Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance and Commonwealth land

Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline (DUAP 1995/1996) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
Any environmental impact on a community? During construction of the proposal, there would be impacts from construction related noise to surrounding receivers and impacts to traffic and transport including closure of the existing Greenwich Point Wharf. Impacts would be minimised through implementing the safeguards and management measures identified in Chapter 7. Operation of the wharf would have improved public transport facilities at Greenwich Point Wharf.	Moderate, short-term negative Long term positive
Any transformation of a locality? Overall the proposal would have a moderate to high impact on visual and landscape character. Impacts would be reduced through the retention of vegetation and detailed design of the wharf.	Moderate to high, long term negative
Any environmental impact on the ecosystems of the locality? The assessment of biodiversity indicates there would be a minor impact to marine biodiversity during construction. Impacts to biodiversity would be minimised through implementing the safeguards and management measures identified in Chapter 7.	Minor, short term negative Negligible, long term
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? There would be temporary impacts during construction, including elevated noise levels and restricted recreational access. Landscape character and visual impacts have been assessed as moderate to high. Impacts would be reduced through the retention of vegetation and detailed design of the wharf. No long-term impacts to environmental quality and value are anticipated.	Moderate, short term negative Moderate to high, long term negative Negligible long term
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? The proposed work would result in a moderate direct impact to Greenwich Point Wharf (SHI no. 4920084, Lane Cove LEP no. I130). However, because a new wharf would be built in the same location, the heritage values of the item would be retained and the site would not be delisted from the Heritage and Conservation Register. The proposed work would not impact the overall significance of the other heritage items within and adjacent to the proposal area, or the heritage items within the visual buffer zone. Impact to heritage values would be minimised through implementing the safeguards and management measures identified in Chapter 7.	Minor/negligible long term
Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974)?* The assessment of biodiversity indicates there would be a minor impact to biodiversity during construction. The proposal would remove around	Minor, short term negative Negligible, long term

Factor	Impact
570 square metres of rocky reef/soft sediment and around 280 square metres of landscaped vegetation (mown lawn and ground cover). No threatened species were observed during the field survey, however, potential habitat for ten threatened fauna species with a moderate to high likelihood of occurrence occurs in the study area. The proposal is unlikely to have a significant impact on these threatened species. Impacts to biodiversity would be minimised through implementing the safeguards and management measures identified in Chapter 7 of the REF.	
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? 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.	No impact
Any long-term effects on the environment? The proposal would result in long term moderate to high landscape character and visual impacts. No other long-term negative effects on the environment are anticipated. The proposal would result in improvements in user amenity for the wharf.	Moderate to high, long term negative Long term positive
Any degradation of the quality of the environment? The proposal would result in localised sediment disturbance during demolition, piling and earthwork activities, which could result in temporary impacts to water quality. There is potential for accidental spills/leaks of fuel, oil or other chemicals to impact water quality during construction. Impacts would be minor with implementation of the safeguards and management measures identified in Chapter 7.	Minor, short term negative
Any risk to the safety of the environment? Construction related activities pose potential risks to the safety of the environment through spills/leaks of fuel, oil or other chemicals. Impacts would be minor with implementation of the safeguards and management measures identified in section 7.	Minor, short term negative
Any reduction in the range of beneficial uses of the environment? The proposal would not reduce the range of beneficial uses of the environment.	No impact
Any pollution of the environment? Construction related activities may result in pollution of the environment through spills/leaks of fuel, oil or other chemicals. Impacts would be minor with implementation of the safeguards and management measures identified in Chapter 7.	Minor, short term negative
Any environmental problems associated with the disposal of waste? All wastes generated by the proposal would be disposed of at an off-site facility which is licenced to receive such waste. There would be no significant environmental problems associated with waste disposal.	Minor, short term negative
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? All resources required by the proposal are readily available and are not likely to become in short supply.	No impact

Factor	Impact
Any cumulative environmental effect with other existing or likely future activities? Other projects with the same timing of this proposal include upgrade of other wharfs in the ferry network, and building developments in the Lane Cove LGA. There may be a minor increase in traffic, and noise impacts. No other significant cumulative impacts have been identified for the proposal.	Minor, short term negative
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposal design includes an allowance for climate change projections including sea level rise. No significant impacts to these issues are anticipated for the proposal.	No impact

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following MNES 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
Any impact on a World Heritage property? Impacts to heritage items listed on the WHL, NHL and CHL as a result of the proposal would be limited to negligible visual impacts.	Negligible
Any impact on a National Heritage place? Impacts to heritage items listed on the WHL, NHL and CHL as a result of the proposal would be limited to negligible visual impacts.	Negligible
Any impact on a wetland of international importance? There are no nationally important wetlands or Ramsar Wetlands in the proposal area or the wider study locality. The closest Ramsar Wetlands are located at Towra Point Nature Reserve, over 16 kilometres south of the proposal area.	No impact
Any impact on a listed threatened species or communities? Three threatened species listed under the EPBC Act were considered to have a moderate to high likelihood of occurrence in the proposal area. The biodiversity assessment (refer section 6.3) concluded that the proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the EPBC Act..	Minor, short term
Any impacts on listed migratory species? No migratory species under the EPBC Act were considered to have a moderate or high likelihood of occurrence in the proposal area. This area is unlikely to be occupied by migratory species due to the level of disturbance from pedestrians and domestic cats. Impacts to these species as a result of the proposal are considered unlikely.	No impact
Any impact on a Commonwealth marine area? The proposal area does not reside within any Commonwealth marine reserves. The closest marine reserves are the Hunter Commonwealth Marine Reserve, approximately 170 kilometres north of the proposal area, and the Jervis Commonwealth Marine Reserve, approximately 127 kilometres south of the proposal area.	No impact
Does the proposal involve a nuclear action (including uranium mining)?	No impact
Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	No impact

Appendix B

Statutory consultation checklists

Infrastructure SEPP

Certain development types

Development type	Description	Yes/No	If 'yes' consult with	ISEPP clause
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No	-	ISEPP cl. 95A
Bus Depots	Does the project propose a bus depot?	No	-	ISEPP cl. 95A
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	-	ISEPP cl. 95A

Development within the Coastal zone

Issue	Description	Yes/No/ NA	If 'yes' consult with	ISEPP clause
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	N/A	-	ISEPP cl. 15A

Note: See interactive map here: https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Stormwater	Is the work likely to have a *substantial* 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 *strain* 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 *substantial* impact on the capacity of any part of the system?	No	-	ISEPP cl.13(1)(c)
Water usage	Would the work involve connection to a council owned water supply system? If	No	-	ISEPP cl.13(1)(d)

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
	so, would this require the use of a *substantial* volume of water?			
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 *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	Yes	LCC	ISEPP cl.13(1)(e)
Road & footpath excavation	Would the work involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes	LCC	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 *minor* or *inconsequential?*	Yes	LCC	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 *minor* 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 *National Parks and Wildlife Act 1974*, 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 *Marine Estate Management Act 2014*?	No	-	ISEPP cl.16(2)(c)
Sydney Harbour foreshore	Is the work in the Sydney Harbour Foreshore Area as defined by the *Place Management NSW Act 1998?*	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 *Mine Subsidence Compensation Act 1961*?	No	-	ISEPP cl. 16(2)(i)

Sydney Harbour SREP consultation

Issue	Potential impact	Yes/No	If 'yes' consult with	SREP clause
Provision of services	Do the works require the provision of services (including water, sewerage or stormwater systems)?	Yes	Ausgrid, Sydney Water	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
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

Issue	Potential impact	Yes/No	If 'yes' consult with	SREP clause
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?	Yes	DPIE (former Foreshores and Waterways Planning and Development Advisory Committee)	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 skis (ie an inclined ramp used for the manual launching of small craft but not including a slipway)?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Swimming enclosures	Do the works include a swimming enclosure?	No	-	SREP cl.31(2)(a)(i) & Schedule 2
Water based restaurants and entertainment facilities	Do the works include water based restaurants and/or entertainment facilities? (ie 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

Issue	Potential impact	Yes/No	If 'yes' consult with	SREP clause
Waterfront access 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 C

Preliminary site investigation

Preliminary Site Investigation

Greenwich Point Wharf Upgrade

AWE200198

Prepared for
Transport for NSW

30 November 2021

Cardno

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards NSW 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9439 5170

Document Information

Prepared for	Transport for NSW
Project Name	Greenwich Point Wharf Upgrade
File Reference	AWE200198_R405_Rev0_GreenwichPoint_PSI.docx
Job Reference	AWE200198
Date	30 November 2021
Version Number	Rev 0

Author(s):

Erin Probert
Experienced Environmental Scientist

Effective Date 30/11/2021

Approved By:

Sam Levi (CEnvP CS)
Principal Environmental Geoscientist

Date Approved 30/11/2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
Rev A	20 April 2021	Draft for client review	Dan McCallum	Sam Levi
Rev B	24 September 2021	Draft for client review (incorporating new design)	Erin Probert	Sam Levi
Rev C	11 October 2021	Final draft for client review	Erin Probert	Sam Levi
Rev 0	30 November 2021	Final report	Erin Probert	Sam Levi

© Cardno. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

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 to undertake a Preliminary Site Investigation (PSI) to evaluate the risk of land and water contamination at the Greenwich Point wharf. Transport for NSW proposes to upgrade the wharf at Greenwich (the Site) as part of the NSW Government's Transport Access Program (TAP). The proposal is to improve access to the wharf via a new footpath, skybridge, lift, jetty, gangway and pontoon. The proposal also includes the removal of the existing wharf structure.

Construction of the land-based elements would involve earthworks including excavation for the lift and staircase structures, and piling. Construction of the water-based elements, including the new gangway and pontoon, would require piling in the waterway.

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

- Identify historical sources of potential contamination or potentially contaminating activities that may have taken place on or adjacent to the Site
- 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 that occurred on the 2 March 2021, the following contaminating activities at the Site were identified:

- Fill material that was imported to the landside portion of the Site during construction of Greenwich Point wharf and ancillary features
- Other potential contamination legacy migration to landside and waterside portions of the Site from Sydney Harbour, particularly from Cockatoo Island.

The following contaminants of concern were identified as having potential to occur at the Site:

- Polycyclic aromatic hydrocarbons (PAH)
- Total recoverable hydrocarbons (TRH)
- Heavy metals
- Tributyltin (TBT)
- Organochlorine pesticides/Organophosphorus pesticides (OCP/OPP).

Preliminary assessment of risk

The information sourced during preparation of this PSI has been utilised to determine the likelihood for historical and current land use activities to have affected the suitability of the Site. Taking into consideration the available background data and the site inspection, the main sources of possible contamination are:

- Potentially impacted fill materials imported to the landside portion of the Site. The current impacts and origin of soils at the Site are unknown. It is possible that impacted materials have been transported to the Site during construction activities in the 1980's. The Site history indicates that there is low to medium risk that impacted soils are present at the Site
- Contaminated sediments in the waterside portion of the Site. The previous assessment by Coffey (2016) indicates that sediment is contaminated with concentrations of various analytes above the adopted criteria. There is a medium risk that impacted sediment could be disturbed during the piling works. There is potential acid sulfate soils (ASS) in sediments at depths greater than 0.2 metres below the seabed level
- Groundwater on the landside portion of the Site may be impacted by tidal influences from Sydney Harbour. Historical crude oil and marine fuel spills at the Gore Cove terminal could have impacted the underlying groundwater at the landside portion of the Site due to tidal influences from Sydney Harbour. The condition of water entering the landside portion of the Site from the harbour can change depending on tides and storm events (Birch and Taylor, 2004). Further, if subsurface soil is impacted, it is possible that contaminants could be leaching to the underlying groundwater and tidal flows could be transporting contaminants into Sydney Harbour from the landside portion of the Site.

Conclusions

Soil

The landside soil impacts at the Site are currently unknown. Due to the age of the Site, there is potential that fill material of unknown quality and sources is present at the Site from the land contouring, road construction and maintenance of the ferry wharf and/or other sources.

Sediment

Previous investigations by Birch and Taylor (2004) indicate that sediment at the Site could contain elevated levels of contaminants. Sampling undertaken by Coffey (2016) found that there were elevated concentrations of mercury, lead, and the following PAHs; benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, pyrene and total PAH. There is some potential that sediment from Cockatoo Island has been transported to the Site. There is potential ASS in sediments at depths greater than 0.2 metres below the seabed level.

Groundwater

Impacts to groundwater are currently unknown. There are no groundwater monitoring wells on-site, however, it is considered possible that groundwater underlying the landside portion of the Site could be impacted by historical crude oil and marine fuel spills and possible leaching of potentially contaminated onsite soils into the underlying groundwater with tidal flows of Sydney Harbour.

Recommendations

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

- The piling activity shall mitigate the risk of sediment dispersal by applying industry best practice using pilling methods or any other seabed interference
- Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's W*aste 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
- Future waste classification works are to be designed and undertaken by a suitably qualified contaminated land specialist
- An Unexpected Finds Protocol should be followed for excavation and pile boring.

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background

Transport for NSW proposes to upgrade the wharf at Greenwich (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 to improve 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 people with mobility issues
- Existing and predicted future patronage and use.

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

- Improve the accessibility for people with mobility issues by providing accessible paths and 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.
- Design for sea level rises.

1.2 Proposal description

The proposal is to upgrade the Greenwich Point wharf as part of the TAP.

The water based features of the proposal would include:

- Installation of a new three metre wide by 22 metre long concrete jetty, supported by eight new piles
- Installation of a new, uncovered 18 metre long by 2.5-metre-wide gangway to provide access to the new pontoon
- Installation of a new covered steel nine metre by 18 metre pontoon containing a curved zinc roof supported by steel columns, glass weather protection, stainless steel balustrades, seating and information boards. The pontoon would be supported by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of new signage, information boards and opal card readers
- Installation of safety and security features including a help point, lighting, closed circuit television (CCTV) cameras, ladders to the water, a life buoy and tactile ground surface indicators where required
- Removal of the existing waiting shelter, jetty and tidal stairs including associated piles.

The land based features of the proposal would include:

- Construction of a 9.8-metre-long skybridge from the approximate location of the existing bus shelter on Lower Serpentine Road, connecting the existing footpath to the proposed lift
- Relocation of the existing bus shelter on Lower Serpentine Road approximately three metres to the east to accommodate new skybridge entrance
- Construction of a 12 metre high lift that connects the proposed skybridge to the wharf level. Five metres of the lift would be visible from street level
- Regrading of pavement at street level and wharf level to create the entry/exit points of the skybridge, stairs and lift
- Replacement of the existing non *Disability Discrimination Act 1992* (DDA) compliant stairs with DDA compliant stairs connecting Lower Serpentine Road and the new wharf, near the proposed lift. The new stairs would use part of the existing stair footprint on Lower Serpentine Road, which currently connects Mary Carlson Park to wharf level
- Partial excavation of the embankment to provide room for the new stairs connecting at the western side of the existing bus shelter

- Installation of three bicycle hoops
- Replacement of balustrades and handrail at wharf level
- Electrical work including relocation of existing electrical switchboard cabinet at wharf level, removal of two existing power poles and placing existing electrical overhead wires underground
- Pruning of fig trees to accommodate the new skybridge, stairs and lift
- Retention of the current existing ramp near Greenwich Park connecting road level to the foreshore.

Figure 1 in Appendix A shows the key features of the proposal including the water-based and land-based features.

Construction of the land-based elements would involve earthworks including excavation for the lift and staircase structures, and piling. Construction of the water-based elements, including the new gangway and pontoon, would require piling in the waterway.

1.3 Purpose and objectives

Cardno NSW/ACT Pty Ltd (Cardno) was engaged by Transport for NSW to undertake a Preliminary Site Investigation (PSI) to determine the risk of contamination at the Greenwich Point wharf and immediate surrounds. The study area for the PSI is defined by the proposal area presented in Figure 2 in Appendix A (the Site).

The purpose of the PSI is to provide Transport for NSW with preliminary advice on the potential constraints at the Site from a soil and groundwater 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 Site
- Identify potential sources and indicators of contamination including potential sensitive receptors.

1.4 Scope

The following tasks were undertaken 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* (ANZECC, 1999)
- *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM) (NEPC, 1999)
- *Managing Land Contamination: Planning Guidelines: SEPP 55 Remediation of Land* (DUAP, 1999)
- *Waste Classification Guidelines* (EPA, 2014)
- *Consultants reporting on contaminated land Contaminated land guidelines* (EPA, 2020)
- *Lane Cove Local Environmental Plan 2009* (Lane Cove LEP).

2 Site condition and surrounding environment

The Site is located on the southern peninsula of the suburb of Greenwich NSW. The Site is bound by Sydney Harbour to the south. The northern portion of the Site is bound by Lower Serpentine Road, Mitchell Street and low density residential dwellings. To the east and west are recreational areas; Mark Carlson Park and Greenwich Park respectively.

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	Mitchell Street, Greenwich Sydney Harbour at Greenwich Point
Approximate Site Area	0.7 hectare
Title Details	> Lot 117 DP 913826 (part of Greenwich Park) > Lot 265 DP 752067 (part of Greenwich Park) > Lot 1121 DP 752067 (part of existing wharf, former wharf) > Lot 116 DP 913826 (grass verge opposite wharf entrance) > Road corridor (Lower Serpentine Road, Mitchell Street) > Works below mean high water mark
Local Government Area (LGA)	Lane Cove Council
Suburb	Greenwich
Site Owners at the time of this engagement	Crown land > Lot 117 DP 913826 (part of Greenwich Park) > Lot 265 DP 752067 (part of Greenwich Park) > Lot 1121 DP 752067 (part of existing walk) > Lot 116 DP 913826 (grass verge opposite wharf entrance) Lane Cove Council > Road corridor (Lower Serpentine Road, Mitchell Street) Roads and Maritime / Transport for NSW: > Works below mean high water mark.

2.2 Site description

The Site is irregular in shape and located to the south of Lower Serpentine Road on the foreshore of Greenwich. It is understood that Greenwich Point wharf has remained unchanged since at least 1986 (refer Table 3-1). Currently the Site consists of a concrete footpath from Mitchell Street and stairs from Lower Serpentine Road that descend to Greenwich Point wharf on the foreshore.

An inspection of the Site was undertaken on 2 March 2021. Details and observations made during the site inspection are 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 waterside portion of the Site is currently used as a berthing point for the F8 Circular Quay to Cockatoo Island ferry network. The landside portion of the Site is a foreshore and recreational area, bordered by the road corridor.
Weather condition	Sunny
Site Slope and Drainage Features	The Site slopes downward to the south, with a cliff located between Lower Serpentine Road/Mitchell Street and the foreshore. A stormwater pit was observed within the kerbside guttering of Lower Serpentine Road. It is anticipated that overland flow along Lower Serpentine Road and Mitchell Street

Item	Observations
	is collected in the kerbside gutters and underlying drain network to be directed into Sydney Harbour.
Nearby water bodies	A portion of the Site lies within Sydney Harbour.
Site surface coverings	The landside portion of the Site is contains, grass, shrubs and mature trees. Road, footpaths and stairs comprise the only hardstand areas within the Site.
Site cut and fill	The natural environment of the Site has been heavily modified to form Greenwich Park and Greenwich Point 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 existing wharf structures.
Manufacturing, industrial or chemical processes and infrastructure	The ferry wharf which acts as a berthing point for ferries on the F8 Circular Quay to Cockatoo Island Network.
Fuel storage tanks (USTs/ASTs)	Not observed.
Dangerous goods	Not observed.
Solid waste deposition	General waste and recycling receptacles were observed on the existing Greenwich Point wharf.
Liquid waste disposal features	Not observed.
Evidence of previous site contamination investigations	Stage 2 Contamination Assessment – Greenwich Point Ferry Wharf (Coffey, 2016)
Evidence of land contamination (staining or odours)	Not observed.
Evidence of groundwater contamination	Not observed.
Groundwater use	Not observed.
Vegetation	Established trees and low-lying vegetation are present on top of the rocky outcrop that separates the wharf and the footpath.. Greenwich Park and Mary Carlson Park is primarily grass-covered with sparse established trees.

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	Residential, Recreational	Low density residential, Mitchell Street, Lower Serpentine Road
South	Waterway	Sydney Harbour
East	Residential, Recreational	Low density residential, Lower Serpentine Road, Mary Carlson Park, Sydney Harbour
West	Waterway	Low density residential, Greenwich Park, Sydney Harbour

2.4 Topography and drainage

The Site is located on the southern foreshore of Greenwich Point and is comprised of a landside and waterside portion. The Site is comprised of hardstand surfaces of Mitchell Street and Lower Serpentine Road, and associated footpaths that lead to the foreshore. A footpath runs along the length of Mitchell Street and Lower Serpentine Road which separates the road from foreshore vegetation. The footpath provides

access on the western side of the wharf via a sloping path through Greenwich Park. Stairs provide access from the eastern side of the footpath to the wharf. The waterside portion is comprised of Sydney Harbour with Greenwich Point wharf above the sea level.

The landside portion of the Site slopes downward to the south. The elevation of the northern portion of the Site is approximately 14 mAHD with the southern portion approximately 4mAHD. A sandstone retaining wall separates the landside and waterside portions. Approximately three metres to the north of the wharf is a rocky outcrop which rises sharply to approximately 10 mAHD. The Site is located at the end of Lower Serpentine Road and Mitchell Street which both increase in elevation to the north.

During rainfall events it is expected that overland flow from Lower Serpentine Road and Mitchell Street is directed toward the Site due to the sloping topography.

The bathymetry at the site slopes from 0 metres Chart Datum (CD), at the foreshore to -6.5 metres CD about 20 metres from the foreshore at the end of the existing wharf.

2.5 Flood potential

The Site is unlikely to be subject to flooding as no flood planning areas were identified in the Lane Cove LEP.

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 landside portion of the Site is underlain by Hawkesbury Sandstone, which is characterised by medium to coarse grained quartz sandstone, very minor shale and laminite lenses.

The waterside portion is underlain by estuarine basin and bay, which is characterised by clay, silt, shell and very fine to fine grained lithic quartz sand.

2.6.1 Acid sulfate soils (ASS)

A review of the Australian Atlas of Acid Sulfate Soils (ASRIS) on the 1 February 2021 indicates there is a high probability of occurrence for ASS in the subtidal marine environments. The landside portion of the Site is not within any classified zone of the Lane Cove LEP, with the risk considered low.

2.6.2 Salinity

During the background information review, there were no salinity hazards identified.

2.7 Groundwater database

A search of the Australian Groundwater Explorer database identified three groundwater bores within 500 metres of the Site. Information obtained from the database is summarised in Table 2-4.

Table 2-4 Groundwater bore details

Bore ID	Bore depth (mBGL)	Drilled Date	Purpose	Distance (m) / direction
GW103997	4.5	26/08/1998	Monitoring	469 m / north-east
GW109590	4.4	30/04/2003	Monitoring	486 m / north-east
GW109592	4.5	5/09/2003	Monitoring	495 m / north-east

**below ground level*

The waterside portion of the Site includes Sydney Harbour. It is expected that there would be tidal influence to groundwater on the landside portion of the Site. Sydney Harbour has been identified as having high levels of water contamination which would vary from tide and storm flows (Birch and Taylor, 2004).

2.8 Previous environmental reports

2.8.1 The Contaminant Status of Sydney Harbour Sediments, A handbook for the Public and Professionals (Birch and Taylor, 2004)

The study into the contaminant status of Sydney Harbour primarily assessed four groups of contaminants:

- Heavy metals
- Organochlorine pesticides (OCP) residues
- Polycyclic aromatic hydrocarbons (PAH)
- Polychlorinated biphenyls (PCB).

Assessment of organic compounds such as total recoverable hydrocarbons (TRH) were not undertaken due to cost.

The location of the Site is within the upper harbour, upstream of the Harbour Bridge and is not as well flushed as areas in the lower harbour. The study did not include any sampling locations that would be considered representative of the sediment located at the Site, however the interpolated findings indicated that OCP and PCB may be present at the Site.

2.8.2 Stage 2 Contamination Assessment – Greenwich Point South Ferry Wharf (Coffey, 2016)

Coffey Geotechnics Pty Ltd (Coffey) was commissioned by Hansen Yuncken (HY) to provide a contamination assessment for the proposed Greenwich Point wharf upgrade. The project area for this assessment was the waterside portion of Greenwich Point and included taking two sediment samples in the harbour to assess the contamination and ASS potential of soils as well as to provide an indicative waste classification.

During fieldwork, the sediment encountered was described as medium to coarse grained, dark grey silty sand, with some shells. This layer was encountered at depths ranging between 1.6 metres to 3.2 metres below the seabed surface and was underlain by sandstone. Analytical laboratory results indicated that the top 0.2 metres below sea level sediment had concentrations above the ANZECC (2000) Australia and New Zealand Guidelines for Fresh and Marine Water Quality, Table 3.5.1 – Interim Sediment Quality Guidelines (ISQG) Low criteria for mercury, lead, and the following PAHs; benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, pyrene and total PAH. No analytes were recorded above the ISQG high criteria.

ASS were not identified in the shallow samples, however it is anticipated that deeper sediments could contain ASS.

2.8.3 Cockatoo Island Management Plan (Sydney Harbour Federation Trust, 2017)

The Cockatoo Island Management Plan (Sydney Harbour Federation Trust, 2017) provides information on the contamination status of Cockatoo Island, located approximately 700 metres upgradient of the Site. The island has undergone extensive remediation due to historical land filling, waste disposal and historical spillage of chemicals and waste materials. Elevated concentrations of contaminants have been identified in soils, surface water, groundwater and near-shore sediment.

Remediation of soils at Cockatoo Island has been undertaken, however remediation of the near-shore sediment has not. The sediment surrounding Cockatoo Island was identified to have elevated concentrations of copper, lead, mercury, zinc and tributyltin (TBT). Considering that remediation of these analytes has not been undertaken, there is a possibility that they have been transported downstream to Greenwich Point.

2.8.4 Viva Energy Australia Pty Ltd fined $100,000 for Sydney Harbour oil spill (EPA, 2019).

A media release by the NSW Environment Protection Agency (NSW EPA) in March 2019 detailed how a marine fuel spill in December 2016 had occurred from the fuel import and store terminal located in Gore Cove, approximately 500 metres to the east of the Site. The source of the fuel spill was from a leaking pipe from the facility.

The NSW EPA ordered Viva to complete a thorough clean up which included pressure cleaning surfaces and the rocky shore as well as using booms and skimmers to contain and collect any displaced oil. The clean up took more than six months and was completed in July 2017.

2.8.5 Historical pollution and casualty incidents - Laura D'Amato, 3 August 1999. (AMSA, 2020)

The Australian Maritime Safety Authority (AMSA) website details the events of the largest ship-sourced oil spill in Sydney Harbour that occurred in Gore Cove. The *Laura D'Amato* was berthed at the Shell Gore Bay terminal when 250 to 300 tonnes of light crude oil was pumped from the ship into Sydney Harbour from an open sea valve system.

To undertake oil recovery, five Marco oil spill recovery vessels, a boat mounted brush skimmer, a number of disk and weir skimmers together with a variety of boom types and shore flushing equipment were used on a daily basis up to 14 August 1999. Spot cleaning of foreshores continued until 20 August 1999. Overall, a very high proportion of the spilt oil was recovered. Of the 250-300 tonnes spilt, an estimated 120-150 tonnes of oil was lost through evaporation. Of the remaining oil, 90 per cent was recovered.

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 2021 did not identify any notified sites within 500 metres 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. A search of the Public Register on 14 September 2021 identified one site with an EPL within 500 metres of the Site. Details of the site are summarised in Table 2-5.

Table 2-5 PoEO public register

Site Name	Address	Activity	EPL Number	Distance (m) / Direction
Gore Bay Terminal	Manns Avenue, Greenwich, NSW 2065	Shipping in bulk Chemical storage waste generation Waste storage – hazardous, restricted solid, liquid, clinical and related waste and asbestos waste	661	343m / north-east

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 14 September 2021 did not identify any contaminated sites notified to the EPA within 500 metres of the Site.

2.10 Planning information

Review of the Lane Cove LEP (Map LZN_004) indicates that the landside portion of the Site is partially within an R2 Low Density Residential zone, partially within a RE1 Public Recreation zone and partially within UL Unzoned Land.

The R2 Low Density Residential zone has the following objectives:

- To provide for the housing needs of the community within a low density residential environment
- To enable other land uses that provide facilities or services to meet the day to day needs of residents
- To retain, and where appropriate improve, the existing residential amenity of a detached single family dwelling area
- To encourage new dwelling houses or extensions of existing dwelling houses that are not highly visible when viewed from the Lane Cove River or Parramatta River
- To ensure that landscaping is maintained and enhanced as a major element in the residential environment.

The RE1 Public Recreation zone has the following objectives:

- To enable land to be used for public open space or recreational purposes.

- To provide a range of recreational settings and activities and compatible land uses.
- To protect and enhance the natural environment for recreational purposes.
- To make provision for rights of public access to more foreshore land and to link existing open space areas.

For the UL Unzoned Land consideration must be given to the objectives for development in the zones of the adjoining land.

The waterside portion bounding the landside portion of the Site is within land zoned W8 Scenic Waters Passive Use under the *Sydney Regional Environmental Plan (Sydney Harbour Catchment)* 2005. The existing and proposed wharf are within this zone. The zone has the following objectives:

(a) To give preference to unimpeded public access along the intertidal zone, to the visual continuity and significance of the landform and to the ecological value of waters and foreshores

(b) To allow low-lying private water-dependent development close to shore only where it can be demonstrated that the preferences referred to in paragraph (a) are not damaged or impaired in any way, that any proposed structure conforms closely to the shore, that development maximises open and unobstructed waterways and maintains and enhances views to and from waters in this zone

(c) To restrict development for permanent boat storage and private landing facilities in unsuitable locations

(d) To allow water-dependent development only where it can be demonstrated that it meets a demonstrated demand and harmonises with the planned character of the locality

(e) To ensure that the scale and size of development are appropriate to the locality and protect and improve the natural assets and natural and cultural scenic quality of the surrounding area, particularly when viewed from waters in this zone or areas of public access.

The waterside portion to the south is zoned as W1 Maritime Waters under the *Sydney Regional Environmental Plan (Sydney Harbour Catchment)* 2005. The zone has the following objectives:

(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

(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

(c) To promote equitable use of the waterway, including use by passive recreation craft.

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, 2021). 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
1943	Lower Serpentine Road and Mitchell Street are sealed and provide access to the wharf. The footpath on the western side runs along the foreshore to the original Greenwich Point wharf, located to the east of the Site. Scattered trees are located within the Site, along the street and the foreshore.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
1951 (low resolution image)	The Site remained relatively unchanged with the exception of some vegetation growth along the foreshore.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
1955	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, the original Greenwich Point wharf and Sydney Harbour. A ferry / barge is present at the wharf.
		West	Greenwich Park, low density residential and Sydney Harbour
1961 (low resolution image)	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
1965	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour

Year	Description of Site	Off-Site Direction	Description
1975 (low resolution image)		East	Low density residential, Mary Carlson Park, the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
1978	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
1986	The current Greenwich Point wharf has been constructed. The remainder of the Site remains unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park and Sydney Harbour. The original Greenwich Point wharf has been decommissioned. Some of the structure remains to provide a location for recreational fishing.
		West	Greenwich Park, low density residential and Sydney Harbour
1991	The Site remained unchanged. A ferry is present at the wharf.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
1998	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
2004	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
2007	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour

Year	Description of Site	Off-Site Direction	Description
2009	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
2012	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
2015	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
2018	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour
2020	The Site remained unchanged.	North	Low density residential
		South	Sydney Harbour
		East	Low density residential, Mary Carlson Park, remains of the original Greenwich Point wharf and Sydney Harbour.
		West	Greenwich Park, low density residential and Sydney Harbour

3.2 Heritage

A search of the DPIE website indicated that there are eight heritage items listed within 100 metres of the Site. A summary of the heritage items is presented in Table 3-2.

Table 3-2 Heritage sites

Item Number	Item Name	Distance from Site(m)	Listing
I130 / SHI no. 4920084	Greenwich Point wharf	Onsite	Lane Cove LEP / Roads and Maritime s170
I64	Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall)	Onsite	Lane Cove LEP
C1	Greenwich Conservation Area, Greenwich	Onsite	Lane Cove LEP
I110	House, 18 Mitchell Street	Adjacent, north	Lane Cove LEP
I111	Buena Vista, 23 Mitchell Street	Adjacent, north-west	Lane Cove LEP
I131	Stone steps to rear of house, 36 Serpentine Road	Adjacent, south-east	Lane Cove LEP
I132	Stone sea wall, 40 Serpentine Road	40 m north-east	Lane Cove LEP
I133	Rockleigh, 44 Serpentine Road	75 m north-east	Lane Cove LEP

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	> Use of fill material of unknown origin and impact	> Construction of the original Greenwich Point wharf
1930 – ongoing	Historical aerial photograph	> Surface water runoff containing heavy metals and PAHs from the road	> Operation of the ferry wharf
Pre 1930 – ongoing	Sydney Harbour Trust Federation	> Sediment transport downgradient to the Site from Cockatoo Island	> Land filling > Waste disposal > Historical spillage of chemicals and waste materials
1978-1986	Historical aerial photograph	> PAHs from machinery and equipment	> Decommissioning of former Greenwich Point wharf
1983-1986	Historical aerial photograph	> PAHs from machinery and equipment	> Construction of the existing Greenwich Point wharf
1999	AMSA	> TRH and PAH contaminant transport from spill	> Gore Cove terminal light crude oil spill
2016	NSW EPA	> TRH and PAH contaminant transport from spill	> Gore Cove terminal marine fuel spill

3.4 Contaminants of potential concern

Based on the available site history the contaminants of potential concern (CoPCs) are listed in Table 3-4.

Table 3-4 Identified contaminants of potential concern

Area of Concern	Potential Source	Potential Contaminant
Landside	> Fill material of unknown origin and impact > Construction and demolition of structures > Tidal flows of contaminated water into subsurface profile.	> TRH/PAHs > Heavy metals > OCP/OPP.
Waterside	> Contaminant transport from the greater Sydney Harbour, particularly Cockatoo Island > Marine fuel and light crude oil spills > Potential ASS at depths greater than 0.2 metres below the seabed > Fuel leaks from vessels.	> PAH > TRH > Heavy metals > TBT > OCP/OPP > PASS.

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 existing ferry wharf since at least 1986, with the original Greenwich Point wharf located there prior to 1930. Sources of contamination at the Site are considered to be surface water runoff from Lower Serpentine Road and Mitchell Street, potentially impacted fill materials at the Site and sediment from Cockatoo Island.
Site Current and Future Use	The current use of the Site is a ferry wharf adjoining the road corridor and Greenwich Park's recreation area. The future use of the Site would remain the same.
Site Geology	The Site is underlain by Hawkesbury Sandstone, which is characterised by medium to coarse grained quartz sandstone, very minor shale and laminite lenses.
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 portion of the Site. Sydney Harbour has been identified as having high levels of water contamination which vary from tides and storm flows (Birch and Taylor, 2006).
CoPCs – Soil and Sediment	> TRH/PAH > Heavy metals > TBT > OCP/OPP > PASS
Potential Human Receptors	> Current and future users of the F8 Circular Quay to Cockatoo Island ferry service > Adjoining residents and visitors accessing the foreshore > Maintenance workers > Future construction workers > Users of Sydney Harbour
Potential Environmental Receptors	> Sydney Harbour > Aquatic biota and vegetation > Soil biota and vegetation
Potential Human Exposure Pathways	> Inhalation of particles > Dermal contact and ingestion of contaminated soils
Potential Environmental Exposure Pathways	> Tidal influences transporting contaminants from the Site > Uptake of contaminants from surrounding soil biota and vegetation

5 Preliminary assessment of risk

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)				
Likelihood (Possibility of Presence)		1. Minor	2. Moderate	3. High	4. Major	5. Critical
	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 aerials and observations from the Site inspection, the Site represents a low to medium risk.

The preliminary risk assessment is limited to the data obtained from provided reports by others, historical aerials 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 of Sydney Harbour	Moderate	Unlikely/Possible	Low/Medium
Groundwater	Waterside	Possible migration of potential leachable soil contaminants out of the Site through groundwater under tidal influences of Sydney Harbour	Moderate	Unlikely / Possible	Low / Medium
Sediment	Waterside	Impacted sediment material	Moderate	Possible	Medium

5.2 Preliminary 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 2 March 2021, the main sources of possible contamination are:

- Potentially impacted fill materials imported to the landside portion of the Site. The current impacts and origin of soils at the Site are unknown. It is possible that impacted materials have been transported to the Site during construction activities in the 1980's. The Site history indicates that there is low to medium risk that impacted soils are present at the Site
- Contaminated sediments in the waterside portion of the Site. The previous assessment by Coffey (2016) indicates that sediment within the Site is contaminated with concentrations of various analytes above the adopted criteria. There is a medium risk that impacted sediment could be disturbed during the piling works. There is potential ASS in sediments at depths greater than 0.2 metres below the seabed level
- Groundwater on the landside portion of the Site may be impacted by tidal influences from Sydney Harbour. Historical crude oil and marine fuel spills at the Gore Cove terminal could have impacted the underlying groundwater at the landside portion of the Site due to tidal influences from Sydney Harbour. The condition of water entering the landside portion of the Site from the harbour can change depending on tides and storm events (Birch and Taylor, 2004). Further, if subsurface soil is impacted, it is possible that contaminants could be leaching to the underlying groundwater and tidal flows could be transporting contaminants into Sydney Harbour from the landside portion of the Site.

6 Conclusions

Cardno has prepared a PSI at Greenwich Point wharf for the Site of the ferry wharf upgrade on behalf of Transport for NSW.

It is understood that the Site has remained largely unchanged as a location for the ferry wharf since approximately 1986 when the original Greenwich Point wharf was decommissioned and the existing wharf was constructed. The surrounding area has remained relatively unchanged. There have been two environmental incidents at the nearby Gore Cove terminal in 1999 and 2016 which resulted in spills of light crude oil and marine fuel. Based on the previous investigations and historical aerials a summary of the contamination is provided below.

6.1.1 Soil

The landside soil impacts at the Site are currently unknown. Due to the age of the Site, there is potential that fill material of unknown quality is present at the Site from the land contouring, road construction and maintenance of the ferry wharf and/or other sources.

6.1.2 Sediment

Previous investigations by Birch and Taylor (2004) indicate that sediment at the Site could contain elevated levels of contaminants. Sampling undertaken by Coffey (2016) found that there were elevated concentrations of mercury, lead, and the following PAHs; benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, pyrene and total PAH. There is some potential that sediment from Cockatoo Island has been transported to the Site. There is potential ASS in sediments at depths greater than 0.2 metres below the seabed level.

6.1.3 Groundwater

Impacts to groundwater are currently unknown. There are no groundwater monitoring wells on-site, however, it is considered possible that groundwater underlying the landside portion of the Site could be impacted by historical crude oil and marine fuel spills and possible leaching of potentially contaminated onsite soils into the underlying groundwater with tidal flows of Sydney Harbour.

6.2 Recommendations

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

- The piling activity shall mitigate the risk of sediment dispersal by applying industry best practice using pilling methods or any other seabed interference
- Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's W*aste 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
- Future waste classification works are to be designed and undertaken by a suitably qualified contaminated land specialist
- An Unexpected Finds Protocol should be followed for excavation and pile boring.

7 References

AMSA (2020) *Historical pollution and casualty incidents - Laura D'Amato, 3 August 1999*. Australian Maritime Safety Authority, November 2020. Available at: https://www.amsa.gov.au/marine-environment/incidents-and-exercises/laura-damato-3-august-1999

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 and Taylor (2004) *The Contaminant Status of Sydney Harbour Sediments, A handbook for the Public and Professionals*. January 2004.

CCME (2010) *Canadian soil quality guidelines: carcinogenic and other polycyclic aromatic hydrocarbons (PAHs) (environmental and human health effects), Scientific criteria document (revised),* Canadian Council of Ministers for the Environment, 2010.

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.

Coffey (2016) *Stage 2 Contamination Assessment – Greenwich Point South Ferry Wharf*. Coffey Geotechnics Pty Ltd, 21 March 2016.

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*. NSW Environment Protection Authority (EPA), November 2014.

EPA (2019) *Viva Energy Australia Pty Ltd fined $100,000 for Sydney Harbour oil spill*. NSW Environment Protection Authority, 18 March 2019. Available at: https://www.epa.nsw.gov.au/news/media-releases/2019/epamedia190318-viva-energy-australia-pty-ltd-fined-$100000-for-sydney-harbour-oil-spill

EPA (2020) *Consultants reporting on contaminated land Contaminated land guidelines.* NSW Environment Protection Authority (EPA), 5 May 2020.

LI Resources (2021) *Due Diligence Insight Report. Property Details: Greenwich Point Wharf.* Land Insight and Resources, 19 February 2021.

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.

Sydney Harbour Federation Trust (2017) *Cockatoo Island Management Plan 2017.* Prepared by Sydney Harbour Federation Trust, 2017.

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 subject to the following limitations:

- This Document has been prepared for the particular purpose outlined in Cardno's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose
- The scope and the period of Cardno's services are as described in Cardno's proposal, and are subject to restrictions and limitations. Cardno did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Cardno in regards to it
- Conditions may exist which were undetectable given the limited nature of the enquiry Cardno was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required
- In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Cardno's opinions are based upon information that existed at the time of the production of the Document. It is understood that the services provided allowed Cardno to form no more than an opinion of the actual conditions of the site at the time this Document was prepared and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations
- Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document
- Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Cardno for incomplete or inaccurate data supplied by others
- Cardno may have retained sub consultants affiliated with Cardno to provide services for the benefit of Cardno. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, Cardno's affiliated companies, and their employees, officers and directors.

This assessment report is not any of the following:

- A Site Audit Report or Site Audit Statement as defined under the *Contaminated Land Management Act, 1997*
- A Detailed ESA or Environmental Site Investigation sufficient for an Environmental Auditor to be able to conclude a Site Audit Report and Site Audit Statement

- A geotechnical report and the bore logs or test pit logs may not be sufficient as the basis for geotechnical advice
- A detailed hydrogeological assessment in conformance with NSW DEC (2007) *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination*
- An assessment of groundwater contaminants potentially arising from other sites or sources nearby.

A total assessment of the site to determine suitability of the entire parcel of land at the site for one or more beneficial uses of land.

APPENDIX A

FIGURES

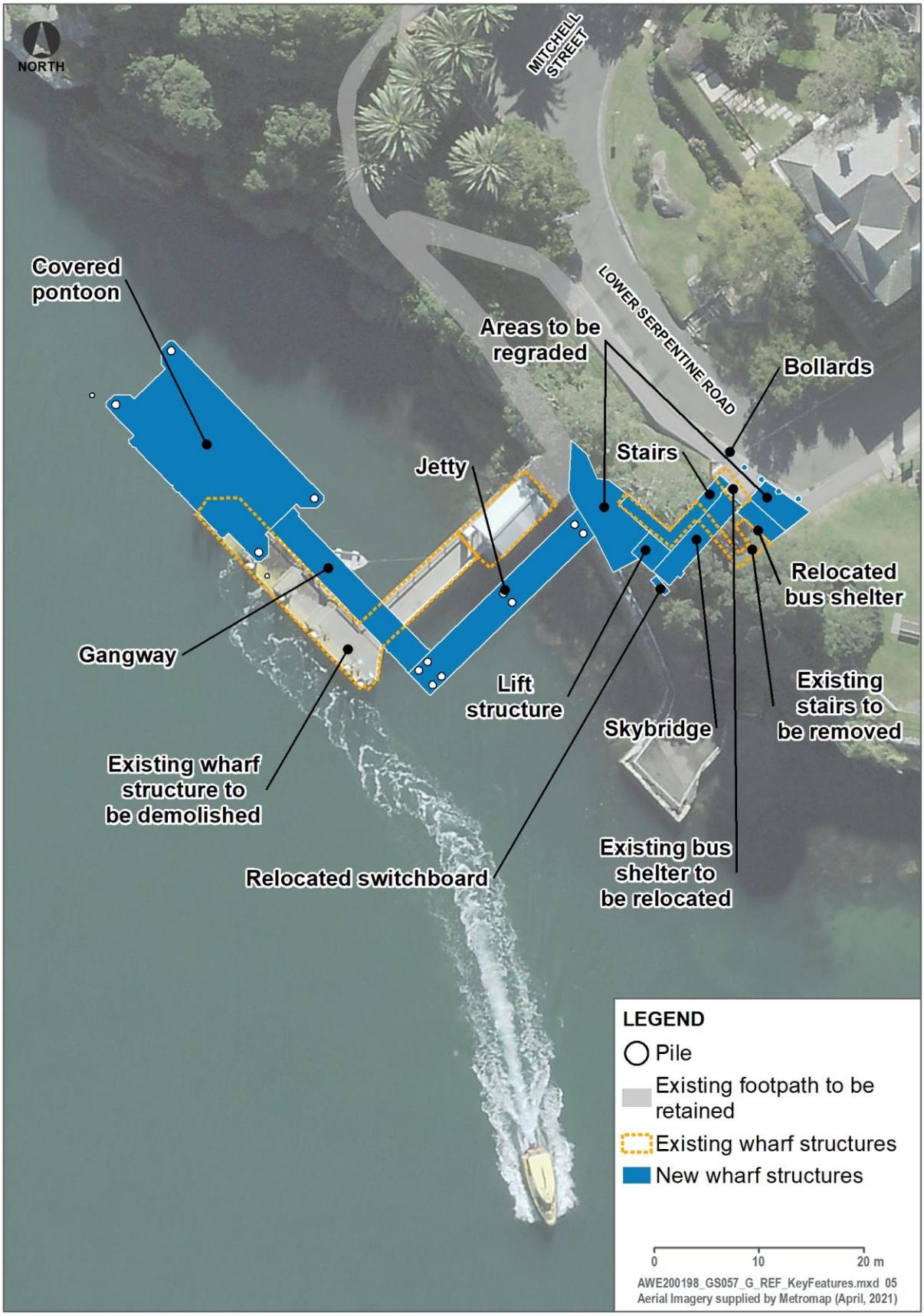


Figure 1: Key features of the proposal

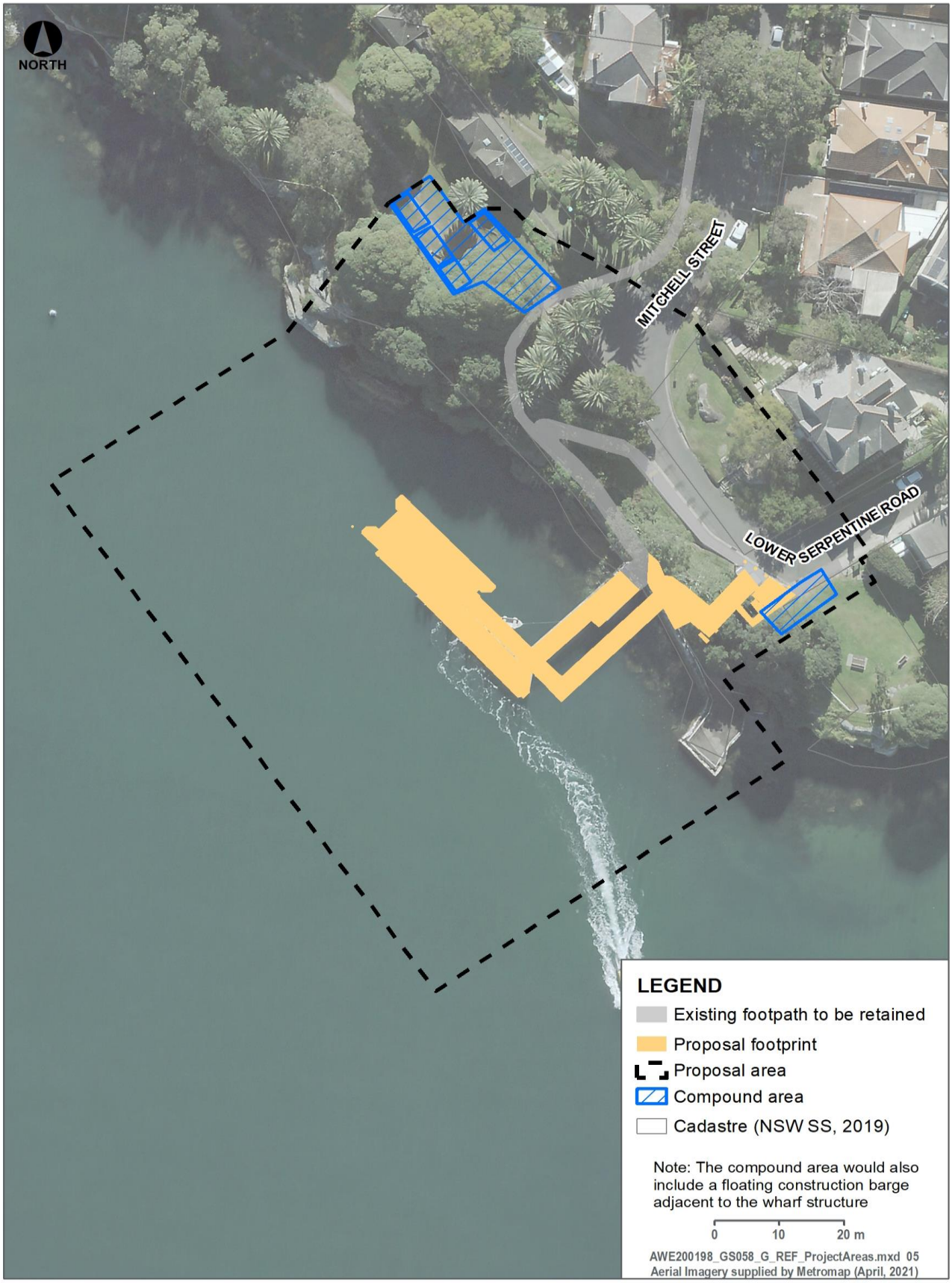


Figure 2: Proposal area and proposal footprint

APPENDIX B

SITE PHOTOGRAPHS

Photograph 1: Facing north-west from the wharf to the landside portion, sea wall and vegetation present.

Photograph 2: Facing north-east, rocky outcrop and stairs the connect Greenwich Point wharf and the footpath.

Photograph 3: Facing west, footpath and vegetation connecting Greenwich Point wharf and the footpath, some cracks evident in hardstand surface.

Photograph 4: Facing east, footpath leading to Greenwich Point wharf.

Photograph 5: Electrical services unit in front of the stairs.

