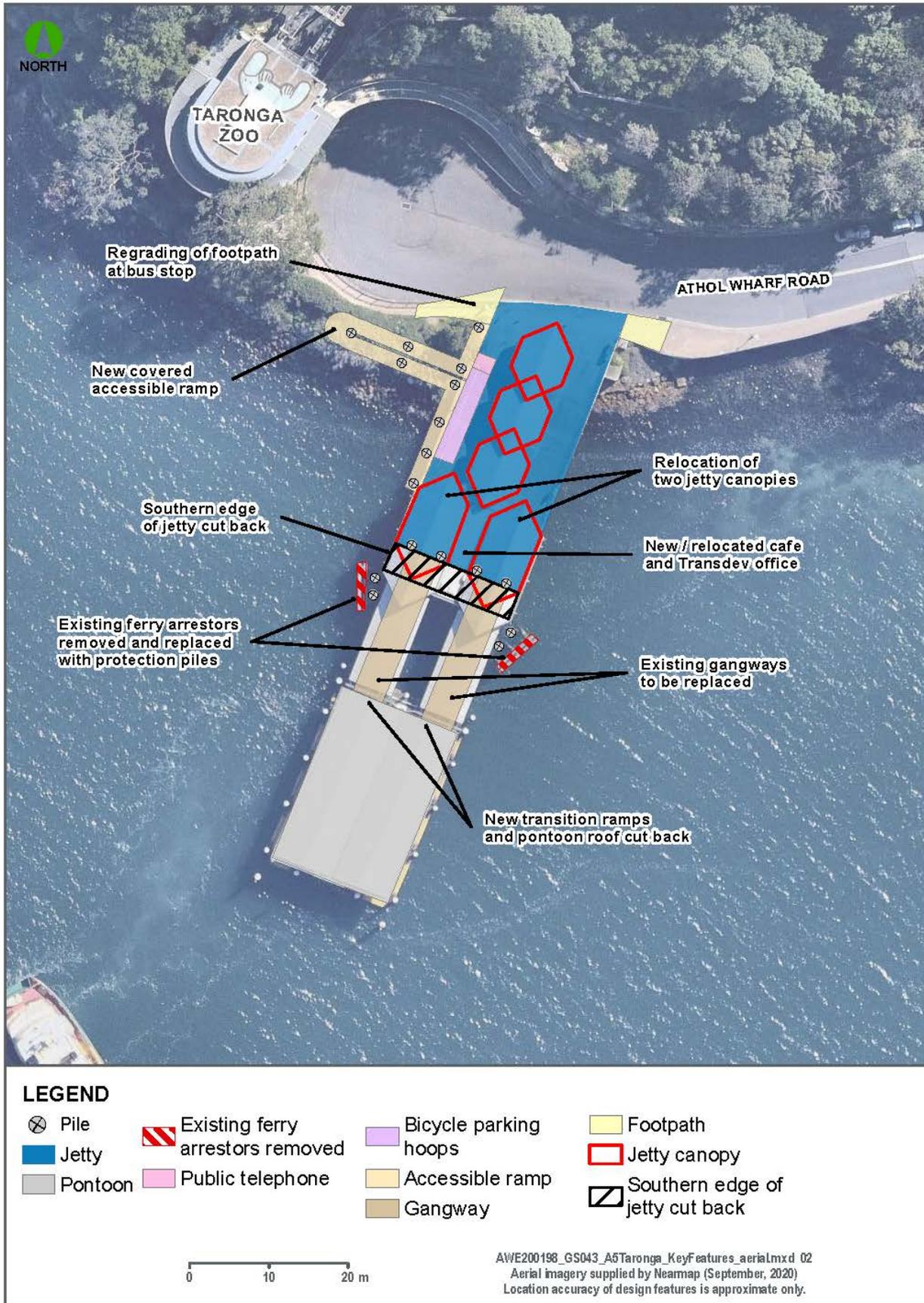


Figure 1-3 Key features of the proposal



Figure 1-4 Taronga Zoo wharf visualisation of proposed changes (Source: Urbaine, 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 users of the Taronga Zoo wharf, businesses around the wharf, 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, 2019a)
 - MOSPLAN: Community Strategic Plan 2018-2028 (Mosman Council, 2018a)
 - MOSPLAN: Revised Delivery Program 2018-2021 and Operational Plan 2020-2021 (Mosman Council, 2020a)
 - 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)
- > Taronga Zoo Wharf Upgrade Concept Design – July 2019 (NSW Government, 2019a)
- > Taronga Zoo Wharf Upgrade Stakeholder Meetings September, 2020 (NSW Government, 2020b) details the outcomes of consultations conducted with Taronga Zoo management
- > 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:

- > Landscape character and visual impacts: Taronga Zoo Wharf Upgrade (Cardno, 2020a)
- > Noise and vibration impact assessment: Taronga Zoo Wharf Upgrade (Cardno, 2020b)
- > Taronga Zoo Wharf – Ferry Wharf Upgrade Program TAP 3 – Communications and Stakeholder Engagement Plan 2020 (Cardno, 2020c).

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 Methodology for evaluating the significance of socio-economic impacts

The methodology for evaluating significance of the proposal impacts is adopted from the Practice Note (Roads and Maritime, 2013).

The proposal has the potential to affect road and water users, nearby residents, businesses, social infrastructure users and the wider community, both positively and negatively. The level of significance of potential impacts has been assessed by considering the sensitivity of the receptor and the magnitude of the proposed works. This includes the assessment of direct and indirect impacts and benefits.

The impact assessment presented in this report has used the following framework to identify and evaluate the changes to existing socio-economic conditions arising from the construction and/or operation of the proposal. The vulnerability to change and capacity to adapt is used to assess the sensitivity of communities, businesses, social facilities, residences etc. and the magnitude of impacts relating to the scale, intensity, spatial extent and duration of impacts.

The significance of an impact would depend on the magnitude of the impact, such as the intensity or duration of the effect and the scale or extent of the effect. Extent is the geographical area affected which may be local, suburb, regional, State, etc. Duration can be short, medium or long-term, hours of works, frequency, etc. The levels of magnitude are set out in Table 2-1.