APPENDIX C

HISTORICAL IMAGERY

HISTORIC AERIAL PHOTOGRAPH - 1943

Due Diligence Insight

Subject area

0 200m

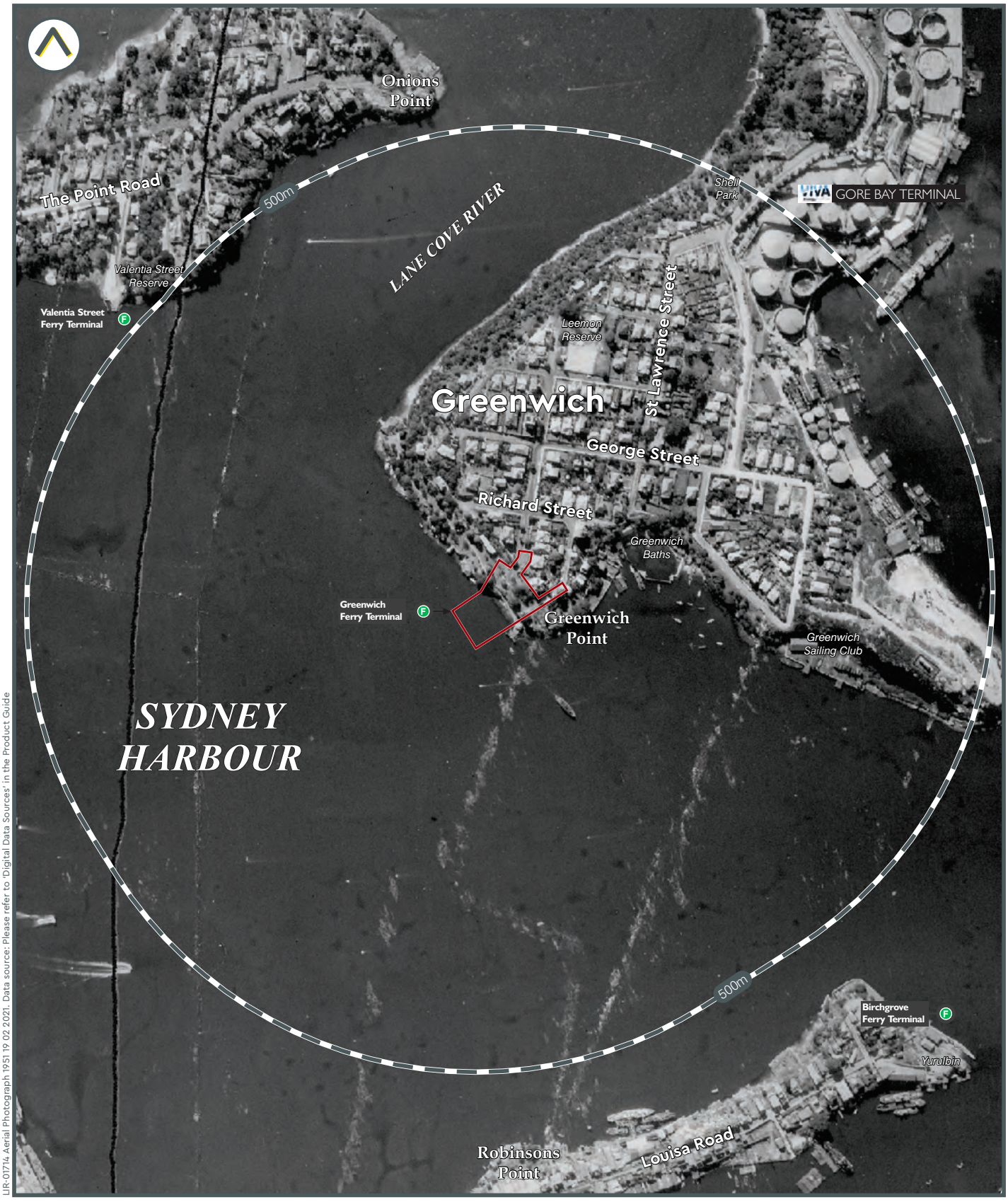
Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

LIR-01714 Aerial Photograph 2020 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORIC AERIAL PHOTOGRAPH - 1951

Due Diligence Insight



Subject area

0 200m

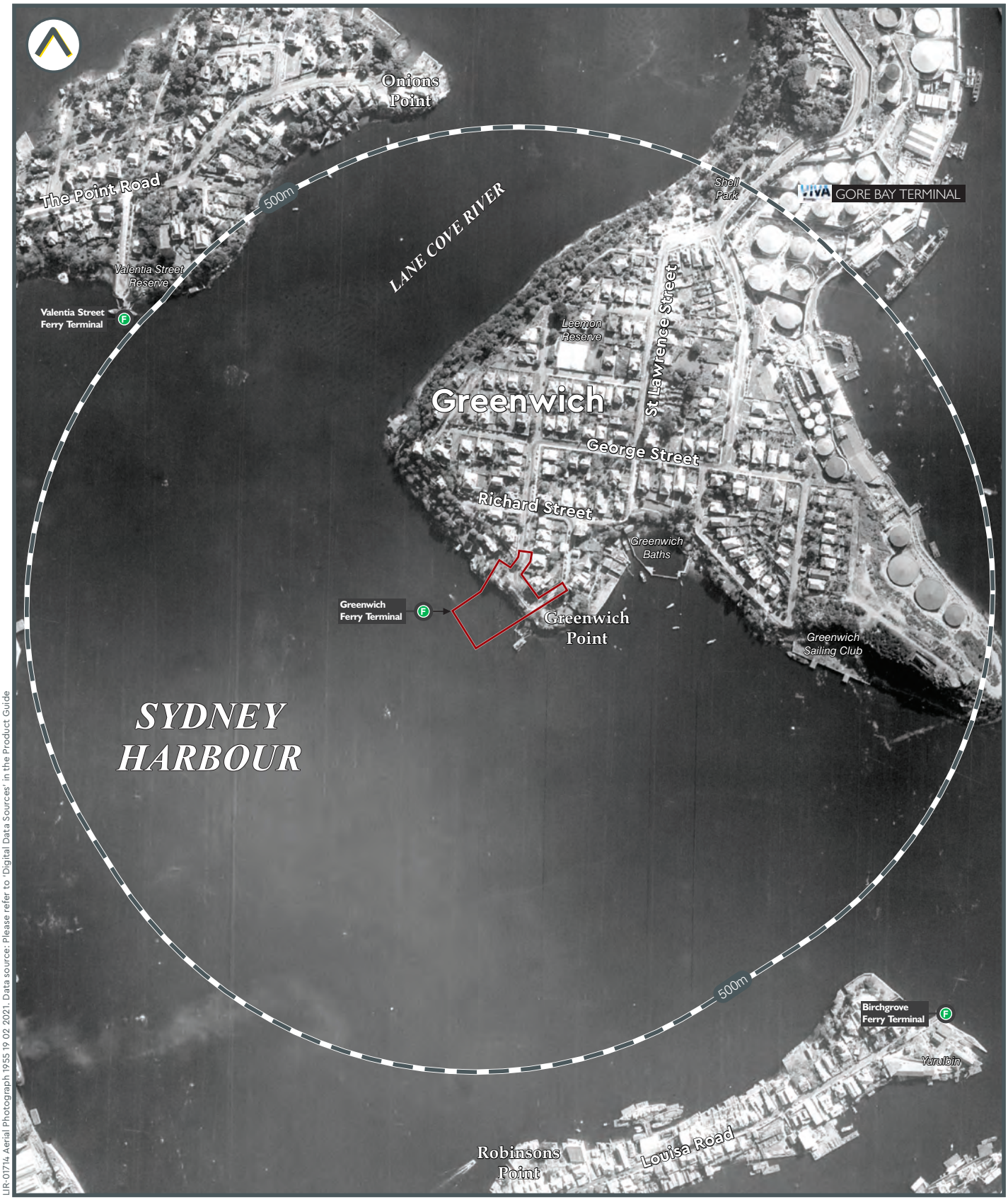
LIR-01714 Aerial Photograph 1951 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1955

Due Diligence Insight



LIR-01714 Aerial Photograph 1955 19 02 2021, Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1961

Due Diligence Insight

LIR-01714 Aerial Photograph 1961 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1965

Due Diligence Insight

LIR-01714 Aerial Photograph 1965 19 02 2021, Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

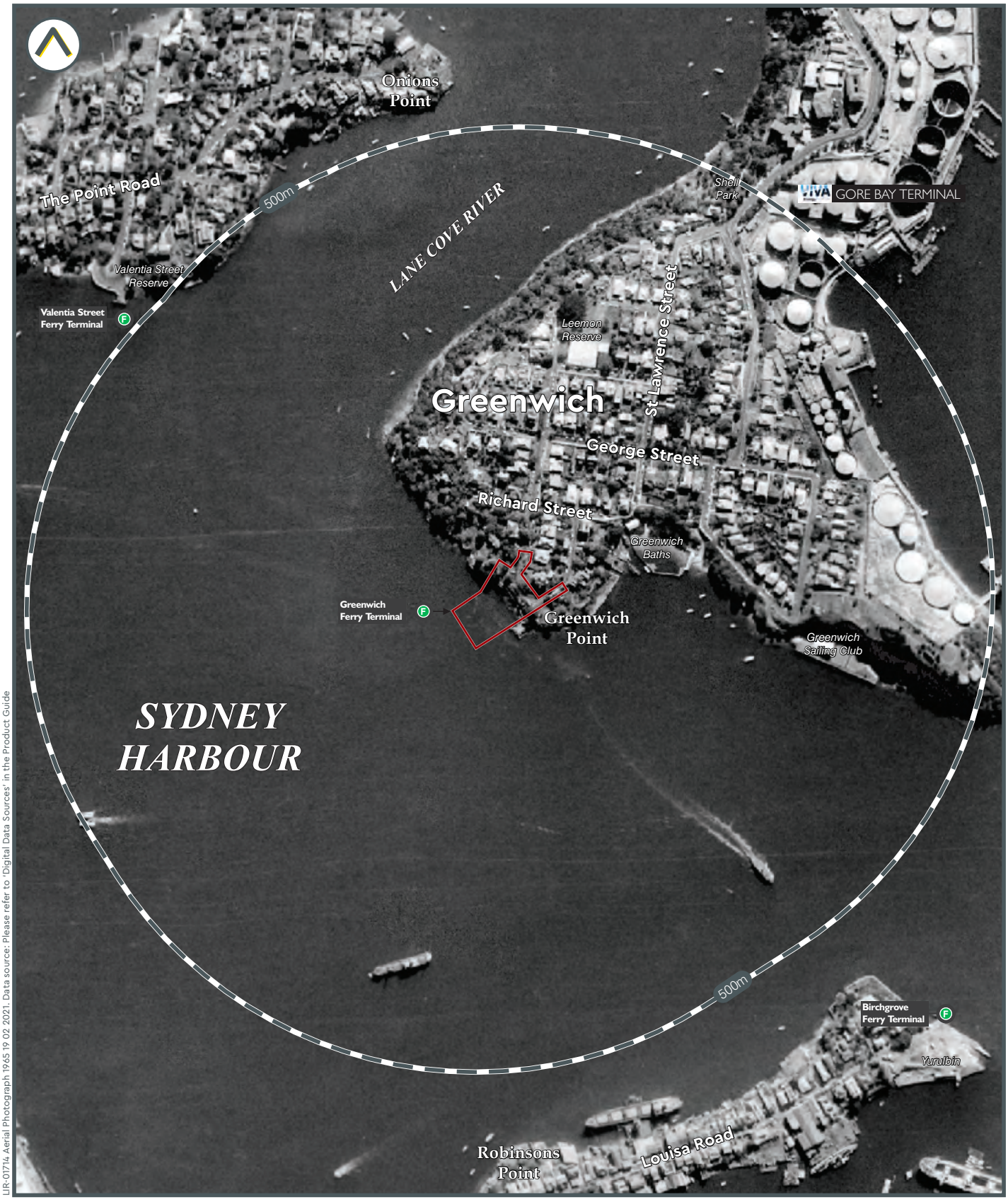
0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1975

Due Diligence Insight



LIR-01714 Aerial Photograph 1965 19 02 2021, Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

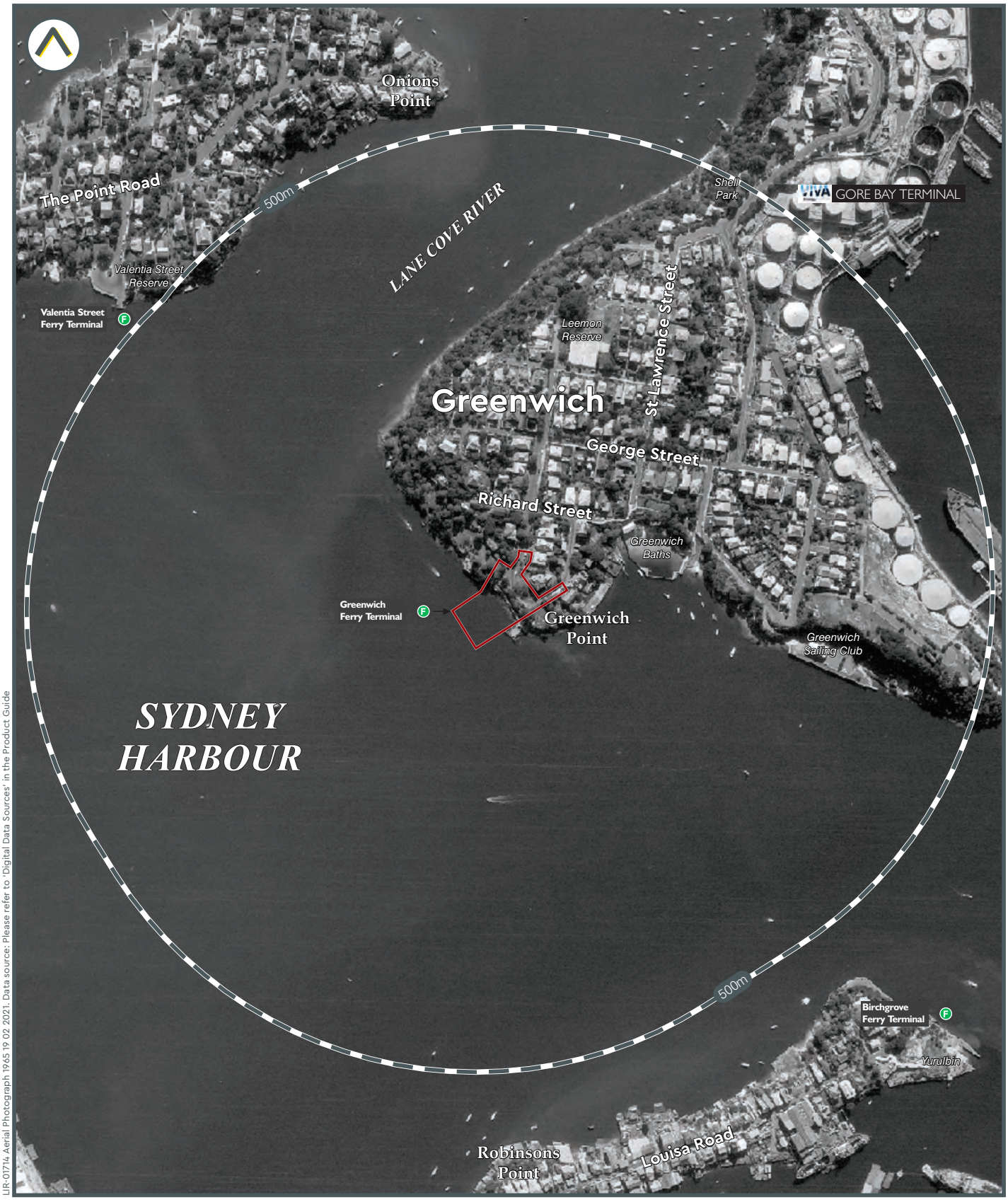
0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1978

Due Diligence Insight



Subject area

0 200m

LIR-01714 Aerial Photograph 1965 19 02 2021, Data source: Please refer to 'Digital Data Sources' in the Product Guide

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1986

Due Diligence Insight

LIR-01714 Aerial Photograph 1965 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

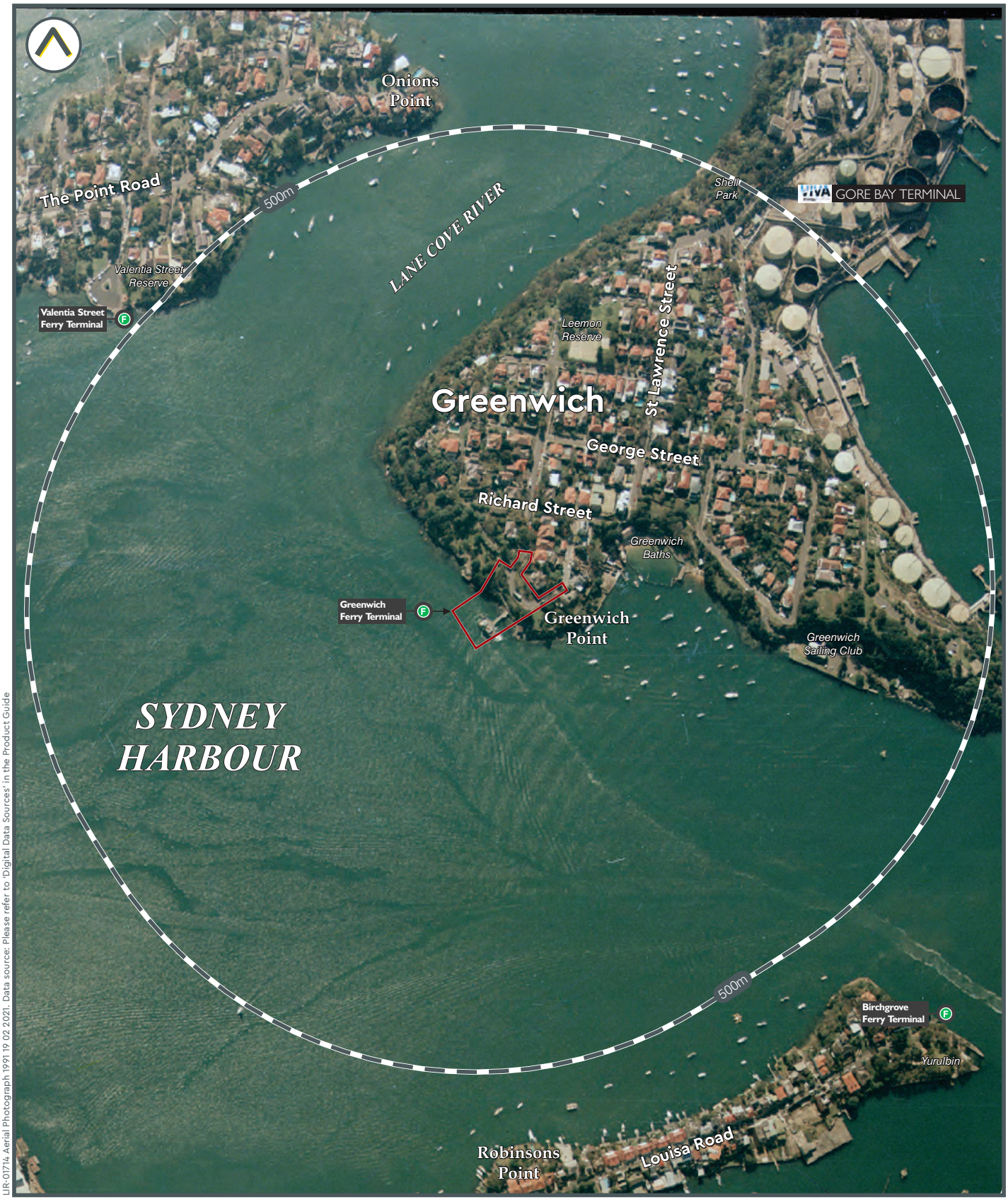
0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1991

Due Diligence Insight



LIR-01714 Aerial Photograph 1991 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

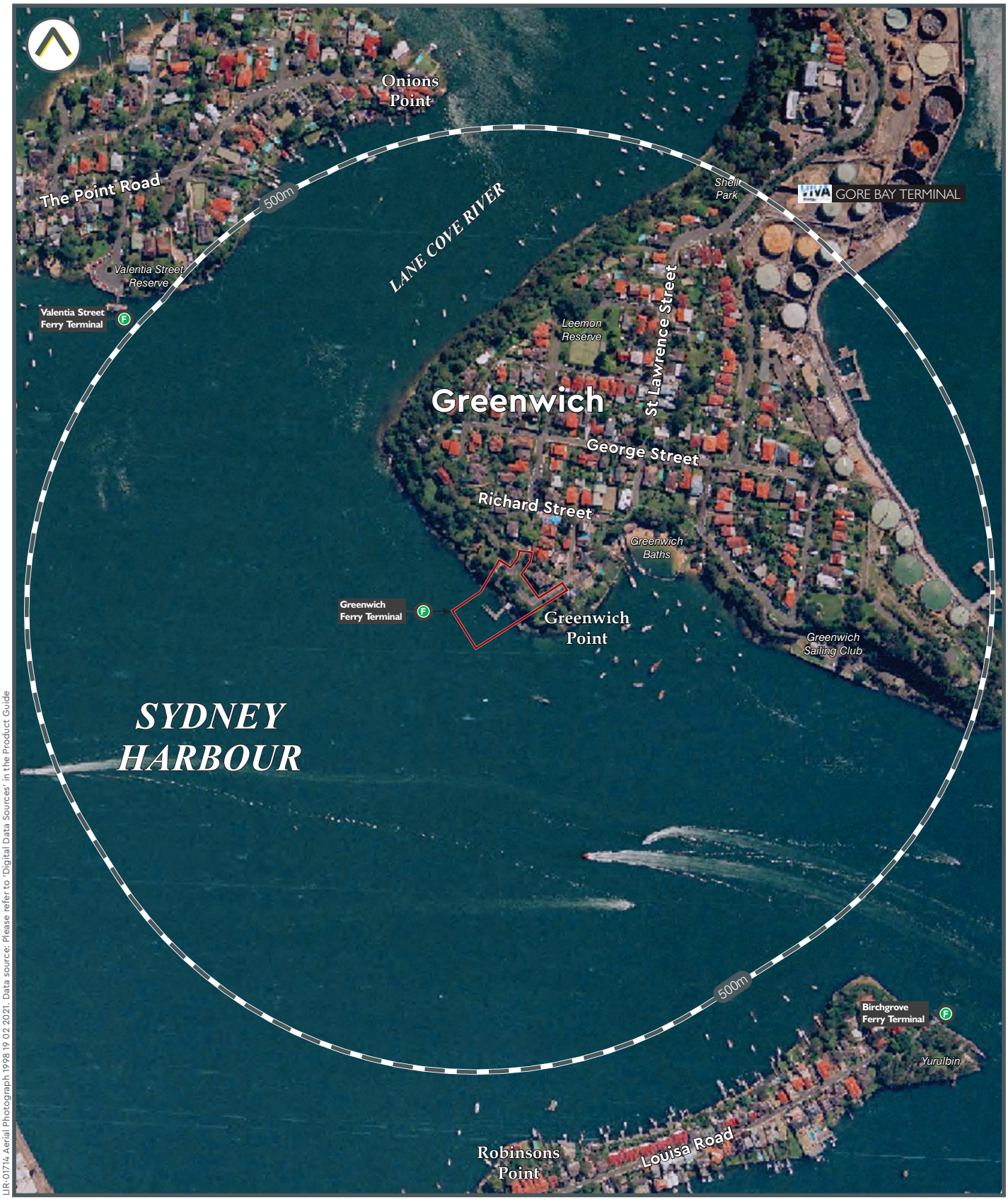
0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 1998

Due Diligence Insight



LIR-01714 Aerial Photograph 1998 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 2004

Due Diligence Insight

Subject area

0 200m

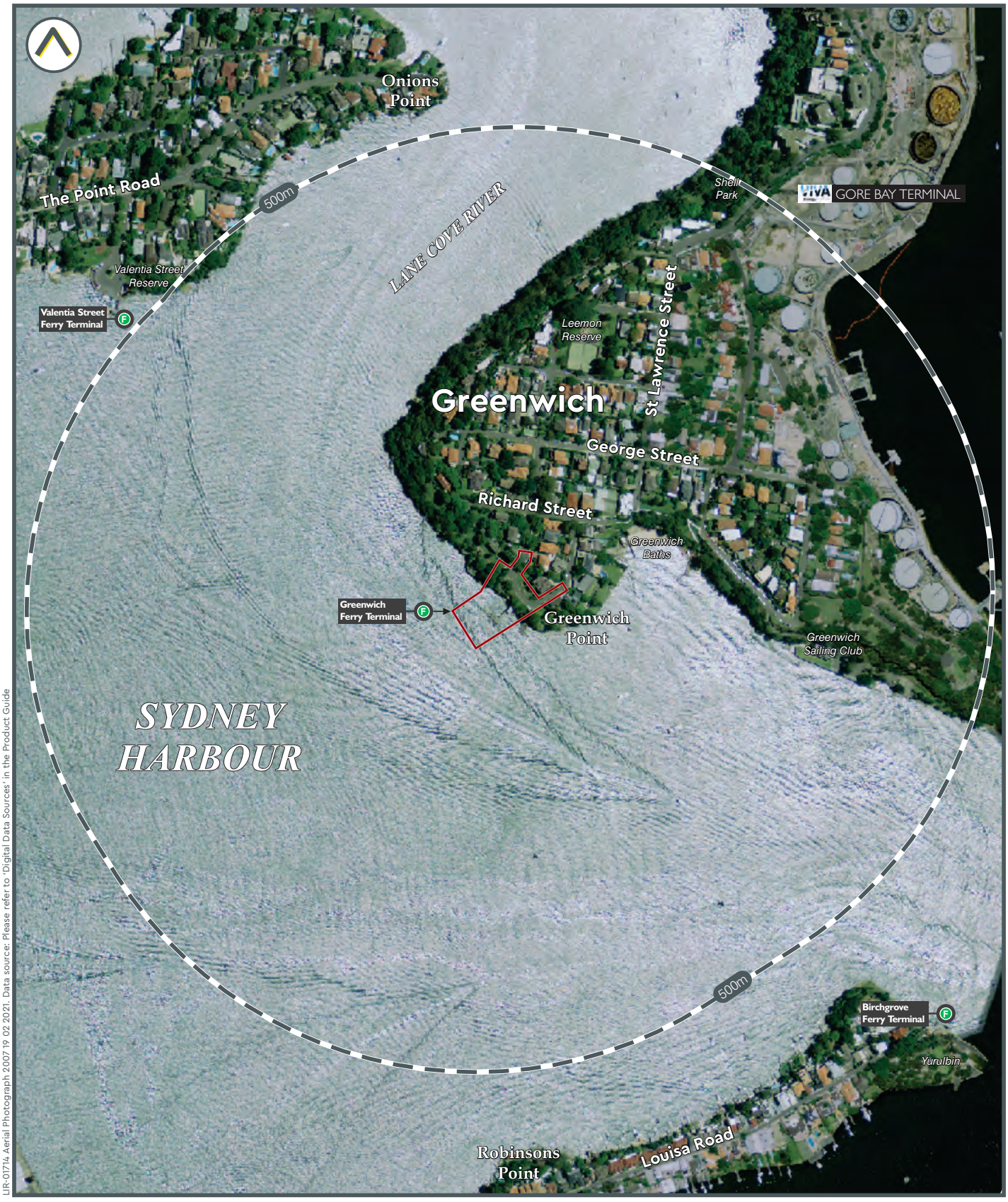
LIR-01714 Aerial Photograph 1998 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 2007

Due Diligence Insight



LIR-01714 Aerial Photograph 2007 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

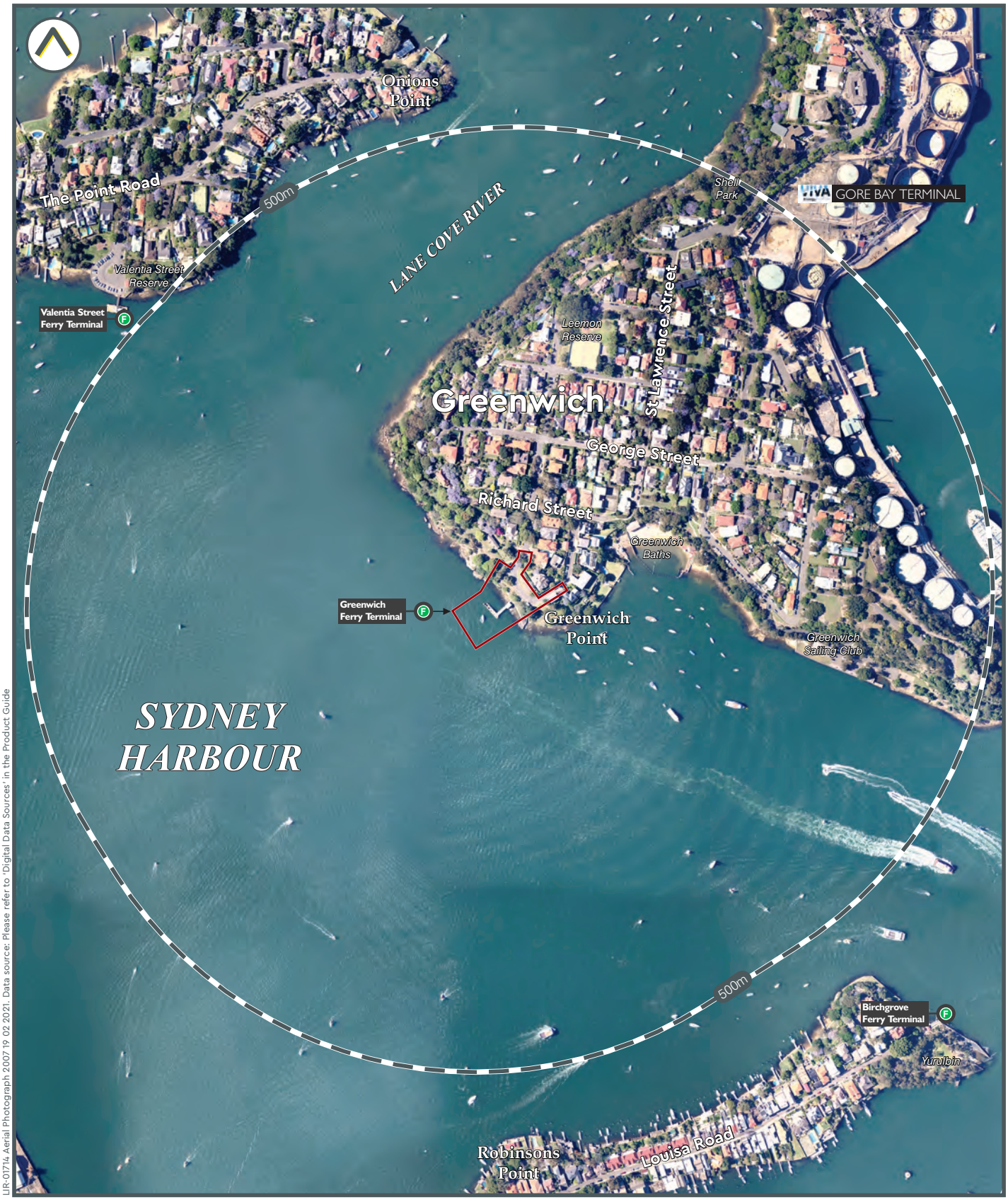
0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 2009

Due Diligence Insight



Subject area

0 200m

LIR-01714 Aerial Photograph 2007 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 2012

Due Diligence Insight

Subject area

0 200m

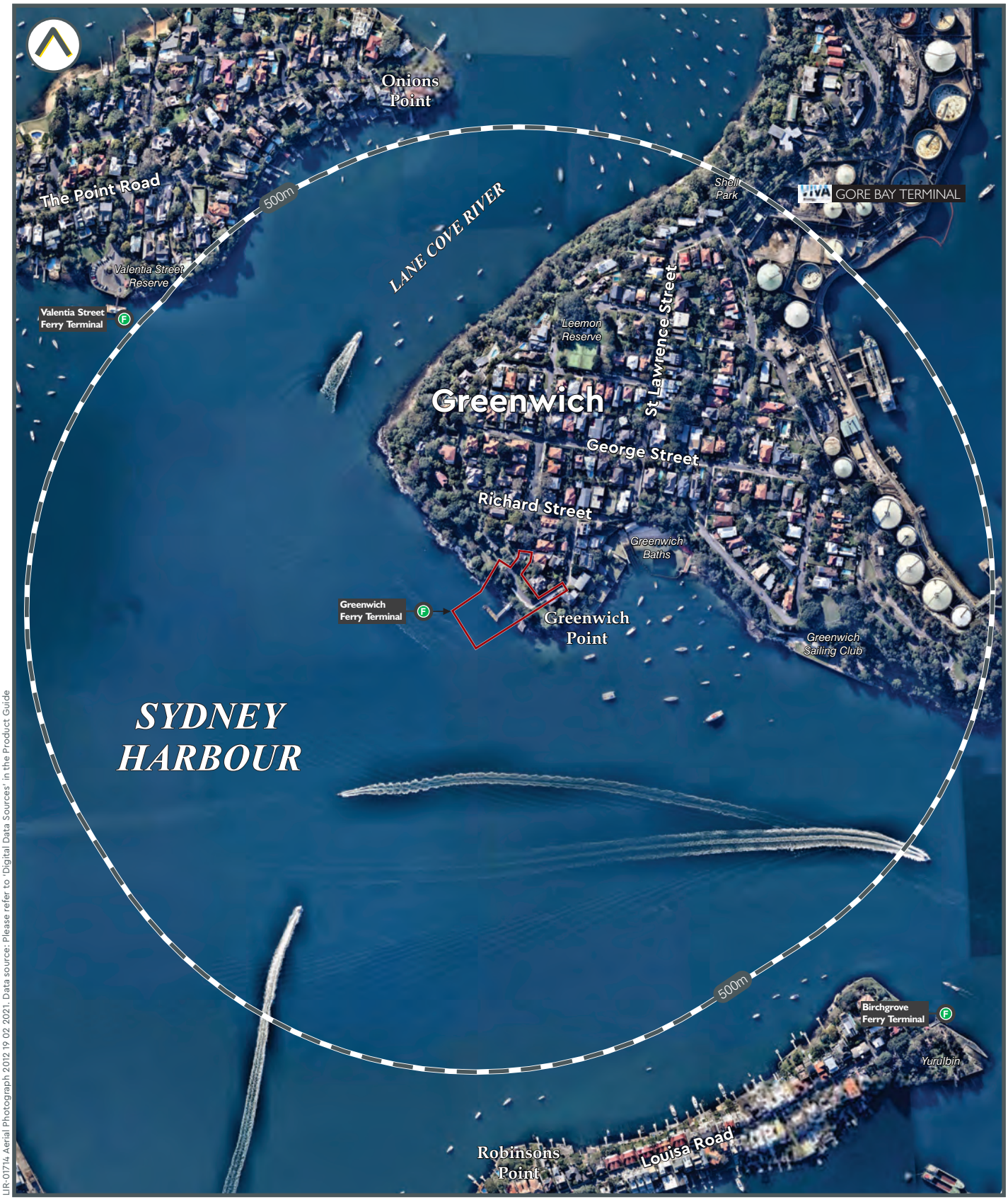
LIR-01714 Aerial Photograph 2012 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 2015

Due Diligence Insight



Subject area

0 200m

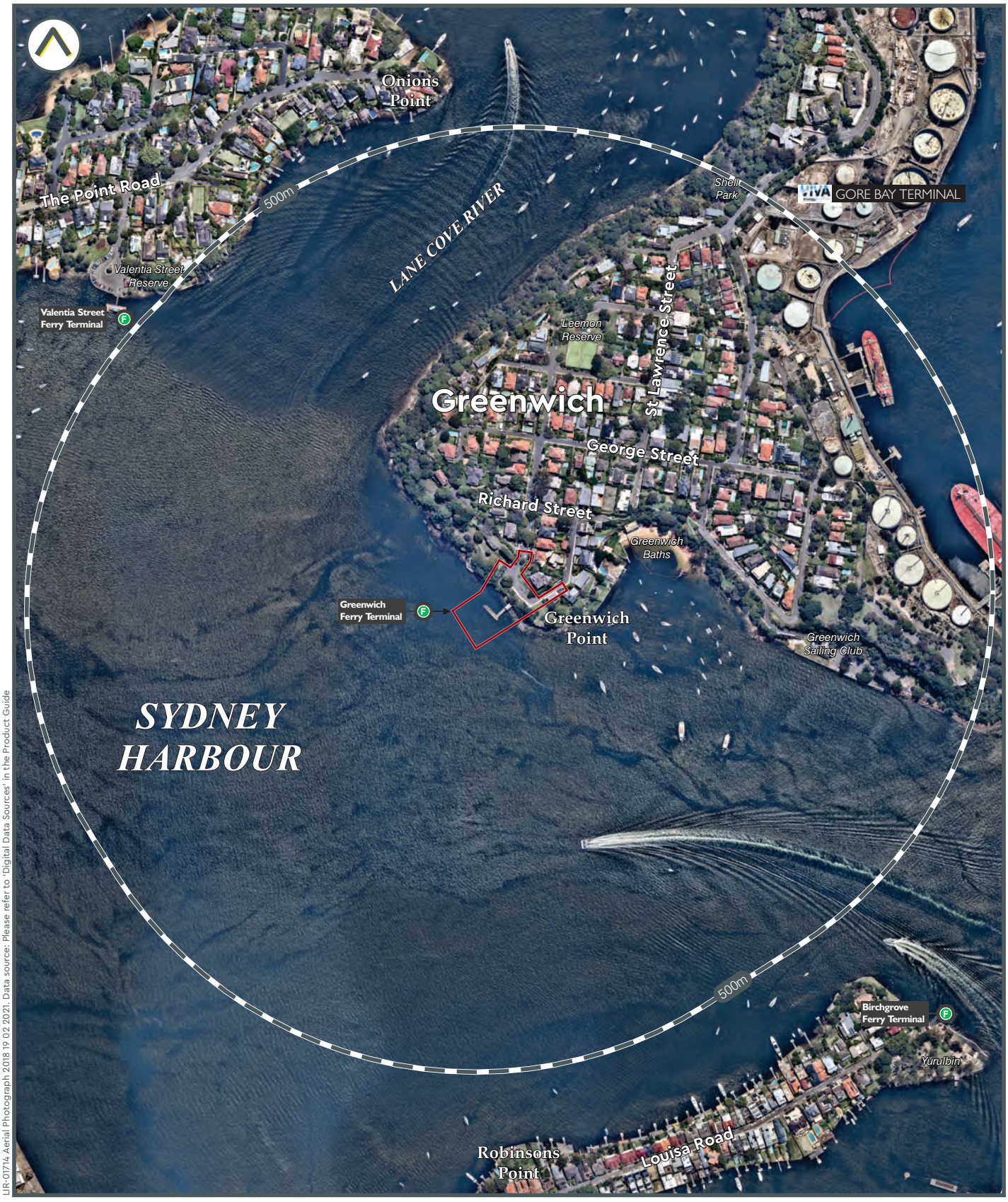
LIR-01714 Aerial Photograph 2012 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

HISTORIC AERIAL PHOTOGRAPH - 2018

Due Diligence Insight



Subject area

0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

LIR-01714 Aerial Photograph 2018 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORIC AERIAL PHOTOGRAPH - 2020

Due Diligence Insight

LIR-01714 Aerial Photograph 2020 19 02 2021. Data source: Please refer to 'Digital Data Sources' in the Product Guide

Subject area

0 200m

Land Insight RESOURCES

Land Insight & Resources do no warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that this company shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

Appendix D

Biodiversity assessment report

Greenwich Point Wharf Upgrade

Biodiversity Assessment Report

Transport for NSW

Greenwich Point Wharf Upgrade

Biodiversity Assessment Report

Transport for NSW | December 2021

Prepared by Cardno (NSW/ACT) Pty Ltd

Copyright: The concepts and information contained in this document are the property of Transport for NSW. Use or copying of this document in whole or in part without the written permission of Transport for NSW constitutes an infringement of copyright.

Document controls

Approval and authorisation

Title	Greenwich Point Wharf Upgrade Biodiversity Assessment Report
Accepted on behalf of Transport for NSW by:	Bob Rimac Senior Project Manager
Signed:	
Dated:	

Document status

Document status		Date	Prepared by	Reviewed by
Rev A	First draft for client review	17 September 2021	Dilys Zhang / Brendan Alderson	Kevin Roberts
Rev B	Second draft for client review	13 October 2021	Dilys Zhang / Brendan Alderson	Kevin Roberts
Rev 0	Final	2 December 2021	Dilys Zhang	Kevin Roberts

Executive summary

The proposal forms part of the Ferry Wharf Upgrade Program and the Transport Action Plan (TAP) and is focused on the upgrade of the Greenwich Point wharf. This includes a number of land and water-based activities for construction of the new wharf and removal of the existing wharf.

A biodiversity assessment was completed to describe the existing environment within the study area and to assess impacts to biodiversity as a result of 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 at Greenwich Point, on the northern foreshore of Sydney Harbour (the harbour), on a peninsula at the confluence of Lane Cove River and the Parramatta River estuary (the estuary). The terrestrial portion of the study area was on land sloping from Mary Carlson Park and Greenwich Park to the seawall while the marine portion was comprised of a vertical sandstone seawall bound by a corridor of intertidal and subtidal rocky reef, and soft sediment habitat in the deeper areas. The area below the sandstone escarpment to the seawall is reclaimed land. There was no remnant native vegetation in the study area but rather native and exotic landscape plantings. There were no mangroves or saltmarsh in or next to the study area however, a mosaic of macroalgae and habitat-forming species colonise the intertidal and subtidal rocky reef (Type 2 KFH) and debris in the soft sediment habitats (Type 3 KFH) within the study area.

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 also forms potential habitat for ten threatened fauna species with a moderate to high likelihood of occurrence:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the *Fisheries Management Act 1994* (FM) Act and the Environment Protection and B*iodiversity Conservation Act 1999* (EPBC Act)
- Black Rockcod (*Epinephelus daemelii*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Seven microbats listed as vulnerable under the *Biodiversity Conservation Act 2016* (BC Act):
    - Large-eared Pied Bat (*Chalinolobus dwyeri*)
    - 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 Sheathtail-bat (*Saccolaimus flaviventris*)
    - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

The proposal is not expected to remove any vegetation (trees or shrubs), although may impact areas of mown lawn and some pruning would be required. The risks of the spread/introduction of weeds and diseases and the potential for erosion and sediment mobilisation associated with construction activities would be managed during construction in accordance with the relevant Transport for NSW guidelines.

With respect to water-based impacts, 14 piles would be driven into intertidal rocky reef, subtidal rocky reef and subtidal soft sediment habitat. The respective habitat and marine vegetation under the footprint of the piles would be permanently lost and shading of structures over these areas would result in altered community assemblages. However, these areas are proportionally small

compared to what is available in the study area. These assemblages are widespread in Sydney Harbour. Design consideration to avoid shading impacts has been recommended.

Removal of the existing wharf structure and piles would result in the removal of 270 square metres of marine vegetation, habitat and sessile/less mobile fauna. These species are common in subtidal rocky reefs and would quickly colonise the piles of the new wharf and pontoon (about 160 square metres of available space) provided suitable materials are used for the new structures. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).

Under Section 199 of the FM Act, consultation with NSW DPI (Fisheries) is required for any dredging and reclamation works. 'Dredging' under the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013) is classified as disturbance of the seabed/streambed. In this case, this refers to removal of structures and piling. Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required. NSW DPI (Fisheries) was consulted on 2 December 2021 and advised that a Section 205 permit is not required for the piling and pile removal works associated with this proposal. Sediment mobilisation and vessel wash and scour were also identified as likely proposal impacts. However, the study area is likely to be frequently exposed to elevated levels of sediment from rainfall, sea conditions and vessel traffic in the waters of Greenwich Point. With the appropriate controls, a small, temporary increase in these impacts is not expected to substantially impact marine biodiversity.

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

The proposal is unlikely to significantly impact threatened species and disturbances to potential habitat would largely be temporary and constitute a very small proportion of available habitat. The proposal would not fragment or isolate threatened species populations or substantially impact any species' lifecycle. Additional controls could be implemented to survey for microbats, Black Rockcod and White's Seahorse prior to the commencement of construction activities so that individuals in the area are not harmed. Species impact statements (SISs) or referrals are not required for the proposal.

Offsets for the residual loss of marine vegetation in subtidal rocky reef (Type 2 KFH) should be considered in accordance with the *Guideline for Biodiversity Offsets* (NSW Roads and Maritime Services, 2016), the *Policy and guidelines for fish habitat conservation and management Update 2013* (NSW DPI, 2013) and in consultation with NSW DPI (Fisheries).

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

Contents

Terms

Biodiversity Assessment Method	The Biodiversity Assessment Method is established under section 6.7 of the BC Act for the purpose of assessing certain impacts on threatened species and threatened ecological communities, and their habitats, and the impact on biodiversity values.
Commonwealth Minister	Australian Minister for the Environment
Compound area	Temporary facility for construction, including for example an office and amenities compound, construction compound and materials storage compound. Compound area is shown on Figure 1-3.
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (ref 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 (NSW 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.
NSW landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (Mitchell, 2002).
Microbats	Microchiropteran bats
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 proposed to be constructed at Greenwich Point 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. The 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 five 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
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BoM	Bureau of Meteorology
CCTV	Closed circuit television
Coastal Management SEPP	NSW *State Environmental Planning Policy (Coastal Management) 2018*
DAWE	Commonwealth Department of Agriculture, Water and the Environment
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 *Environmental Planning and Assessment Act 1979*
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Federal).
FM Act	NSW *Fisheries Management Act 1994*
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
KFH	Key Fish Habitat
LGA	Local government area
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Service
OCP	Organochlorine pesticides
OEH	NSW Office of Environment and Heritage (former)
PAH	Polycyclic aromatic hydrocarbons
PASS	Potential acid sulfate soils/sediments
PCT	Plant community type
PMST	Protected Matters Search Tool
POMS	Pacific Oyster Mortality Syndrome
RBG	Royal Botanic Garden Sydney
REF	Review of Environmental Factors

ROV	Remotely operated vehicle
SIS	Species impact statement
TAP	NSW Government's Transport Access Program
TAPs	Threat Abatement Plans
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened ecological community

1 Introduction

1.1 Proposal background

Transport for NSW proposes to construct a new wharf interchange at Greenwich Point (the proposal) as part of the NSW Government's Transport Access Program (TAP, https://www.transport.nsw.gov.au/projects/tap). This is detailed in Section 3 of the Review of Environmental Factors (REF).

The proposal is located within the local government area (LGA) of Lane Cove. Greenwich Point wharf is located at the southern extent of the suburb of Greenwich, between Greenwich Park and Mary Carlson Park. Greenwich Point wharf sits on the northern foreshore of Sydney Harbour (the harbour), on a peninsula at the confluence of Lane Cove River and the Parramatta River estuary (the estuary). The wharf is accessed from Lower Serpentine Road and a sealed footpath leading down the escarpment terminating at the wharf.

1.2 The proposal

The water based features of the proposal would include:

- Installation of a new three metre wide by 22 metre long concrete jetty, supported by eight new piles
- Installation of a new, uncovered 18 metre long by 2.5 metre wide gangway to provide access to the new pontoon
- Installation of a new covered steel nine metre by 18 metre pontoon containing a curved zinc roof supported by steel columns, glass weather protection, stainless steel balustrades, seating and information boards. The pontoon would be supported by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of new signage, information boards and opal card readers
- Installation of safety and security features including a help point, lighting, closed circuit television (CCTV) cameras, ladders to the water, a life buoy and tactile ground surface indicators where required
- Removal of the existing waiting shelter, jetty and tidal stairs including associated piles.

The land based features of the proposal would include:

- Construction of a 9.8 metre long skybridge from the approximate location of the existing bus shelter on Lower Serpentine Road, connecting the existing footpath to the proposed lift
- Relocation of the existing bus shelter on Lower Serpentine Road approximately three metres to the east to accommodate new skybridge entrance
- Construction of a 12 metre high lift that connects the proposed skybridge to the wharf level. Five metres of the lift would be visible from street level
- Regrading of pavement at street level and wharf level to create the entry/exit points of the skybridge, stairs and lift
- Replacement of the existing non *Disability Discrimination Act 1992* (DDA) compliant stairs with DDA compliant stairs connecting Lower Serpentine Road and the new wharf, near the proposed lift. The new stairs would use part of the existing stair footprint on Lower Serpentine Road, which currently connects Mary Carlson Park to wharf level

- Removal of the existing non DDA compliant stairs
- Partial excavation of the embankment to provide room for the new stairs connecting at the western side of the existing bus shelter
- Installation of three bicycle hoops
- Replacement of balustrades and handrail at wharf level
- Electrical work including relocation of existing electrical switchboard cabinet at wharf level, removal of two existing power poles and placing existing electrical overhead wires underground
- Pruning of fig trees to accommodate the new skybridge, stairs and lift
- Retention of the current existing ramp near Greenwich Park connecting road level to the foreshore.

Figure 1-1 shows the key features of the proposal including the water-based and land-based features.

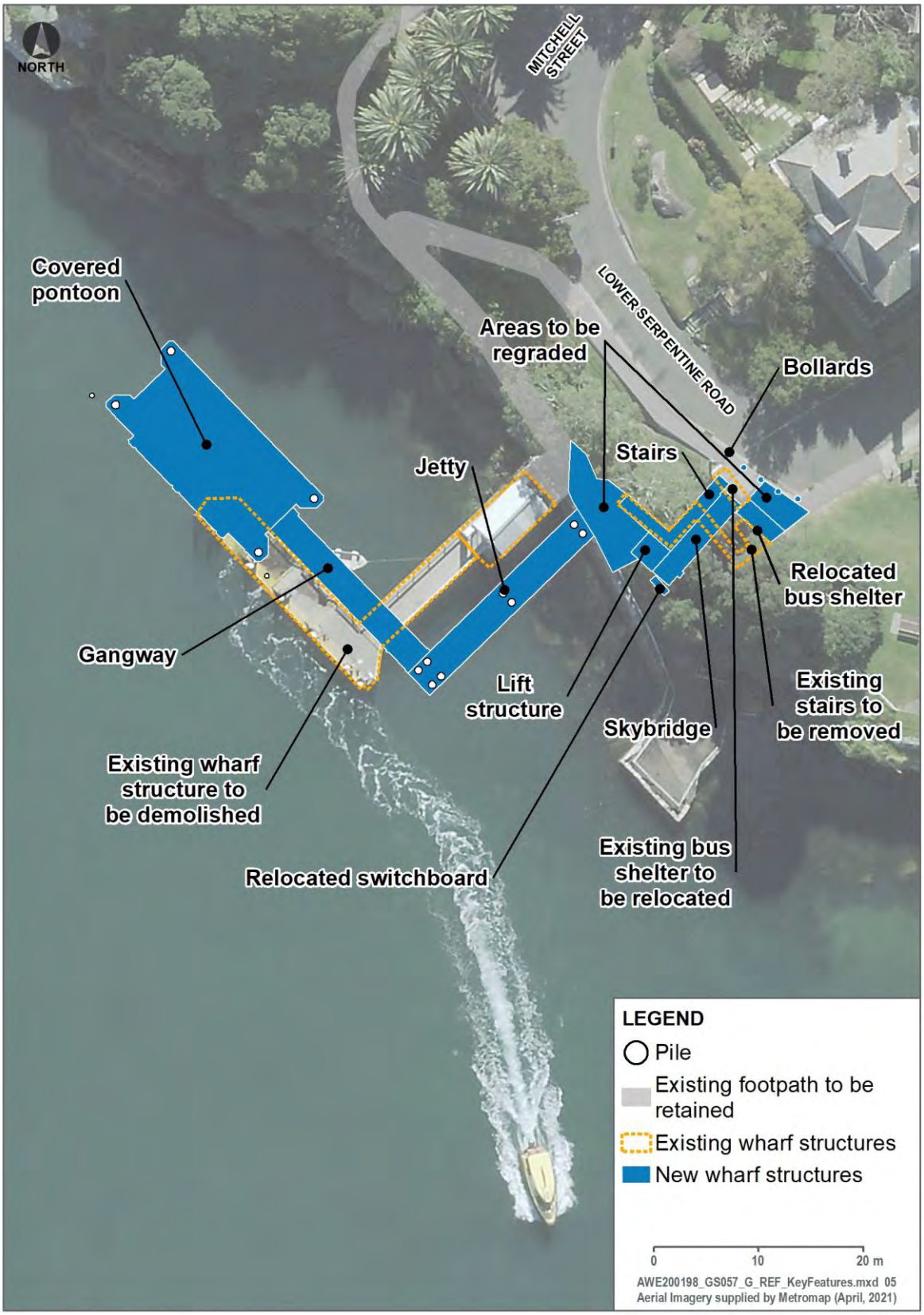


Figure 1-1: Key features of the proposal

1.3 Legislative context

A REF is prepared to satisfy Transport for NSW'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 Greenwich Point wharf upgrade, and assesses the biodiversity impacts of the proposal.

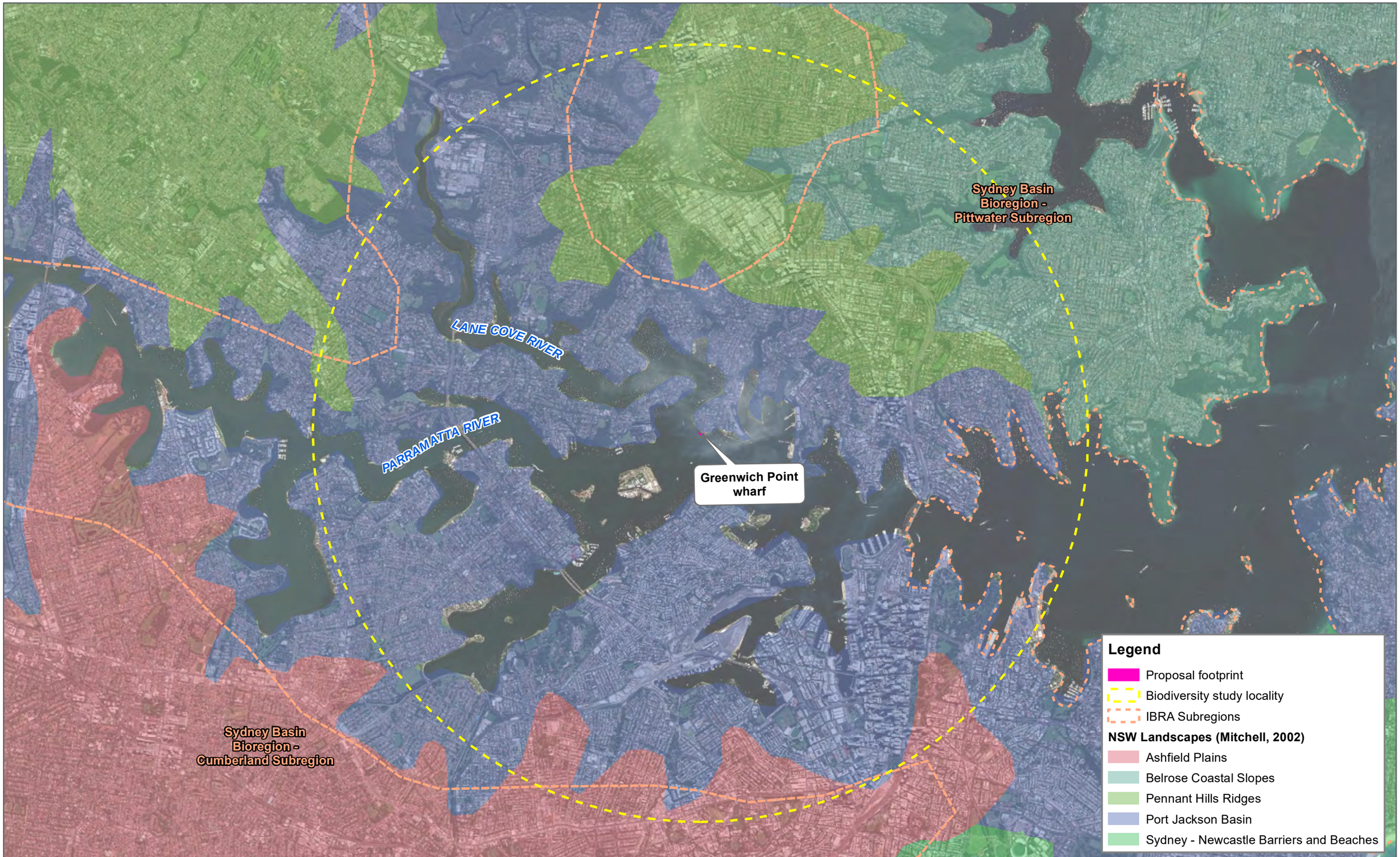
Sections 7.2A of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FM Act) require that the significance of the impact on threatened species, and threatened ecological communities (TECs) is assessed using a five-part test (BC Act) or the 7-part test (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 Transport for NSW 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 the Greenwich Point wharf upgrade as described in Section 1.2
- Proposal footprint - refers to the area directly impacted by the proposed works including the installation and removal of structures (Figure 1-3)
- Compound area – refers to the temporary facility required for construction (Figure 1-3)
- Study area - refers to the proposal and surrounding areas covered by this BAR (about 11,300 square metres and excludes private properties) (Figure 1-3)
- Study locality - refers to an area within five kilometres of the proposal footprint (for the purpose of the background research) (Figure 1-2).



1:46,000 Scale at A3

m

0 500 1,000 1,500 2,000 2,500

Study Locality

FIGURE 1-2

GREENWICH POINT

N

Cardno

Map Produced by National Water & Environment
Date: 2021-09-09 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map: AWE200198_GS_ECO_039_GreenwichPt_StudyLocality.mxd 02
Aerial imagery supplied by ESRI

1:700 Scale at A3

Meters

0 5 10 15 20 25

Proposal Footprint, Compound and Study Areas

FIGURE 1-3

GREENWICH POINT

N

Cardno

Map Produced by National Water & Environment
Date: 2021-10-13 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map: AWE200198_GS_ECO_040_GreenwichPt_ProjectStudyArea.mxd 03
Aerial imagery supplied by Metromaps (2021)

2 Methods

2.1 Personnel

This BAR was prepared by the following personnel:

- Dilys Zhang (BSc (Hons)) – Senior Ecologist
- Brendan Alderson (PhD) – Principal Ecologist
- Jake Ludlow (BSc) - Ecologist
- Kevin Roberts (BSc (Hons), MEnvSt, EMPA) – Senior Principal Environmental Scientist.

2.2 Background research

A review of information and data was completed in March 2021 (before the field survey) 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 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 (TBDC): 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.

Contemporary 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.

Sensitive ecological sites were identified through searches of the following:

- Regional Conservation Plans prepared by the former NSW OEH: http://www.environment.nsw.gov.au/biodiversity/regconsplans.htm
- Areas of Outstanding Biodiversity Value (AOBV) register: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register
- Important Habitat to threatened species as mapped for the BAM (accessed through the Biodiversity Offsets and Agreement Management System (BOAMS))
- 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 Greenwich Point wharf interchange: Concept design report (Aurecon Australasia Pty Ltd, 2019) included a concept design assessment which contains a summary of the biodiversity values to be considered in the REF as well as other environmental considerations. The relevant sections of the document were reviewed and incorporated into this report.

This report considers all coastal marine/estuarine and terrestrial species and ecological communities. Riverine and oceanic species and ecological communities have been excluded from this report as no habitat occurs in or near the study area. Diadromous species (fish that migrate between fresh and salt water) 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 potentially 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 proposal is located, and

- The proposal area 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; collectively known as Assessments of Significance (AoSs)) for species considered 'likely to occur' by the habitat assessment has been completed unless otherwise discussed in Section 3.11.

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 (ie 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 (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.
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 15 April 2021. The aims of the survey on 15 April 2021 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 surveys. The maps were created for the study area using ArcGIS 10.8 from an orthorectified aerial Nearmap imagery captured in April 2021. 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 surveys are summarised in Table 2-2 (BoM, 2021a; WillyWeather, 2021). Conditions during the survey on 15 April 2021 were mostly sunny with light variable winds. There was up to seven millimetres of rainfall in Sydney within seven days prior to the field survey and water visibility was generally no more than 0.5 metres. The marine field survey was completed on a flood tide.

Table 2-2: Weather and sea conditions during the field survey (source: BoM, 2021; WillyWeather, 2021)

Date	Temperature range (°C)	Rainfall (mm)	Wind direction	Max wind speed (km/h)	High tide	Low tide
15/04/2021	16.3-26.7	0	WNW	33	10:14am (1.42 m) 10:23pm (1.70 m)	4:13am (0.52 m) 3:57pm (0.61 m)

2.4.2 Vegetation surveys

The terrestrial portion of the study area includes the southern portion of Greenwich Park, the majority of Mary Carlson Park, the escarpment vegetation along the footpath leading from Lower Serpentine Road to the existing wharf and the vegetated areas along the south-west boundary of 18 Lower Serpentine Road. The vegetation in the study area comprised of native and exotic landscaped/planted vegetation. Thus, the categorisation of plant community type (PCT) and TEC commensuration checks were not required. The vegetation survey was carried out in all vegetated areas within the terrestrial study area. A walkover of the study area was completed to describe and map the type, extent and condition of vegetation. The floristics of the site was also recorded.

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

2.4.3 Targeted flora surveys

As the background research and habitat assessment did not identify any threatened flora with a moderate or high likelihood of occurrence, no targeted threatened flora surveys were completed.

2.4.4 Targeted fauna surveys

No targeted fauna surveys were completed and threatened fauna presence was determined/assumed from an assessment of habitat features.

2.4.5 Aquatic surveys

Fieldwork was carried out from a five metre Cardno survey vessel using a combination of an underwater remotely operated vehicle (ROV) and/or bathyscope. The intertidal areas were

inundated at the time of survey and the landward extent limited by a steep escarpment and existing foreshore infrastructure. Thus, all areas below high tide were surveyed from the vessel.

Visibility of the harbour had been severely impacted by extreme rainfall and flooding events in March 2021. The vessel navigated to areas of potential marine vegetation and habitat areas to verify, describe and classify the presumptive map into categories below.

Seagrasses, where detected, were classified as follows:

- Species:
    - Zostera (*Zostera muelleri* subsp. capricorni (previously *Zostera capricorni)*)
    - Posidonia (*Posidonia australis*)
    - Halophila (*Halophila* spp.)
- Density:
    - High (greater than 50 per cent cover)
    - Medium (between 15 and 50 per cent cover, inclusive)
    - Low (less than 15 per cent cover).

Reef habitat, where detected, was classified into two major categories:

- Reef with monospecific macroalgal communities
- Reef with mixed macroalgal communities.

The complexity of reef habitat was also classified, given complexity is considered a reasonable indicator of the potential for an area of reef to be habitat for threatened species such as Black Rockcod (*Epinephelus daemelii*). 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 using the same methods described above for creating presumptive maps. Where areas comprised more than one species (e.g. Zostera with an understorey of Halophila), these were differentiated by the most abundant species while co-occurring species present were also 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 (eg 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 northern foreshores of Sydney Harbour (the harbour), in the Parramatta River estuary (the estuary). The 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 was deeply incised in Hawkesbury sandstone between 15 and 29 million years ago. Subsequent sea level rise, about 17,000 years ago, resulted in the flooding of the river valley, deposition of sediments and the formation of the tidal estuary.

Sydney Harbour is of high aesthetic, ecological and socio-economic importance to Sydney. The foreshores of the estuary are highly urbanised and the harbour 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 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 northern foreshores of the harbour in the Pittwater Subregion of the Sydney Basin Bioregion (NSW National Parks and Wildlife Service, 2003) and the Port Jackson Basin landscape (Mitchell, 2002). The Pittwater Subregion and the Port Jackson Basin are characterised by small beach, dune and lagoon barrier systems and steep coastal cliffs and rock platforms. The coastal cliffed margins are on Triassic quartz while Quaternary muddy sands and pocket beaches are at the head of most tributary streams. The bathymetry of the study area is a composite of the natural geology and anthropogenic alterations. A wide depth range is a result of dredged shipping channels and deep holes (28 to 45 metres) separated by shoals of three to five metre depths (Sydney Institute of Marine Science, 2018). A number of shallow bays fringe the main channel on the northern and southern sides. The study area is located on a peninsula at the confluence of Lane Cove River and Parramatta River (Figure 1-2).

3.1 Coastal processes and hydrology

The poleward flowing East Australian Current (EAC) brings nutrient depleted waters to the entrance of the harbour. 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 distant 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).

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 parts per million, (ppm)) and manganese (up to 15 ppm).

3.2 Soil and sediment properties

The estuary lies on the southern edge of the Hornsby Plateau, an upland area of massive, vertically jointed Hawkesbury sandstone capped with Wianamatta Group shales (McLoughlin, 2000). Outcrops of Hawkesbury sandstone were visible on the escarpment along the shoreline of the study area. The depth of the soil profile in the study area is unknown however, the visibility of sandstone outcrops suggest a shallow bedrock level (Aurecon Australasia Pty Ltd, 2019).

Northern tributaries have deep, steep-side valleys with little capacity for shoreline sediment accumulation without substantial filling of the valley. The Wianamatta Group shales weather rapidly to fine-grained and easily transported clays. Sediment deposits over bedrock range between 25 and 50 metres vertical depth downstream of the Harbour Bridge and 20 to 35 metres in channels and bays upstream of the Harbour Bridge. The acceleration of sedimentation within the estuary was triggered by the advent of vegetation clearing and soil disturbance from 1788 across the catchment (McLoughlin, 2000). This was followed by the process of removing accumulating silt, reshaping foreshores and seabeds for shipping and amenities virtually continuously for 140 years from 1842. Reclamation aimed to eliminate and replace mudflats and marshes with flat waterside land for industry and recreation. The foreshore reclamation areas also became the final destination for dredged material which otherwise would be taken out to sea.

The present-day estuary comprises five environmental/sedimentological units including:

- Harbour entrance (marine flood-tide delta sands)
- Lower estuary (sands)
- Central estuary (muddy sands)
- Upper estuary (muds)
- Off-channel bays (muds) (Birch, 2006).

Generally, sediments west of Sow and Pigs Reef (where the study area is located) are dominated by terrestrial mud (OzCoasts, 2015). Clay and silt with variable shell content mostly likely characterise sediments in the study area with the shallow margins along the shoreline likely to contain higher sand content (Aurecon Australasia Pty Ltd, 2019).

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 partially within a high-risk zone for ASS (NSW DPIE, 1997; Aurecon Australasia Pty Ltd, 2019). Shallow samples collected in the study area indicate the presence of reducible sulfer concentrations lower than the minimum action criteria outlined by the Acid Sulfate Soils Manual (Acid Sulfate Soil Management Advisory Committee, 1998). However, it is anticipated that deep sediments could contain ASS.

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. 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 five 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 three kilometres north-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.

The level of soil contamination in the terrestrial portion of the study area is currently unknown and the area around Greenwich Point has been used for residential purposes over the years indicating no localised contaminating activities (Aurecon Australasia Pty Ltd, 2019). However, the study area is close to and down gradient of Cockatoo Island where previous studies have found contaminated sediments. This migration of contamination along with stormwater discharge and overland run off are considered key sources of contamination in the study area. A recent Stage 2 contamination assessment found that shallow sediments were contaminated with lead, mercury and PAHs levels above trigger values.

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 three- to five-fold in the Lane Cove River, west of the study area, since pre-European settlement (Local Land Services Greater Sydney, 2015). In general, the turbidity varies along the estuary from clearer, low turbidity oceanic waters near the mouth to higher values near the river/creek inputs. In addition, the temporal variability is characterised by higher turbidity following significant inflow events and relatively low values during dry periods.

Suspended sediments attenuate light penetration through the water column and thereby limit pelagic and benthic primary production (the process of converting light energy into biomass). As the suspended matter settles to the seabed it may also smother benthic organisms and affect the type of organisms and plants that can exist in this environment. Fluctuations in light and rates of sedimentation occur naturally in Sydney Harbour due to regular resuspension of particulate matter by the tidal currents, wind-driven mixing and runoff events. Any activities which involve seabed disturbance have the potential to increase sedimentation and turbidity beyond the natural range.

3.4 Terrestrial vegetation

The foreshore of the Greenwich peninsula is highly urbanised with a narrow corridor of vegetation along the western and southern foreshore. This vegetation is remnant in some areas and highly modified with plantings of native and exotic ornamental species and garden escapees. This vegetated corridor, to about 100 metres east of Greenwich Baths, consists of steep sandstone escarpments, a small sandy beach at Greenwich Baths and mostly unmodified shoreline. The foreshore along the south-eastern tip and the east is mostly modified with a substantial area occupied by a decommissioned oil refinery/storage (Figure 1-3). Residential dwellings and recreational space fringe the foreshore and the peninsula and is characterised by hardstands, landscaped gardens, street plantings or open parks.

The terrestrial study area is located on land sloping from Lower Serpentine Road to the foreshore escarpment. Although most of the foreshore along this reach of the peninsula is natural, the shoreline around the existing wharf was partially reclaimed and modified by a sandstone seawall (Figure 3-1). The south-eastern seawall adjoined a concrete platform likely to be placed over reclaimed land (Figure 3-8).

Figure 3-1: The sandstone seawall to the south-east (left) and north-west (right) of the existing wharf

The vegetation in the study area had been substantially altered by planted vegetation and garden escapees that it was not considered remnant vegetation or conforms to any PCTs. Based on the understorey composition and the prevalence of large planted overstorey species in the study area, the Port Jackson Figs (*Ficus rubiginosa*) were likely to be planted or propagated from plantings. Native trees, including Flax-leaved Paperbark (*Melaleuca linariifolia*), Blue Lilly Pilly (*Syzygium oleosum*), Hairpin Banksia (*Banksia spinulosa*). Sweet Pittosporum (*Pittosporum undulatum*) and young Smooth-barked Apple (*Angophora costata*) recorded in the study area were likely to be propagates from either nearby plantings or remnant foreshore vegetation. There is also the possibility that some of these individuals may have been planted by Council or residents as many of these species are also commonly selected as ornamental plantings.

Vegetation in the study area was found at Greenwich and Mary Carlson Parks, the foreshore escarpment between and the roadside verge on Lower Serpentine Road. The total area of landscaped vegetation in the study area is about 3400 square metres.

Vegetation in Greenwich Park extends from the south-western boundary of 25 Lower Serpentine Road to the top of the foreshore escarpment. A row of adult Phoenix Palms (*Phoenix* sp.) was observed along the eastern fringe of Greenwich Park, planted across a sealed path which becomes unsealed as it extended north-west (Figure 3-2). Adult Brush Boxes (*Lophostemon confertus*) and young Smooth-barked Apples colonised the area to the south-west of the unsealed path while Port Jackson Figs fringed the top of the escarpment with Sweet Pittosporum. The groundcover to the north-east of the path consisted of mown lawn, garden escapees and ornamental plantings. The understorey to the south-west of the path was mown lawn, bare in some sections or covered by a Flax-leaved Paperbark, Hairpin Banksia, Spiny-head Mat-rush (*Lomandra longifolia*) and a number of native and exotic shrubs, herbs and grasses (Figure 3-3).

Figure 3-2: Row of Phoenix Palm planted along the eastern fringe of Greenwich Park

Figure 3-3: Vegetation in Greenwich Park

The vegetation between Greenwich Park and Mary Carlson Park was similar to the vegetation described along the top the foreshore escarpment at Greenwich Park. Port Jackson Figs occurred with Sweet Pittosporum and Blue Lilly Pilly. The groundcover here was either a mix of Spiny-head Mat-rush with a number of exotic forbs and grasses on the top of the escarpment (Figure 3-4) or a mix of ornamental ferns, palms and exotic forbs and grasses on the vertical or sloping escarpment faces. Most of this vegetation encroached on or overhung the sealed path leading from Lower Serpentine Road to the wharf (Figure 3-5).

Figure 3-4: Vegetation at the top of the escarpment between Greenwich and Mary Carlson Parks

Figure 3-5: Vegetation along the vertical and sloping faces of the escarpment between Greenwich and Mary Carlson Parks

Mary Carlson Park is an open, landscaped park where a large Port Jackson Fig overhung mown lawn along the south-western section. Two Swamp Banksias (*Banksia robur*) had been planted next to the Port Jackson Fig and an adult Brush Box stood at the top of the escarpment at the eastern-most corner of the study area (Figure 3-6).

Figure 3-6: Vegetation at Mary Carlson Park

The roadside verge along the south-western boundary of 18 Lower Serpentine Road had a garden bed planted with mostly exotic ornamental varieties including Jade (*Crassula* spp.), Star Jasmin (*Trachelospermum jasminoides*), Chalk Sticks (*Senecio serpens*) and *Carissa macrocarpa*. The mown lawn areas of this verge were planted with Weeping Bottlebrush (*Callistemon viminalis*), a Fried Egg Plant (*Gordonia axillaris*) and a Jacaranda (*Jacaranda mimosifolia*) (Figure 3-7).

Figure 3-7: Vegetation in the roadside verge along Lower Serpentine Road

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

1:700 Scale at A3

Meters

0 5 10 15 20 25

Terrestrial Vegetation and Habitat in the Study Area

FIGURE 3-8

GREENWICH POINT

N

Cardno

Map Produced by National Water & Environment
Date: 2021-10-13 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map: AWE200198_GS_ECO_041_GreenwichPt_TerrestrialVeg.mxd 03
Aerial imagery supplied by Metromap (2021)

3.5 Terrestrial fauna habitat

All landscaped vegetation in the study area form potential habitat for a number of species. Trees and shrubs provide potential foraging habitat for birds and arboreal and aerial mammals, particularly while in bloom/fruiting. 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. A hollow, with an eight centimetre diameter entrance, was recorded in a Port Jackson Fig at the top of the escarpment directly above the existing wharf (Figure 3-8 and Figure 3-9).

Disturbance-tolerant birds may forage in the vegetated areas and the majority of the study area is considered foraging habitat for fruit bats and microchiropteran bats (microbats). Microbats may also roost in the crevices of the existing wharf and terminal structures, in fissures in sandstone escarpments and in any decorticating bark of Brush Boxes. 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. Fauna occupancy (or inoccupancy) in the study area may also be driven by the occurrence of outdoor domestic cats observed during the field survey.

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

Figure 3-9: Hollow in a Port Jackson Fig at the top of the escarpment.

3.6 Priority weeds

Two priority weeds listed under the *Biosecurity Act 2015* for the Greater Sydney region were recorded in the study area during the field survey (Table 3-1).

Table 3-1: Priority weeds recorded in the study area and their associated duty

Scientific name	Common name	Extent of infestation	Duty
Asparagus aethiopicus	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)
Lantana camara	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

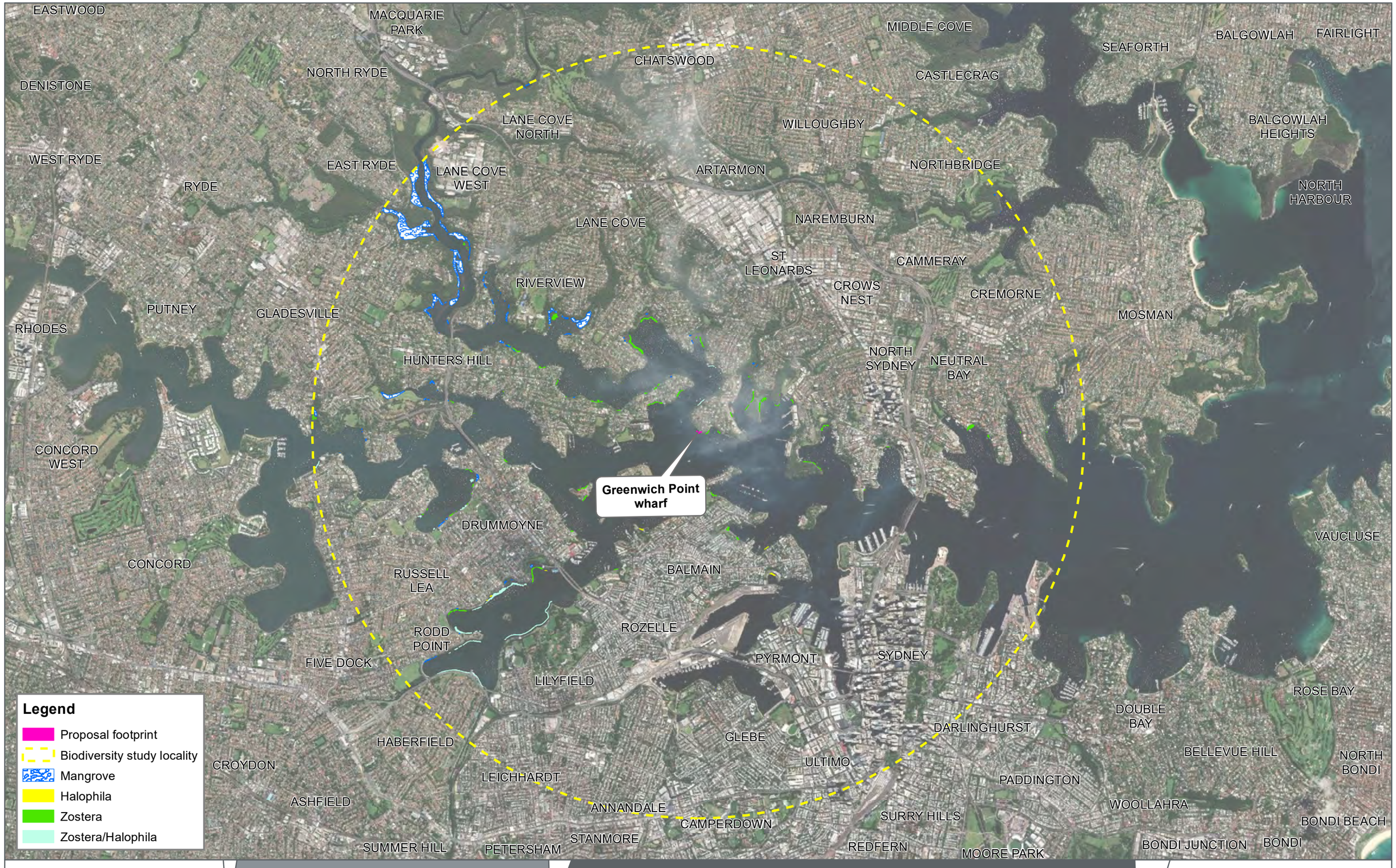
The marine study area comprised of an artificial seawall, the toe of the natural sandstone escarpment, intertidal rocky reef and soft sediment areas and subtidal rocky reefs surrounding the existing Greenwich Point wharf. The harbour is mapped as Key Fish Habitat (KFH) and is estuarine thus, considered a Class 1 waterway – Major KFH (NSW DPI, 2013; NSW DPI, 2020a).

The steep shoreline in the study area did not support mangroves or saltmarsh. This is generally characteristic of the lower reaches of the harbour (Creese, et al., 2009; NSW OEH, 2016) (Figure 3-10).

No seagrass meadows have been previously mapped in the study area (Creese, et al., 2009). Fragmented Zostera meadows were mapped from about 30 metres east of the study area into Berrys Bay while fragmented Zostera and Halophila mixed meadows were mapped along the western fringe of the peninsula in the Lane Cove River (Figure 3-10).

Subtidal rocky reefs either directly abutted the escarpment towards the north-western end of the study area or transitioned from intertidal rocky reefs around the existing wharf and the south-eastern end of the study area (Figure 3-16). These reefs extended about three to four metres into the harbour, where they transitioned from intertidal rock reefs and up to 11 metres were they directly abutted the escarpment (Figure 3-16). The study area encompassed about 560 square metres of low relief subtidal rocky reefs (Table 3-2) and about 270 square metres of submerged vertical pile areas. The construct of subtidal rocky reefs appeared to be of natural bedrock, dislodged natural rock, seawall fragments and trapped soft sediment (Figure 3-11).

Macroalgae and other habitat-forming species, commonly found on subtidal rocky reefs in the harbour, were recorded during the field survey. Epiphytes (ie green and brown filamentous algae) and sediment covered most of subtidal rocky reefs resulting in a higher abundance of habitat-forming invertebrates, including mussels (*Class Bivalvia*), sponges (*Phylum Porifera*) and ascidians (*Class Ascidiacea*), and a low abundance and diversity of macroalgae. Macroalage were found in fragmented patches and mostly comprised of *Ecklonia radiata*, *Sargassum* sp., *Gracilaria* sp. and *Dictyota dichotoma* with the former two species more prevalent in subtidal rocky reef areas and *Dictyota dichotoma* observed mostly on the vertical piles (Figure 3-12).



1:46,000 Scale at A3

m

0 500 1,000 1,500 2,000 2,500

Marine Vegetation and Habitat in the Study Locality

FIGURE 3-10

GREENWICH POINT

Cardno

Map Produced by National Water & Environment
Date: 2021-09-09 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map:
AWE200198_GS_ECO_042_GreenwichPt_MarineVegHabLocality.mxd 02
Aerial imagery supplied by ESRI

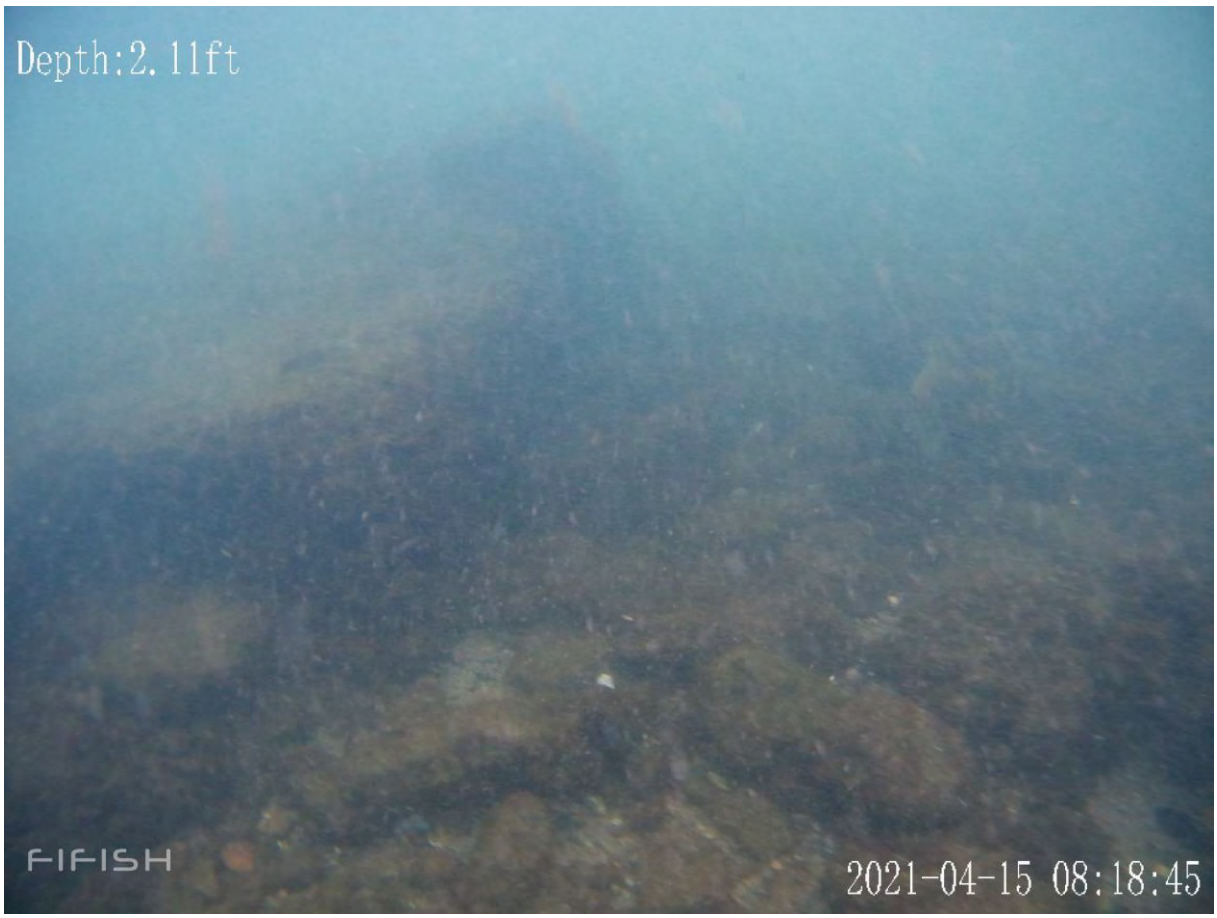


Figure 3-11: Low relief subtidal rocky reef in the study area

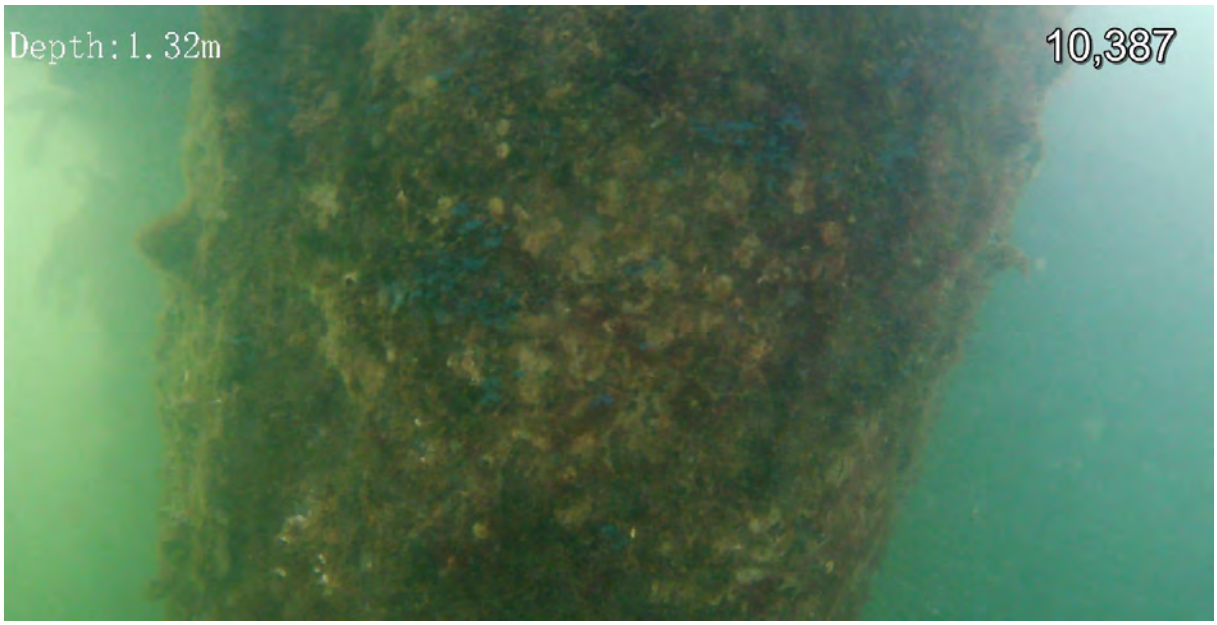


Figure 3-12: Typical subtidal assemblages on piles

The intertidal rocky reefs were mostly bare with some small clusters of Sydney Rock Oysters (*Saccostrea glomerata*) and barnacles (*Infraclass Cirripedia*) (Figure 3-13). These areas occupied about 620 square metres (Table 3-2) in the study area and were more extensive around the wharf and the south-eastern section. There is also a small area (30 square metres; Table 3-2) of intertidal soft sediment (sandflats) at the end of a concrete ramp at the south-eastern section of the study area (Figure 3-14).

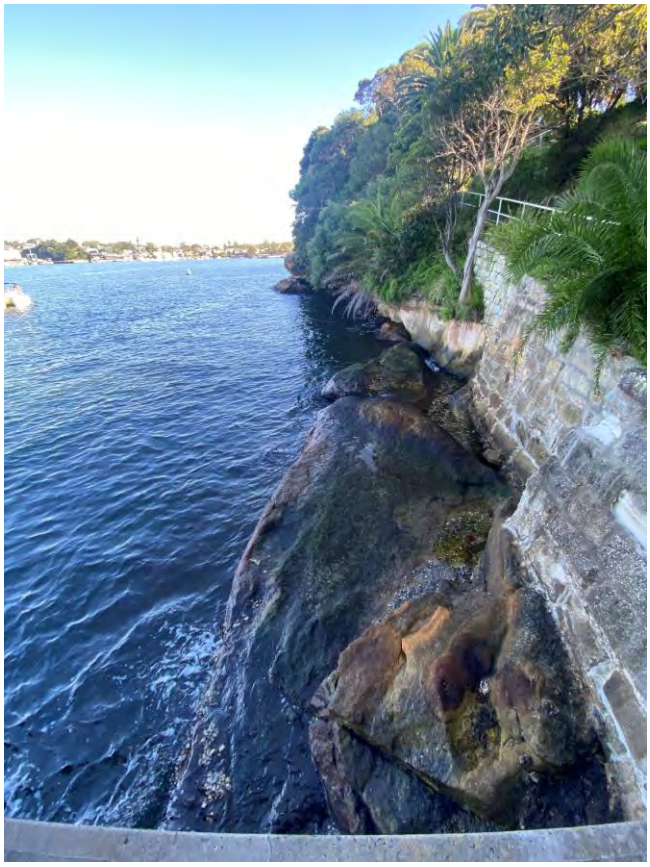


Figure 3-13: Typical condition of intertidal rocky reefs in the study area

Figure 3-14: Small area of intertidal sandflat (submerged at the time of survey)

Subtidal soft sediment habitat occupied that largest area in the study area (about 5590 square metres) and mostly comprised of bare sand and shell grit (Table 3-2 and Figure 3-15). Rock rubble and solid waste materials that had settled on the sandy seabed were observed in this habitat. Some of these materials were colonised by mats of *Gracilaria* sp. and, similar to subtidal rocky reefs in the study area, were covered in epiphytes and sediment. These 'reefs' were generally no larger than one meter in diameter, have potential to mobilise during inclement weather or from vessel wash thus, considered to form the unconsolidated soft sediment landscape. Soft sediment habitats generally lack the habitat complexity of consolidated rocky reef habitat. No visible epifauna (ie fauna that lives on the surface of the seafloor) were observed during this survey. However, infauna (ie fauna that lives in the sediment) activity (ie bioturbation) was observed during the field survey. Soft sediment epifauna and infauna play a central role in ecosystem functions by forming basal elements of many food chains (Gadd & Griffiths, 1977; Eyre & Ferguson, 2005; Connell & Gillanders, 2007).

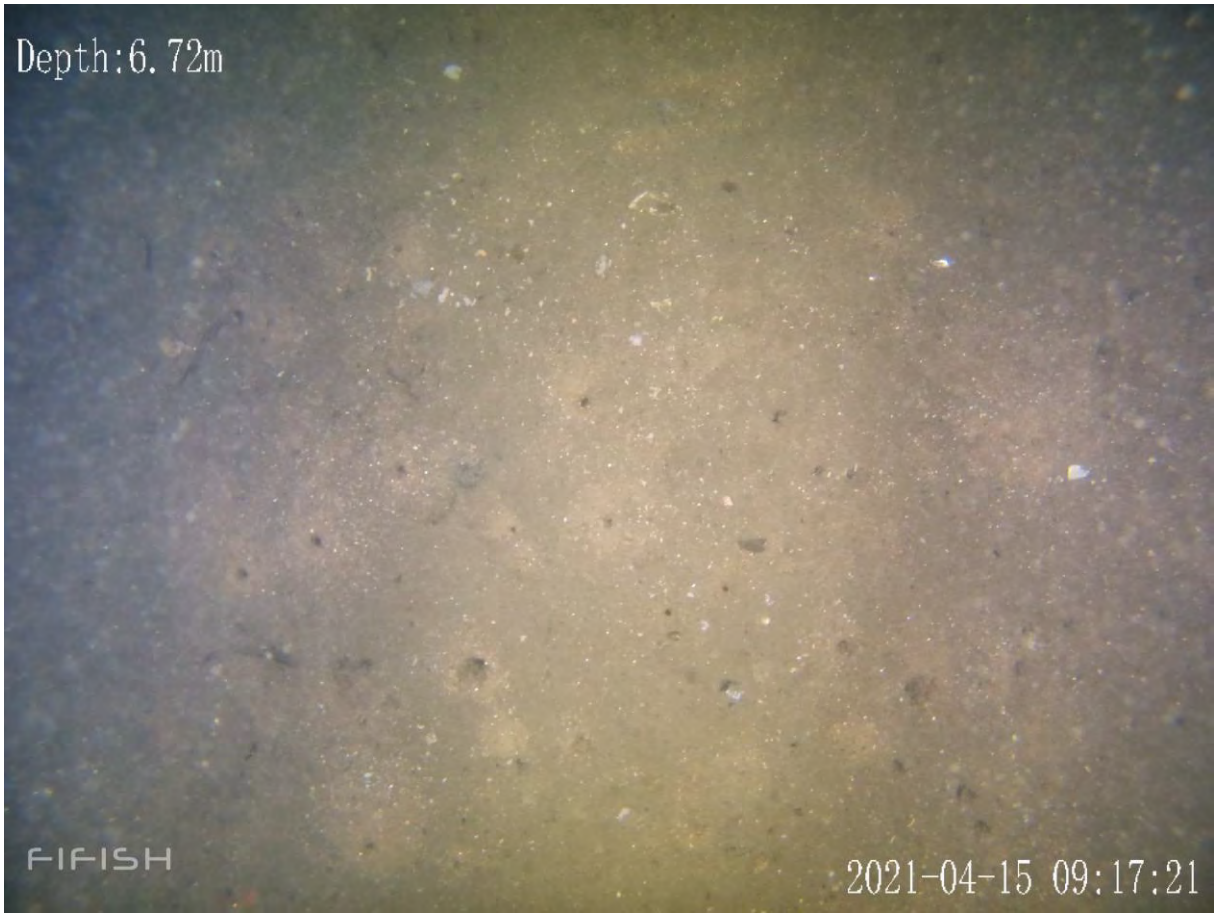


Figure 3-15: Typical soft sediment habitat in the study area with evidence of bioturbation

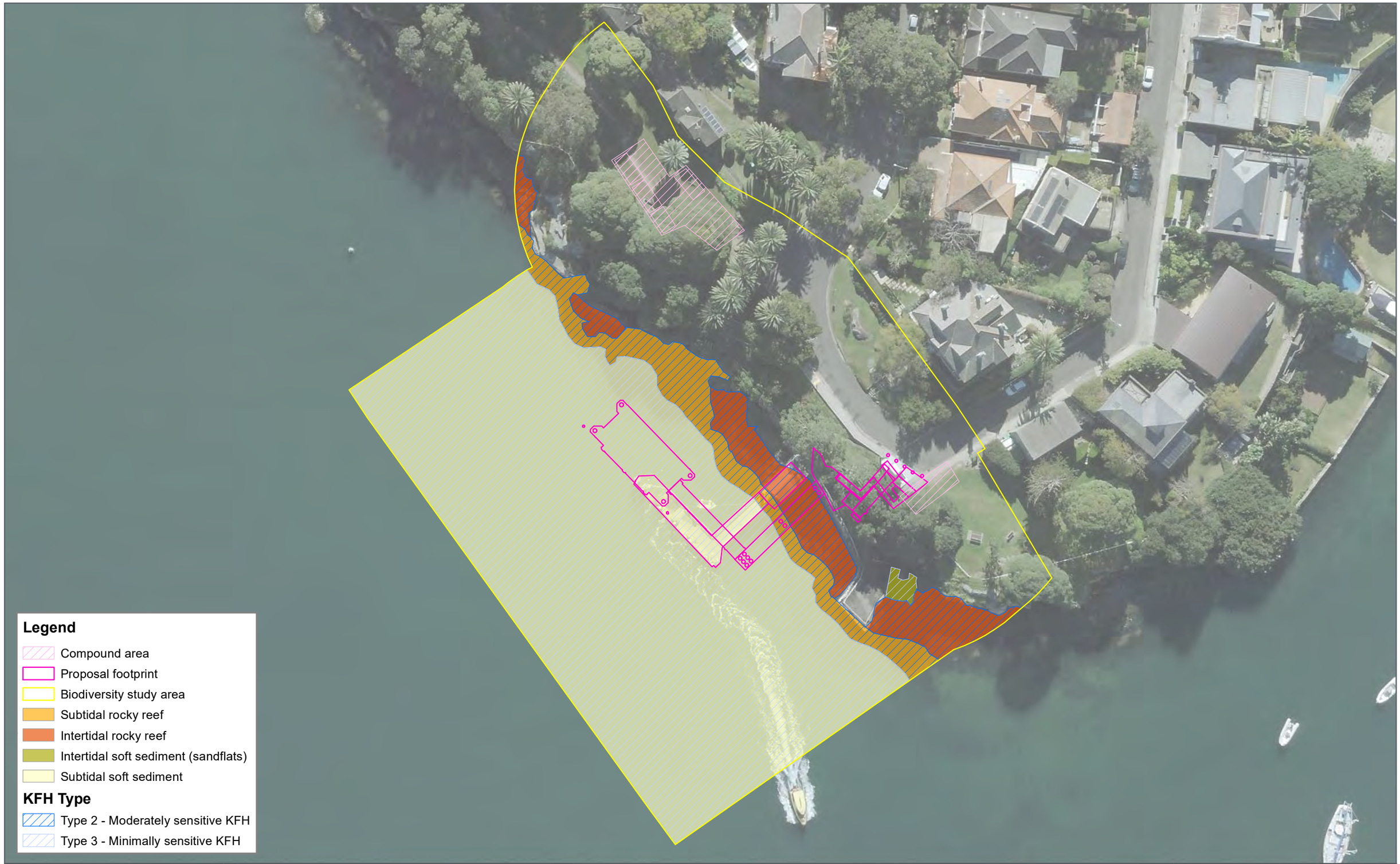
Intertidal and subtidal rocky reefs (including habitat on existing piles) of the study area are considered Type 2 – Moderately sensitive KFH as they meet the descriptions of estuarine rocky reefs and macroalgae were observed on subtidal rocky reefs (NSW DPI, 2013). Intertidal and subtidal soft sediment areas are considered Type 3 – Minimally sensitive KFH as these areas were characterised by unstable or unvegetated sand (Figure 3-16).

Table 3-2: Areas of marine vegetation and habitat within the study area

Marine vegetation and habitat	Area in study area (m^2)
Low relief subtidal rocky reef (Type 2 KFH)	560
Subtidal rocky reef (vertical area on piles) (Type 2 KFH)	270
Intertidal rocky reef (Type 2 KFH)	620
Intertidal soft sediment (sandflats) (Type 3 KFH)	30
Subtidal soft sediment (Type 3 KFH)	5590
Total	**7070**

The marine vegetation and habitat within the study area is characteristic of many nearshore areas in the harbour. Subtidal rocky reefs in the harbour provide habitat for a number of local and vagrant fish and other mobile species and intertidal rocky reef areas can provide habitat for foraging shorebirds. These include threatened and migratory species known to occur in the harbour (see sections 3.11 and 3.17.1). No threatened or migratory species were observed during the field survey.

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



1:700 Scale at A3

Meters

0 5 10 15 20 25

Marine Vegetation and Habitat in Study Area

FIGURE 3-16

GREENWICH POINT

N

Cardno

Map Produced by National Water & Environment
Date: 2021-10-13 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map: AWE200198_GS_ECO_043_GreenwichPt_MarineVegHab.mxd 03
Aerial imagery supplied by Metromap (2021)

3.8 Marine pests and diseases

Labyrinthula spp. is a Stramenopile protist (a pathogen) that causes seagrass wasting disease (Trevathan-Tackett, et al., 2018). This genus of protists is ubiquitous to coastal and marine ecosystems and is 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 loss of chloroplasts, 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 reported in NSW but has been known to occur in Queensland, Victoria and Western Australia, and little is understood of its ecology. Thus, Trevathan-Tackett et al. (2018) highlights the importance of monitoring the disease in Australian seagrass populations.

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

A large number of viral, bacterial and parasitic diseases affecting finfish, molluscs, crustacean and amphibians are known to occur within NSW waterways. The most renowned include Red Spot Disease, QX oyster disease and Pacific Oyster Mortality Syndrome (POMS) (NSW DPI, 2018). Red Spot Disease (or Epizootic ulcerative syndrome) is a fungal disease endemic in a number of waterways in NSW. This disease can affect many species of finfish and shows as red lesions or deep ulcers which can then be susceptible to secondary bacterial infections. Although the freshwater and estuarine waterways of the Sydney region have not recorded Red Spot Disease outbreaks, it is known to occur in all NSW waterways. QX oyster disease and POMS are high risk to oyster aquacultures, of which none currently reside within the study area or the harbour.

3.9 Threatened ecological communities (TEC)

No remnant vegetation or PCTs occur within the study area and therefore no TECs occur within the study area. However, 10 TECs have been mapped within the locality (Figure 3-17) (NSW OEH, 2016). These, and their proximity to the study area, are detailed in Table 3-3.

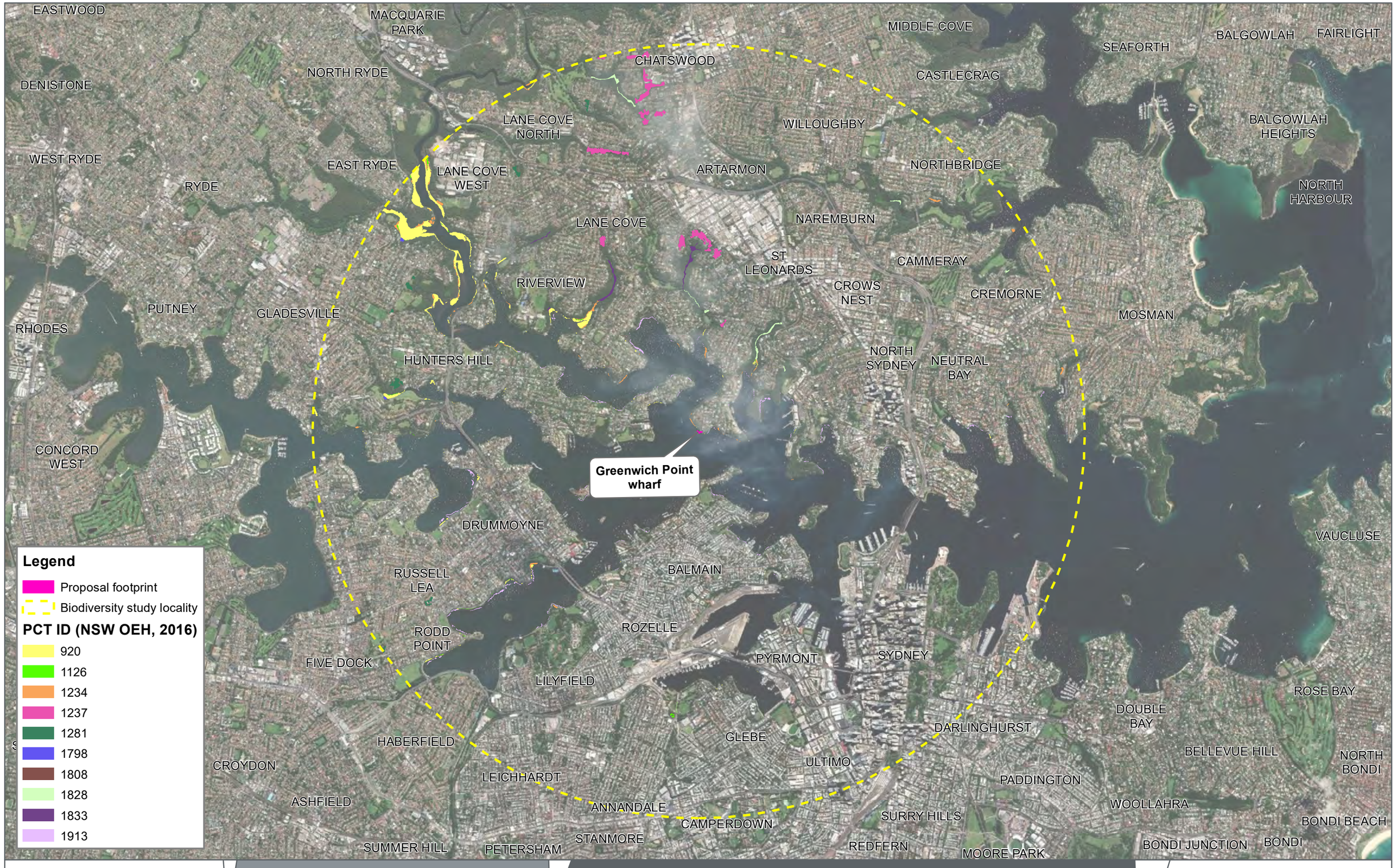
Table 3-3: Threatened ecological communities (TECs) mapped within the study locality and their proximity to the study area

Plant community type (PCT) and ID	Associated TECs BC Act	EPBC Act	Area in locality (ha)	Bearing and proximity of the closest occurrence to the study area
Estuarine mangrove forest (PCT 920)*	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (endangered)	Subtropical and Temperate Coastal Saltmarsh (vulnerable)	29.25	~0.5 km north-west Also mapped in the study area but does not occur as groundtruthed during the field survey
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)	1.01	~1.2 km north-east
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 (Casuarina glauca) Forest of New South Wales and South East Queensland Ecological Community (endangered)	5.33	<0.1 km north-west
Blu Gum high forest (PCT 1237)	Blue Gum High Forest in the Sydney Basin Bioregion (critically endangered)	Blue Gum High Forest of the Sydney Basin Bioregion (critically endangered)	15.10	~1.4 km north

Sydney Turpentine-Ironbark Forest (PCT 1281)	Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion (critically endangered) OR Shale Sandstone Transition Forest in the Sydney Basin Bioregion (critically endangered) OR Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion (endangered)	Turpentine-Ironbark Forest of the Sydney Basin Bioregion (critically endangered) OR Shale Sandstone Transition Forest of the Sydney Basin Bioregion (critically endangered)	3.70	~3.9 km west
Riverflat Paperbark swamp forest (PCT 1798)	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (endangered)	-	0.33	~4.1 km west
Estuarine reedland (PCT 1808)	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (endangered) OR Sydney Freshwater Wetlands in the Sydney Basin Bioregion (endangered)	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland Ecological Community (endangered)	0.10	~4.4 km north-west
Coastal sandstone gallery rainforest (PCT 1828)	Hygrocybeae Community of Lane Cove Bushland Park in the Sydney Basin Bioregion (critically endangered)	-	3.27	~1.2 km north-east

Coastal escarpment littoral rainforest (PCT 1833)	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)	3.26	~1.9 km north
Seagrass meadows (PCT 1913)*	*Posidonia australis* seagrass endangered populations in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (endangered population under the FM Act)	*Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion (endangered)	6.34	~0.4 km east

*Marine vegetation discussed in Section 3.7.



TECs in Study Locality

FIGURE 3-17

GREENWICH POINT

Cardno

Map Produced by National Water & Environment
Date: 2021-09-09 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map: AWE200198_GS_ECO_044_GreenwichPt_TECLocality.mxd 02
Aerial imagery supplied by ESRI

3.10 Groundwater dependent ecosystems

There are no aquatic or terrestrial GDEs in the study area (BoM, 2020b). The closest mapped GDE is at Clarke's Point Reserve, across the Lane Cove River, about 0.5 kilometres 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 106 threatened species with potential to occur in the study locality. Those with records in the study locality are illustrated in Figure 3-18. Of the 106 threatened species, four were amphibians, 28 were flora, three were invertebrates, 39 were birds, three were fish/Syngnathids, 20 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 although visibility in the intertidal and subtidal areas was poor. 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. Some of these habitats were not considered optional/suitable due to the size, condition and level of disturbance (ie prevalence of outdoor domestic cats affecting habitat suitability for birds and mammals). This was a consideration of the likelihood of occurrence assessment. Table 2-1 provides the likelihood of occurrence criteria used in the assessment and Table 3-4 provides a summary of the assessment. The rationale behind the assessment is attached in Annexure B.

The likelihood of occurrence assessment found the majority of threatened species were either unlikely to occur or have a low likelihood of occurrence in the study area. However, due to the presence of suitable habitat in the study area and/or known populations in the harbour, ten species were considered to have a moderate to high likelihood of occurrence. These include:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act and the EPBC Act
- Black Rockcod (*Epinephelus daemelii*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Seven microbats listed as vulnerable under the BC Act:
    - Large-eared Pied Bat (*Chalinolobus dwyeri*)
    - 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 Sheathtail-bat (*Saccolaimus flaviventris*)
    - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

White's Seahorse is listed as endangered under the FM Act and 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, 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 a considered as significant. Although the study area does not extend to the coastal areas of the Hawkesbury Shelf and the subtidal rocky reef areas were low relief, the existing wharf structures have potential to provide habitat for juvenile Black Rockcod. Due to the presence of suitable habitat within the study area and the species' characteristic high site fidelity, AoSs under the FM Act and the EPBC Act have been completed for the species (Annexure D).

Seven microbats, listed under the BC Act, were considered to have a moderate likelihood of occurrence in the study area. There is no breeding habitat in the study area however, some of the existing wharf structures, the sandstone seawall, escarpment and the hollow in the Port Jackson Fig have potential to provide roosting habitat and the entire study area forms potential foraging habitat for these seven species. All of these species prefer to roost in caves or tree hollows however, they are known to roost in human-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 4.2 kilometres north-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, AoSs under the BC Act have been completed for these groups of species (Annexure D).

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. There are no roosting camps in or near the study area. The closest roosting camp is in the Royal Botanic Garden Sydney (RBG), about 3.5 kilometres south-west of the study area. 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 are assess in the AoSs completed under the BC Act and the EPBC Act (Annexure D).