Table 2-1 Levels of magnitude

| Magnitude | Example |
|------------|--|
| Negligible | No discernible positive or negative changes caused by the impact. Change from the baseline remains within the range commonly experienced by receptors. |
| Low | A discernible change from baseline conditions. Tendency is that the impact is to a small proportion of receptors over a limited geographical area and mainly within the vicinity of the project. The impact may be short term or some impacts may extend over the life of the proposal. |
| Moderate | A clearly noticeable difference from baseline conditions. Tendency is that the impact is to a small to large proportion of receptors and may be over an area beyond the vicinity of the project. Duration may be short term to medium or some impacts may extend over the life of the project. |
| High | A change that dominates over existing baseline conditions. The change is widespread or persists over many years or is effectively permanent. |

Sensitivity refers to the qualities of the receptor which influence its vulnerability to change and capacity to adapt. In this context the receptor may include the communities, businesses, business clusters, social infrastructure, residences etc. The levels of sensitivity are set out in Table 2-2.

Table 2-2 Levels of sensitivity

| Sensitivity | Example |
|-------------|---|
| Negligible | No vulnerability and able to absorb or adapt to change |
| Low | Minimal areas of vulnerabilities and a high ability to absorb or adapt to change |
| Moderate | A number of vulnerabilities but retains some ability to absorb or adapt to change |
| High | Multiple vulnerabilities and/or very little capacity to absorb or adapt to change |

2.4.2 Assessing level of significance

Only negative impacts are assigned a level of significance. The level of significance is considered for construction impacts and operational impacts.

Each issue or, alternatively each sub-issue is to be assigned a level of significance. For example, if the issue can be adequately addressed under one heading, such as 'community values' a level of significance of impact is to be assigned under that heading. Where sub-issues are needed under 'community values', each sub-issue is to be assigned a level of significance (but a level of significance is not needed for the overarching issue).

Table 2-3 is used to assess the level of significance of the potential impacts. This is done by combining the level of sensitivity and magnitude.

Table 2-3 Level of significance

| Sensitivity | Magnitude | | | |
|-------------|---------------|---------------|--------------|------------|
| | High | Moderate | Low | Negligible |
| High | High Impact | High-Moderate | Moderate | Negligible |
| Moderate | High-Moderate | Moderate | Moderate-Low | Negligible |
| Low | Moderate | Moderate-Low | Low | Negligible |
| Negligible | Negligible | Negligible | Negligible | Negligible |

The above methodology is not applied to positive impacts however these are assessed and discussed as appropriate.

2.5 Consultation

The SEIA has been informed by stakeholder 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.

Meeting with Mosman Council was held on the 6 February 2020 (Transport for NSW, 2020c) and 29 July 2020 (Transport for NSW, 2020d) to provide an update on concept design of both South Mosman and Taronga Zoo wharf upgrades to Mosman Council in preparation for community engagement.

Taronga Zoo management was consulted on the 4 September 2020 (Transport for NSW, 2020e) to inform them about the proposal, discuss Zoo operational impacts during the wharf construction, the proposal timing and schedule, and potential noise and vibration impacts on the Zoo.

A community consultation program will be implemented at the time of REF exhibition.

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 Taronga Zoo 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 (After: 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"> ▪ providing walkable places at a human scale with active street life ▪ prioritising opportunities for people to walk, cycle and use public transport. |
| 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</p> |

| | |
|------------------------|--|
| | to house older people and people with a disability, are increasingly required as the population grows and demographics change.” |
| 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 Taronga Zoo wharf is increasing and the demand for the ferry services are higher, necessitating the upgrade of the wharf infrastructure
- > Upgrading Taronga Zoo 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 Taronga Zoo 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 Taronga Zoo 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

| | |
|---|--|
| <p>MOSPLAN 2018-2028 Community Strategic Plan (Mosman Council, 2018a)</p> | <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> |
| <p>Disability Inclusion Action Plan 2017-2021 (Mosman Council, 2017a)</p> | <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> |
| <p>Mapping Mosman's Community Services and Programs (Mosman Council, 2018b)</p> | <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> |
| <p>Asset Management Marine Structures (Mosman Council, 2012)</p> | <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 Taronga Zoo 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 has 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 (Source: ABS, 2016)

| 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% |
| People who use multiple methods to travel to work | Bus as the primary method of travel to work | 21% | 17% |
| | 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.

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, the Study Area recorded a population of 30,877 (Mosman Council, 2019a). By 2041, the population 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 NSW. However, in 2016 the Study Area had the smallest ‘young workforce’ (12 per cent) when compared with

North Sydney–Mosman SA3 and the whole of NSW. 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.