Table 3-4: 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					
Heleioporus australiacus	Giant Burrowing Frog	V	V	(PMST)	None
Litoria aurea	Green and Golden Bell Frog	E	V	(PMST)	None
Mixophyes balbus	Stuttering Frog	E	V	(PMST)	None
Pseudophryne australis	Red-crowned Toadlet	V	-	2 (BioNet)	None
Flora					
Acacia bynoeana	Bynoe's Tiny Wattle	E	V	(PMST)	Low
Acacia pubescens	Downy Wattle	V	V	(PMST)	Low
Acacia terminalis subsp. *terminalis*	Sunshine Wattle	E	E	23 (BioNet) (PMST)	Low
Allocasuarina glareicola	-	E	E	(PMST)	Low
Asterolasia elegans	-	E	E	(PMST)	Low
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	(PMST)	None
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	(PMST)	None
Darwinia biflora	-	V	V	(PMST)	None
Epacris purpurascens var. *purpurascens*	-	V	-	6 (BioNet)	None
Eucalyptus camfieldii	Camfields Stringybark	V	V	(PMST)	Low
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	5 (Bionet)	Low
Genoplesium baueri	Yellow Gnat-orchid	E	E	(PMST)	None
Haloragodendron lucasii	Hal	E	E	(PMST)	Low

Scientific Name	Common Name	BC Act (FM Act)*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Hygrocybe reesiae	-	V	-	1 (BioNet)	None
Lasiopetalum joyceae	-	V	V	(PMST)	Low
Leptospermum deanei	-	V	V	(PMST)	Low
Melaleuca biconvexa	Biconvexa Paperbark	V	V	(PMST)	Low
Melaleuca deanei	Deane's Paperbark	V	V	(PMST)	Low
Persicaria elatior	Tall Knotweed	V	V	(PMST)	None
Persoonia hirsuta	Hairy Geebung	E	E	(PMST)	Low
Pimelea curviflora var. *curviflora*	-	V	V	(PMST)	None
Pimelea spicata	Spiked Rice-flower	E	E	(PMST)	None
Prostanthera junonis	Somersby Mintbush	E	E	(PMST)	Low
Rhizanthella slateri	Eastern Underground Orchid	V	E	(PMST)	Low
Rhodamnia rubescens	Scrub Turpentine	CE	-	1 (Bionet) (PMST)	Low
Rhodomyrtus psidioides	Native Guava	CE	CE	(PMST)	Low
Syzygium paniculatum	Magenta Lilly Pilly	V	V	9 (Bionet) (PMST)	Low
Thesium australe	Austral Toadflax	V	V	(PMST)	None
Invertebrates					
Dendronepthya australis	Cauliflower Soft Coral	E (FM Act)	E	(DPI) (PMST)	Low
Petalura gigantea	Giant Dragonfly	E	-	1 (BioNet)	None
Pommerhelix duralensis	Dural Land Snail	E	E	(PMST)	None
Birds					

Scientific Name	Common Name	BC Act (FM Act)*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Anthochaera phrygia	Regent Honeyeater	CE	CE	(PMST)	Low
Ardenna carneipes	Flesh-footed Shearwater	V	M, Ma	(PMST)	Low
Botaurus poiciloptilus	Australasian Bittern	E	E	1 (BioNet) (PMST)	Low
Burhinus grallarius	Bush Stone-curlew	E	-	3 (BioNet)	Low
Calidris canutus	Red Knot	-	E, Mi, Ma	(PMST)	Low
Calidris ferruginea	Curlew Sandpiper	E	CE, Mi, Ma	(PMST)	Low
Calidris tenuirostris	Great Knot	V	CE, Mi, Ma	(PMST)	Low
Calyptorhynchus lathami	Glossy Black Cockatoo	V	-	6 (BioNet)	None
Charadrius leschenaultii	Greater Sand Plover	V	V, Mi, Ma	(PMST)	Low
Charadrius mongolus	Lesser Sand Plover	V	E, Mi, Ma	(PMST)	Low
Daphoenositta chrysoptera	Varied Sitella	V	-	1 (BioNet)	None
Falco hypoleucos	Grey Falcon	E	V	(PMST)	Low
Glossopsitta pusilla	Little Lorikeet	V	-	6 (BioNet)	Low
Grantiella picta	Painted Honeyeater	V	V	(PMST)	None
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	Ma	37 (BioNet) (PMST)	Low
Hirundapus caudacutus	White-throated Needletail		V, Mi, Ma	4 (BioNet) (PMST)	Low
Ixobrychus flavicollis	Black Bittern	V	-	3 (BioNet)	None
Lathamus discolor	Swift Parrot	E	CE, Ma	2 (BioNet) (PMST)	Low

Scientific Name	Common Name	BC Act (FM Act)*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Limosa lapponica baueri	Bar-tailed Godwit	-	V	(PMST)	Low
Limosa limosa	Black-tailed Godwit	V	Mi, Ma	(PMST)	Low
Lophoictinia isura	Square-tailed Kite	V	-	1 (BioNet)	None
Macronectes halli	Northern Giant Petrel	V	V, Mi, Ma	(PMST)	Low
Ninox connivens	Barking Owl	V	-	2 (BioNet)	None
Ninox strenua	Powerful Owl	V	-	393 (BioNet)	Low
Numenius madagascariensis	Eastern Curlew	-	CE, Mi, Ma	(PMST)	Low
Pachyptila turtur subantarctica	Fairy Prion (Southern)	-	V	(PMST)	Low
Pandion cristatus	Eastern Osprey	V	Mi, Ma	1 (BioNet) (PMST)	Low
Pterodroma leucoptera leucoptera	Gould's Petrel	V	E, Ma	(PMST)	Low
Pterodroma neglecta neglecta	Kermadec Petrel	V	V, Ma	(PMST)	Low
Rostratula australis	Australian Painted Snipe	E	E, Ma	(PMST)	None
Sternula albifrons	Little Tern	E	Mi, Ma	1 (BioNet) (PMST)	Low
Sternula nereis	Australian Fairy Tern	-	V	(PMST)	Low
Thalassarche bulleri	Buller's Albatross	-	V, Ma, Mi	(PMST)	Low
Thalassarche bulleri platei	Northern Buller's Albatross	-	V, M, Ma	(PMST)	Low
Thalassarche cauta cauta	Shy Albatross	V	V, Ma, Mi	(PMST)	Low
Thalassarche melanophris	Black-browed Albatross	V	V, Ma, Mi	(PMST)	Low

Scientific Name	Common Name	BC Act (FM Act)*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Thalassarche salvini	Salvin's Albatross	-	V, Ma, Mi	(PMST)	Low
Thinornis rubricollis rubricollus	Hooded Plover	CE	V, Ma	(PMST)	Low
Tyto tenebricosa	Sooty Owl	V	-	1 (BioNet)	None
Fish and Syngnathids					
Hippocampus whitei	**White's Seahorse**	**E (FM Act)**	**E, Ma**	**(DPI) (PMST)**	**High**
Epinephelus daemelii	**Black Rockcod**	**E (FM Act)**	**V**	**(DPI) (PMST)**	**Moderate**
Prototroctes maraena	Eastern Grayling	E (FM Act)	V	(DPI) (PMST)	Low
Mammals					
Arctocephalus forsteri	New Zealand Fur Seal	V	Ma	PMST	Low
Arctocephalus pusillus	Australian Fur Seal	V	Ma	2 (BioNet) (PMST)	Low
Cercartetus nanus	Eastern Pygmy Possum	V	-	1 (BioNet)	None
Chalinolobus dwyeri	**Large-eared Pied Bat**	**V**	**V**	**1 (BioNet) (PMST)**	**Moderate**
Dasyurus maculatus maculatus	Spotted-tail Quoll	V	E	(PMST)	None
Eubalaena australis	Southern Right Whale	E	E, Mi	(PMST)	Low
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern/south eastern)	E	E	(PMST)	None
Micronomus norfolkensis	**Eastern Coastal Free-tailed Bat**	**V**	**-**	**10 (BioNet)**	**Moderate**
Miniopterus australis	**Little Bent-winged Bat**	**V**	**-**	**6 (BioNet)**	**Moderate**

Scientific Name	Common Name	BC Act (FM Act)*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Miniopterus orianae oceanensis	**Large Bent-winged Bat**	**V**	**-**	**70 (BioNet)**	**Moderate**
Myotis macropus	**Southern Myotis**	**V**	**-**	**37 (BioNet)**	**Moderate**
Perameles nasuta	Long-nosed Bandicoot, North Head	EP	-	1 (BioNet)	None
Petauroides volans	Greater Glider	-	V	(PMST)	None
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	(PMST)	None
Phascolarctos cinereus	Koala (combined populations Qld, NSW and the ACT)	V	V	3 (BioNet) (PMST)	None
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	-	1 (BioNet)	None
Pseudomys novaehollandiae	New Holland Mouse	-	V	(PMST)	None
Pteropus poliocephalus	**Grey-headed Flying Fox**	**V**	**V**	**915 (BioNet) (PMST)**	**High**
Saccolaimus flaviventris	**Yellow-bellied Sheathtail-bat**	**V**	**-**	**7 (BioNet)**	**Moderate**
Scoteanax rueppellii	**Greater Broad-nosed Bat**	**V**	**-**	**4 (BioNet)**	**Moderate**
Reptiles					
Caretta caretta	Loggerhead Turtle	E	E, Mi, Ma	2 (BioNet) (PMST)	Low
Chelonia mydas	Green Turtle	V	V, Mi, Ma	(PMST)	Low
Dermochelys coriacea	Leatherback Turtle	E	E, Mi, Ma	1 (BioNet) (PMST)	Low
Eretmochelys imbricata	Hawksbill Turtle	-	V, Mi, Ma	(PMST)	Low

Scientific Name	Common Name	BC Act (FM Act)*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Hoplocephalus bungaroides	Broad-headed Snake	E	V	(PMST)	None
Natator depressus	Flatback Turtle	-	V, Mi, Ma	(PMST)	Low
Elasmobranchs					
Carcharias taurus	Grey Nurse Shark (east coast population)	CE (FM Act)	CE	(DPI) (PMST)	Low
Carcharodon carcharias	Great White Shark	V (FM Act)	V, Mi	(DPI) (PMST)	Low
Rhincodon typus	Whale Shark	-	V, Mi	(PMST)	Low

*V = vulnerable; E = endangered; CE = critically endangered; EP = endangered population; Mi = migratory (EPBC Act); Ma = marine (EPBC Act)

Moderate or high likelihood of occurrence species are in **bold**.

EASTWOOD
MACQUARIE PARK
MIDDLE COVE
SEAFORTH
BALGOWLAH
FAIRLIGHT
CHATSWOOD
NORTH RYDE
CASTLECRAG
DENISTONE
LANE COVE NORTH
WILLOUGHBY
BALGOWLAH HEIGHTS
WEST RYDE
EAST RYDE
LANE COVE WEST
ARTARMON
NORTHBRIDGE
RYDE
NORTH HARBOUR
LANE COVE
NAREMBURN
ST LEONARDS
CAMMERAY
RIVERVIEW
CROWS NEST
CREMORNE
PUTNEY
GLADESVILLE
MOSMAN
RHODES
HUNTERS HILL
NORTH SYDNEY
NEUTRAL BAY
Greenwich Point wharf
CONCORD WEST
DRUMMOYNE
VAUCLUSE
CONCORD
RUSSELL LEA
BALMAIN
ROZELLE
RODD POINT
PYRMONT
SYDNEY
FIVE DOCK
LILYFIELD
ROSE BAY
DOUBLE BAY
DARLINGHURST
HABERFIELD
GLEBE
BELLEVUE HILL
NORTH BONDI
CROYDON
ULTIMO
LEICHHARDT
PADDINGTON
ASHFIELD
ANNANDALE
WOOLLAHRA
SURRY HILLS
CAMPERDOWN
BONDI BEACH
STANMORE
SUMMER HILL
PETERSHAM
REDFERN
BONDI JUNCTION
BONDI
MOORE PARK

Legend

- Proposal footprint
- Biodiversity study locality
- Amphibia
- Aves
- Flora
- Insecta
- Mammalia
- Reptilia

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:46,000 Scale at A3

m
0 500 1,000 1,500 2,000 2,500

Threatened Species Records in Study Locality

FIGURE 3-18

GREENWICH POINT

Cardno

Map Produced by National Water & Environment
Date: 2021-09-09 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map: AWE200198_GS_ECO_045_GreenwichPt_TSLocality.mxd 02
Aerial imagery supplied by ESRI

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 3-5.

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 five bird species listed as Marine under the EPBC Act with potential to occur in the study locality and 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 (ie 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 3-5: Likelihood of occurrence summary of protected species

Scientific Name	Common Name	FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Birds					
Ardea ibis	Cattle Egret	-	Ma	(PMST)	Low
Charadrius ruficapillus	Red-capped Plover	-	Ma	(PMST)	Low
Himantopus	Pied Stilt	-	Ma	(PMST)	Low
Merops ornatus	Rainbow Bee-eater	-	Ma	(PMST)	Low
Recurvirostra novaehollandiae	Red-necked Avocet	-	Ma	(PMST)	Low
Fish, Syngnathids and reptiles					
Acentronura tentaculata	Shortpouch Pygmy Pipehorse	P	Ma	(DPI) (PMST)	High
Anampses elegans	Elegant Wrasse	P	-	(DPI)	High
Epinephelus coioides	Estuary Cod	P	-	(DPI)	High
Epinephelus lanceolatus	Queensland Groper	P	Ma	(DPI)	Moderate
Festucalex cinctus	Girdled Pipefish	P	Ma	(DPI) (PMST)	High
Filicampus tigris	Tiger Pipefish	P	Ma	(DPI) (PMST)	High
Heraldia nocturna	Upside-down Pipefish	P	Ma	(DPI) (PMST)	High
Hippichthys penicillus	Beady Pipefish	P	Ma	(DPI) (PMST)	High
Hippocampus abdominalis	Big-belly Seahorse	P	Ma	(DPI) (PMST)	High
Histiogamphelus briggsii	Crested Pipefish	P	Ma	(DPI) (PMST)	High
Lissocampus runa	Javelin Pipefish	P	Ma	(DPI) (PMST)	High

Scientific Name	Common Name	FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Maroubra perserrata	Sawtooth Pipefish	P	Ma	(DPI) (PMST)	High
Notiocampus ruber	Red Pipefish	P	Ma	(DPI) (PMST)	High
Paraplesiops bleekeri	Eastern Blue Devil	P	-	(DPI)	High
Pelamis platurus	Yellow-bellied Seasnake	-	Ma	(PMST)	Low
Phyllopteryx taeniolatus	Weedy Seadragon	P	Ma	(DPI) (PMST)	High
Solegnathus spinosissimus	Spiny Pipefish	P	Ma	(DPI) (PMST)	High
Solenostomus cyanopterus	Robust Ghost Pipefish	P	Ma	(DPI) (PMST)	High
Solenostomus paradoxus	Ornate Ghost Pipefish	P	Ma	(DPI) (PMST)	Low
Stigmatopora argus	Spotted Pipefish	P	Ma	(DPI) (PMST)	High
Stigmatopora nigra	Widebody Pipefish	P	Ma	(DPI) (PMST)	High
Syngnathoides biaculeatus	Double-end Pipefish	P	Ma	(DPI) (PMST)	High
Trachyrhamphus bicoarctatus	Bentstick Pipefish	P	Ma	(DPI) (PMST)	High
Urocampus carinirostris	Hairy Pipefish	P	Ma	(DPI) (PMST)	High
Vanacampus margaritifer	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 (*Scorpis 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, including the shoreline in the study area, is 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, including the concrete platform in the study area. 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 or next to the study area 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 10 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 and vegetation is restricted to a narrow corridor. Nonetheless, foreshore vegetation is connected along the eastern foreshore of the Lane Cover River, up Gore Creek to Lane Cove Bushland Park. This corridor ends at Mann's Point, about 0.5 km east of the study area.

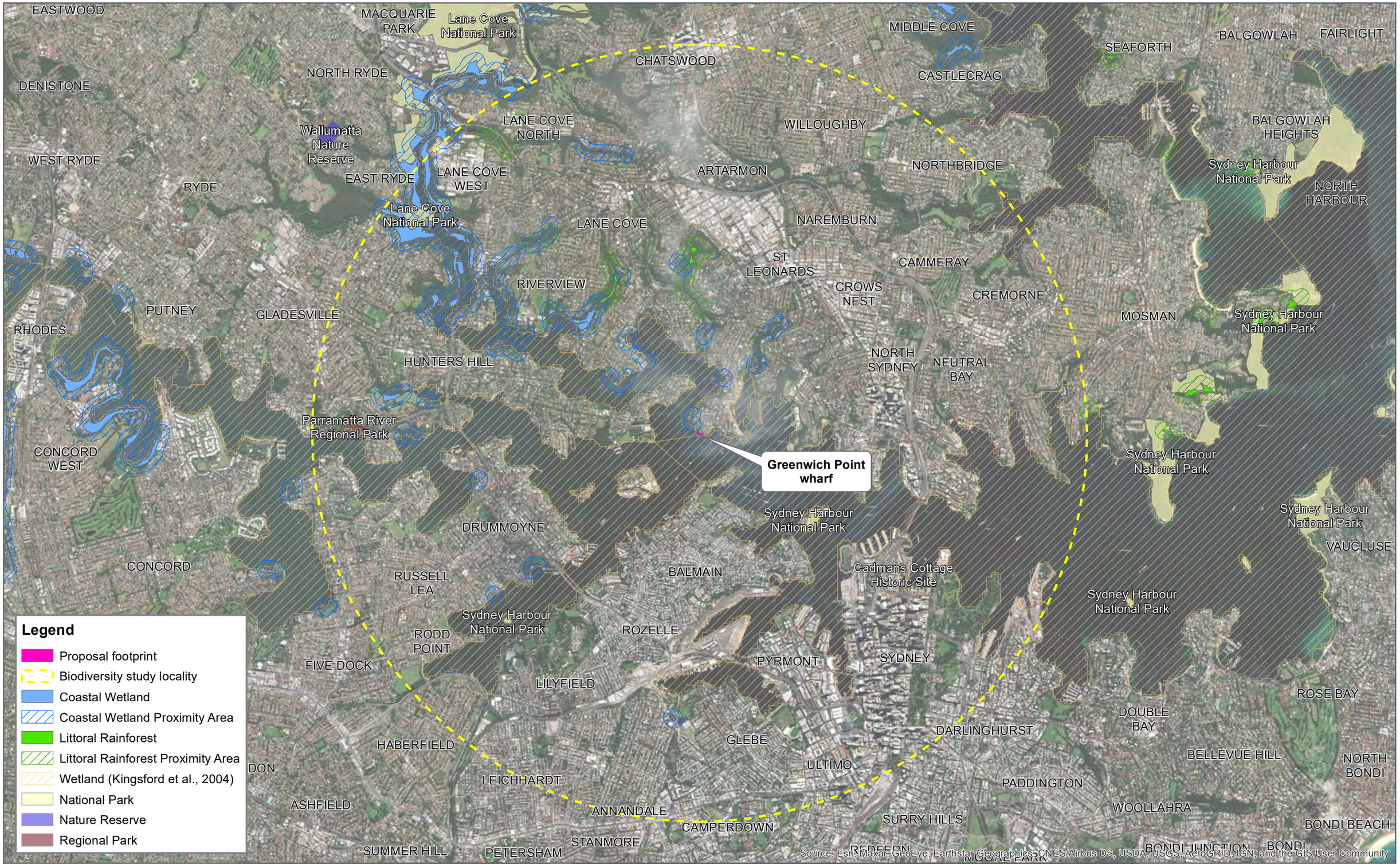
The waters of Greenwich Point forms part of the marine corridor that is the Parramatta Estuary and is easily accessible for marine and estuarine species.

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 nearest Coastal Wetland is located about 70 m north-west of the study area, however, the proximity area of this wetland extends into the study area. The closest Littoral Rainforest is over 1.5 kilometres north of the study area in Lane Cove Bushland Park (Figure 3-20).

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 3-20).

The study area does not fall in or is next to any National Parks, Conservation Reserves, Nature Reserves or Regional Parks. The closest National Parks estate is Goat Island, which forms part of Sydney Harbour National Park, about 1.7 kilometres south-east of the study area (Figure 3-19). No Aquatic Reserves or Marine Parks occur within the study area or the study locality.



Legend

- Proposal footprint
- Biodiversity study locality
- Coastal Wetland
- Coastal Wetland Proximity Area
- Littoral Rainforest
- Littoral Rainforest Proximity Area
- Wetland (Kingsford et al., 2004)
- National Park
- Nature Reserve
- Regional Park

1:46,000 Scale at A3

Meters

0 500 1,000 1,500 2,000 2,500

Conservation Areas and Wetlands in Study Locality

FIGURE 3-19

GREENWICH POINT

Cardno

Map Produced by APAC Water and Environment
Date: 2021-09-09 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map:
AWE200198_GS_ECO_046_GreenwichPt_ConservationAreas.mxd 02
Aerial imagery supplied by ESRI

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 30 bird species and seven marine mammals/elasmobranchs have either been previously recorded or are predicted to occur within the study locality. An assessment of the likelihood of occurrence of all EPBC Act migratory 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.

No listed migratory species were considered to have a moderate or high likelihood of occurrence in the study area and are not addressed further.

Table 3-6: Likelihood of occurrence summary of migratory species

Scientific Name	Common Name	EPBC Act*	Number of records (source)	Likelihood of occurrence
Birds				
Actitis hypoleucos	Common Sandpiper	Mi, Ma	1 (BioNet) (PMST)	Low
Anous stolidus	Common Noddy	Mi, Ma	(PMST)	Low
Apus pacificus	Fork-tailed Swift	Mi, Ma	(PMST)	Low
Ardenna grisea	Sooty Shearwater	Mi, Ma	1 (BioNet) (PMST)	Low

Scientific Name	Common Name	EPBC Act*	Number of records (source)	Likelihood of occurrence
Ardenna pacifica	Wedge-tailed Shearwater	Mi, Ma	2 (BioNet)	None
Ardenna tenuirostris	Short-tailed Shearwater	Mi, Ma	3 (BioNet)	Low
Arenaria interpres	Ruddy Turnstone	Mi, Ma	(PMST)	Low
Calidris acuminata	Sharp-tailed Sandpiper	Mi, Ma	(PMST)	Low
Calidris melanotos	Pectoral Sandpiper	Mi, Ma	(PMST)	Low
Calidris ruficollis	Red-necked Stint	Mi, Ma	(PMST)	Low
Calonectris leucomelas	Streaked Shearwater	Mi, Ma	(PMST)	Low
Charadrius bicinctus	Double-banded Plover	Mi, Ma	(PMST)	Low
Cuculus optatus	Oriental Cuckoo	Mi	(PMST)	None
Fregata ariel	Lesser Frigate Bird	M, Ma	(PMST)	Low
Fregata minor	Great Frigate Bird	Mi, Ma	(PMST)	Low
Gallinago hardwickii	Latham's Snipe	Mi, Ma	(PMST)	Low
Limosa lapponica	Bar-tailed Godwit	Mi, Ma	(PMST)	Low
Monarcha melanopsis	Black-faced Monarch	Mi, Ma	(PMST)	None
Monarcha trivirgatus	Spectacled Monarch	Mi, Ma	(PMST)	None
Motacilla flava	Yellow Wagtail	Mi, Ma	(PMST)	Low
Myiagra cyanoleuca	Satin Flycatcher	Mi, Ma	(PMST)	None
Numenius phaeopus	Whimbrel	Mi, Ma	(PMST)	Low
Philomachus pugnax	Ruff	Mi, Ma	(PMST)	Low
Pluvialis fulva	Pacific Golden Plover	Mi, Ma	(PMST)	Low
Pluvalis squatarola	Grey Plover	Mi, Ma	2 (BioNet)	Low
Rhipidura rufifrons	Rufous Fantail	Mi, Ma	(PMST)	Low
Thalasseus bergii	Crested Tern	Mi, Ma	27 (BioNet)	Low
Tringa brevipes	Grey-tailed Tattler	Mi, Ma	(PMST)	Low

Scientific Name	Common Name	EPBC Act*	Number of records (source)	Likelihood of occurrence
Tringa nebularia	Common Greenshank	Mi, Ma	(PMST)	Low
Tringa stagnatilis	Marsh Sandpiper	Mi, Ma	(PMST)	Low
Mammals and Elasmobranchs				
Balaenoptera edeni	Bryde's Whale	Mi	(PMST)	Low
Caperea marginata	Pygmy Right Whale	Mi	(PMST)	Low
Lagenorhynchun obscurus	Dusky Dolphin	Mi	(PMST)	Low
Lamna nasus	Porbeagle	Mi	(PMST)	Low
Manta alfredi	Reef Manta Ray	Mi	(PMST)	None
Manta birostris	Giant Manta Ray	Mi	(PMST)	None
Sousa chinensis	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. The closest Ramsar Wetlands are located at Towra Point Nature Reserve, over 16 kilometres south of the study area.

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:
    - Ground disturbance during site establishment
    - Movement and use of equipment, plant and vessels
    - Disturbance of the escarpment for installation of stairs and lift
    - Disturbance of the seabed from vessel traffic, anchoring and piling
    - Installation and removal of structures
    - Landscaping
- Operation:
    - Persistence of the new wharf structures/features
    - Vessel and pedestrian traffic.

This section details the extent and significance of impacts as a result of the proposal including:

- Removal and disturbance of vegetation and habitat (terrestrial and marine)
- Mobilisation of soils, sediments and contaminants
- Alterations to hydrology
- Introduction/spread of weeds and/or marine pests and diseases
- Surface and underwater noise and vibration
- Vessel and pedestrian disturbance.

4.1 Construction impacts

4.1.1 Native vegetation and habitat (terrestrial)

The proposal would remove up to 280 square metres (within the proposal footprint and compound areas) of mown lawn and groundcover species in landscaped gardens (Table 4-1 and Figure 4-1). No trees or shrubs would be removed within the proposal footprint and compound areas, however, some pruning of the mature Port Jackson Figs on top of the escarpment may be required to accommodate the proposed skybridge. Impacts to these Figs would be avoided and mitigation measures have been recommended to protect these specimens (see Section 5).

Directly impacted vegetation does not form part of any remnant PCT, however, the area of mown lawn and groundcover species to be removed forms potential foraging habitat and movement corridors habitat for some highly mobile, disturbance tolerant native fauna. This would result in the removal of potential habitat for native fauna. The removal of habitat resources is unlikely to have a significant impact on native fauna as there is an abundance of similar habitat across the study locality of which the study area only forms a small proportion. Further, no tree or shrubs would be cleared and there is little to no habitat in the ground layer.

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.

Ground disturbance could expose soils which can then be easily mobilised. Contaminants in the soil can also be subsequently released into the surrounding environment. Erosion and sedimentation is most likely to impact harbour waters, particular during inclement weather (e.g. rainfall, high winds) if controls are not implemented. This could result in unfavourable, turbid conditions, the smothering of sessile marine vegetation, habitat and fauna and water, sediment and biota contamination in the waters of Greenwich Point and the wider harbour. In addition, as some of the construction would occur on top of the escarpment, there is the risk that rock/excavated material could fall and damage vegetation lower on the escarpment.

4.1.2 Marine vegetation and habitat

The proposal would not require large-scale disturbance of the seabed. However, to support the new wharf structures 14 piles would be installed as follows:

- Two of the piles would be installed directly in the low relief subtidal rocky reef to support the jetty. The jetty structure could also shade up to 10 square metres of the same habitat (Type 2 KFH; Table 4-1, Figure 4-1 and Section 4.2). The removal of the existing wharf structures would offset most of this impacted area.
- Eight support piles and the two pivot piles would be installed in soft sediment habitat. About 270 square metres of soft sediment habitat would also be permanently shaded by the pontoon, gangway and jetty structures (Type 3 KFH; Table 4-1, Figure 4-1 and Section 4.2). The removal of the existing wharf structures would offset approximately 130 square metres of this area. 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 although there is little to no marine vegetation to be impacted by shading. However, soft sediment habitats in the study area are characteristic of the majority of subtidal habitat in the harbour and community assemblages are generally ubiquitous and quick to recolonise following disturbance. Thus, the loss of these small areas would not be a substantial loss and anchor areas in soft sediment would quickly recolonise following the removal of anchors
- Two piles would be installed in the intertidal area to support the accessible jetty structure. The jetty could also shade 20 square metres of the horizontal and vertical intertidal assemblages (Type 2 KFH; Table 4-1 and Figure 4-1). The removal of the existing wharf structures would offset a large proportion of this area. The removal of a small proportion of these assemblages during piling is not considered to be ecologically significant to intertidal assemblages in the study area or across the harbour.

The removal of the existing structure would also result in the removal of marine vegetation, habitat and sessile/less mobile fauna on the piles and pontoon. This constitutes a total vertical marine vegetation/habitat area of 270 square metres (Table 4-1). These existing structures are currently densely colonised and the majority of these species are common in other intertidal areas and subtidal rocky reefs and would quickly colonise the piles and pontoon of the new wharf. The total vertical submerged area of the new wharf available for colonisation is slightly less than the vertical area to be removed (about 160 square metres). 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).

Under Section 199 of the FM Act, consultation with NSW DPI (Fisheries) is required for any dredging and reclamation works. 'Dredging' under the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013) is classified as disturbance of the seabed/streambed. In this case, this refers to removal and installation of piles. Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required as per the definition detailed in Section 3.12. NSW DPI (Fisheries) was consulted on 2 December 2021 and advised that a Section 205 permit is not required for the piling and pile removal works associated with this proposal.

There is potential for coarse and fine debris to be mobilised during piling, removal of existing structures and vessel movement. This can crush, damage and/or smother marine vegetation and habitat depending on the size of debris. Larger debris would be disposed offsite and should not cause any impacts to marine biodiversity. Mobilisation of finer debris (ie sediments) can also result in the mobilisation of contamination known to persist in the 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. The waters at Greenwich Point and the wider harbour periodically experiences impacts from elevated turbidity, usually as a result of rainfall, tides, swell and stormwater discharge. 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 with considerations to anchoring (see Section 5).

Table 4-1: Areas of terrestrial and marine vegetation and habitat to be impacted by the proposal

Vegetation and habitat	Area to be directly and indirectly impacted/removed (m^2)
Landscaped gardens and parks	280 (no tree removal)
Low relief subtidal rocky reef (Type 2 KFH)	10
Low-medium relief subtidal rocky reef (Type 2 KFH)	270 (existing vertical wharf areas)
Intertidal rocky reef (Type 2 KFH)	20 (including vertical seawall areas)
Soft sediment (Type 3 KFH)	270
Total	**~850**

1:700 Scale at A3

Meters

0 5 10 15 20 25

Vegetation and Habitat to be Impacted

FIGURE 4-1

GREENWICH POINT

N

Cardno

Map Produced by APAC Water and Environment
Date: 2021-10-13 | Project: AWE200198
Coordinate System: GDA 1994 MGA Zone 56
Map: AWE200198_GS_ECO_069_GP_ImpactVegHab.mxd 02
Aerial imagery supplied by Metromap (2021)

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. move 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, mammals and diving birds. The proposal footprint is considered suboptimal habitat for most marine turtles, mammals and diving birds 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 these species 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.

Land-based construction activities would create noise and vibration in the study area and the responses of terrestrial fauna are likely to be similar to that of mobile marine fauna (i.e. move away from unfavourable conditions and return once disturbance is removed).

With the correct controls, proposal construction is unlikely to cause mortality to coastal or mobile marine fauna in the study area.

4.1.4 Threatened, migratory and protected species

The proposal is unlikely to significantly impact threatened species and disturbances to potential habitat would largely be temporary and impact areas are generally considered suboptimal habitat and proportionally small to that available in the study area and the wider harbour. The details of the AoSs which assess impacts on threatened species considered potentially occurring in the study area are in Annexure D.

The removal of existing wharf structures and construction activities has potential to remove and temporarily disturb roosting and foraging habitat for the Large-eared Pied Bat, Eastern Coastal Free-tailed Bat, Little Bent-winged Bat, Large Bent-winged Bat, Southern Myotis, Yellow-bellied Sheathtail-bat, Greater Broad-nosed Bat and 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 these species.

Water-based activities have potential to impact habitat for the Southern Myotis, Black Rockcod and White's Seahorse. The foraging resource that the study area represents would be made available for these species following the completion of construction thus, proposal impacts to potential foraging habitat for these species are only temporary. The impact from the removal of the existing structure is considered minimal for Black Rockcod and White's Seahorse. Some of this habitat would be altered but would not be removed from the areas of occupancy for these species. These are also very small proportions 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 proposal area 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

Six 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) focuses on 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 where possible and cleaned and inspected before entering the study area (see Section 5) to avoid introducing non-indigenous fish and marine vegetation. Thus, proposal activities are unlikely to further exacerbate this KTP.

(2) Invasion and Establishment of Exotic Vines and Scramblers (BC Act), (3) Invasion of Native Plant Communities by Exotic Perennial Grasses (BC Act), (4) Loss and Degradation of Native Plant and Animal Habitat by Invasion of Escaped Garden Plants, Including Aquatic Plants (EPBC Act) and (5) 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:

- No tree or shrubs are expected to be cleared
- The mown lawn areas in the proposal footprint are not considered native vegetation
- Controls would be implemented to avoid the introduction/spread of exotic species during and post-construction.

(6) Installation and Operation of Instream Structures and Other Mechanisms That Alter Natural Flow Regimes of Rivers and Streams (FM Act)

The proposal would install 14 piles and remove the existing wharf structures. The size of these structures are small in comparison to the extent of the estuary thus would not interfere with fish passage. Due to the size of these structures in proportion to the estuary, alterations to hydrodynamics are likely to be localised and unlikely to impact any threatened species listed under the FM Act.

The identified threat abatement actions for this KTP include advice to consent authorities, community and stakeholder engagement, research and monitoring and habitat rehabilitation and protection. The proposal is unlikely to interfere with these actions with habitat rehabilitation (in the form of reinstatement of some lost habitat) proposed. Thus, the proposal is unlikely to further exacerbate or trigger this KTP.

4.2 Operational impacts

4.2.1 Marine vegetation and habitat

All elements of the proposal, with the exception of the piles, would sit permanently on or above the water's surface and avoid impacts to the seabed. However, these structures would shade a portion of intertidal rocky reef (20 square metres), subtidal rocky reef (10 square metres), and subtidal soft sediment habitat (270 square metres).

The 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. Design recommendations have been proposed to avoid shading impacts on this habitat (see Section 5). Shading of intertidal and soft sediment habitat is not expected to substantially change community assemblages as these areas generally lack marine vegetation (Table 4-1 and Figure 4-1). Removal of the existing wharf interchange would leave portions of subtidal rocky reef (10 square metres) and soft sediment habitat (about 130 square metres) exposed to sunlight. This is not expected to have any substantial impacts to soft sediment communities and subtidal rocky reef assemblages are likely to revert to those in adjacent, unshaded areas. There is also potential that changes in currents in the vicinity around the piles could cause a scour footprint of about 1.5 metres in diameter around each pile. It is not expected that the impact of scour would extend beyond the shading footprint of the new wharf structures. Shading impacts can be reduced with design considerations which have been recommended in Section 5.

The relocation of the ferry wharf also moves localised ferry wash and underwater turbulence. The waters around Greenwich Point currently experience substantial vessel traffic and ferry routes are likely to vary from time to time. Impacts from the small changes to the docking and departing ferry route at the new terminal are unlikely to be detectable in a highly variable boating environment. There is potential for soft sediment habitat to be scoured from ferry jets while docking and departing the new terminal. However, these habitats are quick to recover as discussed in Section 4.1.2. Sediment mobilisation from ferry jets may affect nearby rocky reef habitat, however, communities in the study area are likely to be well-adapted to turbidity and sedimentation from existing vessel traffic (also see Section 4.1.2).

The structures of the new terminal are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. The proposal would install 14 piles while removing the existing wharf interchange structures. The size of these structures are small in comparison to the extent of the estuary thus would not interfere with fish passage. Due to the size of these structures in proportion to the estuary, alterations to hydrodynamics are likely to be localised and unlikely to produce substantial impacts to marine biodiversity.

4.3 Cumulative impacts

Projects within the Woollahra LGA and the Sydney Ferries Network have been considered for the purposes of this cumulative impact assessment as per the REF.

Projects identified that could create cumulative impacts with the proposal have been detailed in Table 4.2.

Table 4-2: Past, present and future projects

Project	Construction impacts	Operational impacts
TfNSW Ferry Wharf Upgrade Program Program described as per the REF.	Upgrade of Greenwich Point wharf would require additional movements within Sydney Harbour. There would be a potential minor short-term cumulative increase in vessel movements within the study area and the harbour. However, the harbour currently experiences a high level of vessel traffic and this increase is unlikely to generate substantial cumulative impacts on biodiversity. Other upgrades could potentially require the removal of coastal and marine vegetation. However, these areas are generally modified and the proportion of these areas to other similar areas in the harbour is very small, even when combined. This is relevant to the removal of vegetation (terrestrial and marine) and potential habitat for native, threatened and/or migratory species.	Operational impacts of all ferry upgrade locations are likely to resemble those discussed above. Most locations would require the removal of existing structures in place of new structures. This is generally a temporary disturbance to coastal and marine vegetation and habitat and ecologically acceptable for coastal and marine species in the harbour.
DA 129/2021 19 George Street, Greenwich. Lodged August 2021. Demolition of existing dwelling and construction of new dwelling.	Temporary noise impacts to biodiversity in the Greenwich Point area during construction.	No operational impacts are anticipated.

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

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
B1	All project impacts	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: • Documenting and establishing site clearing limits • Establishing no go zones (e.g. no anchoring on rocky reef) and go slow zones (e.g. vessel speeds, restricted areas) and include on sensitive area plans • Implementing tree protection measures • Pre-clearing surveys, vegetation removal, weed management and unexpected finds measures in line with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Pre-construction	Effective	None, assuming the Port Jackson Figs would be protected during construction.
B2	Removal of threatened species habitat and habitat features	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011). Any roosting microbats in the wharf structures to be removed and the seawall to be impacted/disturbed will be captured and relocated to similar or higher condition habitat. Release will only be done at dusk and roosting individuals should be kept in a secure, dark and warm location until then. Injured individuals or unfurred juveniles are to be transported to a veterinarian.	Contractor	Pre-construction	Effective	Removal of the existing wharf structures and minor disturbance to seawall

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
B3	Disturbance of threatened species habitat and habitat features	The unexpected species finds procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified on site.	Contractor	Construction	Proven	Removal of the existing wharf structures and minor disturbance to seawall and working next to vegetation
B4	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 and Contractor	Detailed design	Effective	Loss of habitat from the removal of existing structures, shading of subtidal rocky reef
B5	Removal of marine vegetation and habitat	Minimise anchoring were possible and avoid anchoring on subtidal rocky reef habitat.	Contractor	Construction	Effective	
B6	Removal of marine vegetation and habitat	Complete a targeted survey for Black Rockcod and White's Seahorse within 24 hours prior to the commencement of water-based construction activities. Black Rockcod individuals will be encouraged to move away from the study area and White's Seahorse will be captured and relocated to nearby similar habitat using methods approved by NSW DPI (Fisheries). A White's Seahorse relocation plan will be developed in consultation with NSW DPI (Fisheries) to dictate this activity. These activities are to be completed by a qualified marine ecologist.	Transport for NSW	Pre-construction	Effective	
B7	Removal of marine	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	Transport for NSW	Pre-construction	Effective	

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
	vegetation and habitat	White's Seahorse relocation. Relocation may be undertaken by a pre-qualified permit holder.				
B8	Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (NSW DPI, 2013).	Contractor	Construction	Effective	Potential localised sediment mobilisation
LS7	Aquatic impacts	Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts.	Contractor	Construction	Effective	None
LS8	Aquatic impacts	Prior to commencement of construction activities, sediment control device (such as sediment boom and curtain) will be installed around the site to contain disturbed sediment from water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will extend from a minimum of 100 millimetres above the water line to a minimum of 2.5 metres below the water line before starting work. 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 will be	Contractor	Construction	Effective	Potential localised sediment mobilisation

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
		assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.				
WQ1	Aquatic impacts	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 stored on site. All workers will be advised of the location of the spill kit and trained in its use.	Contractor	Construction	Effective	None
B9	Aquatic impacts	Piling to stop if marine mammals or reptiles are observed within approximately 100 metres of the site and only to recommence once they have moved beyond 100 metres of the site or are not seen for at least 20 minutes.	Contractor	Construction	Effective	None
B10	Changes to coastal processes	The detailed design will aim to avoid/minimise any impact to coastal processes and hydrology.	Transport for NSW	Detailed design	Effective	Potential localised changes to currents.
B11	Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Effective	None
B12	Invasion and spread of weeds, pests and diseases	Weed species will be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Effective	None

No.	Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
B13	Invasion and spread of weeds, pests and diseases	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Effective	None
B14	Invasion and spread of weeds, pests and diseases	Water-based equipment and vessels to be sourced from local suppliers where possible. Equipment and vessels must be cleaned and inspected prior to entering the site.	Contractor	Construction	Effective	None
B15	Invasion and spread of weeds, pests and diseases	Occurrence of any marine pests must be reported to NSW DPI (Fisheries).	Contractor	Construction	Effective	None
B16	Noise, light and vibration	Shading and artificial light impacts will be minimised through detailed design.	Transport for NSW	Detailed design	Effective	None
B17	Tree protection	An Arboricultural impact assessment will be prepared during detailed design to ensure trees on site are not adversely impacted and to outline tree protection measures to be implemented during construction.	Transport for NSW	Detailed design	Effective	None

6 Offset strategy

The proposal is not expected to clear any vegetation (native or otherwise). There may be some minimal impacts to mown lawn.

The proposal is expected to impact marine vegetation in about 280 square metres of subtidal rocky reef colonised by macroalgae and habitat forming species (Type 2 KFH; including vertical areas) (Table 4-1). About 170 square metres of submerged surface area would be available for recolonisation by marine vegetation and other habitat-forming species as part of the new wharf to replace the areas removed during construction. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project). The remaining 110 square metres of subtidal rocky reef would require offsetting as these exceed the thresholds outlined in the *Guideline for Biodiversity Offsets* (NSW Roads and Maritime Services, 2016).

The *Policy and guidelines for fish habitat conservation and management Update 2013* (NSW DPI, 2013) requires a minimum 2:1 offset for the total area of the three 'Types' of KFH lost (see NSW DPI, 2013 for definitions) to help redress direct and indirect impacts of development. NSW DPI (2013) uses a rate of $52 per square metre, or $104 per square metre to meet the 2:1 offsetting requirement. This rate is consistent with aquatic ecosystem services rates calculated by Costanza et al. (1997), and is subject to annual inflation from 1 July each financial year. The rate above is for the 2013–14 financial year and is subject to an annual increase in line with the Consumer Price Index per financial year. NSW DPI (Fisheries) can confirm the current rate through consultation.

7 Conclusion

The proposal forms part of the Ferry Wharf Upgrade Program and the TAP and is focused on the upgrade of the Greenwich Point wharf. This includes a number of land and water-based activities for construction of the new wharf and removal of the existing wharf..

A biodiversity assessment was completed to describe the existing coastal and marine environment within the study area and to assess impacts to coastal and marine biodiversity as a result of 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 at Greenwich Point, on the northern foreshore of Sydney Harbour (the harbour), on a peninsula at the confluence of Lane Cove River and the Parramatta River estuary (the estuary). The terrestrial portion of the study area was on land sloping from Mary Carlson Park and Greenwich Park to the seawall while the marine portion was comprised of a vertical sandstone seawall bound by a corridor of intertidal and subtidal rocky reef, and soft sediment habitat in the deeper areas. The area below the sandstone escarpment to the seawall is reclaimed land. There was no remnant native vegetation in the study area but rather native and exotic landscape plantings. There were no mangroves or saltmarsh in or next to the study area however, a mosaic of macroalgae and habitat-forming species colonise the intertidal and subtidal rocky reef (Type 2 KFH) and debris in the soft sediment habitats (Type 3 KFH) within the study area.

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 also forms potential habitat for ten threatened fauna species with a moderate to high likelihood of occurrence:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act and the EPBC Act
- Black Rockcod (*Epinephelus daemelii*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Seven microbats listed as vulnerable under the BC Act:
    - Large-eared Pied Bat (*Chalinolobus dwyeri*)
    - 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 Sheathtail-bat (*Saccolaimus flaviventris*)
    - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

The proposal is not expected to remove any vegetation (trees or shrubs), although may impact minimal areas of mown lawn. Nonetheless, the risks of the spread/introduction of weeds and diseases and the potential for erosion and sediment mobilisation associated with construction activities would be managed during construction in accordance with the relevant Transport for NSW guidelines.

With respect to water-based impacts, 14 piles would be driven into intertidal rocky reef, subtidal rocky reef and subtidal soft sediment habitat. The respective habitat and marine vegetation under the footprint of the piles would be permanently lost and shading of

structures over these areas would result in altered community assemblages. However, these areas are proportionally small compared to what is available in the study area and the wider harbour and community assemblages are generally ubiquitous. Design consideration to avoid shading impacts has been recommended.

Removal of the existing wharf structure and piles would result in the removal of 270 square metres of marine vegetation, habitat and sessile/less mobile fauna. These species are common in subtidal rocky reefs and would quickly colonise the piles of the new wharf and pontoon (about 160 square metres of available space) provided suitable materials are used for the new structures. Considerations during detailed design to promote colonisation of habitat-forming species could include the installation of structures which provide habitat complexity (e.g. designs available as part of the Living Seawalls Project).

Under Section 199 of the FM Act, consultation with NSW DPI (Fisheries) is required for any dredging and reclamation works. 'Dredging' under the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013) is classified as disturbance of the seabed/streambed. In this case, this refers to removal of structures and piling. Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required. NSW DPI (Fisheries) was consulted on 2 December 2021 and advised that a Section 205 permit is not required for the piling and pile removal works associated with this proposal.

Sediment mobilisation and vessel wash and scour were also identified as likely proposal impacts. However, the study area is likely to be frequently exposed to elevated levels of sediment, associated with rainfall and sea conditions, and vessel traffic in the waters of Greenwich Point.

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 microbats, Black Rockcod and White's Seahorse prior to the commencement of construction activities so that individuals in the area are not harmed. Species impact statements (SISs) or referrals are not required for the proposal.

Offsets for the residual loss of marine vegetation in subtidal rocky reef (Type 2 KFH) should be considered in accordance with the *Guideline for Biodiversity Offsets* (NSW Roads and Maritime Services, 2016), the *Policy and guidelines for fish habitat conservation and management Update 2013* (NSW DPI, 2013) and in consultation with NSW DPI (Fisheries).

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

8 References

Acid Sulfate Soil Management Advisory Committee, 1998. *Acid Sulfate Soil Manual,* s.l.: s.n.

Aquaculture, Conservation and Marine Parks Unit, Port Stephens Fisheries Institute, 2012. *Black Rockcod (Epinephelus daemelii) recovery plan,* s.l.: s.n.

Atlas of Living Australia, 2020a. *Falsistrellus tasmaniensis (Gould, 1858).* [Online]
Available at: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:284c4a52-3070-4b0f-bea5-6e94ee1fb200
[Accessed 2020].

Atlas of Living Australia, 2020b. *Micronomus norfolkensis.* [Online]
Available at: https://bie.ala.org.au/species/ALA_Mormopterus_norfolkensis
[Accessed 2020].

Atlas of Living Australia, 2020c. *Saccolaimus flaviventris (Peters, 1867).* [Online]
Available at: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:d45a3f9e-b8a7-4b96-bc02-a840e67737a4
[Accessed 2020].

Aurecon Australasia Pty Ltd, 2019. *Greenwich Point wharf interchange: Concept design report,* s.l.: s.n.

Australian Museum, 2020. *Seahorses and pipefishes.* [Online]
Available at: https://australianmuseum.net.au/seahorses-and-pipefishes
[Accessed 2020].

Birch, G., 2006. *A short geological and environmental history of the Sydney estuary, Australia,* s.l.: Sydney University Press.

BoM, 2020b. *Groundwater Dependent Ecosystem Atlas.* [Online]
Available at: http://www.bom.gov.au/water/groundwater/gde/map.shtml
[Accessed 2020].

BoM, 2021a. *Climate Data Online.* [Online]
Available at: http://www.bom.gov.au/climate/data/index.shtml?bookmark=136
[Accessed 2021].

Browne, M. et al., 2013. Microplastics Moves Pollutants and Additives to Worms, Reducing Functions Linked to Health and Biodiversity. *Current Biology,* Volume 23, pp. 2388-2392.

Cardno, 2018. *Western Harbour Tunnel and Warringah Freeway Upgrade Technical Working Paper: Marine Water Quality,* s.l.: s.n.

Chapman, G. A. & Murphy, C. L., 1989. *Soil Landscapes of the Sydney 1:100, 000 Sheet,* Sydney: Soil Conservation Service of NSW.

Connell, S. & Gillanders, B., 2007. *Marine Ecology.* Melbourne, Victoria: Oxford University Press.

Costanza, R. et al., 1997. The value of the world's ecosystem dervices and natural capital. *Nature,* Volume 387, pp. 253-260.

Creese, R. G., Glasby, T. M., West, G. & Callen, C., 2009. *Mapping the habitats of NSW estuaries,* s.l.: NSW DPI.

Das, P., Marchesiello, P. & Middleton, J., 2000. Numerical Modelling Of Tide-Induced Residual Circulation In Sydney Harbour. *Marine and Freshwater Research,* Volume 51, pp. 97-112.

Department of the Environment and Energy, 2017. *Draft Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus,* s.l.: Commonwealth of Australia.

Dwyer, P. D. & Hamilton-Smith, E., 1965. Breeding caves and maternity colonies of the bent-winged bat in south-eastern Australia. *Helictite,* Volume 4, pp. 3-21.

Eby, P., 1996. *Interactions between the Grey-headed Flying-fox Pteropus poliocephalus (Chiroptera: Pteropodidae) and its diet plants-seasonal movements and seed dispersal,* Armidale, NSW: University of New England.

Eyre, B. & Ferguson, A., 2005. Benthic metabolism and nitrogen cycling in a subtropical east Australian estuary (Brunwick): temporal variability and controlling factors. *Limnology and Oceanography,* Volume 50, pp. 81-96.

Fisheries Scientific Committee, 1994. *Introduction of Non-indigenous Fish and Marine vegetation to Coastal Waters Key Threatening Process - Recommendation,* s.l.: s.n.
Fisheries Scientific Committee, 2019. *White's seahorse: Hippocampus whitei - Final Determination.* s.l.:s.n.
Gadd, G. & Griffiths, A., 1977. Microorganisms and heavy metal toxicity. *Microbial Ecology,* Volume 4, pp. 303-317.
Griffiths, S., 2002. *Structure and dynamics of rockpool fish assemblages in Southeastern Australia,* s.l.: University of Wollongong.
Harasti, D., Glasby, T. M. & Martin-Smith, K. M., 2010. Striking a balance between retaining populations of protected seahorses and maintaining swimming nets. *Aquatic Conservation: Marine and Freshwater Ecosystems,* Volume 20, pp. 159-166.
Harasti, D., Martin-Smith, K. & Gladstone, W., 2014. Ontogenetic and sex-based differences in habitat preferences and site fidelity of the White's seahorse Hippocampus whitei. *Journal of Fish Biology,* Volume 85, pp. 1413-1328.
Harasti, D., Martin-Smith, K. M. & Gladstone, W., 2012. Population dynamics and life history of a geographically restricted seahorse, Hippocampus whitei. *Journal of Fish Biology,* Volume 81, pp. 1297-1314.
Heemstra, P. C. & Randall, J. E., 1993. *FAO species catalogue. Vol. 16. Groupers of the world (Family Serranidae, Subfamily Epinephelinae). An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyretail species known to date.* s.l.:FAO Fisheries Synopsis.
Henry, G. W., 1984. *Commercial and recreational fishing in Sydney estuary,* s.l.: NSW Department of Agriculture.
Johnston, E. et al., 2015. Sydney Harbour: what we do and do not know about a highly diverse estuary. *Marine and Freshwater Research,* Volume 66, pp. 1073-1087.
Kingsford, R. T. et al., 2004. Classifying landform at broad spatial scales: the distribution and conservation of wetlands in New South Wales, Australia. *Marine and Freshwater Research,* Volume 55, pp. 17-31.
Kuiter, R. H., 2009. *Seahorses and their relatives.* s.l.:Seaford: Aquatic Photographics.
Local Land Services Greater Sydney, 2015. *Sydney Harbour Water Quality Improvement Plan,* s.l.: s.n.
Martin, D. et al., 2016. Functional, phylogenetic and host-geographic signatures of Labyrinthula spp: provide for putative species delimitation and a global-scale view of seagrass wasting disease. *Estuaries Coasts,* Volume 39, pp. 1403-1421.
McKone, C. & Tanner, K., 2009. Role of salinity in the susceptibility of eelgrass Zostera marina to the wasting disease pathogen Labyrinthula zosterae. *Marine Ecology Progress Series,* Volume 377, pp. 123-130.
McLoughlin, L., 2000. Shaping Sydney Harbour; sedimentation, dredging and reclamation 1788-1990s. *Australian Geographer,* Volume 31, pp. 183-208.
Mitchell, P., 2002. *Descriptions of NSW (Mitchell) Landscapes,* s.l.: s.n.
Montoya, D., 2015. *Pollution in Sydney Harbour: sewage. toxic chemicals and microplastics,* s.l.: NSW Parlimentary Research Service.
National Park and Wildlife Service (NPWS), 2003. *Green and Golden Bell Frog (Litoria aurea) Environmental Impact Assessment Guidelines,* s.l.: s.n.
NSW Department of Industry and Investment, 2009. *Black Cod (Epinephelus daemelii) Draft Recovery Plan,* s.l.: Fisheries Conservation and Aquaculture Branch.
NSW DPI, 2008. *Threatened Species Assessment Guidelines: The Assessment of Significance,* s.l.: s.n.
NSW DPI, 2013. *Policy and Guidelines for Fish Conservation and Management,* Wollongbar, NSW: NSW DPI.
NSW DPI, 2016a. *Fish communities and threatened species distributions of NSW,* s.l.: NSW DPI.
NSW DPI, 2016b. *Caulerpa taxifolia.* [Online]
Available at: http://www.dpi.nsw.gov.au/fishing/pests-diseases/marine-pests/found-in-

nsw/caulerpa-taxifolia
[Accessed 2016].
NSW DPI, 2018. *Pests & disease.* [Online]
Available at: https://www.dpi.nsw.gov.au/fishing/pests-diseases
[Accessed 2018].
NSW DPI, 2020a. *Key Fish Habitat maps.* [Online]
Available at: https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps
[Accessed 2020].
NSW DPI, 2020b. *White's Seahorse (Hippocampus whitei).* [Online]
Available at: https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/endangered-species2/whites-seahorse
[Accessed 2020].
NSW DPIE, 1997. *ASS risk maps.* [Online]
Available at: http://www.environment.nsw.gov.au/acidsulfatesoil/riskmaps.htm
[Accessed 2020].
NSW DPIE, 2017a. *Southern Myotis - profile.* [Online]
Available at:
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10549
[Accessed 2020].
NSW DPIE, 2017b. *Greater Broad-nosed Bat - profile.* [Online]
Available at:
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10748
[Accessed 2020].
NSW DPIE, 2017c. *Red-crowned Toadlet - profile.* [Online]
Available at:
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10692
[Accessed 2021].
NSW DPIE, 2020. *Little Bent-winged Bat - profile.* [Online]
Available at:
https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10533
[Accessed 2020].
NSW National Parks and Wildlife Service, 2003. *The Bioregions of New South Wales: they biodiversity, conservation and history,* s.l.: s.n.
NSW OEH, 2016. *The Native Vegetation of the Sydney Metropolitan Area – Version 3.1 VIS_ID 4489.* s.l.:NSW OEH.
NSW OEH, 2017. *Biodiversity Assessment Method,* s.l.: s.n.
OzCoasts, 2015. *The benthic environments of Sydney Harbour, New South Wales.* [Online]
Available at: http://www.ozcoasts.gov.au/geom_geol/case_studies/sydney_final_report.jsp
[Accessed 2018].
Raghukumar, S., 2002. Ecology of the marine protists, the Labyrinthulomycetes (Thraustichytrids and Labyrinthulids). *European Journal of Protistology,* Volume 38, pp. 127-145.
Roads and Traffic Authority (RTA), 2011. *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects,* s.l.: Roads and Maritime.
Roy, P. et al., 2001. Structure and Function of South-east Australian Estuaries. *Estuarine, Coastal and Shelf Science,* Volume 53, pp. 351-384.
Sydney Institute of Marine Science, 2014. *Sydney Harbour. A systemic review of the science 2014,* s.l.: Sydney Institute of Marine Science.
Sydney Institute of Marine Science, 2018. *Underwater research in Sydney Harbour.* [Online]
Available at: http://sims.org.au/research/long-term-projects/sydney-harbour-research-program/about-sydney-harbour/
[Accessed 2018].

Trevathan-Tackett, S. et al., 2018. Pathogenic Labyrinthula associated with Asuatralian seagrasses: Considerations for seagrass wasting disease in the southern hemisphere. *Microbiological Research,* Volume 206, pp. 74-81.
WillyWeather, 2021. *Sydney Tide Times.* [Online]
Available at: http://tides.willyweather.com.au/nsw/sydney.html
[Accessed 2021].

Annexure A

Species recorded

Recorded flora*

*Due to the density of planted vegetation in the study area, this list is not considered exhaustive

Family	Scientific name	Common name	Native/exotic	Priority weed
Alliaceae	*Agapanthus* sp.	-	Exotic ornamental	-
Apiaceae	*Actinotus helianthi*	Flannel Flower	Native	-
Apocynaceae	*Carissa macrocarpa*	-	Exotic ornamental	-
	Trachelospermum jasminoides	Star Jasmine	Exotic ornamental	-
Araceae	*Philodendron bipinnatifidum*	-	Exotic ornamental	-
Arecaceae	*Phoenix* sp.	Phoenix Palm	Exotic ornamental	-
Asparagaceae	*Asparagus aethiopicus*	Ground Asparagus	Exotic	✓
Asphodelaceae	*Dianella* sp.	-	Native	-
Aspleniaceae	*Asplenium oblongifolium*	-	Exotic	-
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	Exotic	-
	Conyza sp.	Fleabane	Exotic	-
	Osteospermum sp.	Shrubby Daisy Bush	Exotic ornamental	-
	Senecio serpens	Chalk Sticks	Exotic ornamental	-
	Taraxacum officinale	Dandelion	Exotic	-
Bignoniaceae	*Jacaranda mimosifolia*	Jacaranda	Exotic	-
Caricaceae	*Carica papaya*	Papaya	Exotic	-

Family	Scientific name	Common name	Native/exotic	Priority weed
Commelinaceae	*Commelina cyanea*	-	Native	-
	Tradescantia fluminensis	Trad	Exotic	-
	Tradescantia pallida	Purple Heart	Exotic ornamental	-
Crassulaceae	*Bryophyllum delagoense*	Mother-of-millions	Exotic	-
	Crassula spp.	Jade	Exotic ornamental	-
Cyatheaceae	*Cyathea* sp.	Tree Fern	Native ornamental	-
Dryopteridaceae	*Dryopteris* sp.	-	Exotic ornamental	-
Euphorbiaceae	*Euphorbia peplus*	Petty Spurge	Exotic	-
Fabaceae	*Senna pendula*	-	Exotic	-
Geraniaceae	*Pelargonium* sp.	-	Exotic ornamental	-
Gleicheniaceae	*Gleichenia* sp.	-	Native	-
Juncaceae	*Juncus* sp.	-	Native	-
Lamiaceae	*Plectranthus verticillatus*	-	Exotic ornamental	-
	Salvia sp.	Rosemary	Exotic ornamental	-
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	Native ornamental	-
Lomariopsidaceae	*Nephrolepis exaltata*	Boston Fern	Exotic ornamental	-
Moraceae	*Ficus rubiginosa*	Port Jackson Fig	Native ornamental	-

Family	Scientific name	Common name	Native/exotic	Priority weed
Myrtaceae	*Angophora costata*	Smooth-barked Apple	Native	-
	Callistemon viminalis	Weeping Bottlebrush	Native ornamental (native north from Gloucester)	-
	Leptospermum sp.	Tea-tree	Native	-
	Lophostemon confertus	Brush Box	Native ornamental (native north from Hunter Valley)	-
	Melaleuca linariifolia	Flax-leaved Paperbark	Native	-
	Syzygium oleosum	Blue Lilly Pilly	Native	-
Oleaceae	*Ligustrum sinense*	Narrow-leaf Privet	Exotic	-
	Olea sp.	Olive	Exotic	-
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	Native	-
Poaceae	*Avena fatua*	Wild Oats	Exotic	-
	Bromus catharticus	Prairie Grass	Exotic	-
	Cynodon dactylon	Couch	Native	-
	Ehrharta erecta	Panic Veldtgrass	Exotic	-
	Microlaena stipoides	Weeping Grass	Native	-
	Rytidosperma sp.	Wallaby Grass	Native	-
	Sporobolus africanus	Parramatta Grass	Exotic	-

Family	Scientific name	Common name	Native/exotic	Priority weed
	Stenotaphrum secundatum	Sir Walter Buffalo	Exotic	-
Proteaceae	*Banksia robur*	Swamp Banksia	Native ornamental	-
	Banksia spinulosa	Hairpin Banksia	Native	-
Pteridaceae	*Adiantum fragrans*	Maidenhair Fern	Native ornamental	-
Rhamnaceae	*Pomaderris ferruginea*	Rusty Pomaderris	Native	-
Solanaceae	*Solanum nigrum*	Blackberry Nightshade	Exotic	-
Theaceae	*Gordonia axillaris*	Fried Egg Plant	Exotic	-
Urticaceae	*Parietaria judaica*	Asthma Weed	Exotic	-
Verbenaceae	*Lantana camara*	Lantana	Exotic	✓

Recorded fauna

Family	Scientific name	Common name	Native/exotic
Meliphagidae	*Manorina melanocephala*	Noisy Miner	Native
Ostreidae	*Saccostrea glomerata*	Sydney Rock Oyster	Native
Psittaculidae	*Trichoglossus moluccanus*	Rainbow Lorikeet	Native
Sparidae	*Acanthopagrus australis*	Yellowfin Bream	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						
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 metres from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Litoria aurea	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 Typha spp. and other aquatics, free from predatory fish.	(PMST)	None. No suitable habitat within the study area.
Mixophyes balbus	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.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pseudophryne australis	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.	2 (BioNet)	None. No suitable habitat within the study area.
Flora						
Acacia bynoeana	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 (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*), Drooping Red Gum (*E. parramattensis*), Old Man Banksia (*Banksia serrata*) and Small-leaved Apple (*Angophora bakeri*).	(PMST)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Acacia pubescens	Downy Wattle	V	V	Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone.	(PMST)	Low. No suitable remnant habitat occurs in the study area.
Acacia terminalis subsp. *terminalis*	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.	23 (BioNet) (PMST)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Allocasuarina glareicola	-	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 *Eucalyptus parramattensis*, *Eucalyptus fibrosa*, *Angophora bakeri*, *Eucalyptus sclerophylla* and *Melaleuca decora*. Common associated understorey species include *Melaleuca nodosa*, *Hakea dactyloides*, *Hakea sericea*, *Dillwynia tenuifolia*, *Micromyrtus minutiflora*, *Acacia elongata*, *Acacia brownei*, *Themeda australis* and *Xanthorrhoea minor*.	(PMST)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Asterolasia elegans	-	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 (*Syncarpia glomulifera* subsp. *glomulifera*), Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), Forest Oak (*Allocasuarina torulosa*) and Christmas Bush (*Ceratopetalum gummiferum*).	(PMST)	Low. No suitable remnant habitat occurs in the study area.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Cryptostylis hunteriana	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 (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*).	(PMST)	None. No suitable habitat within the study area.
Darwinia biflora	-	V	V	Occurs at 129 sites in the northern and north-western suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai local government areas. Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury sandstone. Associated overstorey species include *Eucalyptus haemastoma*, *Corymbia gummifera* and/or *E. squamosa*. The vegetation structure is usually woodland, open forest or scrub-heath.	(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
Epacris purpurascens var. *purpurascens*	-	V	-	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence.	6 (BioNet)	None. No suitable habitat within the study area.
Eucalyptus camfieldii	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 (*Eucalyptus oblonga*), Brown Stringybark (*E. capitellata*) and Scribbly Gum (*E. haemastoma*).	(PMST)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Eucalyptus nicholii	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.	5 (BioNet)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Genoplesium baueri	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.
Haloragodendron lucasii	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)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Hygrocybe reesiae	-	V	-	Type locality, Lane cove Bushland Park, Lane Cove Local Government Area. Also recorded from Blue Mountains National Park in the Hazelbrook area. Also found in Tasmania. Occurs in gallery warm temperate forests dominated by Lilly Pilly (*Acmena smithii*), Grey Myrtle (*Backhousia myrtifolia*), Cheese Tree (*Glochidion ferdinandi*) and Sweet Pittosporum (*Pittosporum undulatum*). Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Occur as individuals or in groups, terrestrial rarely on wood and only if extremely rotten; substrates include soil, humus, or moss. Does not produce above ground fruiting bodies (fungus) all year round. Fruiting bodies begin appearing mid-May to mid-July sometimes to August.	1 (BioNet)	None. No suitable habitat within the study area.
Lasiopetalum joyceae	-	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)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Leptospermum deanei	-	V	V	Known from the Hornsby, Warringah, Ku-ring-gai and Ryde local government areas. Occurs in woodland on lower hill slopes or near creeks, sandy alluvial soil or sand over sandstone, riparian scrub woodland and open forest.	(PMST)	Low. No suitable remnant habitat occurs in the study area.
Melaleuca biconvexa	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)	Low. No suitable remnant habitat occurs in the study area.
Melaleuca deanei	Deane's Paperbark	V	V	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai, Berowra, Holsworthy and Wedderburn areas, and there are also more isolated occurrences at Springwood, Wollemi National Park, Yalwal and the Central Coast areas. The species grows in heath on sandstone.	(PMST)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Persicaria elatior	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.
Persoonia hirsuta	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)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pimelea curviflora var. *curviflora*	-	V	V	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	(PMST)	None. No suitable habitat within the study area.
Pimelea spicata	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.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Prostanthera junonis	Somersby Mintbush	E	E	Has a north-south range of approximately 19 km 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)	Low. The site forms potential habitat for the species although no remnant vegetation occurs and none were observed during the field survey. The likelihood of occurrence is considered low due to the frequency of disturbance in the study area and no records in the study locality.
Rhizanthella slateri	Eastern Underground Orchid	V	E	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	(PMST)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Rhodamnia rubescens	Scrub Turpentine	CE	-	Shrub or small tree to 25 metres high occurring in coastal districts north from Batemans Bay in New South Wales approximately 280 kilometres south of Sydney, to areas inland of Bundaberg in Queensland. Populations typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 metres asl with rainfall of 1,000-1,600 mm. Commonly occurs in all rainforest subforms except cool temperate rainforest.	1 (Bionet) (PMST)	Low. No suitable remnant habitat occurs in the study area.
Rhodomyrtus psidioides	Native Guava	CE	CE	Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW. Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	(PMST)	Low. No suitable remnant habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Syzygium paniculatum	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.	9 (Bionet) (PMST)	Low. No suitable remnant habitat occurs in the study area.
Thesium australe	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 (*Themeda australis*).	(PMST)	None. No suitable habitat within the study area.
Invertebrates						

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Dendronepthya australis	Cauliflower Soft Coral	E	E	Cauliflower Soft Coral (*D. australis*) is a temperate soft coral species endemic to eastern Australia. The species is predominantly found in estuarine environments in NSW where it occurs at depths of 1-15 m, however, it occasionally occurs offshore down to depths of 30 m. The only estuaries where Cauliflower Soft Coral is known to grow in abundance are Port Stephens and the Brisbane Water area of Hawksbury River in New South Wales. They have been found sporadically in other locations in NSW waters including, Sydney Harbour, Terrigal, Botany Bay and Jervis Bay, however their persistence in these areas is uncertain.	(DPI)	Low There are uncertain records of this species in the harbour albeit not observed during the field survey.
Petalura gigantea	Giant Dragonfly	E	-	The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. It is not found west of the Great Dividing Range. Live in permanent swamps and bogs with some free water and open vegetation. Adults spend most of their time settled on low vegetation on or adjacent to the swamp. They hunt for flying insects over the swamp and along its margins.	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
Pommerhelix duralensis	Dural Land Snail	E	E	The Dural land snail is endemic to New South Wales. The species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringe of the Cumberland Plain on shale-sandstone transitional landscapes. The species has been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.	(PMST)	None. No suitable habitat within the study area.
Birds						
Anthochaera phrygia	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)	None. No records in the study locality or suitable habitat in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Ardenna carneipes	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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Botaurus poiciloptilus	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.
Burhinus grallarius	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.	3 (BioNet)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Calidris canutus	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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Calidris ferruginea	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 Peninisula, 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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Calidris tenuirostris	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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Calyptorhynchus lathami	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 (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, Allocasuarina diminuta and *A. gymnathera*. Belah (*Casuarina cristata*) 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.	6 (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
Charadrius leschenaultii	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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Charadrius mongolus	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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Daphoenositta chrysoptera	Varied Sitella	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	1 (BioNet)	None. No suitable habitat within the study area.
Falco hypoleucos	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. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Glossopsitta pusilla	Little Lorikeet	V	-	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. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.	6 (BioNet)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Grantiella picta	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 Amyema.	(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
Haliaeetus leucogaster	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).	37 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Hirundapus caudacutus	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.	4 (BioNet) (PMST)	Low. May fly through and forage in study area however, study area habitat is widely distributed and suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Ixobrychus flavicollis	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.	3 (BioNet)	None. No suitable habitat within the study area.
Lathamus discolor	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 (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Red Ironbark (*E. sideroxylon*), and White Box (*E. albens*).	2 (BioNet) (PMST)	None. No suitable habitat within the study area

Limosa lapponica baueri	Bar-tailed Godwit	-	V	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. 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.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Limosa limosa	Black-tailed Godwit	V	Mi, Ma	A migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently found at Kooragang Island (Hunter River estuary). Occurs in sheltered bays, estuaries and lagoons with large intertidal mudflats and sand flats. Also found at inland mudflats, swamps.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
Lophoictinia isura	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 *E. longifolia*, *C. maculata*, *E. elata*, or *E. smithii*. Individuals appear to occupy large hunting ranges of more than 100 square metres. 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)	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
Macronectes halli	Northern Giant Petrel	V	V, Mi, Ma	The Northern Giant-Petrel has a circumpolar pelagic distribution, usually between 40-64ºS in open oceans. Their range extends into subtropical waters (to 28ºS) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer. Adults usually remain near the breeding colonies throughout the year (though some do travel widely) while immature birds make long and poorly known circumpolar and trans-oceanic movements. Hence most birds recorded in NSW coastal waters are immature birds. Northern Giant-Petrels seldom breed in colonies but rather as dispersed pairs, often amidst tussocks in dense vegetation and areas of broken terrain.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Ninox connivens	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
Ninox strenua	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 (*Syncarpia glomulifera*), Black Sheoak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis*) and a number of Eucalypt species.	393 (BioNet)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Numenius madagascariensis	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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.

Pachyptila turtur subantarctica	Fairy Prion (Southern)	-	V	The southern subspecies (subantarctica) of the Fairy Prion was first recorded on Macquarie Island in 1956, with breeding confirmed in 1978. Breeding has also been recorded on two offshore rock stacks at Macquarie Island, one near Langdon Point, the other near Davis Point. A second sub-population was found on Bishop and Clerk Islands in 1993. The species as a whole has been recorded breeding on subantarctic and cool temperate islands. The southern subspecies of the Fairy Prion is a marine bird, found mostly in temperate and subantarctic seas. The species' oceanic distribution is poorly known. The Fairy Prion sometimes forages over continental shelves and the continental slope, but it can come close inshore in rough weather. It may also feed in deep coastal waters. Off Wollongong, NSW, 79% of Fairy Prions were seen in waters over the continental slope while 21% were counted over neritic water (water more than 200 metres deep). Data from the south-eastern Australian Seabird Atlas confirm this pattern, with 83% (of 24 505 individuals) seen over the continental slope, 9% over continental shelf and only 8% over open ocean. The southern Fairy Prion is found flying over the ocean where sea surface temperatures are 8.6° to 20.2 °C.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pandion cristatus	Eastern Osprey	V	Mi, Ma	Total range of this species is from Esperance in Western Australia to NSW and into Victoria and Tasmania. In some states (Victoria and Tasmania and southern NSW) the species is a rare vagrant. The only single historical breeding record in NSW is from the St. Georges Basin. Occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Mostly found in coastal areas but occasionally travel inland along major rivers.	1 (BioNet) (PMST)	Low. May fly through and forage in study area however, study area habitat is widely distributed and suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pterodroma leucoptera leucoptera	Gould's Petrel	V	E, Ma	Breeds on both Cabbage Tree Island, 1.4 kilometres offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding petrels are unknown. The first arrival of Gould's petrel on cabbage tree Island occurs from mid to late September. Principal nesting habitat is located within two gullies which are characterised by steeply, sloping rock scree with a canopy of Cabbage Tree Palms. They nest predominantly in natural rock crevices among the rock scree and also in hollow fallen palm trunks, under mats of fallen palm fronds and in cavities among the buttresses of fig trees. Seizes prey (squid and fish) from the sea surface.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Pterodroma neglecta neglecta	Kermadec Petrel	V	V, Ma	Ranges over subtropical and tropical waters of the South Pacific. Balls Pyramid (near Lord Howe Island) and Phillip Island (near Norfolk Island) are the only known breeding sites in Australian waters. Breeds on islands across the South Pacific. In Australia it breeds on Ball's Pyramid and Phillip Island (near Norfolk Island). Nests in a crevice amongst rocks. Feeds on squid, fish, crustaceans by skimming and diving into the sea surface.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Rostratula australis	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)	None. No suitable habitat within the study area.
Sternula albifrons	Little Tern	E	Mi, Ma	Migrates from eastern Asia, this species is found along the north, east and south-east Australian coasts. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire coast from Tasmania to northern Queensland. This species is almost exclusively coastal, preferring sheltered environments.	1 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Sternula nereis	Australian Fairy Tern	-	V	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there. The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night. Predates small bait-sized fish via shallow dives in shallow water.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thalassarche bulleri	Buller's Albatross	-	V, Ma, Mi	Buller's Albatross breed in New Zealand (Snares, Solander and Chatham Islands), but are regular visitors to Australian waters. They are frequently seen off the coast from Coffs Harbour, south to Tasmania and west to Eyre Peninsula. In Australia, Buller's Albatross are seen over inshore, offshore and pelagic waters. They appear to congregate over currents where water temperature exceeds 16 °C. Feeds mostly on squid, fish, krill and tunicates via surface seizing.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thalassarche bulleri platei	Northern Buller's Albatross	-	V, M, Ma	The Pacific Albatross is a non-breeding visitor to Australian waters. Foraging birds are mostly limited to the Pacific Ocean and the Tasman Sea, although birds do reach the east coast of the Australian mainland. Occurrence within the Australian Fishing Zone is likely, however, the threat from longline injury is considered low. The Pacific Albatross is a marine, pelagic species. It occurs in subtropical and subantarctic waters of the South Pacific Ocean. Habitat preferences are poorly known. In New Zealand, the species has been observed in association with fishing boats close inshore and over waters of 180–360 metres depth although it is not so strongly associated with fishing grounds as are other albatrosses.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thalassarche cauta cauta	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thalassarche melanophris	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 ºC and 24 ºC. Spends most of its time at sea, breeding on small isolated islands.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thalassarche salvini	Salvin's Albatross	-	V, Ma, Mi	Salvin's Albatross breeds on Bounty, Snares and Chatham Islands, south of New Zealand, as well as on Crozet Island in the Indian Ocean. The species forages over most of the southern Pacific Ocean, where it is particularly common in the Humboldt Current, off South America. There are small numbers in the Indian Ocean and sometimes in the South Atlantic Ocean. During the non-breeding season, the species occurs over continental shelves around continents. It occurs both inshore and offshore and enters harbours and bays. Salvin's Albatross is scarce in pelagic waters. Feeds primarily in shelf waters and takes prey from surface or just below, it has been seen diving up to 2 metres.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thinornis rubricollis rubricollus	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. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Tyto tenebricosa	Sooty Owl	V	-	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist Eucalypt forests.	1 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Fish and Syngnathids						
Hippocampus whitei	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.
Epinephelus daemelii	Black Rockcod	E (FM Act)	V	In Australia, the distribution of black cod ranges from southern Queensland through NSW to northern Victoria. However, records from Queensland and Victoria are rare, and the NSW coastline forms the species' main range, both in Australia and internationally. Adults are usually found in 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)	Moderate. Known to occur in the harbour and suitable resident habitat occurs in the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Prototroctes maraena	Eastern Grayling	E (FM Act)	V	The Australian grayling occurs in rivers and streams on the eastern and southern flanks of the Great Dividing Range but is diadromous. During the freshwater phase of the life cycle, this species inhabits lower altitude reaches of both large rivers and smaller streams spawning in the tidal freshwater reaches of rivers, presumably among a gravel streambed. Very little is known of the Australian grayling's specific habitat requirements during the estuarine or marine phase of the life cycle.	(DPI) (PMST)	Low. May occur in the study area during the marine phase of life-cycle albeit at the end of its range, no records in the study locality and habitat is widespread.
Mammals						
Arctocephalus forsteri	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.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Arctocephalus pusillus	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.	2 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Cercartetus nanus	Eastern Pygmy Possum	V	-	Found in a broad range of habitats from rainforest through to wet and dry sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred.	1 (BioNet)	None. No suitable habitat within the study area.
Chalinolobus dwyeri	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)	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
Dasyurus maculatus maculatus	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.	(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
Eubalaena australis	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).	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern/south eastern)	E	E	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Micronomus norfolkensis	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.
Miniopterus australis	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.	6 (BioNet)	Moderate. Potential foraging and roosting habitat is present in the study area.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	70 (BioNet)	Moderate. Potential 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
Myotis macropus	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.	37 (BioNet)	Moderate. Potential foraging and roosting habitat is present in the study area.
Perameles nasuta	Long-nosed Bandicoot, North Head	EP	-	Restricted to North Head in the Manly Local Government Area. Essentially a solitary animal that occupies a variety of habitats on North Head. Forages mainly at or after dusk, digging for invertebrates, fungi and tubers. The conical holes it leaves in the soil are often seen at the interface of naturally vegetated and areas of open grass around the Quarantine Station, former Defence Lands and Saint Patrick's Estate. Shelters during the day in a well-concealed nest based on a shallow hole lined with leaves and grass, sometimes under debris, sometimes hidden with soil and with the entrance closed for greater concealment.	1 (BioNet)	None. No suitable habitat within the study area.

Petauroides volans	Greater Glider	-	V	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. 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 hectares.	(PMST)	None. No suitable habitat within the study area.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the	(PMST)	None.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				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.		No suitable habitat within the study area.
Phascolarctos cinereus	Koala (combined populations Qld, NSW and the ACT)	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 Eucalypt species and 30 non-Eucalypt species, but in any one area will select preferred browse species.	3 (BioNet) (PMST)	None. No feed trees in the study area and not suitable as movement opportunities due to the level of disturbance from pedestrian traffic and outdoor pets.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	-	In NSW the Eastern Chestnut Mouse mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland. There are however isolated records in the Jervis bay area. Mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again.	1 (BioNet)	None. No suitable habitat within the study area.
Pseudomys novaehollandiae	New Holland Mouse	-	V	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pteropus poliocephalus	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.	915 (BioNet) (PMST)	High. Potential foraging habitat is present in the study area.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	7 (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
Scoteanax rueppellii	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.	4 (BioNet)	Moderate. Potential foraging and roosting habitat is present in the study area.
Reptiles						
Caretta caretta	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.	2 (BioNet) (PMST)	Low. May swim through the study area albeit not considered core range.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Chelonia mydas	Green Turtle	V	V, Mi, Ma	Green Turtles occur in seaweed-rich coral reefs and coastal seagrass pastures in tropical and subtropical areas of Australia. Usually ocean-dwelling but also occurs in coastal waters on the north or central coast with some straying south of the central coast. Green Turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with driftlines and rafts of Sargassum (a floating marine plant that is also carried by currents). Once Green Turtles reach 30 to 40 cm curved carapace length, they settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The shallow foraging habitat of adults contains seagrass beds or algae mats on which Green Turtles mainly feed. In Australia there are seven separate genetic management units for the green turtle, and three of these occur in Queensland. The entire Great Barrier Reef area is an important feeding area for turtles which nest locally, as well as for those which nest in other regions and countries.	(PMST)	Low. May swim through the study area albeit not considered core range.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Dermochelys coriacea	Leatherback Turtle	E	E, Mi, Ma	Throughout the world's tropical and temperate seas and in all coastal waters of Australia. Most sightings are in temperate waters. Occurs in inshore and offshore marine waters. Rarely breeds in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago. Occasional breeding records from NSW coast, including between Ballina and Lennox Head in northern NSW.	1 (BioNet) (PMST)	Low. May swim through the study area albeit not considered core range.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Eretmochelys imbricata	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 *Sargassum* sp. (floating marine algae that is also carried by currents). Once Hawksbill Turtles reach 30 to 40 cm curved carapace length, they settle and forage in tropical tidal and sub-tidal coral and rocky reef habitat. They primarily feed on sponges and algae. They have also been found, though less frequently, within seagrass habitats of coastal waters, as well as the deeper habitats of trawl fisheries. Hawksbill Turtles have been seen in temperate regions as far south as northern NSW.	(PMST)	Low. May swim through the study area albeit not considered core range.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 metres of escarpments in summer.	(PMST)	None. No suitable habitat within the study area.
Natator depressus	Flatback Turtle	-	V, Mi, Ma	The Flatback Turtle is only found in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya and is one of only two species of sea turtle without a global distribution. Post-hatchling and juvenile Flatback Turtles do not have the wide dispersal phase in the oceanic environment like other sea turtles. Adults inhabit soft bottom habitat over the continental shelf of northern Australia, extending into Papua New Guinea and Irian Jaya although the extent of their range is not fully known. Hatchling to subadult Flatback Turtles lack a pelagic life stage and reside in the Australian continental shelf. Flatback Turtles require sandy beaches to nest. Sand temperatures between 25 °C and 33 °C are needed for successful incubation. Beaches free from light pollution are required to prevent disorientation, disturbance, and to allow nesting females to come ashore.	(PMST)	Low. May swim through the study area albeit not considered core range.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Elasmobranchs						
Carcharias taurus	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 sharked have been recorded moving over 800 kilometres between sites in relatively short periods of time.	(DPI) (PMST)	Low. May swim through the study area albeit widespread. No aggregate sites know in the harbour.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Carcharodon carcharias	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.	(DPI) (PMST)	Low. May swim through the study area albeit widespread.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Rhincodon typus	Whale Shark	-	V, Mi	In Australia, the Whale Shark is known from NSW, Queensland, Northern Territory, Western Australia and occasionally Victoria and South Australia, but it is most commonly seen in waters off northern Western Australia, Northern Territory and Queensland. The Whale Shark is an oceanic and coastal, tropical to warm-temperate pelagic shark. It is often seen far offshore, but also comes close inshore and sometimes enters lagoons of coral atolls. The Whale Shark is generally encountered close to or at the surface, as single individuals or occasionally in schools or aggregations of up to hundreds of sharks. This species is generally found in areas where the surface temperature is 21–25 °C, preferably with cold water of 17 °C or less upwelling into it, and salinity of 34 to 34.5 parts per thousand.	(PMST)	Low. May swim through the study area albeit not considered core range.

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					
Actitis hypoleucos	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.	1 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Anous stolidus	Common Noddy	Mi, Ma	Mainly occurs in ocean off the Queensland coast. Breeds on or near islands, on rocky islets and stacks with precipitous cliffs, or on shoal or cays or coral or sand. This species feeds main on fish but are known to take squid, molluscs and aquatic insects in offshore areas.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Apus pacificus	Fork-tailed Swift	Mi, Ma	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 metres to at least 300 metres above ground and probably much higher.	(PMST)	Low. Almost exclusively aerial so unlikely to land in the study area but may fly through the study area.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Ardenna grisea	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.	1 (BioNet) (PMST)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Ardenna pacifica	Wedge-tailed Shearwater	Mi, Ma	The Wedge-tailed Shearwater breeds on the east and west coasts of Australia and on off-shore islands. The Wedge-tailed Shearwater is a pelagic, marine bird known from tropical and subtropical waters.	2 (BioNet)	None. No suitable habitat within the study area.
Ardenna tenuirostris	Short-tailed Shearwater	Mi, Ma	In summer months, the Short-tailed Shearwater is the most common shearwater along the south and south-east coasts of Australia. The Short-tailed Shearwater is found in coastal waters.	3 (BioNet)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Arenaria interpres	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Calidris acuminata	Sharp-tailed Sandpiper	Mi, Ma	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.
Calidris melanotos	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Calidris ruficollis	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Calonectris leucomelas	Streaked Shearwater	Mi, Ma	Found in the western Pacific, breeding on the coast and on offshore islands of Japan, Russia, and on islands off the coasts of China, North Korea and South Korea. This marine species can be found over both pelagic and inshore waters.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Charadrius bicinctus	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Cuculus optatus	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.
Fregata ariel	Lesser Frigate Bird	M, Ma	Breeding populations are found in the tropical waters of Indian and Pacific Oceans, except in the east Pacific, and the South Atlantic on remote tropical and sub-tropical islands. Mainly feeds on fish but can snatch bird eggs and chicks as well as scavenge.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Fregata minor	Great Frigate Bird	Mi, Ma	Breeding populations found on small, remote tropical and sub-tropical islands of the Indian and Pacific Oceans and the South Atlantic. Kleptoparasitic behaviour leads to stealing fish and squid from other bird species as well as snatching small chicks.	(PMST)	Low. Some foraging habitat present in the study area however, is suboptimal in size and condition and highly disturbed.
Gallinago hardwickii	Latham's Snipe	Mi, Ma	Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 metres above sea-level.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Limosa lapponica	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Monarcha melanopsis	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.
Monarcha trivirgatus	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.
Motacilla flava	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 highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Myiagra cyanoleuca	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.
Numenius phaeopus	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Philomachus pugnax	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pluvialis fulva	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 Sarcocornia, or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Pluvalis squatarola	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. Prefers specific habitat not in the study area however, it may fly through.
Rhipidura rufifrons	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 (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby understorey often including ferns.	(PMST)	Low. Prefers specific habitat not in the study area however, it may fly through.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thalasseus bergii	Crested Tern	Mi, Ma	There are few stretches of the Australian coastline where the Crested Tern cannot be seen — it has been known as both the Bass Straits Tern and the Torres Straits Tern! They breed in colonies on small offshore islands where their nests are so densely packed together that adjacent owners can touch each other's bills. Though the Crested Tern is usually a strictly coastal species, there are occasional records in the arid interior of Australia, where birds were possibly blown by passing tropical cyclones.	27 (BioNet)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Tringa brevipes	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Tringa nebularia	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Tringa stagnatilis	Marsh Sandpiper	Mi, Ma	Fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Mammals and Elasmobranchs					
Balaenoptera edeni	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 from of Bryde's whale appears to be limited to the 200 metres depth isobar, moving along the coast in response to availability of suitable prey. The offshore form is found in deeper water (500 metres to 1000 m). Dive times are relatively short, averaging 1.27 minutes but potentially lasting 9 minutes. This suggests that Bryde's whales use the upper layers of the ocean, and can therefore be considered pelagic.	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Caperea marginata	Pygmy Right Whale	Mi	Records of pygmy right whales in Australian waters are distributed between 32° S and 47° S, but are not uniformly spread around the coast. The northern distribution of pygmy right whales may be limited on the west and east coasts of Australia by the warm, south-flowing Leeuwin and East Australian currents. Few or no records are available for NSW, eastern Victoria, and the northern part of the Great Australian Bight, while Western Australia has fewer records than comparative eastern Australian states. Concentrations of stranded animals have occurred at the entrance of the gulfs in South Australia and around Tasmania, but live sightings have predominated in the former region. The numerous strandings in Tasmania may be due to the proximity of the Subtropical Convergence, an apparently important feeding zone for pygmy right whales. Pygmy right whales have primarily been recorded in areas associated with upwellings and with high zooplankton abundance, particularly copepods and small euphausiids which constitute their main prey. There is some evidence to indicate that the area south of 41° S is important for weaned pygmy right whales, possibly because of the higher prey abundance in these waters.	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Lagenorhynchun obscurus	Dusky Dolphin	Mi	In Australia, dusky dolphins are known from only 13 reports since 1828, with two sightings in the early 1980s. They occur across southern Australia from Western Australia to Tasmania, with unconfirmed sightings south of continental Australia but confirmed sightings near Kangaroo Island, South Australia, and off Tasmania, and a recent stranding in the latter State. Given the lack of understanding of the species' distribution in Australian waters, no key localities have yet been identified. Dusky dolphins occur mostly in temperate and subantarctic waters. They are considered to primarily inhabit inshore waters but may also be pelagic at times.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
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.

Scientific Name	Common Name	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Sousa chinensis	Indo-Pacific Humpback Dolphin	Mi	In Australia, Indo-Pacific Humpback Dolphins are known to occur along the northern coastline, extending to Exmouth Gulf on the west coast (25° S), and the Queensland/NSW border region on the east coast (34° S). Within their geographical range, Australian Humpback Dolphins are found primarily in coastal waters however, this species is known to inhabit shallow coastal, estuarine, and occasionally riverine habitats, in tropical and subtropical regions.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

* 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						
Ardea ibis	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 highly disturbed and not suited as preferred foraging habitat.
Charadrius ruficapillus	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.
Himantopus himantopus	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. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Merops ornatus	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 highly disturbed and not suited as preferred foraging habitat.
Recurvirostra novaehollandiae	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						
Acentronura tentaculata	Shortpouch Pygmy Pipehorse	P	Ma	This species is found on tropical inshore reefs. It also occurs in temperate waters associated with shallow sandflats in protected and somewhat silty coastal areas among sparse low plant growth and in algae on rocks. This species inhabits waters of 7-40 metres in depth. Pipefishes feed on small living crustaceans.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Anampses elegans	Elegant Wrasse	P	-	Elegant Wrasse are a widespread but uncommon species found on coral reef and rocky reef habitats at depths from 2 to 35 m. The distribution of elegant wrasse extends from southern Queensland to Montague Island on the NSW south coast, particularly around inshore islands. The species is also found at Lord Howe Island, especially in the shallow lagoon habitat, and at nearby Elizabeth and Middleton Reefs, and they have also been recorded from Norfolk Island, the Kermadec Islands, New Zealand and Easter Island. Elegant wrasse are a subtropical, warm-temperate species that are active during the day.	(DPI)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Epinephelus coioides	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 (*Epinephelus tauvina*) or Malabar Grouper (*Epinephelus malabaricus*), 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.
Epinephelus lanceolatus	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.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Festucalex cinctus	Girdled Pipefish	P	Ma	Endemic to tropical and temperate waters of the Northern Territory, Queensland and New South Wales. Usually inhabits sheltered coastal bays and estuaries, on patches of rubble, sand or in areas of sparse seagrass, algal and sponge growth. Most specimens were dredged or trawled in depths of 8-31 metres but divers collected some specimens over rubble bottoms in depths of 12 m. In Sydney Harbour it is most common in depths of 10-20 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Filicampus tigris	Tiger Pipefish	P	Ma	The tiger pipefish is relatively common in subtropical waters of Australia's east and west coasts. A relic population also occurs in the warmer waters of Spencer Gulf, South Australia. Inhabits areas near channels in inshore sheltered bays and estuaries with sandy or muddy bottoms, or along seagrass bed edges at 2-30 m. Feeds on aggregations of mysid shrimps in sheltered bays adjacent to tidal channels.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Heraldia nocturna	Upside-down Pipefish	P	Ma	Endemic to temperate waters of southern and south-eastern Australia, from about Hastings, New South Wales, southwards to Victoria, to Port Davey on the west coast of Tasmania, westwards through South Australia to Geographe Bay, Western Australia. Upside-down Pipefish inhabit sheltered inshore rocky reefs in harbours, bays and coves where they are found under ledges, in holes, crevices and small caves at 2-30 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Hippichthys penicillus	Beady Pipefish	P	Ma	Widespread in the tropical Indo-west-central Pacific, from the Red Sea and East Africa across the Indian Ocean to north-eastern Australia, north to Taiwan, Japan, Micronesia and east to Samoa and Tonga. This species usually inhabits brackish waters in mangrove estuaries, tidal creeks and sometimes in freshwater reaches in the lower parts of rivers and streams.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Hippocampus abdominalis	Big-belly Seahorse	P	Ma	Known from temperate waters of New Zealand and southern Australia, where it occurs from about South West Rocks, New South Wales, southwards to the northern Great Australian Bight, South Australia, and south to the Derwent Estuary, Tasmania. Big-belly Seahorses live in a range of habitats from low rocky reefs in shallow estuaries, to deep tidal channels and deeper coastal reefs to 100 m. They cling to seagrasses, sponges, macroalgae such as kelp holdfasts and other structures on reefs.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Histiogamphelus briggsii	Crested Pipefish	P	Ma	Endemic to temperate waters of south-eastern Australia, from New South Wales, south to Victoria and Tasmania, and westwards to Gulf St Vincent. Crested pipefish inhabit inshore sandy areas, singly or in small aggregations, often amongst detached seaweed or along the margins of Posidonia seagrass beds and in open sandy areas at 3–20 m; most common in Bass Strait.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Lissocampus runa	Javelin Pipefish	P	Ma	Endemic to temperate waters of southern and eastern Australia; known from southern Qld, southwards to Tasmania, and across to about Rottnest Island, south-western Australia. Usually inhabits tidepools and sheltered bays, usually in seagrass and algal beds, and rocky and shelly rubble substratum to about 20 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Maroubra perserrata	Sawtooth Pipefish	P	Ma	Endemic to temperate southern Australian waters from southern Queensland to Rottnest Island, Western Australia. The sawtooth pipefish inhabits coastal rocky reefs at 3-25 m, sheltering beneath ledges and in caves during day.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Notiocampus ruber	Red Pipefish	P	Ma	Endemic to temperate waters of southern and south-eastern Australia from Sydney Harbour, New South Wales, south and west to Flinders Island in Bass Strait, Tasmania, Victoria, South Australia and the Recherche Archipelago, Western Australia; usually inhabits rocky reefs, often in crevices, in association with sponges and encrusting and filamentous red algae at 5–20 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Paraplesiops bleekeri	Eastern Blue Devil	P	-	Eastern Blue Devil are a shy, secretive fish found in caves, crevices and under ledges on inshore reefs and estuaries. Eastern blue devil fish are distributed from southern Queensland to Montague Island on the NSW south coast. They can be found in waters between 3-30 metres and are generally solitary occupying caves, crevices or under ledges.	(DPI)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Pelamis platurus	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.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Phyllopteryx taeniolatus	Weedy Seadragon	P	Ma	Endemic to temperate coastal waters of southern Australia, from about Newcastle (New South Wales) south to Actaeon Island (Tasmania) and across southern Australia to about Geraldton (Western Australia). Common seadragons inhabit shallow estuaries to deeper offshore reefs, living seagrass beds and on rocky reefs covered in macroalgae, especially kelp beds, in depths of 1-50 m. Individuals usually remain within a broad home range.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Solegnathus spinosissimus	Spiny Pipefish	P	Ma	Known from temperate waters of Australia and New Zealand. In Australian waters, spiny pipehorses have been recorded from off Caloundra, southern Queensland, to southern Tasmania, throughout Bass Strait to south of Cape Otway, Victoria. In the southern part of their range, Spiny Pipehorses inhabit relatively shallow waters. Specimens have been collected from muddy, silty, shelly and rubble substrates, and rocky reefs, and may be washed ashore after storms. Spiny Pipehorses use their prehensile tails to cling to macroalgae and sessile invertebrates on the substrate.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Solenostomus cyanopterus	Robust Ghost Pipefish	P	Ma	Widespread in the tropical Indo-west Pacific, from East Africa and the Red Sea, eastwards to Fiji and southern Japan, and south to Australia. Known in Australian waters from the Shark Bay region, Western Australia, around the tropical north and southwards to at least Sydney Harbour, New South Wales. Robust Ghost Pipefish live in protected coastal and lagoon reefs, deeper coastal reefs and deep, clear estuaries with seagrass or macro-algae in 15-25 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Solenostomus paradoxus	Ornate Ghost Pipefish	P	Ma	Widespread in tropical and warm-temperate regions of the Indo-west Pacific, from East Africa, eastwards to Fiji and Tonga, north to southern Japan, south to Australia and New Caledonia. Ornate ghost pipefish inhabit protected coastal, lagoon and outer reef areas with drop-offs or rock faces, in depths of 3-35 m. They often associate with Crinoids (featherstars), Gorgonians and black corals. Although usually solitary, they may be seen in pairs, or even in small groups.	(DPI) (PMST)	Low. Prefers specific habitat not characterised by study area.
Stigmatopora argus	Spotted Pipefish	P	Ma	Found from the Hawkesbury River, NSW to Shark Bay, WA in temperate waters. Usually among vegetation in bays and estuaries, but sometimes offshore among floating Sargassum.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Stigmatopora nigra	Widebody Pipefish	P	Ma	Known from temperate waters of southern Australia and New Zealand. The Widebody Pipefish occurs from about Fraser Island in southern Queensland to north of Perth (Western Australia), and around Tasmania. It is common in sheltered seagrass and algal beds from intertidal depths to 35 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Syngnathoides biaculeatus	Double-end Pipefish	P	Ma	In Australian waters, known from Geraldton to Shark Bay, and north to Ashmore and Cartier Reefs, Western Australia, and from the Timor Sea, the Northern Territory, eastwards to Queensland and south to Batemans Bay (NSW). Inhabits shallow, protected waters of bays, lagoons and estuaries including mangrove areas, in association with seagrass beds and macroalgae in depths at 0-10 m. Juveniles sometimes found clinging to floating algae and plant debris including Sargassum sp. rafts.	(DPI) (PMST)	High. Potential habitat is present in the study area.
Trachyrhamphus bicoarctatus	Bentstick Pipefish	P	Ma	Widespread in the tropical Indo-west Pacific. Bentstick Pipefish are known in Australian waters from the central coast of Western Australia, northwards throughout the waters of the Northern Territory and Queensland to central New South Wales. They live in sheltered coastal lagoon and reef areas on sandy and rubble habitats amongst seagrasses and macroalgae at 1-30 m.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Urocampus carinirostris	Hairy Pipefish	P	Ma	In Australia, known from the Shoalwater Bay region (Queensland) to northern Tasmania, Victoria, and to the Ceduna region of South Australia, and in south-western Australia where it reaches the Perth region. Rare in South Australia. Inhabits the lower reaches of rivers, sheltered estuaries and shallow reefs in seagrass and algal beds a 0-6 m. One of the most common estuarine pipefishes in eastern Australia, occurring year-round in seagrass beds in Western Port (Victoria), and abundant in seagrass beds in Moreton Bay (Queensland).	(DPI) (PMST)	High. Potential habitat is present in the study area.
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.	(DPI) (PMST)	High. Potential habitat is present in the study area.

Scientific Name	Common Name	FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence

* 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

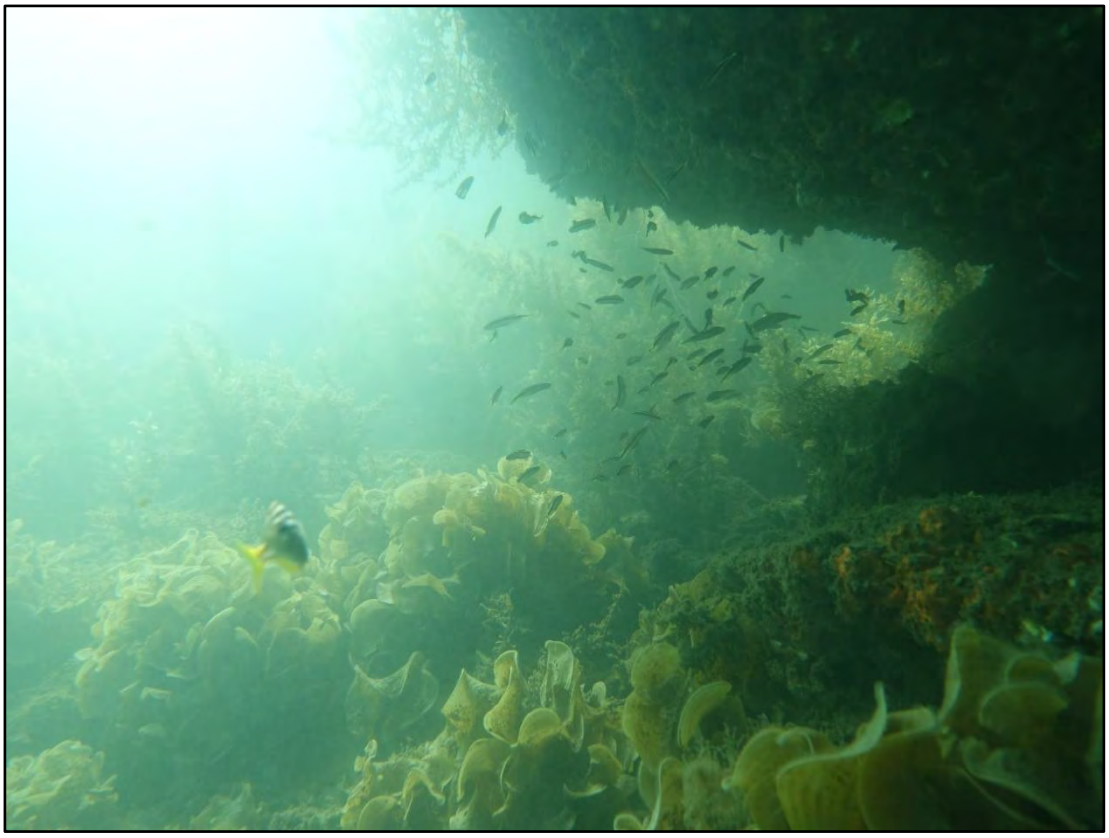


Plate C1: Example of high relief subtidal rocky reef in the Sydney Harbour area

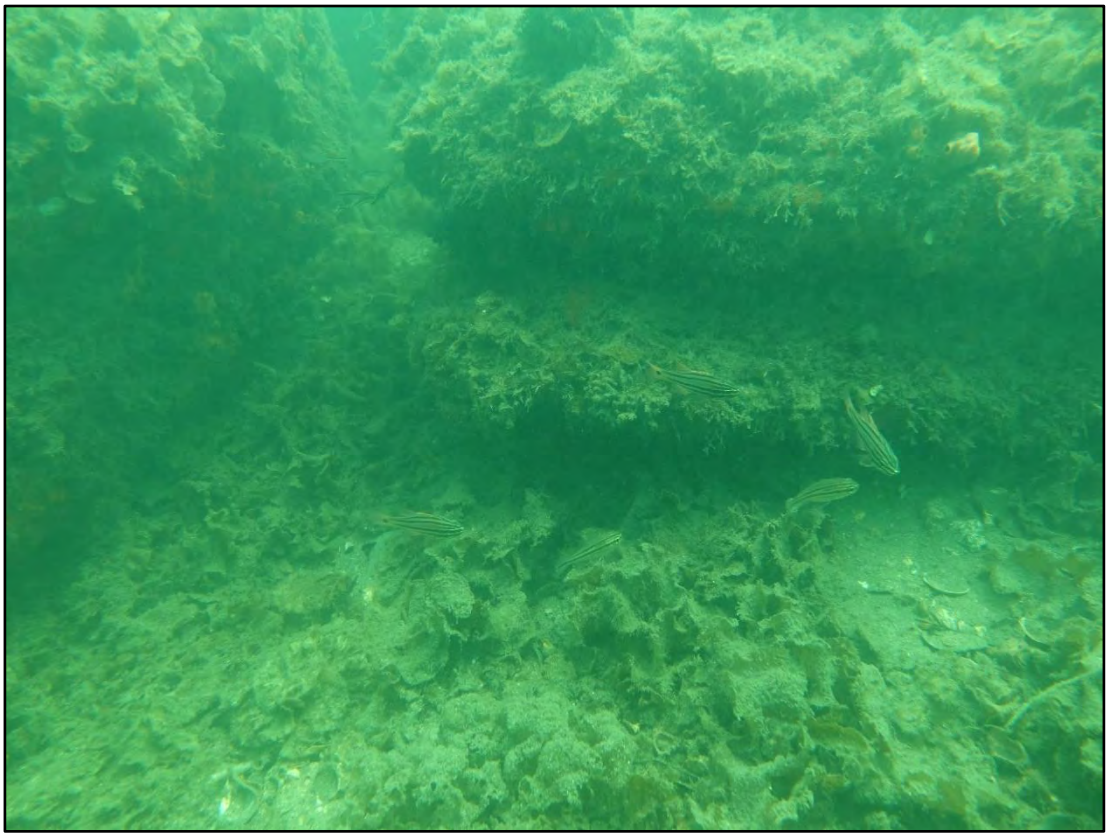


Plate C2: Example of medium relief subtidal rocky reef in the Sydney Harbour area

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 Dr Brendan Alderson (PhD), 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 daemelii*) listed as endangered under the FM Act and vulnerable under the EPBC Act
- Seven microbats:
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- 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 Sheathtail-bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act and the EPBC Act.

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 Coastal Free-tailed Bat (*Micronomus norfolkensis*), Yellow-bellied Sheathtailed-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 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 Sheathtailed-bat 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). Greater Broad-nosed Bats utilise a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest. All three species have preference to roost in tree hollows but would also inhabit man-made structures including under wharf/bridges and in rooves, which occur within the study area. They may roost in colonies but can also be solitary. There are no known maternity sites in or next to the study area.

The proposed works would require the removal of the existing wharf structure. There would be no removal of trees or shrubs. The areas of potential roosting habitat in the study area include existing areas underneath the jetty and in the scuppers and crevices in the seawall. The fissures in the sandstone escarpment could also provide potential roosting habitat. These areas are not considered optimal roosting/breeding habitat for these species as the surrounding vegetation does not form part of the native forests preferred by these species. 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 removal of wharf structures and disturbance to the escarpment (see Section 5). Thus, the proposal is unlikely to adversely affect the life cycle of these species such that a viable local population of these species is likely to be placed at risk of extinction.

2. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*

    (a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

    (b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

3. *In relation to the habitat of a threatened species or ecological community:*

    (a) *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*

    (b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*

    (c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The proposal would remove the existing wharf structures which forms potential roosting habitat however, similar habitat would be reinstated when the new structures are installed. As discussed in (1), the habitat to be removed is not considered optimal for the roosting or breeding of these species. The proposal is also not going to substantially affect the foraging habitat for these species during construction (see (1)). Thus, the project is unlikely to modify, fragment or isolate habitat important to the long-term survival of these species in the locality.

4. *Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).*

There are no Areas of Outstanding Biodiversity Value (AOBVs) listed for these species. This question is not applicable, as no AOBVs have been listed for these species.

5. *Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.*

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community.

Of the KTPs listed under the BC Act, *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 construction. However, no vegetation removal has been proposed and vegetation in the study area is currently ornamental and maintained as part of Greenwich Park and Mary Carlson Park (also see Section 4.1.7).

Conclusion

While there is potential foraging and suboptimal roosting habitat for the three tree-roosting microbats throughout the study area, this habitat is widespread and suboptimal for these species. The proposal would temporarily remove potential roosting habitat for these species however, similar habitat would be reinstated with the installation of new wharf structures. Any individuals roosting in the wharf structures to be removed would be relocated prior to construction. Based on this, the proposal is unlikely to significantly impact these species and a species impact statement (SIS) or entry into the Biodiversity Offsets Scheme 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*))

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

1. *In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

Little and Large Bent-winged Bats have known maternity sites in caves across south-eastern Australian spanning from the NSW/Queensland border to South Australia (Dwyer & Hamilton-Smith, 1965). These sites are not in the Sydney region and in most cases, have specific temperature and humidity characteristics. There are no known breeding locations for the Large-eared Pied Bat and Southern Myotis but roosting habitat include under bridges/wharves and in rooves.

The study area does not occur within or next to any known maternity sites for these species thus, the proposal is unlikely to interfere for breeding. The proposal would remove some potential roosting habitat by removing the existing wharf structures. Individuals may roost underneath the jetty and in the scuppers and crevices in the seawall however, new wharf structures are likely to provide similar habitat to those being removed and any roosting individuals would be relocated prior to demolition. Furthermore, their nocturnal foraging times are unlikely to coincide with land-based construction during the day.

The proposal would create some disturbance over the water during water-based construction activities which would render this foraging habitat unavailable for the Southern Myotis during construction. However, the proposal would not substantially modify this foraging resource to permanently preclude it from the species foraging territory and upon completion of construction, this area would be once again available as foraging territory for the Southern Myotis. Furthermore, the proportion of potential habitat to be impacted by the proposal is very small compared to what is available in the wider locality. Thus, the proposal is unlikely to adversely affect the life cycle of these species such that a viable local population of the species is likely to be placed at risk of extinction.

2. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
    - *(a) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - *(b) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

3. *In relation to the habitat of a threatened species or ecological community:*
    - *(a) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
    - *(b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*
    - *(c) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

The proposal would remove some potential roosting habitat. The existing wharf structures form part of a fragmented landscape of urban, landscaped/modified vegetation and structures. The removal of existing wharf structures 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. 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, *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 construction. However, no vegetation removal has been proposed and vegetation in the study area is currently ornamental and maintained as part of Greenwich Park and Mary Carlson Park (also see Section 4.1.7).

Conclusion

While there is potential foraging habitat for these four species throughout the study area, this habitat is widespread and suboptimal. The proposal would remove temporarily remove potential roosting habitat for these species by removing existing wharf structures and temporarily render the estuarine area unsuitable for foraging for the Southern Myotis during construction. However, this was not considered to substantially impact these species due to their nocturnal foraging preference (in relation to land-based works) and being purely aerial during that time. Furthermore, the proposal would reinstate the removed wharf structures and estuarine habitat would be available as a foraging resource upon completion of water-based construction activities. 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 or entry into the Biodiversity Offsets Scheme 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 project to the Grey-headed Flying-fox will be limited to loss of potential feeding habitat caused by some pruning during the construction phase. The project would not remove any trees which could provide potential foraging habitat while in bloom. 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 project 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 project 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 minimally reduced by some pruning of fig trees within the footprint. This amount of habitat removal is small when the amount of available foraging habitat in the locality is considered.

Importantly, the project 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 project will not affect the movement of the Grey-headed Flying-fox between habitat patches. The project 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 project 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, *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 project if weed controls are not implemented during and after the construction. However, weed invasion is likely to be limited to groundcover grass and herbaceous weeds and these weeds are unlikely to greatly impact on this species.