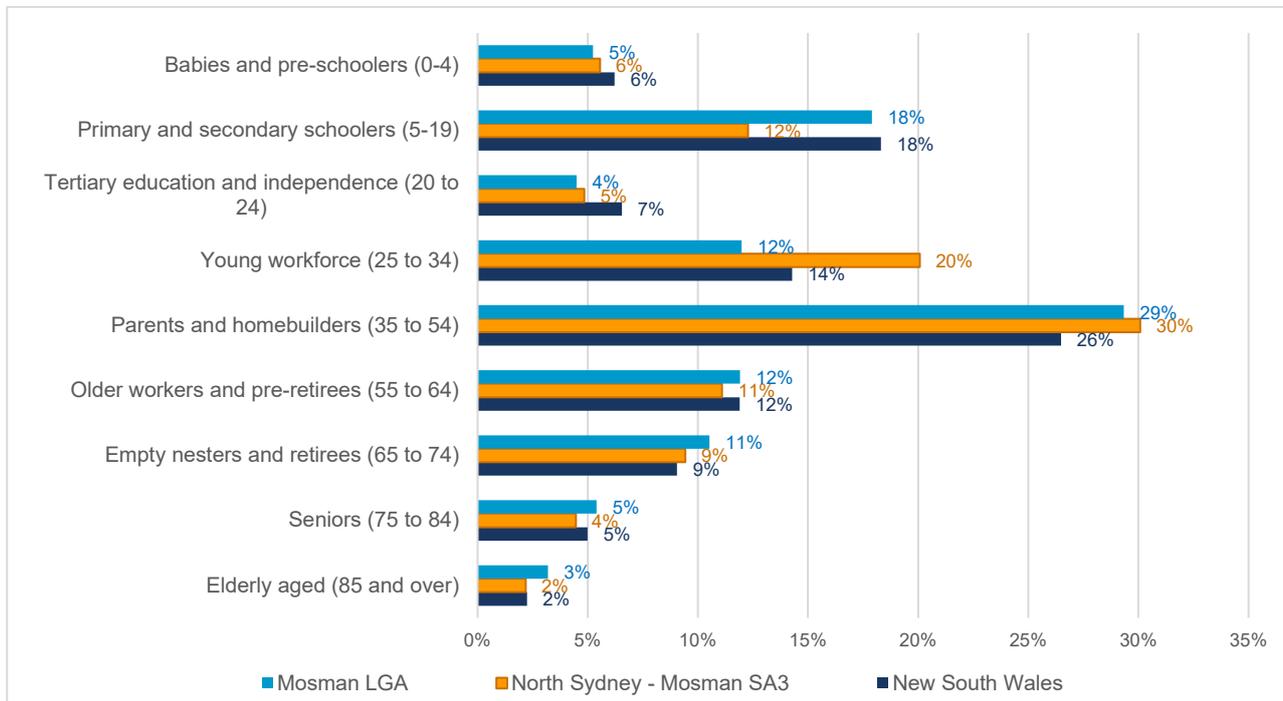


Figure 4-1 Age distribution of population in the Study Area (Mosman LGA), compared with North Sydney-Mosman SA3 and NSW in 2016 (Source: ABS, 2016)

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 (Source: ABS, 2018)

| 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 |

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 4-2, the majority of residents who use public transport are located along the arterial routes and near the main ferry wharves within the Study Area.

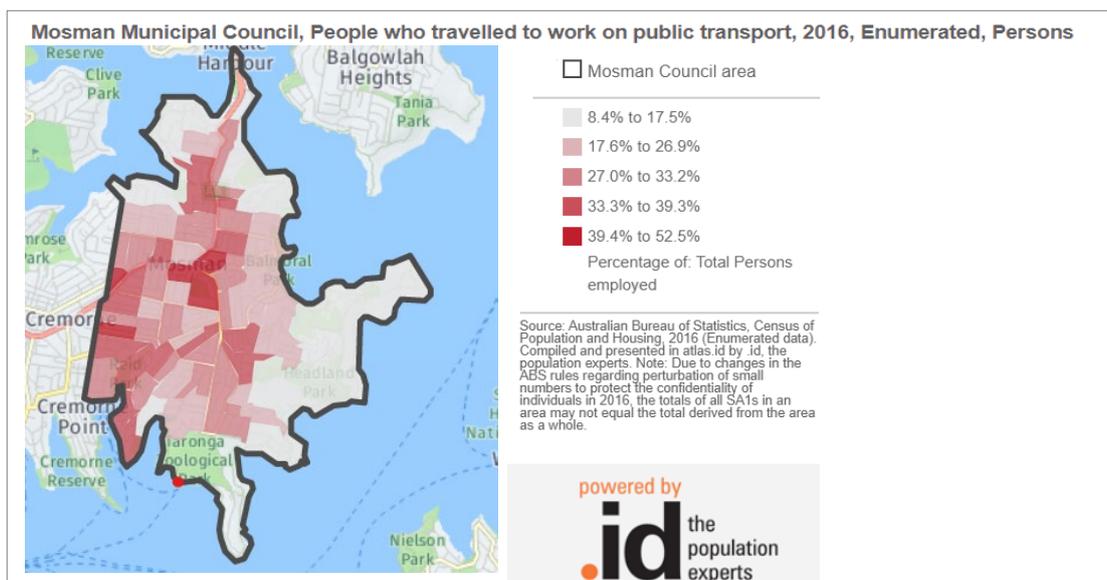


Figure 4-2 Statistical Area Level 1 data showing the percentage of people travel to work on public transport in 2016 within Mosman LGA (Study Area) (Source: Mosman Council, 2020c)

The Taronga Zoo wharf is accessible by both the Sydney ferry network and bus route 238. On-road cycling routes and bushwalking tracks are also provided around the Zoo. Transport options servicing the wharf are discussed below.

Ferry network

Taronga Zoo Sydney, located in Mosman, is a popular tourist attraction and the wharf is one of the busiest wharves in Sydney. This is due to a number of ferry operators providing services to the wharf: Harbour City Ferries, Captain Cook Cruises and Manly Fast Ferry. The peak one-hour period at Taronga Zoo wharf is on Sunday between 4-5 pm, when passengers are departing the zoo before its closure. Ferry services across the peak one-hour period at Taronga Zoo wharf are shown in Table 4-3.

Table 4-3 Peak ferry services at Taronga Zoo wharf (Aurecon, 2019)

| Ferry operator and service | Destination | No. of services, Sunday 16:00 to 17:00 |
|--|--------------------------------|--|
| Harbour City Ferries – F2 Taronga Zoo line | Circular Quay | 3 |
| Captain Cook Cruises – Taronga Zoo to City | Circular Quay, Darling Harbour | 3 |
| Manly Fast Ferry – Manly towards Darling Harbour | Circular Quay, Darling Harbour | 2 |

Taronga Zoo wharf forms part of Sydney’s extensive ferry network (Figure 4-3) which consists of 28 vessels serving eight routes and 39 wharves around the Sydney harbour and along the Parramatta River (Transport for NSW, 2013). Taronga Zoo ferry service (F2) operates mostly between Circular Quay and Taronga Zoo. However, during the weekday morning and evening peak hours, the F2 ferry will make additional stops at Cremorne Point and Mosman Bay. The journey between Taronga Zoo and Circular Quay is about 12 minutes.