Conclusion

The Grey-headed Flying-fox will experience a minimal reduction in the extent of suitable foraging habitat as a result of the project. No roosting camps or other important habitat will be impacted. The project is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. Thus, the project 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; Kuiter, 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 relief rocky reef (about 0.06 hectares) and existing piles (vertical area of up to 0.03 hectares). The loss of individuals from the removal of suitable habitat could affect the viability of local populations due to their monogamous breeding behaviour and site fidelity although the proportion of suitable habitat to be impacted is small relative to that available in the harbour. The precise number of White's Seahorse with potential to be impacted by the proposal, although likely to be small, is uncertain. Targeted surveys could be completed prior to the commencement of water-based construction activities to capture and relocate individuals in the study area (see Section 5). With this measure, the proposal is unlikely to adversely affect the life cycle of the White's Seahorse such that a viable local population of the species is likely to be placed at risk of extinction.

2. *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

Not applicable.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*

    (a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

    (b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Not applicable.

4. *In relation to the habitat of a threatened species, population or ecological community:*

(a) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(c) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality

As indicated in (1), White's Seahorse are found in subtidal rocky reef, seagrass meadows and artificial structures which, with the exception of seagrasses, are all present in the study area. However, optimal habitat and known populations are found elsewhere in the harbour (e.g. Clifton Gardens). It is also likely that the frequent exposure to ferry and other vessel wash may render habitat in the study area suboptimal. The proposal would permanently remove existing piles which form suitable habitat for the species. The proposal would 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 these impacts would not remove these areas from the species occupancy (eg the species is still able to transit or disperse through soft sediment areas). Furthermore, the new piles and pontoon to be installed would form potential habitat once habitat-forming species have colonised. Thus, although the proposal will remove habitat important for the long-term survival of the species, replacement habitat of a similar or greater quantity would be reinstated and habitat removal would not fragment or isolate potential habitat for the species in the harbour.

5. Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)

Critical habitat refers to those areas listed in the Register of Critical Habitat kept by NSW DPI (Fisheries). This question is not applicable, as no critical habitat has been listed for White's Seahorse.

6. Whether the proposed development or activity is consistent with a recovery plan or threat abatement plan

There is no recovery plan or threat abatement plan (TAP) for this species. It was, however, in the opinion of the Fisheries Scientific Committee that White's Seahorse is eligible to be listed nationally as endangered under the Common Assessment Method (Fisheries Scientific Committee, 2019). Since then, White's Seahorse has also been nominated for endangered-listing under the EPBC Act. Invitation to comment on the proposed listing came to a close 15 April 2020 and DAWE are currently reviewing the proposition.

In the interim, the Scientific Committee has recommended management actions for White's Seahorse, including:

- Collate and synthesise data collected to quantify the significance of high and moderate risk threat interactions with *H. whitei* (medium priority)
- Reduce the impact of public and private boat moorings that impact on *H. whitei* habitats (high priority)
- Councils to maintain best practice management of protective swimming nets by using the suggested NSW DPI seahorse friendly cleaning methods (high Priority)
- Consider information on *H. whitei* distribution, abundance and habitat preferences during development and review of Marine Park Zoning Plans (medium priority)
- Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on *H. whitei* habitats (medium priority)

- Continue to monitor the distribution and abundance of *H. whitei* at important sites (Port Stephens and Sydney Harbour) to inform population status and to assist in determining the effectiveness of recovery actions (high priority)
- Develop and trial artificial habitats to promote recovery of *H. whitei* populations (high priority).
- Implement research using eDNA to investigate the occurrence of *H. whitei* in estuaries and embayments across its range (high priority)
- Implement genetics research to investigate population structure of *H. whitei* across its entire range (NSW and Qld) (medium priority)
- Encourage the reporting of sightings of seahorses along the east coast of Australia to iSeahorse and iNaturalist (medium priority).

The proposal would not interfere with any of the above recommendations. Targeted surveys during pre-construction to capture and relocate individuals could be completed in consultation with NSW DPI (Fisheries) 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. considerations to potential loss of habitat due to localised changes in hydrodynamics has been considered as habitat loss in (1) and (4). These structures are unlikely to substantially alter nearshore natural tidal flow and therefore would not be exacerbated by the proposal to significantly 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, seagrass meadows and existing subtidal jetty structures. The proposal would include control measures to capture and relocate individuals prior to water-based construction activities, which would avoid any mortality to individuals in the study area. The proposal would also replace suitable habitat proposed to be removed such that there would not be a substantial loss, fragmentation or isolation of White's Seahorse habitat. Thus, the proposal is unlikely to have a significant impact on White's Seahorse with the implementation of construction measures and a small proportion of White's Seahorse habitat to be impacted in relation to that available in the harbour. Thus, a SIS is not required.

Black Rockcod (*Epinephelus daemelii*) – endangered (FM Act)

The following questions test whether a proposed development or activity is likely to significantly affect Black Rockcod:

1. *In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

Black Rockcod, also known as Black Cod or Saddled Rockcod, occurs from southern Queensland to Kangaroo Island in South Australia and are found offshore at Lord Howe Island, Norfolk Island, Kermadec Islands and the North Island of New Zealand (Heemstra & Randall, 1993). New South Wales is the centre of the species distributional range in Australia. They are protogynous hermaphrodites (ie change sex from female to male) and at the time of spawning, males establish a harem within their territory. Black Rockcod are opportunistic carnivores, eating mainly other fish and crustaceans.

Black Rockcod are mostly found in caves and gutters in coastal areas. Dispersal of eggs is thought to be pelagic and juveniles can recruit to rockpools (Griffiths, 2002). Adults are highly territorial, usually adopting a cave as core territory. Black Rockcod have been observed by divers or caught by anglers in estuaries, including Sydney Harbour. Although the locations of these occurrences have generally been at the mouths of estuaries and involved juvenile fish, there is anecdotal evidence that Black Rockcod have been caught in embayments of the harbour. Although the species may have been prevalent in estuaries in the past (NSW Department of Industry and Investment, 2009), it is unlikely that viable populations of Black Rockcod currently occur in the estuary. The few individuals that occur are more likely to be part of one or many populations in nearby coastal areas. Since any Black Rockcod in the harbour are likely to form a very small proportion of a viable population of the species, and with the appropriate proposal controls to complete targeted surveys for individuals and encouraging them to vacate the study area 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 low-medium relief rocky reef areas in the study area may again become more commonly occupied.

The proposal would remove a small area of low-medium relief subtidal rocky reef by piling and shade <0.01 hectares. Suitable habitat in the study area would also be temporarily disturbed by increased vessel/barge traffic, piling noise and vibration and anchoring during construction. Habitat removal and disturbance is not considered to result in the fragmentation or isolation of Black Rockcod habitat 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, this area is a very small proportion of similar habitat in the study area and the wider harbour. Thus, the proposal is unlikely to 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 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 is known to occur in estuaries, particularly on medium to high relief rocky reefs. The project would remove a very small proportion of potential habitat and temporarily disturb potential habitat for the species from an increase in 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 daemelii*) – 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 study area 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-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 elsewhere in the harbour. The proposal would remove and shade <0.01 hectares of this habitat and 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 area of potential habitat to be removed/shaded is proportionately small compared to what is available in the study area and the wide harbour. 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 remove/shade a small proportion of potential habitat and temporarily impact other habitat in the study area, 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 remove/shade a small proportion of potential habitat and 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.

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; Kuiter, 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-medium relief subtidal rocky reef and existing piles (about 0.09 hectares). The potential loss of individuals from the removal of part 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, artificial structures and seagrass, which are all 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 area of approximately 0.03 ha. The proposal would also be installing 14 support piles and 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 and shading of subtidal rocky reef habitat is unlikely to remove these areas from use by the species. The new piles to be installed would form potential habitat once habitat-forming species have colonised. The surface area of the newly installed piles would amount to an area slightly smaller than that removed, however much of this habitat would remain available for the species in the long-term. Thus, 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 are not known to occur 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, suboptimal habitat for the species. However, some of the lost habitat would be reinstated and the remaining habitat would be altered but 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 has 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 of 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 the harbour. The study area possesses suboptimal 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-medium relief rocky reefs and the submerged sections of the existing artificial structures. The proposal would temporarily remove some habitat and alter others. However, lost potential habitat would be mostly reinstated and altered 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.

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 project would not directly affect any known breeding site of the Grey-headed Flying-fox. Therefore, the impacts of the project would be confined to loss of foraging habitat caused by direct clearing during the construction phase.

The project would not remove any trees which form potential foraging habitat, although some pruning would occur. 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 project 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 project will only minimally reduce the area of foraging habitat available to the species however, the area occupied by this species will remain the same and disturbed areas would be landscaped and reinstated following construction completion.

c. fragment an existing important population into two or more populations

There is currently a high degree of habitat fragmentation across the wide locality. Highly mobile species, such as Grey-headed Flying-foxes, are expected to be less impacted by fragmentation and this species is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. Thus, the project would not fragment an important population of the Grey-headed Flying-fox.

d. adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- to maintain genetic diversity and long-term evolutionary development
- for the reintroduction of populations or recovery of the species.

The proposed area of habitat loss represents a very small proportion of potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of the study area and known roosting camps in the region. This species typically exhibits very large home ranges and Grey-headed Flying-foxes are known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources (Eby, 1996). No evidence of a Grey-headed Flying-fox camp has been identified in or next to the study area.

The project would require the pruning of some fig trees however, the affected area of foraging habitat represents a very 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 project 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 project 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 project is not expected to lead to a decline in 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 project 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 project. The project 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:

6. identify, protect and enhance native foraging habitat critical to the survival of Grey-headed Flying-foxes.
7. identify, protect and enhance roosting habitat of Grey-headed Flying-foxes camps.
8. determine population trends in Grey-headed Flying-foxes so as to monitor species' national distribution and conservation status.
9. build community capacity to coexist with flying-foxes and minimise the impacts on urban settlements from existing camps without resorting to dispersal.
10. increase public awareness and understanding of Grey-headed Flying-foxes and the recovery program, and involve the community in the recovery program where appropriate.
11. improve the management of Grey-headed Flying-fox camps in sensitive areas.
12. significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture.
13. support research activities that will improve the conservation status and management of Grey-headed Flying-foxes.
14. 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 project 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 project 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 very minor reduction in extent of suitable foraging habitat from the project. No roosting/breeding camps or other important habitat will be impacted. The project is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. The project 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 project is unlikely to significantly impact the Grey-headed Flying-fox and a referral is not required.

Appendix E

Construction noise and vibration impact assessment

Noise and Vibration Impact Assessment

Greenwich Point Wharf Upgrade

AWE200198

Prepared for
Transport for NSW

29 November 2021

Cardno

Document Information

Prepared for	Transport for NSW
Project Name	Greenwich Point Wharf Upgrade
File Reference	AWE200198_R404_Rev 0_GreenwichPoint_N&V.docm
Job Reference	AWE200198
Date	29 November 2021

Contact Information

Cardno QLD Pty Ltd
Trading as Cardno
ABN 57 051 074 992

L11 Green Square North Tower
515 St Pauls Terrace
Fortitude Valley QLD 4006

Telephone: 07 3369 822
Facsimile: 07 3369 9722
International: +61 7 3369 9822

Julie.mcdonagh@cardno.com.au
www.cardno.com

Document Control

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
Rev A	23 April 2021	Draft for client review	Karen McMorrow	Julie McDonagh
Rev B	13 September 2021	Draft for client review	Karen McMorrow	Julie McDonagh
Rev C	12 October 2021	Final draft for client review	Karen McMorrow	Julie McDonagh
Rev 0	29 November 2021	Final report	Karen McMorrow	Julie McDonagh

© Cardno 2021. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

Executive summary

This noise and vibration impact assessment was conducted on behalf of Transport for NSW, for inclusion in the Review of Environmental Factors prepared for the proposed Greenwich Point wharf upgrade. Greenwich Point wharf is located approximately 3.5 kilometres northwest of Circular Quay, Sydney. Currently, the wharf does not provide equitable access to ferry services.

The noise and vibration impact assessment provided in this report is based on the concept design developed in July 2019. Since this time the concept design has been amended and the proposed wharf has been relocated by approximately 35 metres. The wharf would still be constructed using a similar construction methodology as detailed in this report. In consultation with Transport for NSW these changes have not been reflected in this assessment. The design change may result in some localised differences in predicted noise and vibration impacts, however, the change would not result in modification to the identified mitigation measures.

The water based features of the assessed design include:

- Installation of a new four metre wide by 7.5 metre long concrete jetty, supported by two new piles
- Installation of a new, uncovered 18 metre gangway to provide access to the new pontoon
- Installation of a new covered steel nine metre by 18 metre pontoon containing a curved zinc roof supported by steel columns, glass weather protection, stainless steel balustrades, seating and information boards. The pontoon would be supported by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of new signage, information boards and opal card readers
- Installation of safety and security features including a help point, lighting, closed circuit television (CCTV) cameras, ladders to the water, a life buoy and tactile ground surface indicators where required
- Removal of the existing waiting shelter, jetty and tidal stairs including associated piles.

The land based features of the assessed design include:

- Installation of three bicycle hoops
- Relocation of the existing bus shelter on Lower Serpentine Road at the location of the bus stop
- Construction of a skybridge connecting the footpath to the lift and stairs
- Excavation of cliff face to provide a stable platform for the lift and staircase
- Construction of a 13 metre tall lift
- Construction of new stairs connecting Lower Serpentine Road and the new wharf -near the lift. The staircase would also connect to the existing pathway to the existing stairs near Mary Carlson Park
- Removal of trees and shrubs for construction of the new skybridge, lift and jetty.

This assessment has been carried out to determine the predicted noise and vibration impacts associated with the construction of the proposed Greenwich Point wharf upgrade. Noise modelling has been carried out to determine whether the proposed construction works associated with the assessed design 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 and Climate Change (DECC)) and Roads and Maritime guidelines for the control of construction noise impacts
- Construction vibration from the project in accordance with NSW EPA and Roads and 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) (AV:ATG)
- 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
- Construction noise levels are predicted to exceed the NSW ICNG noise management levels (NML) for "standard" construction hours at NCA 1 for construction Scenario 1. The NML at NCA 2 is not predicted to be exceeded for construction Scenario 1 during "standard" work hours
- Construction noise levels are predicted to exceed the NSW ICNG NML for "standard" construction hours at both NCAs for construction Scenarios 2 to 4
- Construction noise levels are predicted to exceed NML for "non-standard" hours of operation for Scenario 5 at the nearby residential receivers in both NCAs, particularly for receivers located on Lower Serpentine Road and Mitchell Street in NCA 1 and The Point Road in NCA 2. This is due to the proximity of receivers to the construction works
- Predicted levels are expected to be highly intrusive at a number of receivers in NCA 1 for Scenario 5 for works during the out of hours work (OOHW) time period 2. Construction noise is likely to have the highest impact on and cause sleep disturbance at sensitive receivers located on Lower Serpentine Road and Mitchell Street in NCA 1, 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 would 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
- Use of temporary noise barriers are recommended where practical. The height and location of these barriers will be determined during preparation of the CNVMP when more information regarding the proposed plant to be used for each construction scenario is available
- Best practice mitigation measures are recommended in Section 8 of this report
- 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. Indicative predictions only, of expected L_{Amax} impact have been carried out for this assessment, as it is difficult to predict L_{Amax} for construction noise sources because L_{Amax} levels vary considerably. The predicted levels in this assessment, are based on previously measured relationships between L_{Aeq} and L_{Amax} of typical construction plant, and may vary from those predicted in practice
- The minimum working distances indicated in Table 7-1 for cosmetic damage must be complied with at all times, unless otherwise approved by Transport for NSW or under the environmental license as relevant, as stipulated in the CNVG
- A detailed CNVMP will 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

Table of contents

Appendices

Tables

Figures

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	*Assessing Vibration: A Technical Guide* (DEC 2006)
Background Sound Level	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources.
CNVG	Construction Noise and Vibration Guideline (RMS 2016)
CNVMP	Construction Noise and vibration Management Plan
CoRTN	Calculation of Road Traffic Noise (HMSO 1988)
dB(A)	Unit of acoustic measurement electronically weighted to approximate the sensitivity of human hearing to sound frequency.
DEC	former NSW Department of Environment and Conservation
DECC	former NSW Department of Environment and Climate Change
DECCW	former NSW Department of Environment and Climate Change and Water
Decibel, dB	Unit of acoustic measurement. Measurements of power, pressure and intensity may be expressed in dB relative to standard reference levels.
ECRTN	superseded Environmental Criteria for Road Traffic Noise (EPA 1999).
ENMM	Environmental Noise Management Manual (RTA 2001).
EPA	NSW Environmental Protection Authority
ICNG	*Interim Construction Noise Guideline* (DECCW 1999).
INP	*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.
L_{Abg}, T	The A-weighted background sound level measured over a time interval T.
L_{AMax}	The A-weighted maximum noise level measured during the measurement period.
L_{Aeq}, 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	*Road Noise Policy* (DECCW 2011).
RTA	former NSW Roads and Traffic Authority
Roads and Maritime	former NSW Roads and Maritime Services (now known as Transport for NSW)
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be

Term	Definition
	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, for inclusion in the Review of Environmental Factors prepared for the proposed Greenwich Point wharf upgrade.

The noise and vibration impact assessment provided in this report is based on the concept design developed in July 2019. Since this time the concept design has been amended and the proposed wharf has been relocated by approximately 35 metres. The wharf would still be constructed using a similar construction methodology as detailed in this report. In consultation with Transport for NSW these changes have not been reflected in this assessment. The design change may result in some localised differences in predicted noise and vibration impacts, however, the change would not result in modification to the identified mitigation measures.

The Greenwich Point wharf is located off Lower Serpentine Road, on the northern side of Sydney Harbour, within the suburb of Greenwich. The existing wharf consists of the ferry jetty, associated shade structure, and existing ramps and stairs providing access from Lower Serpentine Road.

The assessment has been carried out to determine the predicted noise and vibration impacts associated with the construction of the proposed Greenwich Point wharf upgrade.

Noise modelling has been carried out to identify any potential noise impacts on nearby sensitive receivers as a result of proposed construction works associated with the assessed design. Potential vibration impacts have also been assessed at the nearest sensitive receivers to the works.

This assessment considers the following policies and guidelines:

- *NSW Interim Construction Noise Guideline* (DECC 2009) (ICNG)
- *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 Greenwich Point 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 assessed design, and to determine the levels of mitigation that are likely to be required, if applicable, to enable compliance with the current NSW legislation.

2 Design assessed

2.1 Description of the design assessed

The water based features of the assessed design include:

- Installation of a new four metre wide by 7.5 metre long concrete jetty, supported by two new piles
- Installation of a new, uncovered 18 metre gangway to provide access to the new pontoon
- Installation of a new covered steel nine metre by 18 metre pontoon containing a curved zinc roof supported by steel columns, glass weather protection, stainless steel balustrades, seating and information boards. The pontoon would be supported by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of new signage, information boards and opal card readers
- Installation of safety and security features including a help point, lighting, closed circuit television (CCTV) cameras, ladders to the water, a life buoy and tactile ground surface indicators where required
- Removal of the existing waiting shelter, jetty and tidal stairs including associated piles.

The land based features of the assessed design include:

- Installation of three bicycle hoops
- Relocation of the existing bus shelter on Lower Serpentine Road at the location of the bus stop
- Construction of a skybridge connecting the footpath to the lift and stairs
- Excavation of cliff face to provide a stable platform for the lift and staircase
- Construction of a 13 metre tall lift
- Construction of new stairs connecting Lower Serpentine Road and the new wharf -near the lift. The staircase would also connect to the existing pathway to the existing stairs near Mary Carlson Park
- Removal of trees and shrubs for construction of the new skybridge, lift and jetty.

Figure 2-1 shows a visual perspective of the assessed design from a waterside perspective.

Figure 2-1 Photomontage of the assessed design for the Greenwich Point wharf (Urbaine, 2020)

Figure 2-2 Key features of the assessed design

2.2 Existing site description

The Greenwich Point wharf is located off Lower Serpentine Road, adjacent Greenwich Park, approximately 30 metres from residential properties located to the north and northeast on Lower Serpentine Road. The existing wharf is surrounded by a range of noise sensitive receivers, mostly residential. Non-residential receivers include areas such as Greenwich Park, Mary Carlson Park, Clarke's Point Reserve, Greenwich Sailing Club and Woolwich Dock.

The assessment area for the assessed design, is shown in Figure 2-3 and includes the land uses listed in Table 2-1.

Table 2-1 Existing land uses

Label	Description	Land Use
1	Greenwich Park/Greenwich Point Reserve/Mary Carlson Park	Passive recreation
2	Residential northeast	Residential
3	Greenwich Sailing Club	Community
4	Residential northwest	Residential
5	Deckhouse Woolwich	Commercial
6	Clarke's Point Reserve/The Goat Paddock	Passive recreation
7	Cockatoo Island camping	Residential
8	Cockatoo Island industrial precinct	Industry
9	Residential south	Residential

The above locations are shown in Figure 2-3.

Figure 2-3 Site location and surrounding land uses

2.3 Assessed construction methodology

The proposed upgrade to the existing Greenwich Point wharf is a Transport for NSW initiative to provide a modern and integrated upgrade to transport infrastructure in NSW.

The assessed construction methodology generally comprises of the following construction scenarios, onsite activities and timing listed in Table 2-2.

Table 2-2 Construction scenarios

Activity	Associated work
Scenario 1: Site establishment and enabling works	> Establishment of a temporary compound area (erect site offices, amenities and plant/material storage areas etc.) on the land. The compound area would be located in Greenwich Park. > Site entry and exit points would be established for the construction work site. > 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. > Overhead cabling along the southern side of Lower Serpentine Road would be relocated to provide clearance for craneage and spoil removal.
Scenario 2: Excavation of lift and stairs slot	> A medium size excavator (13tonne) would construct a ramp from Lower Serpentine Road to the lift and stair slot excavation. > The excavator would excavate the overburden and rock. Rock hammers and rock saws would be required to cut through harder rock. A long reach excavator would be used to muck out the deeper excavation. > Rockbolts and shotcrete would be installed progressively as required. > The excavator would be lifted out of the slot by a large mobile crane installed on Lower Serpentine Road when the excavation is complete. This operation would block traffic along Lower Serpentine Road for periods of several hours.
Scenario 3: Construction of lift tower, stairs and skybridge	> Construct concrete base slab, lift pit and gantry abutment. Concrete would be placed by concrete pump on Lower Serpentine Road. > The lift tower (assumed to prefabricated steel), lift car, stairs and skybridge would be lifted by a large mobile crane located in Mitchell Street cul de sac. These operations would block traffic along Lower Serpentine Road for periods of several hours.
Scenario 4: Construction of landside works	> Landside infrastructure would involve the installation of footpaths and bus infrastructure.
Scenario 5: Demolition of the existing Greenwich Point wharf	> The existing wharf would be closed > 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 would travel to the site from the off-site facility. One barge would be fitted with a crane (about 12 metres high). When on-site it would be anchored by four points but would reposition around the site during the work, as required. > The existing shelter, wharf furniture, fixed tidal structure and jetty decking would be cut away from the piles and loaded onto a barge by crane to be transported to an appropriately approved and licensed facility for reuse and/or disposal. > The existing steel and timber piles would be removed by vibratory methods. If a pile is unable to be extracted by vibratory methods, it would be cut off level with the harbour bed. Divers would cut the pile at the seabed level using appropriate underwater equipment. Piles would be transported by barge to an appropriately approved and licensed facility for reuse and/or disposal.

Activity	Associated work
Scenario 6: Installation of steel pipes within the waterway	> Steel locator piles for the pontoon would be installed into bedrock. These piles would be transported by barge to the site from the off-site facility. > Construct pile foundation systems in bedrock as follows: o Pre-drilling into rock o Positioning steel pile casing with crane mounted driving unit and piling guide o Driving or vibrating the steel pile casings into position o Cutting the steal pile casings to length and backfilling with concrete.
Scenario 7: Installation of the pontoon and gangway	> Lifting and placement of components for the new wharf would be carried out using a barge mounted crane. > The new pontoon structure would be constructed at an off-site facility and floated to site. The pontoon would be secured to the locator piles and packing plates used to trim the plan position. > The new gangway would be fabricated at an off-site facility and floated to site by barge. The gangway would be lifted into position a large barge mounted crane. > Finishing works completed (architectural, services, handrails, etc).
Scenario 8: Installation of new or improved facilities	> Provision for new electronic ticketing machines. > Installation of bicycle hoops adjacent to the wharf. > Installation of way-finding signage. > Re-landscaping of the construction areas.
Scenario 9: Site clean-up	> 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 traffic noise on local roads and noise from boats on the bay.

3.1 Unattended noise monitoring methodology

Unattended noise monitors were installed at the following two locations to measure ambient (i.e. background) noise levels for a period of seven days to determine the ambient background noise levels. Noise monitors were configured to measure 15-minute statistics between 2 and 9 March 2021.

The unattended noise monitors were configured to measure noise levels as follows:

- 'A' weighting
- 'Fast' response
- 15 minute statistical intervals
- Measurement descriptors L_{AMax}, L_{Aeq}, L_{A1}, L_{A10}, L_{A90}.

The loggers were deployed at the following locations (Figure 3-1):

- **Logger 1** was located within Greenwich Park, approximately 75 metres north of the Greenwich Point wharf pontoon
- **Logger 2** was located at The Goat Paddock, approximately 720 metres northwest of the Greenwich Point wharf pontoon.
- 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	16-306-037
2	ARL EL-316	16-306-036

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 ±0.3dB recorded.

3.3 Metrological monitoring conditions

A summary of the environmental conditions noted during the measurement period were as follows (source: Sydney weather station):

3.3.1 Monitoring period – 2 to 9 March 2021

Conditions: Mostly fine

Wind: 0-37 km/h from a variety of directions

Humidity: 44 - 91 per cent (%)

Temperature: 16 – 31ºC

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.

It should be noted that Bureau of Meteorology wind speed was recorded at seven metres above the ground and that the ground level wind speed is significantly less. Adjustments have been made for this in Appendix A. As shown in Appendix A, the number of occurrences of the adjusted wind speed exceeding 5 m/s was negligible 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 in Table 3-2.

Table 3-2 Observed existing noise environment

Logger	Location	Observed Noise Environment
1	Greenwich Park	The primary source of noise was from nearby waterway vessels.
2	The Goat Paddock	The primary source of noise was from nearby waterway vessels.

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	Greenwich Park	41	39	33
2	The Goat Paddock	43	38	32

The measured RBLs from Table 3-3 have been used to formulate the noise objectives for construction noise impacts as detailed in Section 5.1. Typical measured noise levels, averaged from measured data, are shown below in Figure 3-2 for Logger 1 and Figure 3-3 for Logger 2. Full noise charts are displayed in Appendix A.

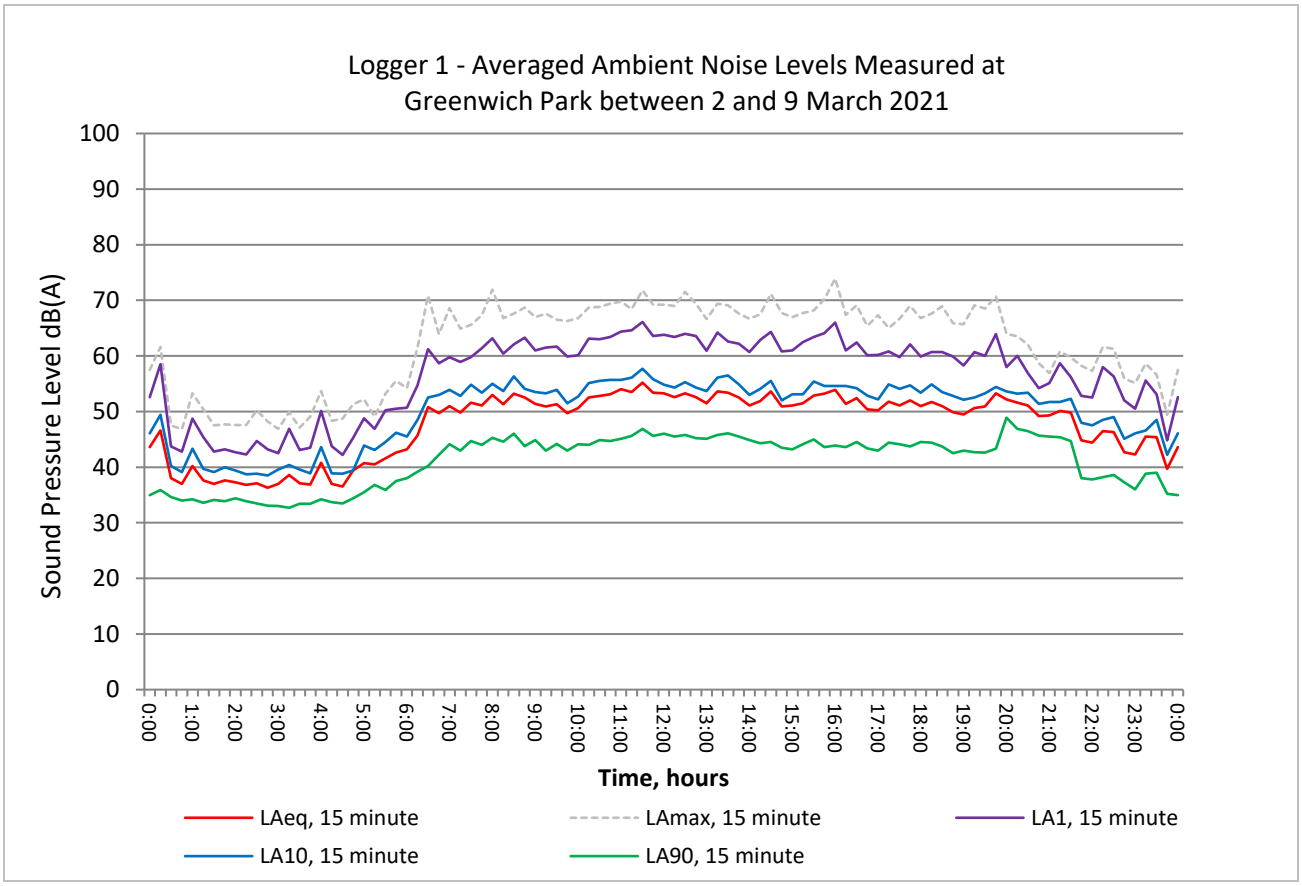


Figure 3-2 Averaged measured noise levels – Logger 1

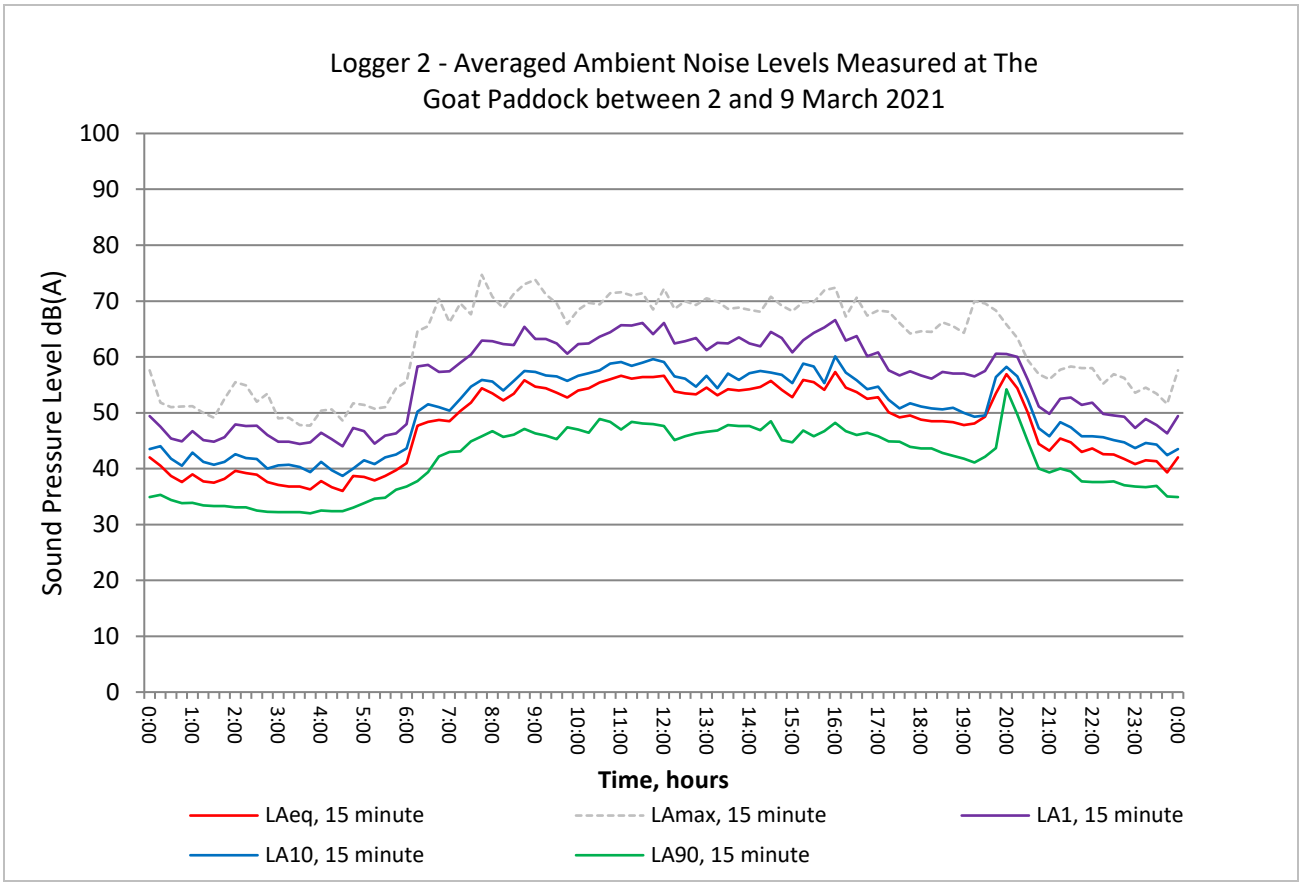


Figure 3-3 Averaged measured noise levels – Logger 2

4 Statutory noise and vibration criteria

4.1 Noise criteria

4.1.1 Roads and maritime construction noise and vibration guideline

The Roads and Maritime *Construction Noise and Vibration Guideline* (RMS, 2016) (CNVG) provides a framework for the assessment of noise during the construction phase of the project. 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* (DECC, 2009) (AVATG)
- NSW *Road Noise Policy* (DECCW, 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 Transport for NSW or under the environmental licence as relevant. The minimum working distances are summarised in Section 7.1.2

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.

Time of day	Management level $L_{Aeq\ (15\ min)}$*	How to apply
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Notes:

(1) For Residential receivers - Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 metre from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

(2) Other sensitive use receivers - Internal noise levels are to be assessed at the centre of the occupied room. External noise levels are to be assessed at the most affected point within 50 m of the area boundary

A strong justification would typically be required for works outside the recommended standard hours (see Table 4-1). The proponent should apply all feasible and reasonable work practices to meet the noise affected level. The definition of feasible and reasonable work practices is outlined in Section 1.4 of the NSW ICNG, with the following excerpts providing a brief description:

“A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.”

“Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.”

A number of factors may be considered in selecting reasonable measures, including the level of impact, the number of people affected, and the order of treatments applied to previous, similar projects. Where all feasible and reasonable practices have been applied and noise remains more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community on suitable mitigation measures. For guidance on negotiating agreements see section 7.2.2 of the NSW ICNG.

4.1.2.2 Sleep disturbance

Section 4.3 of the NSW ICNG defines the assessment of sleep disturbance as follows:

“Where construction works are planned to extend over more than two consecutive nights, and a quantitative assessment method is used, the analysis should cover the maximum noise level, and the extent and the number of times that the maximum noise level exceeds the RBL. Some guidance indicating the potential for sleep disturbance is in the now superseded NSW Environmental Criteria for Road Traffic Noise (EPA 1999).”

The *NSW Environmental Criteria for Road Traffic Noise* (EPA, 1999) (NSW ECRTN) discusses a number of methodologies with respects to sleep disturbance. In general, the methodologies address sleep disturbance due to continuous noise (expressed in terms of a $L_{Aeq, T}$) 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, and
- The time of day (normally between 10pm and 7am).

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 NSW ICNG and refers to Section 2.5 of the document Assessing Vibration: A Technical Guideline (NSW AV:ATG) issued by DEC (2006).

The NSW AV:ATG outlines vibration limits in relation to human comfort. Criteria in this guideline are based on the British Standard BS6472-1992 Evaluation of human exposure to vibration in buildings (1-80Hz).

Vibration sources are defined as continuous, impulsive or intermittent. Table 4-2 provides a definition and examples of each type of vibration.

Table 4-2 Types of vibration

Type of Vibration	Definition	Examples
Continuous	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing 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 7.1.2 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 assessed design.

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 assessed construction 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 assessed construction methodology 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 $L_{A1,\ 1\ min}$
		Standard Hours (RBL + 10 dB(A))	Outside Standard Hours (RBL + 5 dB(A)		
		Day	Evening	Night	
1	1	51	44	38	60
2	2	53	43	37	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).*

5.2 Construction vibration

5.2.1 Human comfort criteria

The vibration criteria for human comfort that apply to the assessed designare outlined 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 vibration[3] (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 vibration[3] (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
Workshops	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
Intermittent vibration[4] (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 scenarios was provided by Transport for NSW. 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 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 Transport for NSW. 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 project.

The proposed works, with the potential to generate the most noise, are detailed in Section 6.6. To provide an indicative assessment of construction noise impact, a noise model was created for a selection 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 construction scenarios in Table 6-2 have been modelled for the proposed Greenwich Point wharf upgrade.

Table 6-2 Modelled construction scenarios

Modeled Scenario No.	Corresponding Construction Scenario (Ref Table 2-2)	Construction Scenario Description
1	1	Site establishment and enabling works
2	2 and 3	Excavation and construction of skybridge, lift and stairs
3	4	Construction of landside works
4	5	Demolition of existing wharf
5	6	Installation of steel piles within the waterway – piling – outside of standard work hours

To provide an indicative assessment of construction noise impact, a noise model was created for each of the above construction scenarios

6.4 Noise catchment areas

Noise modelling was conducted to determine the predicted level of noise impact at sensitive locations surrounding the project. Works associated with the modelled scenarios are likely to remain within a finite work area. Therefore, construction works have been modelled as a number of point sources operating simultaneously for each construction scenario to provide the worst case predicted noise levels at each sensitive location. Sensitive areas have been grouped into noise catchment areas as shown below in Figure 6-1.

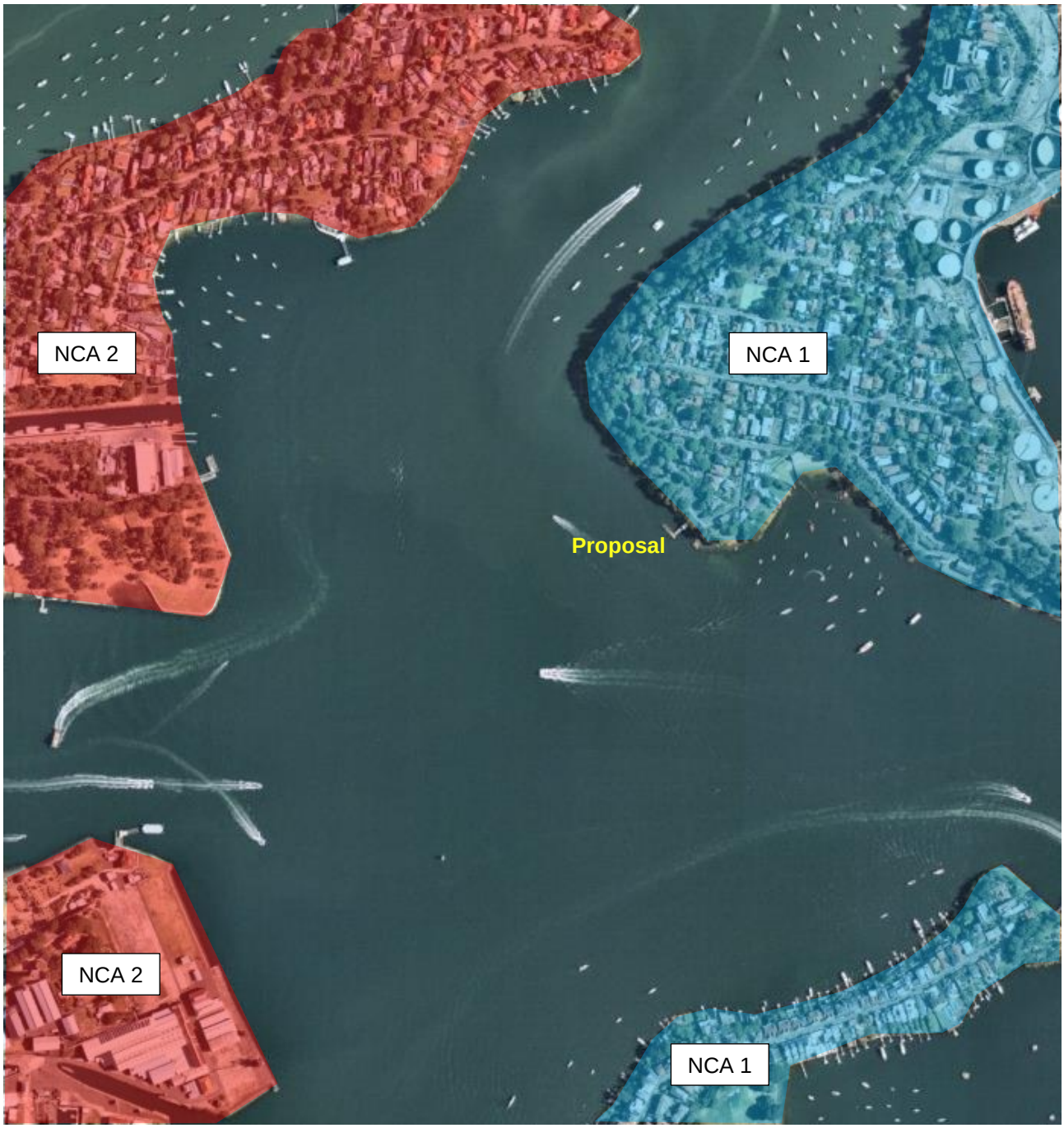


Figure 6-1 Noise catchment areas

Please note that Birchgrove (across the water south of the proposal) has been included in NCA1 as the background noise data from logger location 1 (Greenwich Park) has been adopted for this location. Therefore the criteria for Birchgrove is the same as NCA 1.

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 the 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 1 – Site establishment and enabling works – standard hours	Total L_{Aeq}	113
Truck (medium rigid)	1	103
Road truck	1	108
Franna crane	1	98
EWP	1	98
Floating boom (crane)	1	105
Workboat	1	108
Scenario 2 – Excavation and construction of skybridge, lift and stairs – standard hours	Total L_{Aeq}	120
Rock breaker (mounted) / rock saw	1	115
Excavator	1	108
Road truck	1	108
Truck	1	110
EWP	1	98
Generator	1	98
Barge	1	108
Franna crane	1	98
Concrete truck	1	109
Concrete pump	1	109
Hand tools	1	94
Crane	1	113
Landside piling rig	1	112
Scenario 3 – Construction of landside works – standard hours	Total L_{Aeq}	121
Excavator	1	108
Truck	1	110
Jack hammer	1	115
Pavement profiler	1	117
Generator	1	98
Truck (medium rigid)	1	103
Vibratory roller	1	109
Hand tools	1	94
Asphalt paver	1	106
Scenario 4 – Demolition of existing wharf – standard hours	Total L_{Aeq}	118
Workboat	2	108
Excavator	1	108
Hand tools	1	94

Plant	Number of Plant	Sound Power Level, L_{Aeq},dB(A)
Pneumatic drill	1	115
Barge crane	1	110
Generator	1	98
Scenario 5 – Installation of steel piles within the waterway – piling - outside of standard work hours	Total L_{Aeq}	117
Truck	1	110
Barge Piling rig - bored	1	112
Oxey Acet Cutting	1	96
Generator	1	98
Concrete truck	1	109
Concrete pump	1	109
Workboat	1	108
Daymaker	2	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 below represent the worst case predicted noise impact at the most affected receivers in each NCA. Noise levels as a result of construction activities are predicted to be lower than these levels for the remaining receivers within each associated NCA.

A full list of predicted noise levels at all modelled receivers is included in Appendix B.

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 1 – Site establishment and enabling works – Proposed for standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), $L_{Aeq\ 15hr}$	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
36 Lower Serpentine Road	403	GF	SW	1	82	51	-	31	-
25 The Point Road	527	L1	S	2	52	53	-	0	-

The above results for Scenario 1 indicate highly intrusive noise levels and exceedance of the ICNG noise management levels during standard work hours for NCA 1. For NCA 2, the results indicate clearly audible noise levels with no exceedances of the ICNG noise management levels predicted during standard work hours.

The above predictions are based on all plant operating at once, which is unlikely to occur regularly. The above results should therefore be considered conservative on this basis.

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 6-5 Predicted construction noise levels – Scenario 2 – Excavation and construction of skybridge, lift and stairs – Proposed for standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), $L_{Aeq\ 15hr}$	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
18 Lower Serpentine Road	404	GF	SW	1	87	51	-	36	-
25 The Point Road	527	F1	S	2	59	53	-	6	-

The above results for Scenario 2 indicate clearly audible and highly intrusive noise levels, and exceedances of the ICNG noise management levels for the standard hours for both NCAs to varying extents.

The above predictions are based on all plant operating at once, which is unlikely to occur regularly. The above results should therefore be considered conservative on this basis.

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 3 – Construction of landside works – Proposed for standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), $L_{Aeq\ 15hr}$	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
36 Lower Serpentine Road	403	GF	SW	1	91	51	-	40	-
25 The Point Road	527	F1	S	2	59	53	-	6	-

The above results for Scenario 3 indicate clearly audible and highly intrusive noise levels, and exceedances of the ICNG noise management levels for the standard hours for both NCAs to varying extents.

The above predictions are based on all plant operating at once, which is unlikely to occur regularly. The above results should therefore be considered conservative on this basis.

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 6-7 Predicted construction noise levels – Scenario 4 – Demolition of existing wharf – Proposed for standard working hours

Most Affected Receivers	Obj No.	Floor	Facade Facing	NCA	Predicted Construction Noise Level dB(A), $L_{Aeq\ 15hr}$	ICNG Noise Management Levels (NMLs), dB(A)		Predicted Worst Case Exceedance of ICNG NMLs	
						Std. Hours	Non-Std. Hours	Day	Night
Noticeable: RBL + 5 dB(A) to RBL + 10 dB(A)									
Clearly audible: RBL + 10 dB(A) to RBL + 20 dB(A)									
Moderately intrusive: RBL + 20 dB(A) to RBL + 30 dB(A)									
Highly intrusive / Highly noise affected: > RBL + 30 dB(A) or > 75 dB(A)									
18 Lower Serpentine Road	404	F1	SW	1	79	51	-	28	-
25 The Point Road	527	F1	S	2	56	53	-	3	-

The above results for Scenario 4 indicate clearly audible and highly intrusive noise levels, and exceedances of the ICNG noise management levels for the standard hours for both NCAs to varying extents.

The above predictors are based on all plant operating at once, which is unlikely to occur regularly. The above results should therefore be considered conservative on this basis.

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 5 – Installation of steel 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), $L_{Aeq\ 15hr}$	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 and 1pm – 10pm), Sun/Pub Hol (8am – 6pm) OOHW2 (Night) - Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Hol (6pm – 7am)									
18 Lower Serpentine Road	404	GF	SW	1	83	44	38	39	45
25 The Point Road	527	F1	S	2	56	43	37	13	19

The above results for Scenario 5 indicate moderately and highly intrusive noise levels, and exceedances of the ICNG noise management levels for the out of hours work periods for both NCAs to varying extents. Properties located on Lower Serpentine Road and Mitchell Street would experience the highest exceedances.

The above predictors are based on all plant operating at once, which is unlikely to occur regularly. The above results should therefore be considered conservative on this basis.

It is proposed that Scenario 5 works would take place outside of standard working hours (early morning – OOHW2). Reduced operations are recommended and careful planning would be required for the proposed works to manage potential impacts on all NCAs.

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 the most 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 1	72	-	-	2
Scenario 2	207	-	-	9
Scenario 3	208	-	-	9
Scenario 4	142	-	-	4
Scenario 5	-	-	250	21

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

Construction noise levels are predicted to exceed management levels for “standard” and “non-standard” hours of operation for all construction scenarios at the nearest 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 5

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

Maximum noise levels have been predicted to the nearest affected residential receivers to allow a review of the potential for sleep disturbance from construction activities at night. In the absence of measurement data typical construction source L_{Amax} noise levels were assumed to be 10 dB(A) above the predicted L_{Aeq} noise levels, on the basis of measurements from previous projects. On this basis, the receivers where the sleep disturbance criteria is likely to be exceeded are summarised in Table 6-10.

Table 6-10 Predicted construction maximum (L_{AMax}) noise levels – Scenario 5

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
1 George Street	481	GF	S	1	55	60
1 George Street	481	F 1	S	1	57	60
1 O’Connell Street	454	GF	W	1	65	60
1 O’Connell Street	454	F 1	W	1	66	60
1 Upper Serpentine Road	460	GF	S	1	65	60
1 Upper Serpentine Road	460	F 1	S	1	67	60
1 Victoria Street	483	GF	W	1	64	60
1 Victoria Street	483	F 1	W	1	65	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
10 George Street	476	GF	S	1	57	60
10 George Street	476	F 1	S	1	61	60
10 Mitchell Street	424	GF	W	1	77	60
10 Mitchell Street	424	F 1	W	1	79	60
10 Victoria Street	491	GF	W	1	62	60
10 Victoria Street	491	F 1	W	1	64	60
100-102 Louisa Road	572	GF	N	1	63	60
100-102 Louisa Road	572	F 1	N	1	64	60
104 Louisa Road	571	GF	N	1	63	60
104 Louisa Road	571	F 1	N	1	64	60
106 Louisa Road	570	GF	N	1	63	60
106 Louisa Road	570	F 1	N	1	64	60
108-116 Louisa Road	569	GF	N	1	63	60
108-116 Louisa Road	569	F 1	N	1	64	60
11 George Street	475	GF	W	1	55	60
11 George Street	475	F 1	W	1	59	60
11 Mitchell Street	436	GF	E	1	71	60
11 Mitchell Street	436	F 1	E	1	72	60
11 Richard Street	414	GF	S	1	69	60
11 St Lawrence Street	468	GF	S	1	59	60
11 St Lawrence Street	468	F 1	S	1	62	60
113 Louisa Road	560	GF	NW	1	57	60
113 Louisa Road	560	F 1	NW	1	63	60
113A Louisa Road	559	GF	NW	1	55	60
113A Louisa Road	559	F 1	NW	1	62	60
115 Louisa Road	558	GF	NW	1	63	60
115 Louisa Road	558	F 1	NW	1	63	60
117 Louisa Road	557	GF	NW	1	51	60
117 Louisa Road	557	F 1	NW	1	59	60
118-124 Louisa Road	568	GF	N	1	64	60
118-124 Louisa Road	568	F 1	N	1	64	60
119-121 Louisa Road	556	GF	NW	1	50	60
119-121 Louisa Road	556	F 1	NW	1	57	60
12 George Street	446	GF	S	1	57	60
12 George Street	446	F 1	S	1	60	60
12 Mitchell Street	423	GF	W	1	78	60
12 Mitchell Street	423	F 1	W	1	81	60
12 Victoria Street	490	GF	W	1	64	60
12 Victoria Street	490	F 1	W	1	64	60
123 Louisa Road	553	GF	NW	1	51	60
123 Louisa Road	553	F 1	NW	1	57	60
126 Louisa Road	567	GF	NW	1	64	60
126 Louisa Road	567	F 1	NW	1	65	60
128 Louisa Road	566	GF	NW	1	63	60
128 Louisa Road	566	F 1	NW	1	63	60
13 George Street	473	GF	S	1	54	60
13 George Street	473	F 1	S	1	59	60
13 Mitchell Street	434	GF	E	1	72	60
13 Mitchell Street	434	F 1	E	1	73	60
13 Werambie Street	669	GF	S	1	44	60
130 Louisa Road	565	GF	N	1	64	60
130 Louisa Road	565	F 1	N	1	64	60
132 Louisa Road	564	GF	N	1	64	60
132 Louisa Road	564	F 1	N	1	64	60
134 Louisa Road	563	GF	NW	1	64	60
134 Louisa Road	563	F 1	NW	1	64	60
136 Louisa Road	562	GF	NW	1	64	60
136 Louisa Road	562	F 1	NW	1	64	60
138 Louisa Road	561	GF	NW	1	64	60
138 Louisa Road	561	F 1	NW	1	64	60
14 George Street	445	GF	S	1	61	60
14 George Street	445	F 1	S	1	62	60
14 Mitchell Street	422	GF	W	1	80	60
14 Mitchell Street	422	F 1	W	1	81	60
14 Victoria Street	489	GF	W	1	64	60
14 Victoria Street	489	F 1	W	1	64	60
140 Louisa Road	555	GF	NW	1	64	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
140 Louisa Road	555	F 1	NW	1	64	60
142 Louisa Road	554	GF	N	1	64	60
142 Louisa Road	554	F 1	N	1	64	60
144 Louisa Road	551	GF	NW	1	64	60
144 Louisa Road	551	F 1	NW	1	64	60
146 Louisa Road	552	GF	NW	1	63	60
146 Louisa Road	552	F 1	NW	1	64	60
148 Louisa Road	550	GF	NW	1	54	60
148 Louisa Road	550	F 1	NW	1	54	60
15 George Street	472	GF	S	1	54	60
15 George Street	472	F 1	S	1	60	60
15 Mitchell Street	433	GF	E	1	73	60
15 Mitchell Street	433	F 1	E	1	73	60
15 Richard Street	406	GF	SW	1	76	60
15 Richard Street	406	F 1	SW	1	77	60
15 St Lawrence Street	441	GF	S	1	60	60
15 St Lawrence Street	441	F 1	S	1	59	60
150 Louisa Road	549	F 1	NW	1	58	60
16 George Street	444	GF	S	1	62	60
16 George Street	444	F 1	S	1	63	60
16 Mitchell Street	420	GF	W	1	83	60
16 Mitchell Street	420	F 1	W	1	84	60
16 Victoria Street	488	GF	W	1	64	60
16 Victoria Street	488	F 1	W	1	64	60
16-14 Louisa Road	600	GF	NW	1	60	60
16-14 Louisa Road	600	F 1	NW	1	60	60
17 George Street	471	GF	S	1	55	60
17 George Street	471	F 1	S	1	59	60
17 Mitchell Street	415	GF	S	1	73	60
17 Mitchell Street	415	F 1	S	1	76	60
17 St Lawrence Street	431	GF	S	1	59	60
17 St Lawrence Street	431	F 1	S	1	62	60
18 George Street	443	GF	S	1	57	60
18 George Street	443	F 1	S	1	61	60
18 Louisa Road	599	GF	NW	1	60	60
18 Louisa Road	599	F 1	NW	1	61	60
18 Lower Serpentine Road	404	GF	SW	1	93	60
18 Lower Serpentine Road	404	F 1	SW	1	93	60
18 Victoria Street	487	GF	W	1	65	60
18 Victoria Street	487	F 1	W	1	66	60
19 George Street	470	GF	S	1	56	60
19 George Street	470	F 1	S	1	57	60
19 Mitchell Street	416	GF	S	1	71	60
1A Victoria Street	480	GF	W	1	66	60
1A Victoria Street	480	F 1	W	1	66	60
2 Albert Street	458	GF	W	1	56	60
2 Albert Street	458	F 1	W	1	57	60
2 Mitchell Street	437	GF	W	1	71	60
2 Mitchell Street	437	F 1	W	1	73	60
2 Numa Street	547	GF	NW	1	64	60
2 Numa Street	547	F 1	NW	1	64	60
2 O'Connell Street	453	GF	W	1	64	60
2 O'Connell Street	453	F 1	W	1	66	60
2 Victoria Street	495	GF	W	1	53	60
2 Victoria Street	495	F 1	W	1	57	60
20 George Street	442	GF	S	1	57	60
20 George Street	442	F 1	S	1	62	60
20 Louisa Road	598	GF	NW	1	61	60
20 Louisa Road	598	F 1	NW	1	61	60
21 Mitchell Street	412	GF	S	1	79	60
21 Mitchell Street	412	F 1	S	1	80	60
21 St Lawrence Street	469	GF	S	1	61	60
21 St Lawrence Street	469	F 1	S	1	61	60
23 Mitchell Street	413	GF	S	1	82	60
23 Mitchell Street	413	F 1	S	1	84	60
24 George Street	440	GF	S	1	62	60
24 George Street	440	F 1	S	1	61	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
24 George Street	474	F 1	SE	1	51	60
24 Louisa Road	597	GF	W	1	63	60
24 Louisa Road	597	F 1	W	1	63	60
26 George Street	439	GF	S	1	60	60
26 George Street	439	F 1	S	1	61	60
26 Louisa Road	596	GF	NW	1	65	60
26 Louisa Road	596	F 1	NW	1	64	60
27 George Street	467	GF	S	1	60	60
27 George Street	467	F 1	S	1	65	60
28 George Street	409	F 1	SW	1	58	60
28 George Street	438	GF	S	1	63	60
28 George Street	438	F 1	S	1	64	60
28-32 Louisa Road	595	GF	NW	1	61	60
28-32 Louisa Road	595	F 1	NW	1	61	60
29 George Street	466	GF	S	1	62	60
29 George Street	466	F 1	S	1	64	60
3 O'Connell Street	452	GF	W	1	65	60
3 O'Connell Street	452	F 1	W	1	66	60
3 Richard Street	430	GF	S	1	63	60
3 Richard Street	430	F 1	S	1	64	60
3 Victoria Street	484	GF	W	1	65	60
3 Victoria Street	484	F 1	W	1	65	60
30 George Street	407	F 1	S	1	74	60
30A George Street	426	GF	S	1	71	60
30A George Street	426	F 1	S	1	74	60
31 George Street	465	GF	S	1	63	60
31 George Street	465	F 1	S	1	67	60
32 Harrison Street	425	GF	S	1	71	60
32 Harrison Street	425	F 1	S	1	74	60
33 George Street	464	GF	S	1	71	60
33 George Street	464	F 1	S	1	72	60
34 Harrison Street	410	GF	S	1	75	60
34 Harrison Street	410	F 1	S	1	76	60
34 Louisa Road	594	GF	NW	1	61	60
34 Louisa Road	594	F 1	NW	1	61	60
35 George Street	463	GF	S	1	64	60
35 George Street	463	F 1	S	1	68	60
36 Lower Serpentine Road	403	GF	SW	1	89	60
36 Lower Serpentine Road	403	F 1	SW	1	90	60
37 George Street	462	GF	S	1	63	60
37 George Street	462	F 1	S	1	67	60
38 Lower Serpentine Road	408	GF	SW	1	70	60
38 Lower Serpentine Road	408	F 1	SW	1	74	60
39 George Street	461	GF	S	1	64	60
39 George Street	461	F 1	S	1	68	60
4 Albert Street	457	GF	W	1	60	60
4 Albert Street	457	F 1	W	1	60	60
4 George Street	482	GF	S	1	65	60
4 George Street	482	F 1	S	1	66	60
4 Mitchell Street	435	GF	W	1	70	60
4 Mitchell Street	435	F 1	W	1	73	60
4 O'Connell Street	451	GF	SW	1	63	60
4 O'Connell Street	451	F 1	SW	1	65	60
4 Victoria Street	494	GF	W	1	53	60
4 Victoria Street	494	F 1	W	1	57	60
40 Lower Serpentine Road	417	GF	SE	1	62	60
40 Lower Serpentine Road	417	F 1	SE	1	69	60
42 Louisa Road	593	GF	NW	1	62	60
42 Louisa Road	593	F 1	NW	1	62	60
42 Lower Serpentine Road	419	GF	S	1	67	60
42 Lower Serpentine Road	419	F 1	S	1	68	60
44 Louisa Road	592	GF	W	1	64	60
44 Louisa Road	592	F 1	W	1	64	60
44A Louisa Road	591	GF	W	1	62	60
44A Louisa Road	591	F 1	W	1	62	60
46A Louisa Road	590	GF	NW	1	62	60
46A Louisa Road	590	F 1	NW	1	62	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
48 Louisa Road	589	GF	NW	1	64	60
48 Louisa Road	589	F 1	NW	1	64	60
5 Numa Street	548	GF	NE	1	57	60
5 Numa Street	548	F 1	NE	1	57	60
5 Numa Street	548	F 2	NE	1	58	60
5 Numa Street	548	F 3	NE	1	58	60
50 Louisa Road	588	GF	NW	1	63	60
50 Louisa Road	588	F 1	NW	1	63	60
54-56 Louisa Road	587	GF	NW	1	63	60
54-56 Louisa Road	587	F 1	NW	1	63	60
5-6 O'Connell Street	450	GF	SW	1	62	60
5-6 O'Connell Street	450	F 1	SW	1	64	60
58 Louisa Road	586	GF	NW	1	63	60
58 Louisa Road	586	F 1	NW	1	63	60
6 Albert Street	456	GF	W	1	59	60
6 Albert Street	456	F 1	W	1	61	60
6 Mitchell Street	432	GF	W	1	64	60
6 Mitchell Street	432	F 1	W	1	69	60
6 Victoria Street	493	GF	W	1	57	60
6 Victoria Street	493	F 1	W	1	61	60
64 Louisa Road	585	GF	NW	1	63	60
64 Louisa Road	585	F 1	NW	1	63	60
66 Louisa Road	584	GF	N	1	63	60
66 Louisa Road	584	F 1	N	1	63	60
7 George Street	479	GF	S	1	57	60
7 George Street	479	F 1	S	1	61	60
7 Numa Street	546	GF	N	1	64	60
7 Numa Street	546	F 1	N	1	64	60
7 O'Connell Street	449	GF	SW	1	68	60
7 O'Connell Street	449	F 1	SW	1	69	60
7 Richard Street	429	GF	S	1	62	60
7 Richard Street	429	F 1	S	1	65	60
7 Victoria Street	485	GF	W	1	65	60
7 Victoria Street	485	F 1	W	1	65	60
72 Louisa Road	583	GF	N	1	63	60
72 Louisa Road	583	F 1	N	1	63	60
74 Louisa Road	581	GF	NW	1	63	60
74 Louisa Road	581	F 1	NW	1	63	60
76 Louisa Road	582	GF	N	1	63	60
76 Louisa Road	582	F 1	N	1	63	60
78A Louisa Road	580	GF	N	1	63	60
78A Louisa Road	580	F 1	N	1	63	60
8 Albert Street	455	GF	W	1	61	60
8 Albert Street	455	F 1	W	1	62	60
8 George Street	477	GF	S	1	65	60
8 George Street	477	F 1	S	1	66	60
8 Mitchell Street	427	GF	W	1	75	60
8 Mitchell Street	427	F 1	W	1	76	60
8 O'Connell Street	448	GF	SW	1	67	60
8 O'Connell Street	448	F 1	SW	1	68	60
8 Victoria Street	492	GF	W	1	59	60
8 Victoria Street	492	F 1	W	1	62	60
80-82 Louisa Road	579	GF	N	1	63	60
80-82 Louisa Road	579	F 1	N	1	63	60
84-86 Louisa Road	578	GF	N	1	63	60
84-86 Louisa Road	578	F 1	N	1	63	60
88 Louisa Road	577	GF	N	1	63	60
88 Louisa Road	577	F 1	N	1	63	60
9 George Street	478	GF	S	1	55	60
9 George Street	478	F 1	S	1	59	60
9 Lower Serpentine Road	421	GF	S	1	78	60
9 Lower Serpentine Road	421	F 1	S	1	80	60
9 O'Connell Street	447	GF	SW	1	65	60
9 O'Connell Street	447	F 1	SW	1	66	60
9 Richard Street	411	GF	S	1	76	60
9 Richard Street	411	F 1	S	1	77	60
9 Richard Street	428	GF	S	1	63	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
9 Richard Street	428	F 1	S	1	64	60
9 Victoria Street	486	GF	SW	1	64	60
9 Victoria Street	486	F 1	SW	1	64	60
90 Louisa Road	576	GF	N	1	63	60
90 Louisa Road	576	F 1	N	1	63	60
92 Louisa Road	575	GF	N	1	63	60
92 Louisa Road	575	F 1	N	1	63	60
94 Louisa Road	574	GF	N	1	63	60
94 Louisa Road	574	F 1	N	1	63	60
96-98 Louisa Road	573	GF	N	1	63	60
96-98 Louisa Road	573	F 1	N	1	63	60
Greenwich Park Building	405	GF	SW	1	82	60
Greenwich Park Building	405	F 1	SW	1	83	60
1 Hunter Street	641	GF	E	2	61	60
1 Hunter Street	641	F 1	E	2	61	60
1 Mayfield Avenue	537	GF	SE	2	62	60
1 Mayfield Avenue	537	F 1	SE	2	62	60
1 Mount Morris Street	514	GF	E	2	64	60
1 Mount Morris Street	514	F 1	E	2	64	60
10 The Point Road	630	GF	S	2	61	60
10 The Point Road	630	F 1	S	2	61	60
101 Woolwich Road	656	GF	E	2	60	60
101 Woolwich Road	656	F 1	E	2	60	60
10-14 Elgin Street	657	GF	E	2	59	60
10-14 Elgin Street	657	F 1	E	2	59	60
11 Hunter Street	637	GF	E	2	57	60
11 Hunter Street	637	F 1	E	2	61	60
11 Margaret Street	665	GF	E	2	58	60
11 Margaret Street	665	F 1	E	2	58	60
11 Mayfield Avenue	542	GF	E	2	62	60
11 Mayfield Avenue	542	F 1	E	2	62	60
11 The Point Road	533	GF	E	2	62	60
11 The Point Road	533	F 1	E	2	62	60
12 The Point Road	629	F 1	S	2	62	60
13 Hunter Street	634	GF	E	2	62	60
13 Hunter Street	634	F 1	E	2	62	60
13 Margaret Street	666	GF	E	2	58	60
13 Margaret Street	666	F 1	E	2	58	60
13 Mayfield Avenue	543	GF	SE	2	62	60
13 Mayfield Avenue	543	F 1	SE	2	62	60
13 The Point Road	534	GF	E	2	62	60
13 The Point Road	534	F 1	E	2	62	60
14 The Point Road	628	GF	S	2	62	60
14 The Point Road	628	F 1	S	2	64	60
15 Hunter Street	636	GF	E	2	61	60
15 Hunter Street	636	F 1	E	2	62	60
15 Margaret Street	667	GF	E	2	58	60
15 Margaret Street	667	F 1	E	2	58	60
15 Mayfield Avenue	544	GF	E	2	63	60
15 Mayfield Avenue	544	F 1	E	2	63	60
15 The Point Road	532	GF	S	2	63	60
15 The Point Road	532	F 1	S	2	63	60
15B Mayfield Avenue	545	GF	E	2	63	60
15B Mayfield Avenue	545	F 1	E	2	63	60
16 The Point Road	627	GF	S	2	59	60
16 The Point Road	627	F 1	S	2	61	60
17 Collingwood Street	654	GF	E	2	60	60
17 Collingwood Street	654	F 1	E	2	60	60
17 Gale Street	646	GF	E	2	58	60
17 Gale Street	646	F 1	E	2	60	60
17 The Point Road	531	GF	S	2	64	60
17 The Point Road	531	F 1	S	2	65	60
18 and 20 The Point Road	626	F 1	S	2	61	60
19 Gale Street	647	GF	E	2	60	60
19 Gale Street	647	F 1	E	2	60	60
19 The Point Road	530	GF	S	2	64	60
19 The Point Road	530	F 1	S	2	64	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
2 Mayfield Avenue	642	GF	E	2	61	60
2 Mayfield Avenue	642	F 1	E	2	61	60
2 The Point Road	633	F 1	S	2	60	60
20 Edgecliff Road	658	GF	SE	2	59	60
21 The Point Road	529	GF	S	2	63	60
21 The Point Road	529	F 1	S	2	64	60
22 The Point Road	625	F 1	S	2	63	60
23 The Point Road	528	GF	S	2	65	60
23 The Point Road	528	F 1	S	2	65	60
24 The Point Road	624	GF	S	2	57	60
24 The Point Road	624	F 1	S	2	61	60
25 Gale Street	649	GF	E	2	59	60
25 Gale Street	649	F 1	E	2	60	60
25 Gale Street	648	GF	E	2	58	60
25 Gale Street	648	F 1	E	2	60	60
25 The Point Road	527	GF	S	2	65	60
25 The Point Road	527	F 1	S	2	66	60
26 The Point Road	623	F 1	S	2	60	60
27 Gale Street	650	GF	E	2	60	60
27 Gale Street	650	F 1	E	2	61	60
27 The Point Road	525	GF	S	2	65	60
27 The Point Road	525	F 1	S	2	65	60
27A The Point Road	526	GF	S	2	65	60
27A The Point Road	526	F 1	S	2	65	60
28 The Point Road	622	GF	S	2	62	60
28 The Point Road	622	F 1	S	2	62	60
29 The Point Road	524	GF	S	2	63	60
29 The Point Road	524	F 1	S	2	64	60
2A Margaret Street	660	GF	E	2	58	60
2A Margaret Street	660	F 1	E	2	58	60
2B Margaret Street	661	GF	NE	2	57	60
2B Margaret Street	661	F 1	NE	2	59	60
2C Margaret Street	659	GF	NE	2	58	60
2C Margaret Street	659	F 1	NE	2	58	60
3 Hunter Street	640	GF	E	2	61	60
3 Hunter Street	640	F 1	E	2	61	60
3 Margaret Street	662	GF	E	2	58	60
3 Margaret Street	662	F 1	E	2	58	60
3 Mayfield Avenue	538	GF	E	2	62	60
3 Mayfield Avenue	538	F 1	E	2	62	60
3 Mount Morris Street	515	GF	E	2	64	60
3 Mount Morris Street	515	F 1	E	2	65	60
3 The Point Road	651	GF	E	2	60	60
3 The Point Road	651	F 1	E	2	61	60
30 The Point Road	621	GF	S	2	53	60
30 The Point Road	621	F 1	S	2	58	60
31-33 The Point Road	523	GF	S	2	63	60
31-33 The Point Road	523	F 1	S	2	63	60
32 The Point Road	620	GF	S	2	53	60
32 The Point Road	620	F 1	S	2	59	60
34 The Point Road	619	GF	S	2	62	60
34 The Point Road	619	F 1	S	2	64	60
35 The Point Road	522	GF	S	2	63	60
35 The Point Road	522	F 1	S	2	63	60
36 The Point Road	618	GF	S	2	65	60
36 The Point Road	618	F 1	S	2	65	60
37 The Point Road	521	GF	S	2	49	60
37 The Point Road	521	F 1	S	2	55	60
37A The Point Road	520	GF	S	2	64	60
37A The Point Road	520	F 1	S	2	64	60
37B The Point Road	519	GF	S	2	64	60
37B The Point Road	519	F 1	S	2	64	60
38 The Point Road	617	GF	S	2	54	60
38 The Point Road	617	F 1	S	2	59	60
39 The Point Road	518	GF	S	2	64	60
39 The Point Road	518	F 1	S	2	65	60
42 The Point Road	616	GF	S	2	54	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
42 The Point Road	616	F 1	S	2	57	60
43 The Point Road	517	GF	S	2	65	60
43 The Point Road	517	F 1	S	2	65	60
44 The Point Road	615	GF	S	2	58	60
44 The Point Road	615	F 1	S	2	61	60
45 The Point Road	513	GF	E	2	62	60
45 The Point Road	513	F 1	E	2	62	60
46 The Point Road	614	GF	S	2	62	60
46 The Point Road	614	F 1	S	2	64	60
47 The Point Road	511	GF	E	2	62	60
47 The Point Road	511	F 1	E	2	62	60
47A The Point Road	510	GF	SE	2	61	60
47A The Point Road	510	F 1	SE	2	61	60
48 The Point Road	613	GF	S	2	63	60
48 The Point Road	613	F 1	S	2	64	60
49 The Point Road	509	GF	SE	2	60	60
49 The Point Road	509	F 1	SE	2	60	60
5 Gale Street	644	GF	E	2	60	60
5 Gale Street	644	F 1	E	2	61	60
5 Hunter Street	639	GF	E	2	61	60
5 Hunter Street	639	F 1	E	2	61	60
5 Mayfield Avenue	539	GF	E	2	62	60
5 Mayfield Avenue	539	F 1	E	2	62	60
5 Mount Morris Street	516	GF	SE	2	65	60
5 Mount Morris Street	516	F 1	SE	2	65	60
5 The Point Road	652	GF	E	2	59	60
5 The Point Road	652	F 1	E	2	60	60
50 The Point Road	612	GF	SE	2	60	60
50 The Point Road	612	F 1	SE	2	62	60
52 The Point Road	611	GF	SE	2	61	60
52 The Point Road	611	F 1	SE	2	61	60
53 The Point Road	508	GF	SE	2	58	60
53 The Point Road	508	F 1	SE	2	59	60
54 The Point Road	610	GF	S	2	58	60
54 The Point Road	610	F 1	S	2	61	60
55-57 The Point Road	507	GF	SE	2	54	60
55-57 The Point Road	507	F 1	SE	2	54	60
56 The Point Road	609	GF	S	2	53	60
56 The Point Road	609	F 1	S	2	60	60
5-7 Margaret Street	663	GF	E	2	58	60
5-7 Margaret Street	663	F 1	E	2	58	60
58 The Point Road	608	GF	S	2	56	60
59 The Point Road	506	GF	SE	2	51	60
59 The Point Road	506	F 1	SE	2	51	60
6 The Point Road	632	F 1	S	2	57	60
60 The Point Road	607	GF	S	2	50	60
61-63 The Point Road	505	GF	SE	2	51	60
61-63 The Point Road	505	F 1	SE	2	51	60
62 The Point Road	606	GF	S	2	46	60
62a The Point Road	605	GF	S	2	45	60
64 The Point Road	604	GF	E	2	50	60
64 The Point Road	604	F 1	E	2	51	60
65 The Point Road	504	GF	SE	2	50	60
65 The Point Road	504	F 1	SE	2	51	60
67 The Point Road	503	GF	S	2	49	60
67 The Point Road	503	F 1	S	2	50	60
68 The Point Road	602	GF	SW	2	45	60
68 The Point Road	602	F 1	SW	2	45	60
69 The Point Road	502	GF	S	2	49	60
69 The Point Road	502	F 1	S	2	49	60
7 Gale Street	645	GF	E	2	61	60
7 Gale Street	645	F 1	E	2	61	60
7 Hunter Street	638	GF	E	2	56	60
7 Hunter Street	638	F 1	E	2	61	60
7 Mayfield Avenue	540	GF	E	2	62	60
7 Mayfield Avenue	540	F 1	E	2	62	60
7 The Point Road	643	GF	E	2	61	60

Receiver	Obj No.	Floor	Facade Facing	NCA	Construction Noise Level dB(A), L_{AMax}	LAmax Criteria, dB(A)
					Scenario 5	
7 The Point Road	643	F 1	E	2	61	60
71 The Point Road	501	GF	SE	2	48	60
71 The Point Road	501	F 1	SE	2	48	60
73 The Point Road	499	GF	S	2	48	60
73 The Point Road	499	F 1	S	2	48	60
75 The Point Road	498	GF	E	2	47	60
75 The Point Road	498	F 1	E	2	47	60
77 The Point Road	500	GF	E	2	43	60
77 The Point Road	500	F 1	E	2	44	60
77 Woolwich Road	668	GF	E	2	58	60
77 Woolwich Road	668	F 1	E	2	58	60
7A The Point Road	536	GF	S	2	56	60
7A The Point Road	536	F 1	S	2	62	60
8 The Point Road	631	F 1	S	2	62	60
9 Hunter Street	635	GF	E	2	62	60
9 Hunter Street	635	F 1	E	2	62	60
9 Margaret Street	664	GF	E	2	58	60
9 Margaret Street	664	F 1	E	2	58	60
9 Mayfield Avenue	541	GF	E	2	62	60
9 Mayfield Avenue	541	F 1	E	2	62	60
9 The Point Road	535	GF	SE	2	58	60
9 The Point Road	535	F 1	SE	2	61	60
Clarkes Point Reserve	496	GF		2	63	60
Clarkes Point Reserve	496	F 1		2	63	60
Cockatoo Island Biloela Lawn Building	673	GF	NE	2	60	60
Cockatoo Island Biloela Lawn Building	673	F 1	NE	2	60	60
Cockatoo Island Camp Site	677	GF		2	60	60
Cockatoo Island Camp Site	677	F 1		2	60	60
Cockatoo Island Visitor Centre	674	GF	NE	2	60	60
Cockatoo Island Visitor Centre	674	F 1	NE	2	60	60
Cockatoo Island Wharf Building	671	GF	E	2	61	60
Scout Hall, The Point Road	601	GF	SE	2	43	60
Woolwich Pier Hotel 1 Woolwich Road	655	GF	E	2	60	60
Woolwich Pier Hotel 1 Woolwich Road	655	F 1	E	2	60	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 the assessed receivers in NCAs 1 and 2. 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:

a Effect on human comfort

b 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* (AVATG) issued by DEC (2006). The 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 is 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 distances between vibration intensive plant and sensitive receivers for minimising the risk of cosmetic damage are listed in the CNVG 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 Transport for NSW.

7.1.1 Vibration assessment

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

- Bored piling rig
- Vibratory roller
- Rock breakers / rock saw
- Rock drill
- Truck movements.

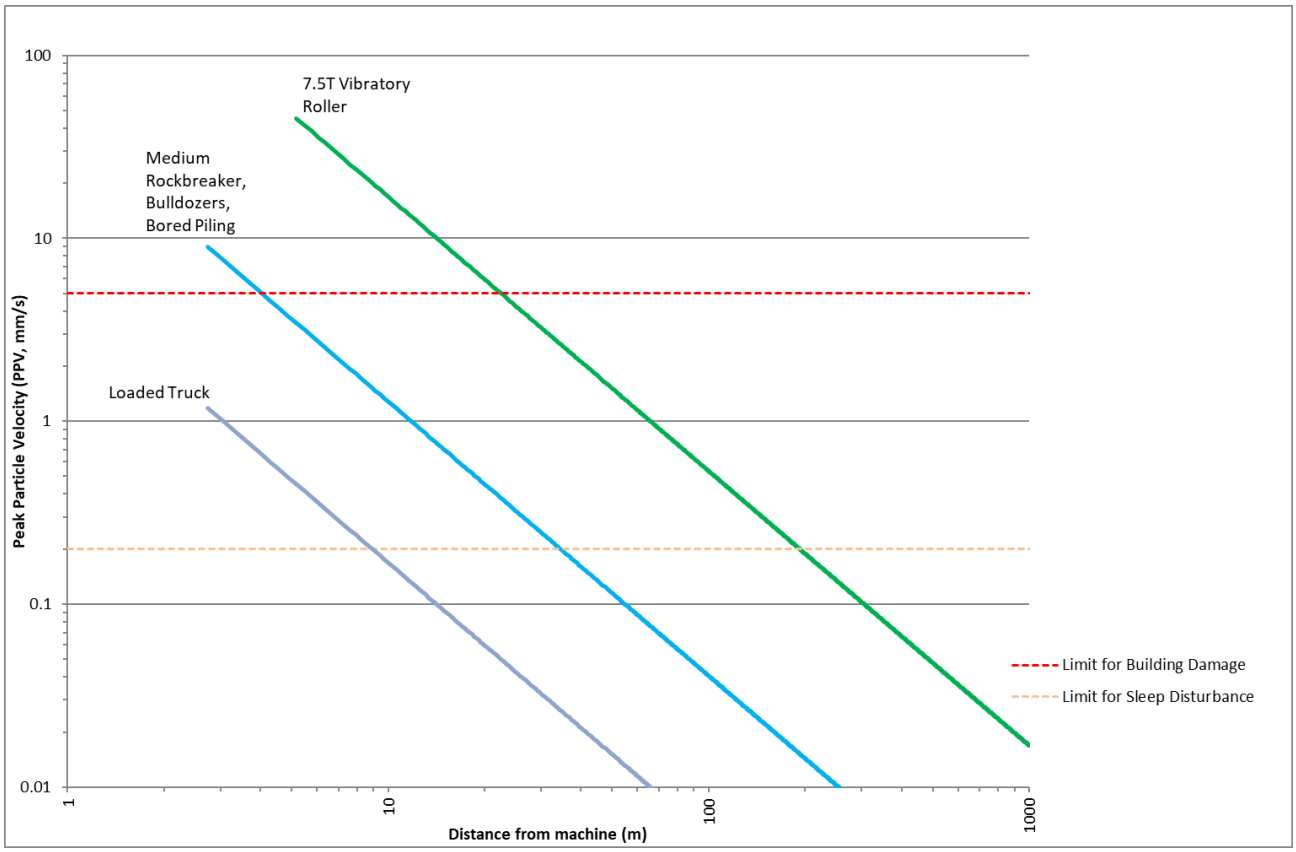
Construction vibration levels vary depending on the distance from the equipment in use, the energy level imparted to the ground by the construction process, and the bedrock type. The highest vibration sources associated with the construction work would be vibratory rollers, pile hammers and bored piling rigs. It is anticipated that no blasting would be required as part of this project.

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.”

Based on the methodology provided by the TNVIA and the predicted TfNSW safe working distances in Table 7-1, the predicted vibration impact results compared to distance from the works are shown in Figure 7-1.

Depending on the actual ground conditions, (i.e. greater density of rock), vibration levels may increase and affect residents to a greater extent subjectively.



Note: The predicted vibration levels in the figure above include a safety margin for carrying ground types.

Figure 7-1 Estimates of vibration levels generated by common construction activities / equipment at various distances (Source: FTA 2006)

Based on the impact distances detailed in Figure 7-1, construction works including bored piling may be undertaken with a minimum separation distance of 4-5 metres from the nearest residential buildings. Where impacted buildings or structures are heritage listed or of similar more sensitive construction, the minimum separation distance should be increased to 15 metres. Where exsiting heritage structures are observed to be fragile or damged, this distance should be increased to 40 metres as per the requirements of Table 7-1.

However for rock hammers, piling hammers and vibratory rollers, the minimum required safe working distance between construction activities and sensitive receivers is increased, as detailed in Table 7-1, depending on their size, to reduce vibration to within levels unlikely to cause building damage.

7.1.2 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
	< 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

7.1.3 Heritage structures

Heritage structures listed on the *Lane Cove Local Environmental Plan* 2009 (Lane Cove LEP) are located in proximity to the project as shown in Figure 7-2.

Figure 7-2 Heritage listing within and in close proximity to the project

The assessed design includes the demolition of the existing Greenwich Point Wharf (Figure 7-2: LEP no. I130). The closest heritage structures are located approximately 10-20 metres from the proposed piling works and/or use of a vibratory roller, and are streetscape elements such as sandstone steps, outcrops, kerbing, retaining wall (Figure 7-2: LEP 2009 LEP no. I64) and House (Figure 7-2: LEP no. I110). House (Figure 7-2: LEP no. I111), and stone steps at rear of the house (Figure 7-2: LEP no. I131) would be located over 41 metres from the proposed piling works and use of a vibratory roller. The works would also be undertaken within the Greenwich Conservation Area (Figure 7-2: LEP no. C1) which includes the heritage items identified above.

The proposed works would involve piling and the use of a vibratory roller 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 41 metres for 7.5t rollers.

Based on the above, with the use of 7.5t vibratory rollers, a predicted vibration level of > 5 mm/s could be experienced at the closest existing heritage structures described above, which exceeds the limits stated in DIN 4150.3, and occurs at a distance of less than the safe working distances stated in the CNVG. Therefore, where use of vibratory rollers is required, the smallest available size (<50kN) should be utilised. In addition, use of vibratory rollers within 15 metres of the heritage structures is not recommended.

Bored piling is also proposed for the assessed construction methodology. Based on Table 7-1, bored piling should not be carried out within 40 metres of heritage structures. At 10 metres, predicted vibration levels would be expected to be around 2 mm/s, which is lower than the limits stated in DIN 4150.3.

Similar results to those structures assessed above apply to the other heritage structures in proximity to the project to a lesser extent due to their larger separation distance.

In summary, the proposed works would be located at less than minimum safe working distance for cosmetic damage to heritage fabric, which is identified in the CNVG as being within 41 metres 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 existing streetscape elements (LEP no. I64) and House (LEP no. I110).

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 at less than safe working distances, 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 Transport for NSW 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 and 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	Preparation of a construction noise and vibration management plan (CNVMP) 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: > Plant controls: – Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc. – Maintain plant and equipment in good working order to prevent excess noise generation. – Locate 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 will be determined during preparation of the CNVMP 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 will be investigated for stationery plant within the worksites once a detailed schedule of works and plant is available. > Management and behavioural controls: – 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 on site by creating a loop road or similar. – Avoid dropping materials from height. – Workers will avoid shouting, minimise talking loudly, and avoid slamming vehicle doors. > 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 plant exceed those assumed in this assessment. > Modifying 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.	Contractor	Pre-construction
NV2	Noise and vibration	> Carry out work within standard construction hours as follows: – 7:00 am to 6:00 pm Monday to Friday	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		– 8:00 am to 1:00 pm Saturdays, no work on Sundays or public holidays. > Do not carry out work during the evening or night, unless required for safety reasons. > Should work be required outside standard hours, an Out of Hours procedure detailing the work schedule, approval process, communication requirements and management measures will be prepared. > All reasonable and feasible efforts will 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-work with reduced numbers of plant for example.		
NV3	Noise and vibration	> 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 seven 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	Vibration impact to heritage structures	> Determine safe working distances based on proposed plant and where possible, smallest plant able to carry out required work should be utilised to minimize potential impacts. Where work is proposed within the safe working distances, for the heritage structures, specialist advice will be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed work could potentially result in impacts to heritage structures. > A vibration monitoring plan will be prepared as part of the CNVMP and implemented to confirm vibration levels prior to construction commencement. Where exceedances are recorded, work will be modified in consultation with the identified specialist to reduce vibration levels.	Contractor	Pre-construction / Construction
NV5	Vibration impact to heritage structures	Regular inspections of the construction activities and work areas will be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology to confirm the integrity of the heritage items. Assessment and monitoring of vibration impacts will 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.*	Contractor	Pre-construction
NV6	Vibration	Where buildings are located within the safe working distances, pre and post dilapidation surveys will be carried out.	Contractor	Pre-construction / Post-Construction
NV7	Vibration	Where buildings are located within the safe work distances (non-heritage structures), 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 and Maritime Construction Noise and Vibration Guideline noise management recommendations

The 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 and 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 B 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	
		NCA 1	NCA 2
(5) Installation of Steel Piles – Piling	Period 1	V, IB, N, R1, DR, PC, SN	N, R1, DR
	Period 2	AA, 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
- Construction noise levels are predicted to exceed the NSW ICNG noise management levels (NML) for "standard" construction hours at NCA 1 for construction Scenario 1. The NML at NCA 2 is not predicted to be exceeded for construction Scenario 1 during "standard" work hours
- Construction noise levels are predicted to exceed the NSW ICNG noise management levels (NML) for "standard" construction hours at both NCAs for construction Scenarios 2 to 4
- Construction noise levels are predicted to exceed noise management levels for "non-standard" hours of operation for Scenario 5 at the nearby residential receivers in both NCAs, particularly for receivers located on Lower Serpentine Road and Mitchell Street in NCA 1 and The Point Road in NCA 2. This is due to the proximity of receivers to the construction works
- Predicted levels are expected to be highly intrusive at a number of receivers in NCA 1 for Scenario 5 for works during the OOHW2 time period. Construction noise is likely to have the highest impact on and cause sleep disturbance at sensitive receivers located on Lower Serpentine Road and Mitchell Street in NCA 1, 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 would 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
- Use of temporary noise barriers are recommended where practical. The height and location of these barriers will be determined during preparation of the CNVMP when more information regarding the proposed plant to be used for each construction scenario is available
- Best practice mitigation measures are recommended in Section 8 of this report
- 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. Indicative predictions only, of expected L_{Amax} impact have been carried out for this assessment, as it is difficult to predict L_{Amax} for construction noise sources because L_{Amax} levels vary considerably. The predicted levels in this assessment, are based on previously measured relationships between L_{Aeq} and L_{Amax} of typical construction plant, and may vary from those predicted in practice
- 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 Transport for NSW or under the environmental license as relevant, as stipulated in the CNVG
- A detailed CNVMP will 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.

Note:

The noise and vibration impact assessment provided in this report is based on the concept design developed in July 2019. Since this time the concept design has been amended and the proposed wharf has been relocated by approximately 35 metres. The wharf would still be constructed using a similar construction methodology as detailed in this report. In consultation with Transport for NSW these changes have not been reflected in this assessment. The design change may result in some localised differences in predicted noise and vibration impacts, however, the change would not result in modification to the identified mitigation measures.

Greenwich Point
Wharf Upgrade

APPENDIX A
NOISE MONITORING CHARTS

Cardno
Shaping the Future

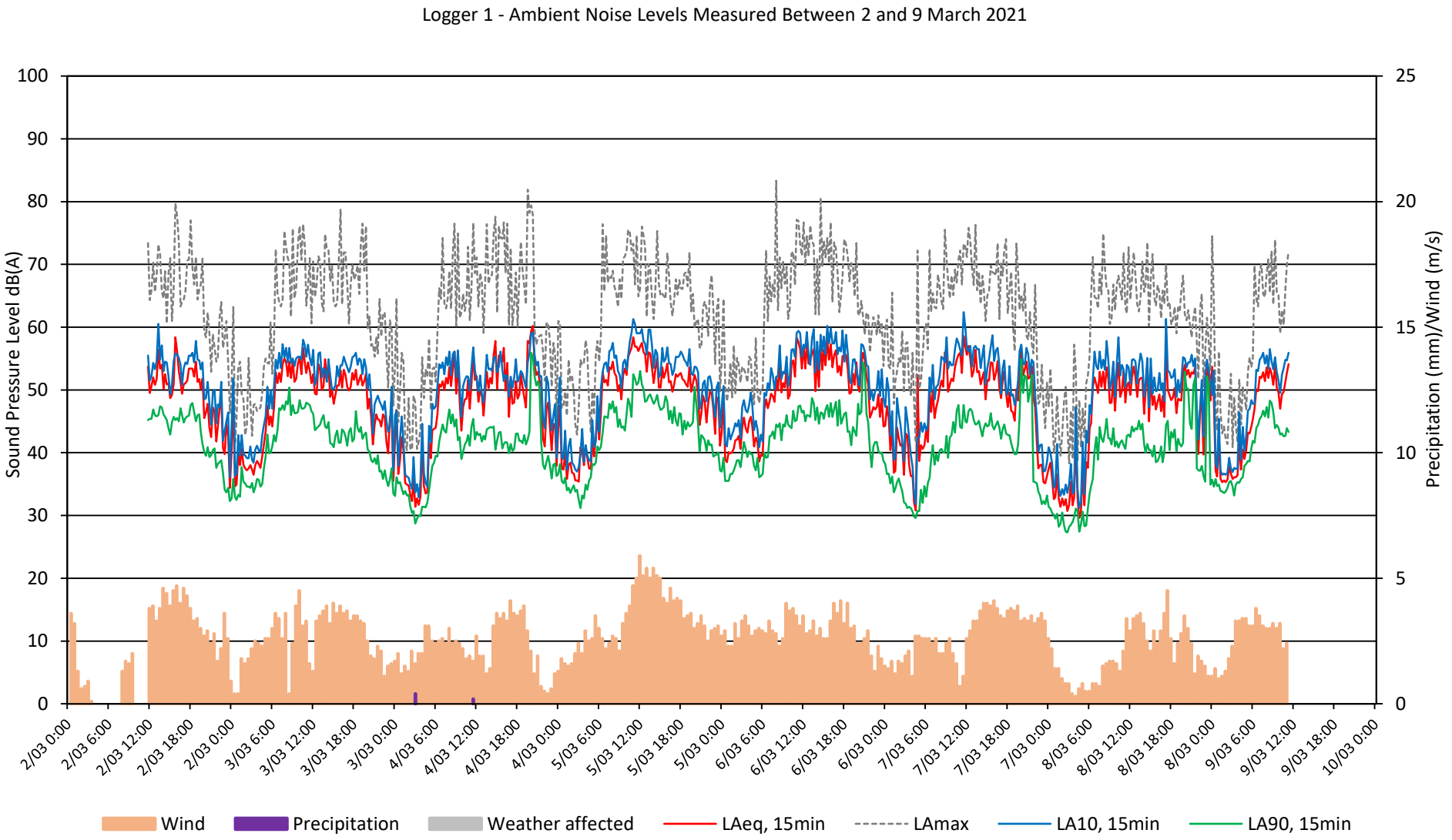


Figure A1 Ambient Noise Levels Measured Between 2 and 9 March 2021 at Logger Location 1

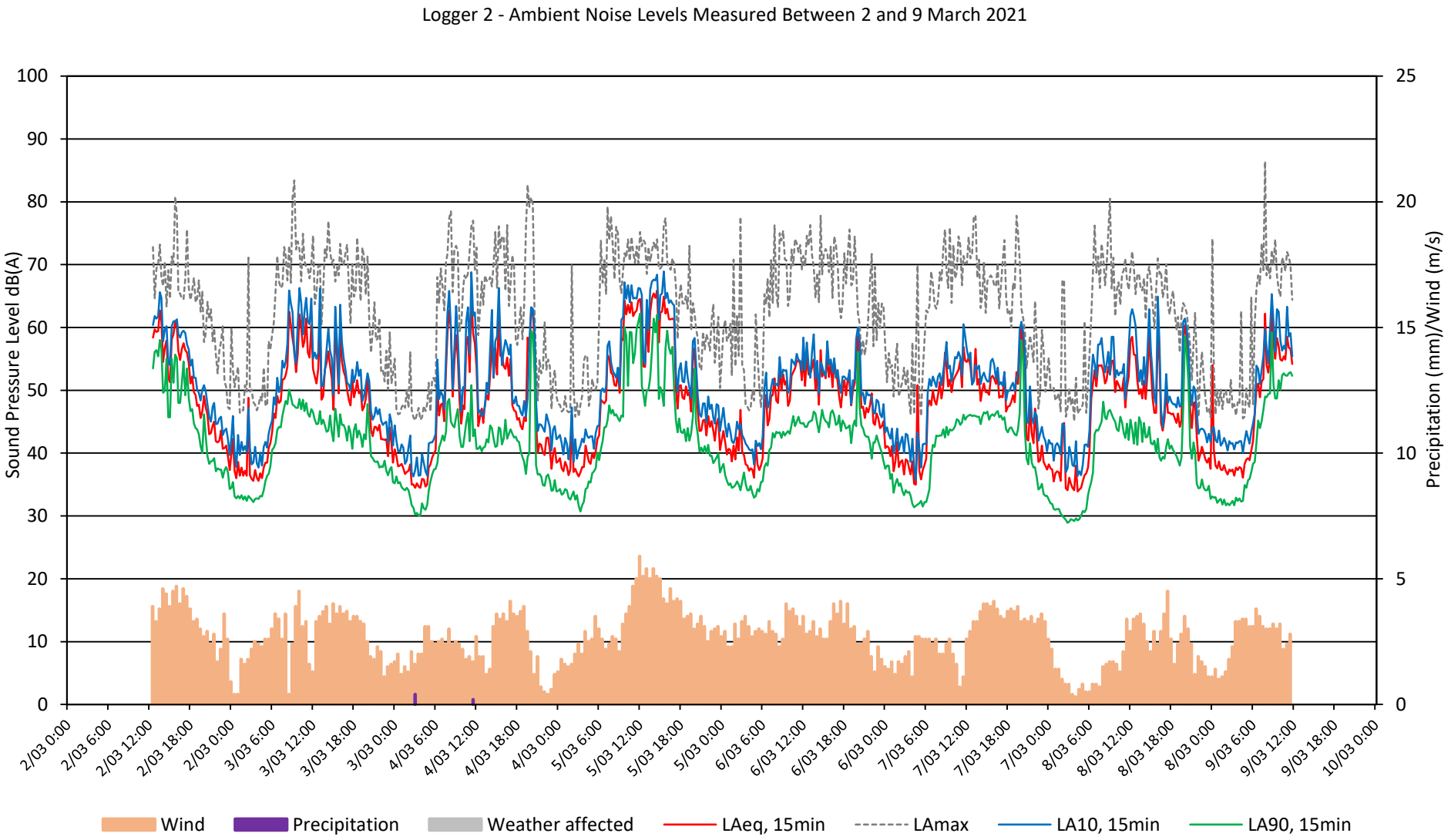


Figure A2 Ambient Noise Levels Measured Between 2 and 9 March 2021 at Logger Location 2

Greenwich
Point 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 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 46-51 dB(A)								
Clearly audible: 51-61 dB(A)								
Moderately intrusive: 61-71 dB(A)								
Highly Intrusive: >71 dB(A)								
1 George Street	1	481	GF	S	43	48	53	44
1 George Street	1	481	F 1	S	46	51	57	45
1 O'Connell Street	1	454	GF	W	48	55	56	49
1 O'Connell Street	1	454	F 1	W	51	56	59	51
1 Upper Serpentine Road	1	460	GF	S	52	57	55	56
1 Upper Serpentine Road	1	460	F 1	S	54	59	58	58
1 Victoria Street	1	483	GF	W	50	56	58	50
1 Victoria Street	1	483	F 1	W	51	56	59	51
10 George Street	1	476	GF	S	53	55	60	47
10 George Street	1	476	F 1	S	54	56	62	51
10 Mitchell Street	1	424	GF	W	61	72	69	64
10 Mitchell Street	1	424	F 1	W	63	73	71	66
10 Victoria Street	1	491	GF	W	51	57	52	48
10 Victoria Street	1	491	F 1	W	53	58	56	53
100-102 Louisa Road	1	572	GF	N	49	57	57	54
100-102 Louisa Road	1	572	F 1	N	49	57	57	54
104 Louisa Road	1	571	GF	N	49	57	57	54
104 Louisa Road	1	571	F 1	N	49	57	57	54
106 Louisa Road	1	570	GF	N	49	57	57	54
106 Louisa Road	1	570	F 1	N	49	57	57	54
108-116 Louisa Road	1	569	GF	N	49	57	57	54
108-116 Louisa Road	1	569	F 1	N	50	57	57	54
11 George Street	1	475	GF	W	51	47	59	47
11 George Street	1	475	F 1	W	53	52	61	50
11 Mitchell Street	1	436	GF	E	59	66	67	60
11 Mitchell Street	1	436	F 1	E	59	67	68	61
11 Richard Street	1	414	GF	S	55	64	63	59
11 St Lawrence Street	1	468	GF	S	54	53	60	50
11 St Lawrence Street	1	468	F 1	S	52	57	62	52
113 Louisa Road	1	560	GF	NW	44	51	52	48
113 Louisa Road	1	560	F 1	NW	49	56	56	53
113A Louisa Road	1	559	GF	NW	42	49	49	45
113A Louisa Road	1	559	F 1	NW	48	55	55	52
115 Louisa Road	1	558	GF	NW	49	56	56	54
115 Louisa Road	1	558	F 1	NW	49	57	57	54
117 Louisa Road	1	557	GF	NW	37	44	45	41
117 Louisa Road	1	557	F 1	NW	46	53	54	49
118-124 Louisa Road	1	568	GF	N	49	57	57	54
118-124 Louisa Road	1	568	F 1	N	50	57	57	54
119-121 Louisa Road	1	556	GF	NW	36	44	44	40
119-121 Louisa Road	1	556	F 1	NW	44	51	52	46
12 George Street	1	446	GF	S	52	54	59	48
12 George Street	1	446	F 1	S	55	57	62	50
12 Mitchell Street	1	423	GF	W	60	72	67	64
12 Mitchell Street	1	423	F 1	W	63	74	70	67
12 Victoria Street	1	490	GF	W	52	58	56	51
12 Victoria Street	1	490	F 1	W	53	58	57	53
123 Louisa Road	1	553	GF	NW	37	44	43	41
123 Louisa Road	1	553	F 1	NW	43	50	50	47
126 Louisa Road	1	567	GF	NW	50	57	57	54
126 Louisa Road	1	567	F 1	NW	51	58	58	55
128 Louisa Road	1	566	GF	NW	49	57	57	54
128 Louisa Road	1	566	F 1	NW	49	57	57	54
13 George Street	1	473	GF	S	50	48	58	47

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 46-51 dB(A)								
Clearly audible: 51-61 dB(A)								
Moderately intrusive: 61-71 dB(A)								
Highly Intrusive: >71 dB(A)								
13 George Street	1	473	F 1	S	53	52	61	49
13 Mitchell Street	1	434	GF	E	58	67	68	60
13 Mitchell Street	1	434	F 1	E	59	68	68	61
13 Werambie Street	1	669	GF	S	30	38	38	34
130 Louisa Road	1	565	GF	N	49	57	57	54
130 Louisa Road	1	565	F 1	N	50	57	57	54
132 Louisa Road	1	564	GF	N	50	57	57	54
132 Louisa Road	1	564	F 1	N	50	57	57	55
134 Louisa Road	1	563	GF	NW	50	57	57	54
134 Louisa Road	1	563	F 1	NW	50	57	57	55
136 Louisa Road	1	562	GF	NW	50	57	57	54
136 Louisa Road	1	562	F 1	NW	50	57	57	55
138 Louisa Road	1	561	GF	NW	50	57	57	54
138 Louisa Road	1	561	F 1	NW	50	57	57	55
14 George Street	1	445	GF	S	55	58	63	50
14 George Street	1	445	F 1	S	56	58	64	52
14 Mitchell Street	1	422	GF	W	64	75	72	67
14 Mitchell Street	1	422	F 1	W	66	76	74	68
14 Victoria Street	1	489	GF	W	51	57	58	53
14 Victoria Street	1	489	F 1	W	51	58	58	53
140 Louisa Road	1	555	GF	NW	50	57	57	55
140 Louisa Road	1	555	F 1	NW	50	57	57	55
142 Louisa Road	1	554	GF	N	50	57	57	55
142 Louisa Road	1	554	F 1	N	50	57	57	55
144 Louisa Road	1	551	GF	NW	50	57	57	54
144 Louisa Road	1	551	F 1	NW	50	57	57	55
146 Louisa Road	1	552	GF	NW	49	57	56	54
146 Louisa Road	1	552	F 1	NW	50	57	57	54
148 Louisa Road	1	550	GF	NW	43	47	48	43
148 Louisa Road	1	550	F 1	NW	43	48	49	44
15 George Street	1	472	GF	S	50	49	58	47
15 George Street	1	472	F 1	S	54	52	61	49
15 Mitchell Street	1	433	GF	E	59	68	69	61
15 Mitchell Street	1	433	F 1	E	60	68	69	62
15 Richard Street	1	406	GF	SW	62	68	69	66
15 Richard Street	1	406	F 1	SW	62	69	69	67
15 St Lawrence Street	1	441	GF	S	55	53	59	49
15 St Lawrence Street	1	441	F 1	S	56	53	58	48
150 Louisa Road	1	549	F 1	NW	46	53	54	41
16 George Street	1	444	GF	S	56	54	64	51
16 George Street	1	444	F 1	S	57	55	64	53
16 Mitchell Street	1	420	GF	W	67	78	75	70
16 Mitchell Street	1	420	F 1	W	69	79	76	71
16 Victoria Street	1	488	GF	W	51	57	58	53
16 Victoria Street	1	488	F 1	W	51	58	58	54
16-14 Louisa Road	1	600	GF	NW	46	54	54	51
16-14 Louisa Road	1	600	F 1	NW	46	54	54	51
17 George Street	1	471	GF	S	51	49	59	44
17 George Street	1	471	F 1	S	54	51	62	48
17 Mitchell Street	1	415	GF	S	61	66	67	62
17 Mitchell Street	1	415	F 1	S	63	68	69	65
17 St Lawrence Street	1	431	GF	S	55	53	61	49
17 St Lawrence Street	1	431	F 1	S	58	55	62	51
18 George Street	1	443	GF	S	53	51	61	47
18 George Street	1	443	F 1	S	57	53	65	50
18 Louisa Road	1	599	GF	NW	46	54	54	51

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 46-51 dB(A)								
Clearly audible: 51-61 dB(A)								
Moderately intrusive: 61-71 dB(A)								
Highly Intrusive: >71 dB(A)								
18 Louisa Road	1	599	F 1	NW	46	54	54	51
18 Lower Serpentine Road	1	404	GF	SW	82	89	90	78
18 Lower Serpentine Road	1	404	F 1	SW	81	88	90	79
18 Victoria Street	1	487	GF	W	51	57	58	54
18 Victoria Street	1	487	F 1	W	52	57	59	54
19 George Street	1	470	GF	S	50	50	53	45
19 George Street	1	470	F 1	S	53	54	57	48
19 Mitchell Street	1	416	GF	S	60	65	67	59
1A Victoria Street	1	480	GF	W	53	58	62	53
1A Victoria Street	1	480	F 1	W	51	56	59	52
2 Albert Street	1	458	GF	W	54	51	62	49
2 Albert Street	1	458	F 1	W	55	54	63	50
2 Mitchell Street	1	437	GF	W	55	66	62	59
2 Mitchell Street	1	437	F 1	W	57	68	63	62
2 Numa Street	1	547	GF	NW	50	57	57	55
2 Numa Street	1	547	F 1	NW	50	57	58	55
2 O'Connell Street	1	453	GF	W	52	54	55	50
2 O'Connell Street	1	453	F 1	W	54	55	58	52
2 Victoria Street	1	495	GF	W	39	45	46	42
2 Victoria Street	1	495	F 1	W	42	47	49	44
20 George Street	1	442	GF	S	46	51	51	46
20 George Street	1	442	F 1	S	54	56	57	50
20 Louisa Road	1	598	GF	NW	47	54	54	52
20 Louisa Road	1	598	F 1	NW	47	54	54	52
21 Mitchell Street	1	412	GF	S	64	73	71	68
21 Mitchell Street	1	412	F 1	S	65	74	72	69
21 St Lawrence Street	1	469	GF	S	49	54	57	48
21 St Lawrence Street	1	469	F 1	S	50	55	57	49
23 Mitchell Street	1	413	GF	S	69	77	76	71
23 Mitchell Street	1	413	F 1	S	70	78	77	73
24 George Street	1	440	GF	S	47	56	55	51
24 George Street	1	440	F 1	S	47	57	56	50
24 George Street	1	474	F 1	SE	36	45	44	42
24 Louisa Road	1	597	GF	W	49	57	57	54
24 Louisa Road	1	597	F 1	W	49	57	57	54
26 George Street	1	439	GF	S	51	54	57	49
26 George Street	1	439	F 1	S	51	55	57	51
26 Louisa Road	1	596	GF	NW	51	59	59	56
26 Louisa Road	1	596	F 1	NW	49	57	57	54
27 George Street	1	467	GF	S	46	54	53	49
27 George Street	1	467	F 1	S	49	57	56	53
28 George Street	1	409	F 1	SW	46	52	53	49
28 George Street	1	438	GF	S	47	56	55	51
28 George Street	1	438	F 1	S	49	58	56	53
28-32 Louisa Road	1	595	GF	NW	47	55	55	52
28-32 Louisa Road	1	595	F 1	NW	47	55	55	52
29 George Street	1	466	GF	S	47	57	54	51
29 George Street	1	466	F 1	S	49	59	56	53
3 O'Connell Street	1	452	GF	W	52	58	54	50
3 O'Connell Street	1	452	F 1	W	54	60	57	53
3 Richard Street	1	430	GF	S	51	56	63	51
3 Richard Street	1	430	F 1	S	55	58	67	53
3 Victoria Street	1	484	GF	W	53	55	57	53
3 Victoria Street	1	484	F 1	W	53	55	57	53
30 George Street	1	407	F 1	S	58	65	64	64
30A George Street	1	426	GF	S	57	65	63	60