On weekdays between 6:48 to 8:18, ferries operate clockwise from Circular Quay to Mosman Bay and then to Taronga Zoo (Transport for NSW, 2020a). From 8:50 to 16:50 ferries operate from Circular Quay direct to Taronga Zoo. In the evening from 17:15 to 18:45, ferries operate anti-clockwise from Circular Quay to Cremorne Point and then to Taronga Zoo (Transport for NSW, 2020a). During the weekend and public holidays, ferries operate from Circular Quay to Taronga Zoo direct from 9:00 to 18:50 (Transport for NSW, 2020a).

The service frequency varies from every 30 minutes during the weekdays to every 20 minutes on weekends and public holidays.

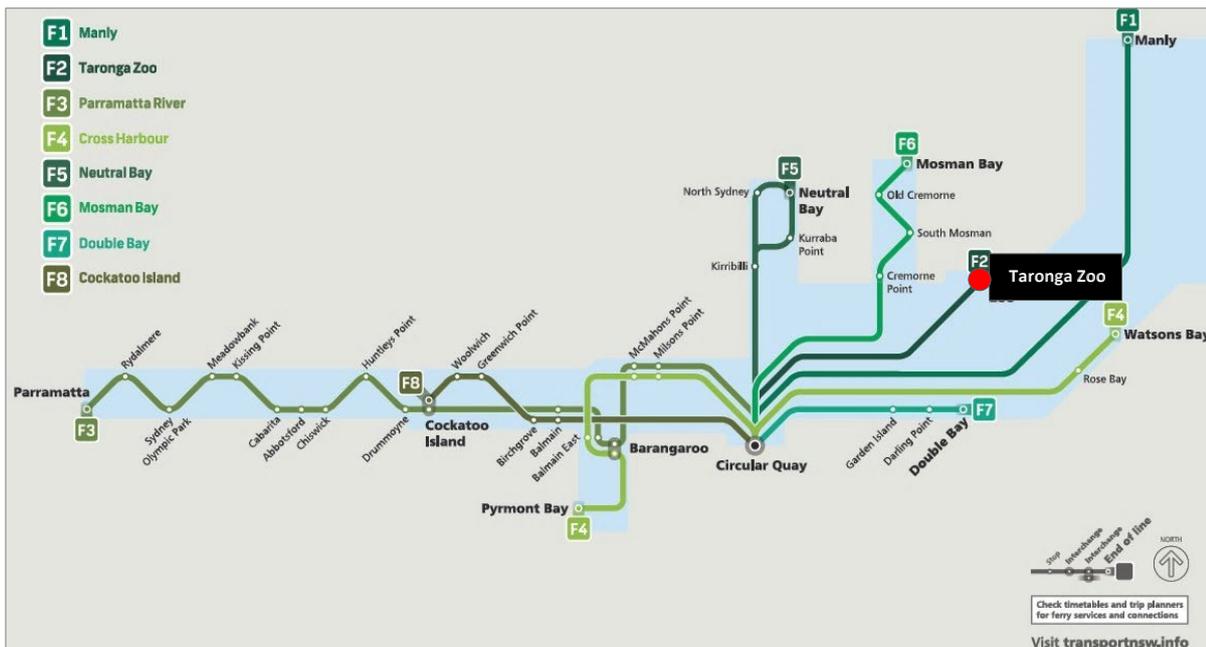


Figure 4-3 Sydney Ferries Network map with Taronga Zoo wharf highlighted (Source: TfNSW, 2017)

Around 16 million trips were made on the Sydney ferries network in 2019 (calculated using Opal Ferry Trips) and both Cross Harbour (F4) and Manly (F1) are the most popular routes. In 2019, passengers made about 1.45 million trips on Taronga Zoo line (F2), which represents about nine per cent of the total trips made on the ferry network (Transport for NSW, 2020b).

Captain Cook Cruises operates ferry services between Darling Harbour, Circular Quay, Taronga Zoo, Shark Island, Watsons Bay, Manly and Lane Cove. The frequency of services is varied throughout the day due to the different routes undertaken by each vessel. There are 13 services spread between 9am and 5pm on weekdays and 14 services on the weekend across the same time period. The journey between Darling Harbour and Taronga Zoo takes about 30 minutes (Aurecon, 2019).

Manly Fast Ferry operates a Taronga Zoo Sightseeing Cruise between Darling Harbour and Manly via Circular Quay, Taronga Zoo, Watsons Bay and Q Station. There are 11 to 12 services run throughout the week, generally between 9am and 4pm towards the Manly direction and around 12 to 13 services operate between 10am and 5pm towards Darling Harbour. Journey time to Taronga Zoo wharf varies from 35 minutes from Darling Harbour to 15 minutes from Circular Quay.

The 2017 data for the busiest peak hour of the week is provided in Table 4-4. By using 2017 Opal card data, the maximum number of boarding and alighting passengers from the wharf in an hour over a 10-month period was 801 (Table 4-4).

Table 4-4 Peak hour patronage at Taronga Zoo wharf in 2017 (Source: Aurecon, 2019)

| Peak hour of week – highest average one-hour period Jan-Dec2017 (day and hour) | 2017 patronage/hour | | | Special events maximum patronage – maximum patronage / hour 2017 (total boarding and alighting) |
|--|---------------------|-----------|-------|---|
| | Boarding | Alighting | Total | |
| Sunday, 16:00-17:00 | 744 | 57 | 801 | 1473 |

Future patronage information was based on population and employment forecasts for areas surrounding the wharf and based on Harbour City Ferry/Transdev services only. A further 15 per cent was added to the highest average 2036 forecast, which is the patronage used as the basis for the wharf design upgrade (Aurecon, 2019; refer to Table 4-5).

An additional patronage of 184 persons are anticipated during the peak hour for Manly Fast Ferry and Captain Cook Cruises (Aurecon, 2019).

Table 4-5 Future patronage forecasted for the Taronga Zoo wharf (Source: 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 |
| Sunday, 16:00-17:00 | 955 | 73 | 1028 | 1891 |

Road network

Taronga Zoo wharf is located about two kilometres south of Military Road and can be accessed via Athol Wharf Road, which connects Bradleys Head Road and Military Road to the wharf. Bradleys Head Road terminates at the end of the peninsula at Bradleys Head Light House.

Bus network

Bus route 238 (refer to Figure 4-4) services the wharf exclusively, traveling between Balmoral Beach and Taronga Zoo wharf. The bus stop is located directly outside the wharf entrance on Athol Wharf Road or at Taronga Zoo entrance. The entire journey takes about 15 minutes. The frequency of bus services on Route 238 range between 30 minutes on weekdays, and 20 minutes on weekends when there are large number of Zoo visitors. Bus services along this route operate more frequently (every 10 to 15 minutes) for trips between the wharf and the zoo's north entry point, rather than the full route. This shortened route is concentrated to periods when zoo visitors are arriving in the morning and departing in the afternoon.

As a ferry passenger visiting Taronga Zoo, entry is via the Zoo’s northern entrance by taking Sky Safari cable car from the wharf to the top, or via the Zoo’s southern entrance is about five-minute walk from the wharf along Athol Wharf Road. In addition to taking Sky Safari cable car, Zoo’s northern entrance can be reached by bus route 238, within two bus stops.

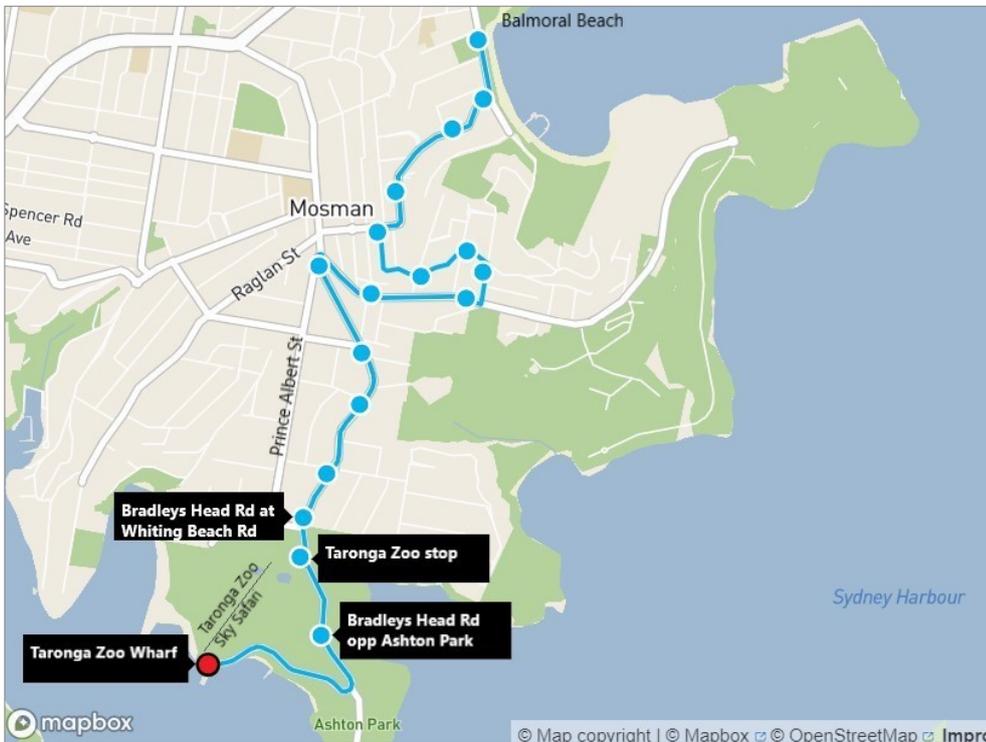


Figure 4-4 Sydney Buses Network – Route 238 (Source: Transport for NSW website <https://transportnsw.info/routes/details/sydney-buses-network/238/28238>)

Train network

Milsons Point Station and North Sydney Station are located about 4.9 kilometres (walking distance) away from the wharf. 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

On-road marked bicycle routes established by Mosman Council are present along Athol Wharf Road and Bradley's Head Road (northern section). These bicycle routes provide connectivity to Military Road in the north and towards the Pacific Highway, Milsons Point Station and North Sydney Station. Scenic cycling routes along Athol Wharf Road and Bradley's Head Road connect Mosman’s various parks and recreational areas such as Sydney Harbour National Park, Georges Heights, Chowder Bay and Balmoral Beach.

The wharf currently has five uncovered bicycle parking hoops.

Pedestrian access

Pedestrian access to the wharf is along Athol Wharf Road from the southern Taronga Zoo entry, as well as from the Taronga Zoo Sky Safari cable car. Taronga Zoo wharf also provides a starting point to the Balmoral Beach to Taronga Zoo foreshore walk.

4.3 Economic profile

Table 4-6 summarises the employment profile of the Study Area.

Table 4-6 Economic profile of the Mosman LGA (Source: ABS, 2016)

| Sub-category | Indicator | 2016 census |
|--------------|---|--|
| Income | Median total household income (\$/week) | 2,522 |
| | Median total personal income (\$/week) | 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 (ABS, 2016) number of local businesses due to the close proximity to the Sydney and North Sydney CBDs. 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 4-5. The main types of local businesses and service providers within 500 metres include:

- > Café located on Wharf jetty
- > Taronga Zoo and associated facilities
- > Athol Hall Function Centre.



Figure 4-5 Land planning zones, 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 in the Study Area (Figure 4-5), close to the proposal includes:

- > Local parks and recreational areas including:
 - Sydney Harbour National Park
 - Sirius Cove Reserve
 - Whiting Beach
 - Athol Beach
 - Curlew Camp Artists' Walk
 - Bradleys Head Walking Track
 - Bradleys Head Amphitheatre
- > Public transport facilities such as bus stops operating in the Athol Wharf Road and Bradleys Head Road.

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.

A community satisfaction survey conducted in 2017 (Mosman Council, 2017) 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.

4.6 Landscape character and visual amenity

Land use zoning across the study area is shown in Figure 4-5.

The wharf provides the southern entry point to Taronga Zoo and Sydney Harbour National Park, with the foreshore landscape being heavily vegetated with native and exotic tree species. The topography grades steeply down to the waterfront via sandstone cliffs. The character of the foreshore to the north and into Taronga Zoo is essentially dominated by vegetated hillsides with buildings and structures associated with the operations of the Zoo. A wide variety of buildings are scattered throughout the Zoo ranging from traditional to contemporary architectural types, which have been developed over the last 100 years, to cater for the vast array of animals that reside at the Zoo. The Zoo also includes a large cable car which stretches from the southern portion of the Zoo to the main entry point.

Sydney Harbour National Park is a prominent bushland area which wraps around the foreshore and Bradleys Head. A gentle bushwalk weaves around the harbour headland providing scenic views of the Harbour and towards the Sydney Opera House and Sydney Harbour Bridge.

There is a low-density residential area (see Figure 4-5) located outside the 500 metres from the wharf characterised by a mix of two to three storey residential dwellings and four to eight storey residential flat buildings. Architectural styles vary from Victorian and Federation dwellings, to more contemporary styles incorporating traditional architectural elements. The terrain generally slopes down from ridgelines towards the harbour. Tree lined streets and mature vegetation is interspersed through the residential areas which and contribute significantly to the visual character of the area.

Views from Little Sirius Point/Whiting Beach headland looking south-east toward the wharf, before and after the upgrade of the wharf, are provided in Figure 4-6 and Figure 4-7 respectively.



Figure 4-6 Little Sirius Point/Whiting Beach headland looking south-east toward the wharf (Source: Urbaine, 2020)



Figure 4-7 Post-upgrade views from Little Sirius Point/Whiting Beach headland looking south-east toward the wharf (Source: Urbaine, 2020)

Views from the Athol Wharf Road pathway looking south towards the wharf are provided in Figure 4-8 and Figure 4-9, both before and after the upgrade of the accessible ramp leading from the street level wharf entrance to the gangway entrances.



Figure 4-8 Athol Wharf Road pathway looking south toward the wharf (Source: Urbaine, 2020)



Figure 4-9 Post-upgrade views from accessible ramp leading from the street level wharf entrance to the gangway entrances pathway looking south toward the wharf (Source: Urbaine, 2020)

4.7 Heritage sites

The wharf is located in an area adjacent to several non-Indigenous heritage sites (Table 4-7) listed under the *Mosman Local Environmental Plan 2012* (Mosman LEP). These include former Athol Wharf Tram Terminus (including escarpment and retaining wall) and Taronga Zoo wharf (remains and sea wall).

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 section 6.10 and section 6.11 of the REF.

Table 4-7 Non-Aboriginal heritage sites within the proposal vicinity

| Item number | Site | Address | Approx. distance from project boundary (metres) |
|-------------|---|------------------|---|
| A482 | Former Athol Wharf Tram Terminus, including escarpment and retaining walls (Road reserve adjacent to Taronga Zoo Ferry Wharf) | Athol Wharf Road | Within project boundary |
| A483 | Site of first wharf serving Taronga Zoo (Taronga Zoo Ferry Wharf) | Athol Wharf Road | Adjacent to project boundary |

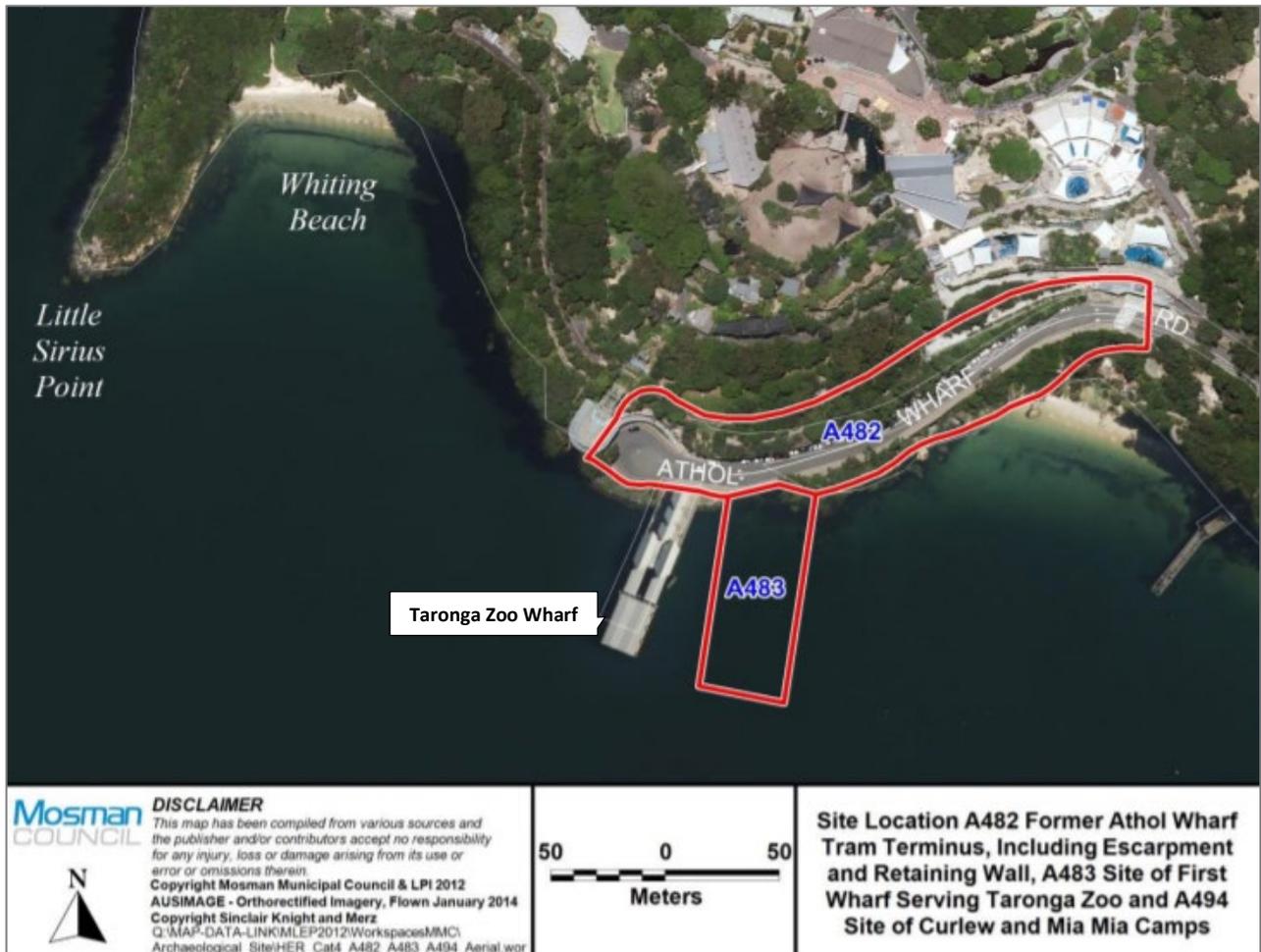


Figure 4-10 Non-aboriginal heritage sites around the Taronga Zoo wharf (Source: Mosman Council, 2015).

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 period of up to five months starting in late 2021. Due to the importance of the Taronga Zoo wharf to the adjoining Taronga Zoo and other recreational facilities, the construction and demolition activities would be staged and the wharf would remain operational during construction. However, there may be changes to the Taronga Zoo wharf ferry timetable during construction.

5.1.1 Transport and access impacts

Existing bus services would be used to support access to Taronga Zoo and surrounding areas as bus transport would remain unchanged. Ferry customers travelling from the City could catch the existing 430 bus service to the Bradleys Head Road and then catch 238 bus service along Athol Wharf Road to Taronga Zoo as an alternative to using the ferry service, if required.

Although Athol Wharf Road would remain open, temporary partial closure of the Athol Wharf Road cul-de-sac may be required during construction and demolition activities. These can potentially be undertaken at night to avoid any impacts to bus services and Taronga Zoo visitors. Alternatively, the delivery of wharf components could be via barge and installed by barge mounted crane.

Disruptions to ferry timetables may result in increased travel times for ferry users in the event they need to use bus services, or a combination of bus and train, when compared to travelling by ferry. Taronga Zoo visitors may also use private vehicles during the construction period, which may result in additional traffic and parking issues during the weekends and public holidays. Any disruption would be minimised via notification ahead of construction, and consequent updates provided to customers.

There would be a number of heavy vehicles accessing the proposal site via Athol Wharf Road and Bradleys Head Road during demolition activities, earthworks, and for installation of the access ramp. It is anticipated that most materials and equipment required for the land-based elements of the proposal would be delivered by road. Temporary traffic lights or stop-go provisions on Bradleys Head Road and Athol Wharf Road may be required if major deliveries take place by road. The additional construction traffic expected is considered minor in the context of existing levels of traffic in the area, and would be unlikely to affect the capacity of the road network. Any potential impact associated with construction vehicles accessing the site would be mitigated through the preparation and implementation of a traffic management plan.

A maritime exclusion zone may be required around the proposal footprint during construction to prevent unauthorised commercial and recreational traffic entering the works area.

It is expected that these 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).

5.1.2 Noise and vibration impacts

The noise and vibration impact assessment (Cardno, 2020b) identified that for a the worst case scenario, construction noise levels are predicted to exceed management levels for 'standard' and 'non-standard' hours of operation for all construction stages at nearby residential receivers. The most likely source of potential sleep disturbance from outside of construction hours works would be from piling proposed as early morning works.

Due to the close proximity of the works to receivers, the vibration associated with the piling works and additional plant have the potential to cause impacts to the archaeological remains of the former wharf, as well as the extant remains of the sandstone seawall. However, only a small number of piles are required and the potential impacts could also be largely mitigated through control measures listed in the noise and vibration impact assessment (Cardno, 2020b). As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal (Cardno, 2020b).

5.1.3 Local amenity

Noise, vibration, air quality and visual impacts from construction activities would disrupt the amenity of the area. This would directly impact visitors to the Taronga Zoo and recreational users, as well as residents living 500 metres from 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. Some vegetation clearing is required to construct the accessible ramp, however, this is considered to have a minor impact. The loss of amenity, along with disruption to ferry timetables, may discourage the use of these areas in the vicinity of the wharf during construction.

Construction activities may be required to carry out during Saturday mornings (8am to 1pm) when the Taronga Zoo wharf is busy with Zoo visitors and recreational users, and these customers would be disrupted by the activities.

The management measures described in Chapter 6 would aim to minimise these impacts on local amenity.

5.1.4 Local businesses

The existing café at the wharf would need to be demolished during construction and would be closed for the entire construction phase. This would inconvenience Taronga Zoo visitors and recreational users to the area who patronise the café.

Indirect impacts to Taronga Zoo and other 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 businesses and the community would be undertaken to determine sensitive periods for surrounding businesses and other receivers. The management measures described in Chapter 6 aim to minimise these impacts.

5.1.5 Opportunities

Construction activity would generate regional demand for services such as recruitment agencies, construction companies, suppliers and construction services. Local businesses such as cafes would benefit from the presence of construction personnel.

5.2 Operational impacts

The proposal would provide a range of long-term socio-economic benefits for the community of the Study Area and visitors to Taronga Zoo, as well as communities and businesses in the wider region.

5.2.1 Transport and access impacts

The existing wharf at Taronga Zoo is a large pontoon with two berths. The existing fixed jetty leading up to the bus stop and entrance to the Skyway is steep (1:10 grade) and the pontoon and shorter gangway are not fully DSAPT compliant. Customers with mobility needs currently use the gangways to get to the bottom of the jetty ramp. From there, assistance may be required for wheelchairs to get to the top of the jetty ramp.

The proposed wharf design includes a new covered DSAPT compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. Two new covered dual-lane aluminium gangways which would connect the fixed jetty structure to the pontoon would be constructed. The new features would provide an accessible pathway from the accessible ramp to the gangways and around the wharf facilities, including the Harbour City Ferries office, toilet and café.

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 users travelling to and from the wharf.

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

5.2.2 Landscape and visual amenity impacts

The overall visual impact of the proposed concept design for Taronga Zoo wharf, is considered moderate following the assessment of the viewpoints. The visual impacts generated by the proposal would be variable depending on the location of the viewer and distance from the wharf site.

The proposed Taronga Zoo wharf, which is an extension from the existing wharf, is expected to have a moderate impact on the landscape character of the surrounding area (Cardno, 2020a). The design is not considered to represent a significant contrast to the existing wharf and is relatively distant from some

sensitive receivers. Some vegetation clearing is required to accommodate the accessible ramped pathway, however, this is considered a minor impact on the landscape. The additional structures would increase the overall size of the existing wharf; however, would not have a significant impact on the existing landscape character. More detailed assessment of the visual impacts during operation are described in the Landscape character and visual impact assessment: Taronga Zoo wharf upgrade (Cardno, 2020a).

Ferry patrons and visitors to the zoo are expected to be the most affected by the proposed design from a visual perspective; however, it should be noted that the proposed design is provided to benefit and improve the experience of patrons making the wharf interchange more accessible for ferry users and zoo visitors.

5.2.3 Local businesses and community impacts

Once operational, the surrounding businesses would benefit from a moderate increase in visitor numbers to Taronga Zoo and nearby parks, thereby supporting the economic sustainability of many businesses.

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

5.3 Significance of impacts

Table 5-1 shows the significance of social and economic impacts of the proposal with regard to the factors of sensitivity and magnitude.

Table 5-1 Significance of impacts

| Impact | Stakeholder | Duration | Magnitude | Sensitivity | Significance |
|--|---|------------------------|------------|-------------|--------------|
| Construction Impacts | | | | | |
| Disruptions to ferry timetables may result in increased travel times for ferry users | Visitors to Taronga Zoo, visitors to the surrounding areas, local residents | Short term | Moderate | Low | Moderate-Low |
| Local road network congestion as a result of increased use of roads by visitors to Taronga Zoo | Local residents, visitors to Taronga Zoo | Short term | Low | Negligible | Negligible |
| Reduction in availability of local parking during the weekends and public holidays | Local residents | Short term | Low | Negligible | Negligible |
| Introduction of temporary access restrictions, diversions and traffic controls | Local residents, visitors to Taronga Zoo | Short term | Low | Negligible | Negligible |
| Construction noise and vibration | Local residents, visitors to Taronga Zoo, Taronga Zoo | Short term | Moderate | Low | Moderate-Low |
| Reduced local amenity (air quality and visual impacts) during construction | Local residents, visitors to Taronga Zoo, Taronga Zoo | Short term | Negligible | Negligible | Negligible |
| Reduced patronage of local businesses and Taronga Zoo | Taronga Zoo, local businesses | Short term | Low | Low | Low |
| Operational Impacts | | | | | |
| Visual impact of the proposed design Taronga Zoo wharf from nearby viewpoints | Local residents, visitors to Taronga Zoo | Medium term | Moderate | Negligible | Negligible |
| <i>Improved customer experience of ferry services from the wharf</i> | <i>Local residents, visitors to Taronga Zoo</i> | <i>Positive impact</i> | | | |
| <i>Improved access to services, and economic opportunities for locals</i> | <i>Local residents, visitors to Taronga Zoo</i> | <i>Positive impact</i> | | | |

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

| ID | Impact | Safeguards | Responsibility | Timing |
|-----|--------------------------------|--|--------------------------------|-----------------------------------|
| SE1 | General Socio-economic impacts | A Communications and Stakeholder Engagement Plan would 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): <ul style="list-style-type: none"> ▪ Mechanisms to provide details and timing of proposed activities to Zoo visitors, affected businesses, local community including changes to traffic, public transport services and access ▪ A contact name and telephone number for complaints. | Transport for NSW | Pre-construction/ Construction |
| SE2 | General Socio-economic impacts | <ul style="list-style-type: none"> • A webpage and free-call number will be established for enquiries regarding the proposal, and would remain active for the duration of construction. • Contact details will be clearly displayed at the entrance to the site. • All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received. | Contractor | Pre-construction/ Construction |
| SE3 | Socio-economic benefits | 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 benefits | Investigate opportunities to encourage the construction Contractor to purchase goods and services locally. | Contractor | Construction/ Construction |
| SE5 | Socio-economic benefits | Investigate opportunities to incorporate community health and well-being initiatives in the design and construction of the proposal. | Transport for NSW / Contractor | Design/ Construction |
| T2 | Land transport and parking | 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 and parking | Public transport passengers will be notified of any impacts to transport services and alternative transport arrangements prior to the commencement of construction and ancillary facilities on Athol Wharf Road. This will include updates to the timetable (online and Opal | Transport for NSW | Pre-construction/ construction |

| ID | Impact | Safeguards | Responsibility | Timing |
|----|--------------------|---|----------------|--------------|
| | | app) indicating the construction works at the Taronga Zoo wharf. | | |
| T4 | Maritime transport | <ul style="list-style-type: none"> • A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area. • This zone will be clearly defined to communicate access for other water users. | Contractor | Construction |

7 Conclusion

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 facing issues accessing the top of the jetty ramp. The existing wharf at Taronga Zoo is a large pontoon with two berths. The current fixed jetty leading up to the bus stop and entrance to the Skyway is steep (1:10 grade), and the pontoon and shorter gangway are not fully DSAPT compliant. Transport for NSW are planning to upgrade the wharf at Taronga Zoo to improve accessibility.

The proposed wharf design includes a new covered DSAPT compliant accessible ramp leading from the street level wharf entrance to the gangway entrances. Two new covered dual-lane gangways which would connect the fixed jetty structure to the pontoon would be constructed. The existing jetty would also be modified to comply with DSAPT requirements and provide an accessible pathway from the accessible ramp to the gangways and around the wharf facilities including the Harbour City Ferries office, toilet and café.

This SEIA has assessed the potential socio-economic impacts associated with the design, construction and operation of the proposal. The assessment has reviewed the designs of the proposal, existing environment, 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 disruption to Taronga Zoo visitors and recreational activities conducted around the wharf. There would be a short-term decline in local amenity due to noise, vibration and dust emissions, and some reduction in visual amenity. These impacts on the amenity of the locality would need to be carefully and proactively managed with Taronga Zoo management, local 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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