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 46-51 dB(A)								
Clearly audible: 51-61 dB(A)								
Moderately intrusive: 61-71 dB(A)								
Highly Intrusive: >71 dB(A)								
30A George Street	1	426	F 1	S	60	67	67	63
31 George Street	1	465	GF	S	48	57	55	53
31 George Street	1	465	F 1	S	52	63	59	55
32 Harrison Street	1	425	GF	S	59	65	66	59
32 Harrison Street	1	425	F 1	S	60	67	67	62
33 George Street	1	464	GF	S	55	65	60	59
33 George Street	1	464	F 1	S	56	65	63	60
34 Harrison Street	1	410	GF	S	61	68	67	66
34 Harrison Street	1	410	F 1	S	61	68	68	66
34 Louisa Road	1	594	GF	NW	47	55	55	52
34 Louisa Road	1	594	F 1	NW	47	55	55	52
35 George Street	1	463	GF	S	50	59	61	51
35 George Street	1	463	F 1	S	54	64	66	54
36 Lower Serpentine Road	1	403	GF	SW	82	83	91	76
36 Lower Serpentine Road	1	403	F 1	SW	82	85	91	78
37 George Street	1	462	GF	S	50	57	58	52
37 George Street	1	462	F 1	S	55	60	62	54
38 Lower Serpentine Road	1	408	GF	SW	62	63	67	66
38 Lower Serpentine Road	1	408	F 1	SW	65	68	70	68
39 George Street	1	461	GF	S	54	56	59	50
39 George Street	1	461	F 1	S	56	59	63	54
4 Albert Street	1	457	GF	W	54	56	62	49
4 Albert Street	1	457	F 1	W	55	57	62	51
4 George Street	1	482	GF	S	51	56	59	51
4 George Street	1	482	F 1	S	51	56	59	52
4 Mitchell Street	1	435	GF	W	55	63	60	60
4 Mitchell Street	1	435	F 1	W	57	67	63	61
4 O'Connell Street	1	451	GF	SW	49	59	57	52
4 O'Connell Street	1	451	F 1	SW	51	60	59	54
4 Victoria Street	1	494	GF	W	40	45	47	43
4 Victoria Street	1	494	F 1	W	43	48	49	44
40 Lower Serpentine Road	1	417	GF	SE	51	56	58	51
40 Lower Serpentine Road	1	417	F 1	SE	58	63	63	56
42 Louisa Road	1	593	GF	NW	47	55	55	52
42 Louisa Road	1	593	F 1	NW	48	55	55	53
42 Lower Serpentine Road	1	419	GF	S	67	60	75	58
42 Lower Serpentine Road	1	419	F 1	S	68	61	76	60
44 Louisa Road	1	592	GF	W	50	57	57	55
44 Louisa Road	1	592	F 1	W	50	57	57	55
44A Louisa Road	1	591	GF	W	48	56	55	53
44A Louisa Road	1	591	F 1	W	48	56	55	53
46A Louisa Road	1	590	GF	NW	48	56	56	53
46A Louisa Road	1	590	F 1	NW	48	56	56	53
48 Louisa Road	1	589	GF	NW	50	58	58	55
48 Louisa Road	1	589	F 1	NW	50	58	58	55
5 Numa Street	1	548	GF	NE	47	54	56	35
5 Numa Street	1	548	F 1	NE	47	54	56	36
5 Numa Street	1	548	F 2	NE	47	54	56	38
5 Numa Street	1	548	F 3	NE	47	54	56	42
50 Louisa Road	1	588	GF	NW	49	56	56	54
50 Louisa Road	1	588	F 1	NW	49	56	56	54
54-56 Louisa Road	1	587	GF	NW	49	56	56	54
54-56 Louisa Road	1	587	F 1	NW	49	56	56	54
5-6 O'Connell Street	1	450	GF	SW	49	56	57	52
5-6 O'Connell Street	1	450	F 1	SW	51	58	60	54
58 Louisa Road	1	586	GF	NW	49	56	56	54

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 46-51 dB(A)								
Clearly audible: 51-61 dB(A)								
Moderately intrusive: 61-71 dB(A)								
Highly Intrusive: >71 dB(A)								
58 Louisa Road	1	586	F 1	NW	49	56	56	54
6 Albert Street	1	456	GF	W	55	55	62	50
6 Albert Street	1	456	F 1	W	55	57	63	51
6 Mitchell Street	1	432	GF	W	50	57	57	52
6 Mitchell Street	1	432	F 1	W	53	63	61	56
6 Victoria Street	1	493	GF	W	46	47	49	45
6 Victoria Street	1	493	F 1	W	49	49	51	47
64 Louisa Road	1	585	GF	NW	49	56	56	54
64 Louisa Road	1	585	F 1	NW	49	57	56	54
66 Louisa Road	1	584	GF	N	49	57	57	54
66 Louisa Road	1	584	F 1	N	49	57	57	54
7 George Street	1	479	GF	S	51	52	59	46
7 George Street	1	479	F 1	S	52	55	60	50
7 Numa Street	1	546	GF	N	50	58	58	55
7 Numa Street	1	546	F 1	N	51	58	58	55
7 O'Connell Street	1	449	GF	SW	54	61	62	57
7 O'Connell Street	1	449	F 1	SW	55	61	62	57
7 Richard Street	1	429	GF	S	49	57	58	51
7 Richard Street	1	429	F 1	S	51	61	60	54
7 Victoria Street	1	485	GF	W	53	59	57	53
7 Victoria Street	1	485	F 1	W	54	59	57	53
72 Louisa Road	1	583	GF	N	49	57	57	54
72 Louisa Road	1	583	F 1	N	49	57	57	54
74 Louisa Road	1	581	GF	NW	49	57	57	54
74 Louisa Road	1	581	F 1	NW	49	57	57	54
76 Louisa Road	1	582	GF	N	49	57	57	54
76 Louisa Road	1	582	F 1	N	49	57	57	54
78A Louisa Road	1	580	GF	N	49	57	57	54
78A Louisa Road	1	580	F 1	N	49	57	57	54
8 Albert Street	1	455	GF	W	52	56	62	51
8 Albert Street	1	455	F 1	W	53	57	63	51
8 George Street	1	477	GF	S	53	58	62	53
8 George Street	1	477	F 1	S	53	58	62	53
8 Mitchell Street	1	427	GF	W	59	69	66	62
8 Mitchell Street	1	427	F 1	W	61	70	68	64
8 O'Connell Street	1	448	GF	SW	54	60	61	56
8 O'Connell Street	1	448	F 1	SW	55	61	61	57
8 Victoria Street	1	492	GF	W	47	53	50	46
8 Victoria Street	1	492	F 1	W	50	56	51	47
80-82 Louisa Road	1	579	GF	N	49	57	57	54
80-82 Louisa Road	1	579	F 1	N	49	57	57	54
84-86 Louisa Road	1	578	GF	N	49	57	57	54
84-86 Louisa Road	1	578	F 1	N	49	57	57	54
88 Louisa Road	1	577	GF	N	49	57	57	54
88 Louisa Road	1	577	F 1	N	49	57	57	54
9 George Street	1	478	GF	S	51	52	58	47
9 George Street	1	478	F 1	S	53	55	60	50
9 Lower Serpentine Road	1	421	GF	S	62	74	72	59
9 Lower Serpentine Road	1	421	F 1	S	64	75	74	63
9 O'Connell Street	1	447	GF	SW	53	58	60	54
9 O'Connell Street	1	447	F 1	SW	53	58	60	55
9 Richard Street	1	411	GF	S	63	69	70	66
9 Richard Street	1	411	F 1	S	63	69	70	67
9 Richard Street	1	428	GF	S	49	58	57	54
9 Richard Street	1	428	F 1	S	51	59	58	54
9 Victoria Street	1	486	GF	SW	50	57	58	53

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 46-51 dB(A)								
Clearly audible: 51-61 dB(A)								
Moderately intrusive: 61-71 dB(A)								
Highly Intrusive: >71 dB(A)								
9 Victoria Street	1	486	F 1	SW	51	58	59	53
90 Louisa Road	1	576	GF	N	49	57	57	54
90 Louisa Road	1	576	F 1	N	49	57	57	54
92 Louisa Road	1	575	GF	N	49	57	57	54
92 Louisa Road	1	575	F 1	N	49	57	57	54
94 Louisa Road	1	574	GF	N	49	57	57	54
94 Louisa Road	1	574	F 1	N	49	57	57	54
96-98 Louisa Road	1	573	GF	N	49	57	57	54
96-98 Louisa Road	1	573	F 1	N	49	57	57	54
Greenwich Park Building	1	405	GF	SW	68	76	75	73
Greenwich Park Building	1	405	F 1	SW	69	77	76	74

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 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 48-53 dB(A)								
Clearly audible: 53-63 dB(A)								
Moderately intrusive: 63-73 dB(A)								
Highly Intrusive: >73 dB(A)								
1 Hunter Street	2	641	GF	E	48	54	54	52
1 Hunter Street	2	641	F 1	E	48	55	55	52
1 Mayfield Avenue	2	537	GF	SE	47	55	55	52
1 Mayfield Avenue	2	537	F 1	SE	48	55	55	52
1 Mount Morris Street	2	514	GF	E	50	56	56	54
1 Mount Morris Street	2	514	F 1	E	50	56	57	55
10 The Point Road	2	630	GF	S	47	54	54	51
10 The Point Road	2	630	F 1	S	47	55	54	51
101 Woolwich Road	2	656	GF	E	47	53	54	51
101 Woolwich Road	2	656	F 1	E	47	53	54	51
10-14 Elgin Street	2	657	GF	E	46	53	53	50
10-14 Elgin Street	2	657	F 1	E	46	53	53	50
11 Hunter Street	2	637	GF	E	44	50	51	48
11 Hunter Street	2	637	F 1	E	47	55	55	52
11 Margaret Street	2	665	GF	E	44	52	51	49
11 Margaret Street	2	665	F 1	E	44	52	52	49
11 Mayfield Avenue	2	542	GF	E	49	56	55	53
11 Mayfield Avenue	2	542	F 1	E	49	56	55	53
11 The Point Road	2	533	GF	E	47	55	55	52
11 The Point Road	2	533	F 1	E	47	55	55	52
12 The Point Road	2	629	F 1	S	48	54	54	52
13 Hunter Street	2	634	GF	E	48	56	55	53
13 Hunter Street	2	634	F 1	E	48	56	56	53
13 Margaret Street	2	666	GF	E	44	51	51	49
13 Margaret Street	2	666	F 1	E	44	52	51	49
13 Mayfield Avenue	2	543	GF	SE	49	56	56	53
13 Mayfield Avenue	2	543	F 1	SE	49	56	56	53
13 The Point Road	2	534	GF	E	47	55	55	52
13 The Point Road	2	534	F 1	E	48	55	55	53
14 The Point Road	2	628	GF	S	48	54	55	51
14 The Point Road	2	628	F 1	S	49	56	56	53
15 Hunter Street	2	636	GF	E	47	54	54	51
15 Hunter Street	2	636	F 1	E	47	55	55	52
15 Margaret Street	2	667	GF	E	44	51	51	49
15 Margaret Street	2	667	F 1	E	44	52	51	49
15 Mayfield Avenue	2	544	GF	E	48	56	56	53
15 Mayfield Avenue	2	544	F 1	E	48	56	56	53
15 The Point Road	2	532	GF	S	49	58	57	53
15 The Point Road	2	532	F 1	S	49	58	58	53
15B Mayfield Avenue	2	545	GF	E	48	56	56	53
15B Mayfield Avenue	2	545	F 1	E	48	56	56	53
16 The Point Road	2	627	GF	S	45	52	52	47
16 The Point Road	2	627	F 1	S	46	53	53	50
17 Collingwood Street	2	654	GF	E	47	54	54	51
17 Collingwood Street	2	654	F 1	E	47	54	54	51
17 Gale Street	2	646	GF	E	44	53	52	48
17 Gale Street	2	646	F 1	E	46	54	54	51
17 The Point Road	2	531	GF	S	50	58	58	55
17 The Point Road	2	531	F 1	S	50	58	58	55
18 and 20 The Point Road	2	626	F 1	S	47	53	53	50
19 Gale Street	2	647	GF	E	46	54	54	51
19 Gale Street	2	647	F 1	E	47	54	54	51
19 The Point Road	2	530	GF	S	50	58	57	55
19 The Point Road	2	530	F 1	S	50	58	57	55
2 Mayfield Avenue	2	642	GF	E	47	55	54	52

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 48-53 dB(A)								
Clearly audible: 53-63 dB(A)								
Moderately intrusive: 63-73 dB(A)								
Highly Intrusive: >73 dB(A)								
2 Mayfield Avenue	2	642	F 1	E	47	55	54	52
2 The Point Road	2	633	F 1	S	46	53	53	51
20 Edgecliff Road	2	658	GF	SE	46	53	53	50
21 The Point Road	2	529	GF	S	49	58	57	53
21 The Point Road	2	529	F 1	S	49	58	57	53
22 The Point Road	2	625	F 1	S	49	56	56	53
23 The Point Road	2	528	GF	S	51	59	58	56
23 The Point Road	2	528	F 1	S	51	59	58	56
24 The Point Road	2	624	GF	S	43	50	50	46
24 The Point Road	2	624	F 1	S	47	53	53	50
25 Gale Street	2	649	GF	E	46	53	53	49
25 Gale Street	2	649	F 1	E	47	54	54	51
25 Gale Street	2	648	GF	E	44	52	52	48
25 Gale Street	2	648	F 1	E	47	54	54	51
25 The Point Road	2	527	GF	S	51	59	58	56
25 The Point Road	2	527	F 1	S	52	59	59	56
26 The Point Road	2	623	F 1	S	47	53	54	49
27 Gale Street	2	650	GF	E	47	54	53	51
27 Gale Street	2	650	F 1	E	47	54	54	51
27 The Point Road	2	525	GF	S	51	59	58	56
27 The Point Road	2	525	F 1	S	51	59	58	56
27A The Point Road	2	526	GF	S	51	59	58	56
27A The Point Road	2	526	F 1	S	51	59	58	56
28 The Point Road	2	622	GF	S	48	55	55	53
28 The Point Road	2	622	F 1	S	48	56	56	53
29 The Point Road	2	524	GF	S	49	57	57	54
29 The Point Road	2	524	F 1	S	50	58	58	54
2A Margaret Street	2	660	GF	E	44	51	52	49
2A Margaret Street	2	660	F 1	E	44	51	52	49
2B Margaret Street	2	661	GF	NE	44	51	52	48
2B Margaret Street	2	661	F 1	NE	45	52	52	49
2C Margaret Street	2	659	GF	NE	44	51	52	49
2C Margaret Street	2	659	F 1	NE	44	51	52	49
3 Hunter Street	2	640	GF	E	48	55	54	52
3 Hunter Street	2	640	F 1	E	48	55	55	52
3 Margaret Street	2	662	GF	E	45	52	51	49
3 Margaret Street	2	662	F 1	E	45	52	51	49
3 Mayfield Avenue	2	538	GF	E	47	55	55	52
3 Mayfield Avenue	2	538	F 1	E	47	55	55	52
3 Mount Morris Street	2	515	GF	E	50	57	57	55
3 Mount Morris Street	2	515	F 1	E	50	57	57	55
3 The Point Road	2	651	GF	E	46	54	54	51
3 The Point Road	2	651	F 1	E	46	54	54	52
30 The Point Road	2	621	GF	S	40	47	48	42
30 The Point Road	2	621	F 1	S	44	51	52	47
31-33 The Point Road	2	523	GF	S	49	57	57	54
31-33 The Point Road	2	523	F 1	S	49	57	57	54
32 The Point Road	2	620	GF	S	40	47	47	43
32 The Point Road	2	620	F 1	S	45	52	53	48
34 The Point Road	2	619	GF	S	48	55	56	50
34 The Point Road	2	619	F 1	S	51	58	58	53
35 The Point Road	2	522	GF	S	49	57	57	54
35 The Point Road	2	522	F 1	S	49	57	57	54
36 The Point Road	2	618	GF	S	48	57	57	54
36 The Point Road	2	618	F 1	S	50	58	59	55
37 The Point Road	2	521	GF	S	36	42	43	39

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 48-53 dB(A)								
Clearly audible: 53-63 dB(A)								
Moderately intrusive: 63-73 dB(A)								
Highly Intrusive: >73 dB(A)								
37 The Point Road	2	521	F 1	S	41	49	50	43
37A The Point Road	2	520	GF	S	49	56	56	54
37A The Point Road	2	520	F 1	S	50	57	57	55
37B The Point Road	2	519	GF	S	48	56	55	55
37B The Point Road	2	519	F 1	S	49	56	57	55
38 The Point Road	2	617	GF	S	41	47	48	44
38 The Point Road	2	617	F 1	S	46	52	53	49
39 The Point Road	2	518	GF	S	50	57	58	55
39 The Point Road	2	518	F 1	S	50	57	58	55
42 The Point Road	2	616	GF	S	41	48	49	43
42 The Point Road	2	616	F 1	S	44	51	52	46
43 The Point Road	2	517	GF	S	51	57	58	56
43 The Point Road	2	517	F 1	S	51	57	58	56
44 The Point Road	2	615	GF	S	45	50	51	47
44 The Point Road	2	615	F 1	S	48	53	53	50
45 The Point Road	2	513	GF	E	48	53	55	52
45 The Point Road	2	513	F 1	E	48	54	55	52
46 The Point Road	2	614	GF	S	46	52	50	52
46 The Point Road	2	614	F 1	S	49	54	53	54
47 The Point Road	2	511	GF	E	47	53	51	51
47 The Point Road	2	511	F 1	E	48	54	52	51
47A The Point Road	2	510	GF	SE	47	53	50	51
47A The Point Road	2	510	F 1	SE	47	53	51	51
48 The Point Road	2	613	GF	S	49	54	54	53
48 The Point Road	2	613	F 1	S	50	56	56	53
49 The Point Road	2	509	GF	SE	46	50	49	49
49 The Point Road	2	509	F 1	SE	46	51	50	50
5 Gale Street	2	644	GF	E	46	54	54	51
5 Gale Street	2	644	F 1	E	46	54	54	51
5 Hunter Street	2	639	GF	E	48	55	55	52
5 Hunter Street	2	639	F 1	E	48	55	55	52
5 Mayfield Avenue	2	539	GF	E	47	55	55	52
5 Mayfield Avenue	2	539	F 1	E	48	55	55	52
5 Mount Morris Street	2	516	GF	SE	50	57	57	55
5 Mount Morris Street	2	516	F 1	SE	51	57	58	55
5 The Point Road	2	652	GF	E	44	52	52	49
5 The Point Road	2	652	F 1	E	46	54	54	51
50 The Point Road	2	612	GF	SE	46	50	50	50
50 The Point Road	2	612	F 1	SE	48	54	55	53
52 The Point Road	2	611	GF	SE	47	53	52	50
52 The Point Road	2	611	F 1	SE	47	54	53	52
53 The Point Road	2	508	GF	SE	44	48	48	48
53 The Point Road	2	508	F 1	SE	45	48	48	49
54 The Point Road	2	610	GF	S	44	48	47	48
54 The Point Road	2	610	F 1	S	47	50	48	51
55-57 The Point Road	2	507	GF	SE	41	44	45	43
55-57 The Point Road	2	507	F 1	SE	41	45	46	44
56 The Point Road	2	609	GF	S	39	44	46	43
56 The Point Road	2	609	F 1	S	47	51	52	50
5-7 Margaret Street	2	663	GF	E	44	51	51	49
5-7 Margaret Street	2	663	F 1	E	44	51	51	49
58 The Point Road	2	608	GF	S	43	47	47	46
59 The Point Road	2	506	GF	SE	38	44	47	40
59 The Point Road	2	506	F 1	SE	39	45	47	41
6 The Point Road	2	632	F 1	S	43	51	51	48
60 The Point Road	2	607	GF	S	39	44	46	42

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Noticeable: 48-53 dB(A)								
Clearly audible: 53-63 dB(A)								
Moderately intrusive: 63-73 dB(A)								
Highly Intrusive: >73 dB(A)								
61-63 The Point Road	2	505	GF	SE	37	44	45	40
61-63 The Point Road	2	505	F 1	SE	37	44	45	40
62 The Point Road	2	606	GF	S	33	40	40	36
62a The Point Road	2	605	GF	S	32	39	39	36
64 The Point Road	2	604	GF	E	37	43	42	40
64 The Point Road	2	604	F 1	E	38	44	43	40
65 The Point Road	2	504	GF	SE	36	43	44	40
65 The Point Road	2	504	F 1	SE	37	43	44	41
67 The Point Road	2	503	GF	S	36	43	42	39
67 The Point Road	2	503	F 1	S	36	44	42	39
68 The Point Road	2	602	GF	SW	31	38	38	35
68 The Point Road	2	602	F 1	SW	32	39	39	36
69 The Point Road	2	502	GF	S	35	41	41	38
69 The Point Road	2	502	F 1	S	35	42	42	39
7 Gale Street	2	645	GF	E	46	54	54	51
7 Gale Street	2	645	F 1	E	46	54	54	51
7 Hunter Street	2	638	GF	E	42	51	47	46
7 Hunter Street	2	638	F 1	E	47	54	54	51
7 Mayfield Avenue	2	540	GF	E	48	55	55	53
7 Mayfield Avenue	2	540	F 1	E	48	55	55	53
7 The Point Road	2	643	GF	E	46	54	54	52
7 The Point Road	2	643	F 1	E	47	55	54	52
71 The Point Road	2	501	GF	SE	34	41	41	37
71 The Point Road	2	501	F 1	SE	35	42	42	38
73 The Point Road	2	499	GF	S	34	41	41	37
73 The Point Road	2	499	F 1	S	35	42	41	38
75 The Point Road	2	498	GF	E	34	41	41	37
75 The Point Road	2	498	F 1	E	34	41	41	37
77 The Point Road	2	500	GF	E	29	37	37	34
77 The Point Road	2	500	F 1	E	30	38	37	34
77 Woolwich Road	2	668	GF	E	44	51	52	48
77 Woolwich Road	2	668	F 1	E	44	51	52	49
7A The Point Road	2	536	GF	S	43	49	49	48
7A The Point Road	2	536	F 1	S	48	55	55	54
8 The Point Road	2	631	F 1	S	48	54	54	53
9 Hunter Street	2	635	GF	E	48	56	55	53
9 Hunter Street	2	635	F 1	E	48	56	55	53
9 Margaret Street	2	664	GF	E	44	51	51	49
9 Margaret Street	2	664	F 1	E	45	52	51	49
9 Mayfield Avenue	2	541	GF	E	48	55	55	53
9 Mayfield Avenue	2	541	F 1	E	49	56	55	53
9 The Point Road	2	535	GF	SE	44	53	53	44
9 The Point Road	2	535	F 1	SE	47	55	55	50
Clarkes Point Reserve	2	496	GF		49	57	58	54
Clarkes Point Reserve	2	496	F 1		49	57	58	54
Cockatoo Island Biloela Lawn Building	2	673	GF	NE	46	53	53	51
Cockatoo Island Biloela Lawn Building	2	673	F 1	NE	46	53	53	51
Cockatoo Island Camp Site	2	677	GF		45	53	53	50
Cockatoo Island Camp Site	2	677	F 1		45	53	53	50
Cockatoo Island Visitor Centre	2	674	GF	NE	46	53	53	51
Cockatoo Island Visitor Centre	2	674	F 1	NE	46	53	53	51
Cockatoo Island Wharf Building	2	671	GF	E	47	54	54	52
Scout Hall The Point Road	2	601	GF	SE	29	37	36	34
Woolwich Pier Hotel 1 Woolwich Road	2	655	GF	E	47	54	55	51
Woolwich Pier Hotel 1 Woolwich Road	2	655	F 1	E	47	54	55	51

Table B3 Predicted Construction LAeq Noise Levels Compared to TfNSW Night-time (OOH2) Noise Impact Categories, dB(A) – NCA 1

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 38-43 dB(A)					
Clearly audible: 43-53 dB(A)					
Moderately intrusive: 53-63 dB(A)					
Highly Intrusive: >63 dB(A)					
1 George Street	1	481	GF	S	45
1 George Street	1	481	F 1	S	47
1 O'Connell Street	1	454	GF	W	55
1 O'Connell Street	1	454	F 1	W	56
1 Upper Serpentine Road	1	460	GF	S	55
1 Upper Serpentine Road	1	460	F 1	S	57
1 Victoria Street	1	483	GF	W	54
1 Victoria Street	1	483	F 1	W	55
10 George Street	1	476	GF	S	47
10 George Street	1	476	F 1	S	51
10 Mitchell Street	1	424	GF	W	67
10 Mitchell Street	1	424	F 1	W	69
10 Victoria Street	1	491	GF	W	52
10 Victoria Street	1	491	F 1	W	54
100-102 Louisa Road	1	572	GF	N	53
100-102 Louisa Road	1	572	F 1	N	54
104 Louisa Road	1	571	GF	N	53
104 Louisa Road	1	571	F 1	N	54
106 Louisa Road	1	570	GF	N	53
106 Louisa Road	1	570	F 1	N	54
108-116 Louisa Road	1	569	GF	N	53
108-116 Louisa Road	1	569	F 1	N	54
11 George Street	1	475	GF	W	45
11 George Street	1	475	F 1	W	49
11 Mitchell Street	1	436	GF	E	61
11 Mitchell Street	1	436	F 1	E	62
11 Richard Street	1	414	GF	S	59
11 St Lawrence Street	1	468	GF	S	49
11 St Lawrence Street	1	468	F 1	S	52
113 Louisa Road	1	560	GF	NW	47
113 Louisa Road	1	560	F 1	NW	53
113A Louisa Road	1	559	GF	NW	45
113A Louisa Road	1	559	F 1	NW	52
115 Louisa Road	1	558	GF	NW	53
115 Louisa Road	1	558	F 1	NW	53
117 Louisa Road	1	557	GF	NW	41
117 Louisa Road	1	557	F 1	NW	49
118-124 Louisa Road	1	568	GF	N	54
118-124 Louisa Road	1	568	F 1	N	54
119-121 Louisa Road	1	556	GF	NW	40
119-121 Louisa Road	1	556	F 1	NW	47
12 George Street	1	446	GF	S	47
12 George Street	1	446	F 1	S	50
12 Mitchell Street	1	423	GF	W	68
12 Mitchell Street	1	423	F 1	W	71
12 Victoria Street	1	490	GF	W	54
12 Victoria Street	1	490	F 1	W	54
123 Louisa Road	1	553	GF	NW	41
123 Louisa Road	1	553	F 1	NW	47
126 Louisa Road	1	567	GF	NW	54
126 Louisa Road	1	567	F 1	NW	55
128 Louisa Road	1	566	GF	NW	53
128 Louisa Road	1	566	F 1	NW	53
13 George Street	1	473	GF	S	44
13 George Street	1	473	F 1	S	49
13 Mitchell Street	1	434	GF	E	62

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 38-43 dB(A)					
Clearly audible: 43-53 dB(A)					
Moderately intrusive: 53-63 dB(A)					
Highly Intrusive: >63 dB(A)					
13 Mitchell Street	1	434	F 1	E	63
13 Werambie Street	1	669	GF	S	34
130 Louisa Road	1	565	GF	N	54
130 Louisa Road	1	565	F 1	N	54
132 Louisa Road	1	564	GF	N	54
132 Louisa Road	1	564	F 1	N	54
134 Louisa Road	1	563	GF	NW	54
134 Louisa Road	1	563	F 1	NW	54
136 Louisa Road	1	562	GF	NW	54
136 Louisa Road	1	562	F 1	NW	54
138 Louisa Road	1	561	GF	NW	54
138 Louisa Road	1	561	F 1	NW	54
14 George Street	1	445	GF	S	51
14 George Street	1	445	F 1	S	52
14 Mitchell Street	1	422	GF	W	70
14 Mitchell Street	1	422	F 1	W	71
14 Victoria Street	1	489	GF	W	54
14 Victoria Street	1	489	F 1	W	54
140 Louisa Road	1	555	GF	NW	54
140 Louisa Road	1	555	F 1	NW	54
142 Louisa Road	1	554	GF	N	54
142 Louisa Road	1	554	F 1	N	54
144 Louisa Road	1	551	GF	NW	54
144 Louisa Road	1	551	F 1	NW	54
146 Louisa Road	1	552	GF	NW	53
146 Louisa Road	1	552	F 1	NW	54
148 Louisa Road	1	550	GF	NW	44
148 Louisa Road	1	550	F 1	NW	44
15 George Street	1	472	GF	S	44
15 George Street	1	472	F 1	S	50
15 Mitchell Street	1	433	GF	E	63
15 Mitchell Street	1	433	F 1	E	63
15 Richard Street	1	406	GF	SW	66
15 Richard Street	1	406	F 1	SW	67
15 St Lawrence Street	1	441	GF	S	50
15 St Lawrence Street	1	441	F 1	S	49
150 Louisa Road	1	549	F 1	NW	48
16 George Street	1	444	GF	S	52
16 George Street	1	444	F 1	S	53
16 Mitchell Street	1	420	GF	W	73
16 Mitchell Street	1	420	F 1	W	74
16 Victoria Street	1	488	GF	W	54
16 Victoria Street	1	488	F 1	W	54
16-14 Louisa Road	1	600	GF	NW	50
16-14 Louisa Road	1	600	F 1	NW	50
17 George Street	1	471	GF	S	45
17 George Street	1	471	F 1	S	49
17 Mitchell Street	1	415	GF	S	63
17 Mitchell Street	1	415	F 1	S	66
17 St Lawrence Street	1	431	GF	S	49
17 St Lawrence Street	1	431	F 1	S	52
18 George Street	1	443	GF	S	47
18 George Street	1	443	F 1	S	51
18 Louisa Road	1	599	GF	NW	50
18 Louisa Road	1	599	F 1	NW	51
18 Lower Serpentine Road	1	404	GF	SW	83
18 Lower Serpentine Road	1	404	F 1	SW	83

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 38-43 dB(A)					
Clearly audible: 43-53 dB(A)					
Moderately intrusive: 53-63 dB(A)					
Highly Intrusive: >63 dB(A)					
18 Victoria Street	1	487	GF	W	55
18 Victoria Street	1	487	F 1	W	56
19 George Street	1	470	GF	S	46
19 George Street	1	470	F 1	S	47
19 Mitchell Street	1	416	GF	S	61
1A Victoria Street	1	480	GF	W	56
1A Victoria Street	1	480	F 1	W	56
2 Albert Street	1	458	GF	W	46
2 Albert Street	1	458	F 1	W	47
2 Mitchell Street	1	437	GF	W	61
2 Mitchell Street	1	437	F 1	W	63
2 Numa Street	1	547	GF	NW	54
2 Numa Street	1	547	F 1	NW	54
2 O'Connell Street	1	453	GF	W	54
2 O'Connell Street	1	453	F 1	W	56
2 Victoria Street	1	495	GF	W	43
2 Victoria Street	1	495	F 1	W	47
20 George Street	1	442	GF	S	47
20 George Street	1	442	F 1	S	52
20 Louisa Road	1	598	GF	NW	51
20 Louisa Road	1	598	F 1	NW	51
21 Mitchell Street	1	412	GF	S	69
21 Mitchell Street	1	412	F 1	S	70
21 St Lawrence Street	1	469	GF	S	51
21 St Lawrence Street	1	469	F 1	S	51
23 Mitchell Street	1	413	GF	S	72
23 Mitchell Street	1	413	F 1	S	74
24 George Street	1	440	GF	S	52
24 George Street	1	440	F 1	S	51
24 George Street	1	474	F 1	SE	41
24 Louisa Road	1	597	GF	W	53
24 Louisa Road	1	597	F 1	W	53
26 George Street	1	439	GF	S	50
26 George Street	1	439	F 1	S	51
26 Louisa Road	1	596	GF	NW	55
26 Louisa Road	1	596	F 1	NW	54
27 George Street	1	467	GF	S	50
27 George Street	1	467	F 1	S	55
28 George Street	1	409	F 1	SW	48
28 George Street	1	438	GF	S	53
28 George Street	1	438	F 1	S	54
28-32 Louisa Road	1	595	GF	NW	51
28-32 Louisa Road	1	595	F 1	NW	51
29 George Street	1	466	GF	S	52
29 George Street	1	466	F 1	S	54
3 O'Connell Street	1	452	GF	W	55
3 O'Connell Street	1	452	F 1	W	56
3 Richard Street	1	430	GF	S	53
3 Richard Street	1	430	F 1	S	54
3 Victoria Street	1	484	GF	W	55
3 Victoria Street	1	484	F 1	W	55
30 George Street	1	407	F 1	S	64
30A George Street	1	426	GF	S	61
30A George Street	1	426	F 1	S	64
31 George Street	1	465	GF	S	53
31 George Street	1	465	F 1	S	57
32 Harrison Street	1	425	GF	S	61

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 38-43 dB(A)					
Clearly audible: 43-53 dB(A)					
Moderately intrusive: 53-63 dB(A)					
Highly Intrusive: >63 dB(A)					
32 Harrison Street	1	425	F 1	S	64
33 George Street	1	464	GF	S	61
33 George Street	1	464	F 1	S	62
34 Harrison Street	1	410	GF	S	65
34 Harrison Street	1	410	F 1	S	66
34 Louisa Road	1	594	GF	NW	51
34 Louisa Road	1	594	F 1	NW	51
35 George Street	1	463	GF	S	54
35 George Street	1	463	F 1	S	58
36 Lower Serpentine Road	1	403	GF	SW	79
36 Lower Serpentine Road	1	403	F 1	SW	80
37 George Street	1	462	GF	S	53
37 George Street	1	462	F 1	S	57
38 Lower Serpentine Road	1	408	GF	SW	60
38 Lower Serpentine Road	1	408	F 1	SW	64
39 George Street	1	461	GF	S	54
39 George Street	1	461	F 1	S	58
4 Albert Street	1	457	GF	W	50
4 Albert Street	1	457	F 1	W	50
4 George Street	1	482	GF	S	55
4 George Street	1	482	F 1	S	56
4 Mitchell Street	1	435	GF	W	60
4 Mitchell Street	1	435	F 1	W	63
4 O'Connell Street	1	451	GF	SW	53
4 O'Connell Street	1	451	F 1	SW	55
4 Victoria Street	1	494	GF	W	43
4 Victoria Street	1	494	F 1	W	47
40 Lower Serpentine Road	1	417	GF	SE	52
40 Lower Serpentine Road	1	417	F 1	SE	59
42 Louisa Road	1	593	GF	NW	52
42 Louisa Road	1	593	F 1	NW	52
42 Lower Serpentine Road	1	419	GF	S	57
42 Lower Serpentine Road	1	419	F 1	S	58
44 Louisa Road	1	592	GF	W	54
44 Louisa Road	1	592	F 1	W	54
44A Louisa Road	1	591	GF	W	52
44A Louisa Road	1	591	F 1	W	52
46A Louisa Road	1	590	GF	NW	52
46A Louisa Road	1	590	F 1	NW	52
48 Louisa Road	1	589	GF	NW	54
48 Louisa Road	1	589	F 1	NW	54
5 Numa Street	1	548	GF	NE	47
5 Numa Street	1	548	F 1	NE	47
5 Numa Street	1	548	F 2	NE	48
5 Numa Street	1	548	F 3	NE	48
50 Louisa Road	1	588	GF	NW	53
50 Louisa Road	1	588	F 1	NW	53
54-56 Louisa Road	1	587	GF	NW	53
54-56 Louisa Road	1	587	F 1	NW	53
5-6 O'Connell Street	1	450	GF	SW	52
5-6 O'Connell Street	1	450	F 1	SW	54
58 Louisa Road	1	586	GF	NW	53
58 Louisa Road	1	586	F 1	NW	53
6 Albert Street	1	456	GF	W	49
6 Albert Street	1	456	F 1	W	51
6 Mitchell Street	1	432	GF	W	54
6 Mitchell Street	1	432	F 1	W	59

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 38-43 dB(A)					
Clearly audible: 43-53 dB(A)					
Moderately intrusive: 53-63 dB(A)					
Highly Intrusive: >63 dB(A)					
6 Victoria Street	1	493	GF	W	47
6 Victoria Street	1	493	F 1	W	51
64 Louisa Road	1	585	GF	NW	53
64 Louisa Road	1	585	F 1	NW	53
66 Louisa Road	1	584	GF	N	53
66 Louisa Road	1	584	F 1	N	53
7 George Street	1	479	GF	S	47
7 George Street	1	479	F 1	S	51
7 Numa Street	1	546	GF	N	54
7 Numa Street	1	546	F 1	N	54
7 O'Connell Street	1	449	GF	SW	58
7 O'Connell Street	1	449	F 1	SW	59
7 Richard Street	1	429	GF	S	52
7 Richard Street	1	429	F 1	S	55
7 Victoria Street	1	485	GF	W	55
7 Victoria Street	1	485	F 1	W	55
72 Louisa Road	1	583	GF	N	53
72 Louisa Road	1	583	F 1	N	53
74 Louisa Road	1	581	GF	NW	53
74 Louisa Road	1	581	F 1	NW	53
76 Louisa Road	1	582	GF	N	53
76 Louisa Road	1	582	F 1	N	53
78A Louisa Road	1	580	GF	N	53
78A Louisa Road	1	580	F 1	N	53
8 Albert Street	1	455	GF	W	51
8 Albert Street	1	455	F 1	W	52
8 George Street	1	477	GF	S	55
8 George Street	1	477	F 1	S	56
8 Mitchell Street	1	427	GF	W	65
8 Mitchell Street	1	427	F 1	W	66
8 O'Connell Street	1	448	GF	SW	57
8 O'Connell Street	1	448	F 1	SW	58
8 Victoria Street	1	492	GF	W	49
8 Victoria Street	1	492	F 1	W	52
80-82 Louisa Road	1	579	GF	N	53
80-82 Louisa Road	1	579	F 1	N	53
84-86 Louisa Road	1	578	GF	N	53
84-86 Louisa Road	1	578	F 1	N	53
88 Louisa Road	1	577	GF	N	53
88 Louisa Road	1	577	F 1	N	53
9 George Street	1	478	GF	S	45
9 George Street	1	478	F 1	S	49
9 Lower Serpentine Road	1	421	GF	S	68
9 Lower Serpentine Road	1	421	F 1	S	70
9 O'Connell Street	1	447	GF	SW	55
9 O'Connell Street	1	447	F 1	SW	56
9 Richard Street	1	411	GF	S	66
9 Richard Street	1	411	F 1	S	67
9 Richard Street	1	428	GF	S	53
9 Richard Street	1	428	F 1	S	54
9 Victoria Street	1	486	GF	SW	54
9 Victoria Street	1	486	F 1	SW	54
90 Louisa Road	1	576	GF	N	53
90 Louisa Road	1	576	F 1	N	53
92 Louisa Road	1	575	GF	N	53
92 Louisa Road	1	575	F 1	N	53
94 Louisa Road	1	574	GF	N	53

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 38-43 dB(A)					
Clearly audible: 43-53 dB(A)					
Moderately intrusive: 53-63 dB(A)					
Highly Intrusive: >63 dB(A)					
94 Louisa Road	1	574	F 1	N	53
96-98 Louisa Road	1	573	GF	N	53
96-98 Louisa Road	1	573	F 1	N	53
Greenwich Park Building	1	405	GF	SW	72
Greenwich Park Building	1	405	F 1	SW	73

Table B4 Predicted Construction LAeq Noise Levels Compared to TfNSW Night (OOH2) Noise Impact Categories, dB(A) – NCA 2

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 37-42 dB(A)					
Clearly audible: 42-52 dB(A)					
Moderately intrusive: 52-62 dB(A)					
Highly Intrusive: >62 dB(A)					
1 Hunter Street	2	641	GF	E	51
1 Hunter Street	2	641	F 1	E	51
1 Mayfield Avenue	2	537	GF	SE	52
1 Mayfield Avenue	2	537	F 1	SE	52
1 Mount Morris Street	2	514	GF	E	54
1 Mount Morris Street	2	514	F 1	E	54
10 The Point Road	2	630	GF	S	51
10 The Point Road	2	630	F 1	S	51
101 Woolwich Road	2	656	GF	E	50
101 Woolwich Road	2	656	F 1	E	50
10-14 Elgin Street	2	657	GF	E	49
10-14 Elgin Street	2	657	F 1	E	49
11 Hunter Street	2	637	GF	E	47
11 Hunter Street	2	637	F 1	E	51
11 Margaret Street	2	665	GF	E	48
11 Margaret Street	2	665	F 1	E	48
11 Mayfield Avenue	2	542	GF	E	52
11 Mayfield Avenue	2	542	F 1	E	52
11 The Point Road	2	533	GF	E	52
11 The Point Road	2	533	F 1	E	52
12 The Point Road	2	629	F 1	S	52
13 Hunter Street	2	634	GF	E	52
13 Hunter Street	2	634	F 1	E	52
13 Margaret Street	2	666	GF	E	48
13 Margaret Street	2	666	F 1	E	48
13 Mayfield Avenue	2	543	GF	SE	52
13 Mayfield Avenue	2	543	F 1	SE	52
13 The Point Road	2	534	GF	E	52
13 The Point Road	2	534	F 1	E	52
14 The Point Road	2	628	GF	S	52
14 The Point Road	2	628	F 1	S	54
15 Hunter Street	2	636	GF	E	51
15 Hunter Street	2	636	F 1	E	52
15 Margaret Street	2	667	GF	E	48
15 Margaret Street	2	667	F 1	E	48
15 Mayfield Avenue	2	544	GF	E	53
15 Mayfield Avenue	2	544	F 1	E	53
15 The Point Road	2	532	GF	S	53
15 The Point Road	2	532	F 1	S	53
15B Mayfield Avenue	2	545	GF	E	53
15B Mayfield Avenue	2	545	F 1	E	53
16 The Point Road	2	627	GF	S	49
16 The Point Road	2	627	F 1	S	51
17 Collingwood Street	2	654	GF	E	50
17 Collingwood Street	2	654	F 1	E	50
17 Gale Street	2	646	GF	E	48
17 Gale Street	2	646	F 1	E	50
17 The Point Road	2	531	GF	S	54
17 The Point Road	2	531	F 1	S	55
18 and 20 The Point Road	2	626	F 1	S	51
19 Gale Street	2	647	GF	E	50
19 Gale Street	2	647	F 1	E	50
19 The Point Road	2	530	GF	S	54
19 The Point Road	2	530	F 1	S	54
2 Mayfield Avenue	2	642	GF	E	51
2 Mayfield Avenue	2	642	F 1	E	51

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 37-42 dB(A)					
Clearly audible: 42-52 dB(A)					
Moderately intrusive: 52-62 dB(A)					
Highly Intrusive: >62 dB(A)					
2 The Point Road	2	633	F 1	S	50
20 Edgecliff Road	2	658	GF	SE	49
21 The Point Road	2	529	GF	S	53
21 The Point Road	2	529	F 1	S	54
22 The Point Road	2	625	F 1	S	53
23 The Point Road	2	528	GF	S	55
23 The Point Road	2	528	F 1	S	55
24 The Point Road	2	624	GF	S	47
24 The Point Road	2	624	F 1	S	51
25 Gale Street	2	649	GF	E	49
25 Gale Street	2	649	F 1	E	50
25 Gale Street	2	648	GF	E	48
25 Gale Street	2	648	F 1	E	50
25 The Point Road	2	527	GF	S	55
25 The Point Road	2	527	F 1	S	56
26 The Point Road	2	623	F 1	S	50
27 Gale Street	2	650	GF	E	50
27 Gale Street	2	650	F 1	E	51
27 The Point Road	2	525	GF	S	55
27 The Point Road	2	525	F 1	S	55
27A The Point Road	2	526	GF	S	55
27A The Point Road	2	526	F 1	S	55
28 The Point Road	2	622	GF	S	52
28 The Point Road	2	622	F 1	S	52
29 The Point Road	2	524	GF	S	53
29 The Point Road	2	524	F 1	S	54
2A Margaret Street	2	660	GF	E	48
2A Margaret Street	2	660	F 1	E	48
2B Margaret Street	2	661	GF	NE	47
2B Margaret Street	2	661	F 1	NE	49
2C Margaret Street	2	659	GF	NE	48
2C Margaret Street	2	659	F 1	NE	48
3 Hunter Street	2	640	GF	E	51
3 Hunter Street	2	640	F 1	E	51
3 Margaret Street	2	662	GF	E	48
3 Margaret Street	2	662	F 1	E	48
3 Mayfield Avenue	2	538	GF	E	52
3 Mayfield Avenue	2	538	F 1	E	52
3 Mount Morris Street	2	515	GF	E	54
3 Mount Morris Street	2	515	F 1	E	55
3 The Point Road	2	651	GF	E	50
3 The Point Road	2	651	F 1	E	51
30 The Point Road	2	621	GF	S	43
30 The Point Road	2	621	F 1	S	48
31-33 The Point Road	2	523	GF	S	53
31-33 The Point Road	2	523	F 1	S	53
32 The Point Road	2	620	GF	S	43
32 The Point Road	2	620	F 1	S	49
34 The Point Road	2	619	GF	S	52
34 The Point Road	2	619	F 1	S	54
35 The Point Road	2	522	GF	S	53
35 The Point Road	2	522	F 1	S	53
36 The Point Road	2	618	GF	S	55
36 The Point Road	2	618	F 1	S	55
37 The Point Road	2	521	GF	S	39
37 The Point Road	2	521	F 1	S	45
37A The Point Road	2	520	GF	S	54

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 37-42 dB(A)					
Clearly audible: 42-52 dB(A)					
Moderately intrusive: 52-62 dB(A)					
Highly Intrusive: >62 dB(A)					
37A The Point Road	2	520	F 1	S	54
37B The Point Road	2	519	GF	S	54
37B The Point Road	2	519	F 1	S	54
38 The Point Road	2	617	GF	S	44
38 The Point Road	2	617	F 1	S	49
39 The Point Road	2	518	GF	S	54
39 The Point Road	2	518	F 1	S	55
42 The Point Road	2	616	GF	S	44
42 The Point Road	2	616	F 1	S	47
43 The Point Road	2	517	GF	S	55
43 The Point Road	2	517	F 1	S	55
44 The Point Road	2	615	GF	S	48
44 The Point Road	2	615	F 1	S	51
45 The Point Road	2	513	GF	E	52
45 The Point Road	2	513	F 1	E	52
46 The Point Road	2	614	GF	S	52
46 The Point Road	2	614	F 1	S	54
47 The Point Road	2	511	GF	E	52
47 The Point Road	2	511	F 1	E	52
47A The Point Road	2	510	GF	SE	51
47A The Point Road	2	510	F 1	SE	51
48 The Point Road	2	613	GF	S	53
48 The Point Road	2	613	F 1	S	54
49 The Point Road	2	509	GF	SE	50
49 The Point Road	2	509	F 1	SE	50
5 Gale Street	2	644	GF	E	50
5 Gale Street	2	644	F 1	E	51
5 Hunter Street	2	639	GF	E	51
5 Hunter Street	2	639	F 1	E	51
5 Mayfield Avenue	2	539	GF	E	52
5 Mayfield Avenue	2	539	F 1	E	52
5 Mount Morris Street	2	516	GF	SE	55
5 Mount Morris Street	2	516	F 1	SE	55
5 The Point Road	2	652	GF	E	49
5 The Point Road	2	652	F 1	E	50
50 The Point Road	2	612	GF	SE	50
50 The Point Road	2	612	F 1	SE	52
52 The Point Road	2	611	GF	SE	51
52 The Point Road	2	611	F 1	SE	51
53 The Point Road	2	508	GF	SE	48
53 The Point Road	2	508	F 1	SE	49
54 The Point Road	2	610	GF	S	48
54 The Point Road	2	610	F 1	S	51
55-57 The Point Road	2	507	GF	SE	44
55-57 The Point Road	2	507	F 1	SE	44
56 The Point Road	2	609	GF	S	43
56 The Point Road	2	609	F 1	S	50
5-7 Margaret Street	2	663	GF	E	48
5-7 Margaret Street	2	663	F 1	E	48
58 The Point Road	2	608	GF	S	46
59 The Point Road	2	506	GF	SE	41
59 The Point Road	2	506	F 1	SE	41
6 The Point Road	2	632	F 1	S	47
60 The Point Road	2	607	GF	S	40
61-63 The Point Road	2	505	GF	SE	41
61-63 The Point Road	2	505	F 1	SE	41
62 The Point Road	2	606	GF	S	36

Receiver	NCA	Obj.-No.	Fl	Dir	Scenario 5
Noticeable: 37-42 dB(A)					
Clearly audible: 42-52 dB(A)					
Moderately intrusive: 52-62 dB(A)					
Highly Intrusive: >62 dB(A)					
62a The Point Road	2	605	GF	S	35
64 The Point Road	2	604	GF	E	40
64 The Point Road	2	604	F 1	E	41
65 The Point Road	2	504	GF	SE	40
65 The Point Road	2	504	F 1	SE	41
67 The Point Road	2	503	GF	S	39
67 The Point Road	2	503	F 1	S	40
68 The Point Road	2	602	GF	SW	35
68 The Point Road	2	602	F 1	SW	35
69 The Point Road	2	502	GF	S	39
69 The Point Road	2	502	F 1	S	39
7 Gale Street	2	645	GF	E	51
7 Gale Street	2	645	F 1	E	51
7 Hunter Street	2	638	GF	E	46
7 Hunter Street	2	638	F 1	E	51
7 Mayfield Avenue	2	540	GF	E	52
7 Mayfield Avenue	2	540	F 1	E	52
7 The Point Road	2	643	GF	E	51
7 The Point Road	2	643	F 1	E	51
71 The Point Road	2	501	GF	SE	38
71 The Point Road	2	501	F 1	SE	38
73 The Point Road	2	499	GF	S	38
73 The Point Road	2	499	F 1	S	38
75 The Point Road	2	498	GF	E	37
75 The Point Road	2	498	F 1	E	37
77 The Point Road	2	500	GF	E	33
77 The Point Road	2	500	F 1	E	34
77 Woolwich Road	2	668	GF	E	48
77 Woolwich Road	2	668	F 1	E	48
7A The Point Road	2	536	GF	S	46
7A The Point Road	2	536	F 1	S	52
8 The Point Road	2	631	F 1	S	52
9 Hunter Street	2	635	GF	E	52
9 Hunter Street	2	635	F 1	E	52
9 Margaret Street	2	664	GF	E	48
9 Margaret Street	2	664	F 1	E	48
9 Mayfield Avenue	2	541	GF	E	52
9 Mayfield Avenue	2	541	F 1	E	52
9 The Point Road	2	535	GF	SE	48
9 The Point Road	2	535	F 1	SE	51
Clarkes Point Reserve	2	496	GF		53
Clarkes Point Reserve	2	496	F 1		53
Cockatoo Island Biloela Lawn Building	2	673	GF	NE	50
Cockatoo Island Biloela Lawn Building	2	673	F 1	NE	50
Cockatoo Island Camp Site	2	677	GF		50
Cockatoo Island Camp Site	2	677	F 1		50
Cockatoo Island Visitor Centre	2	674	GF	NE	50
Cockatoo Island Visitor Centre	2	674	F 1	NE	50
Cockatoo Island Wharf Building	2	671	GF	E	51
Scout Hall The Point Road	2	601	GF	SE	33
Woolwich Pier Hotel 1 Woolwich Road	2	655	GF	E	50
Woolwich Pier Hotel 1 Woolwich Road	2	655	F 1	E	50

Greenwich Point
Wharf Upgrade

APPENDIX C

PREDICTED CONSTRUCTION NOISE IMPACTS – NOISE CONTOUR MAPS

Cardno
Shaping the Future

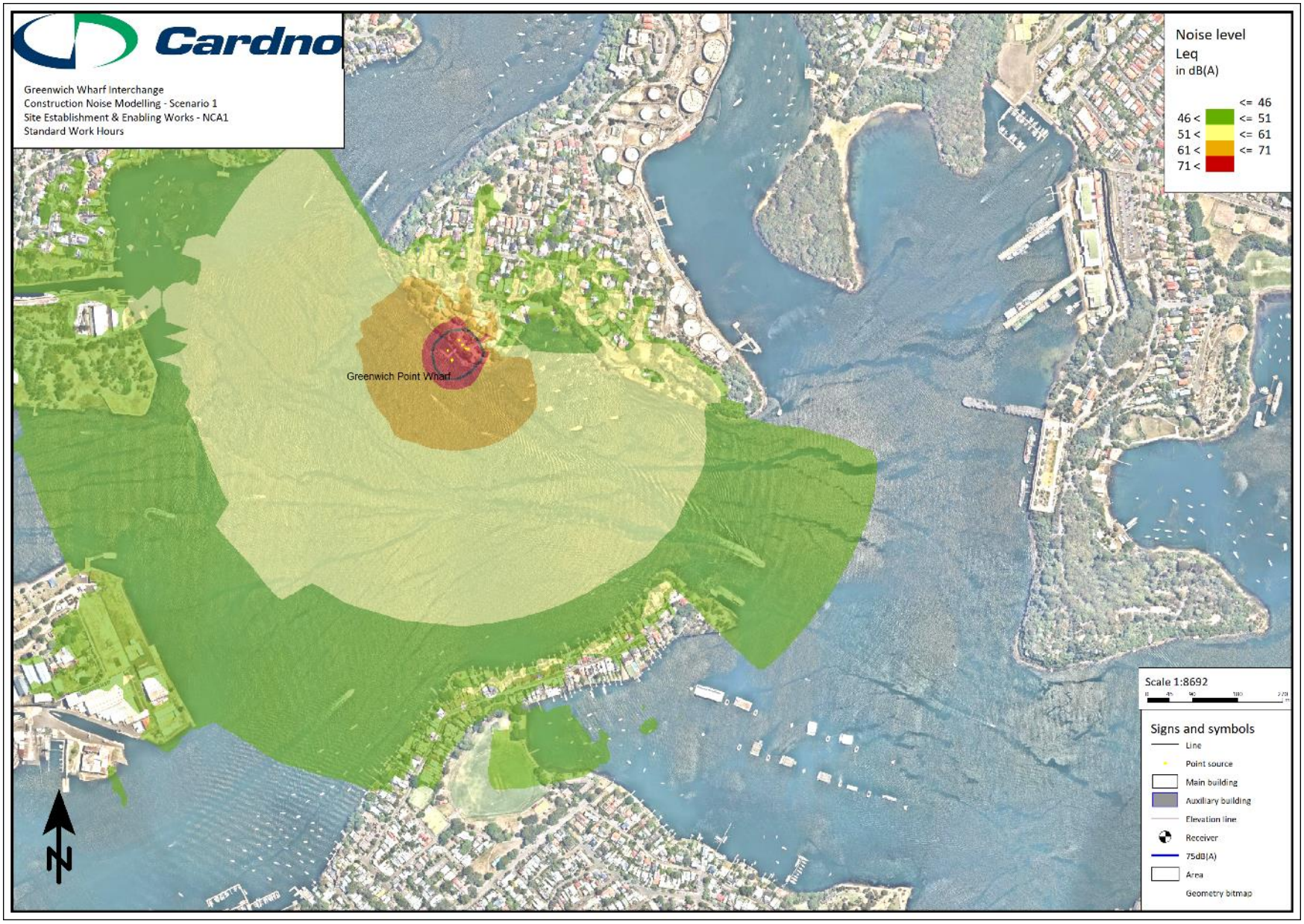


Figure C1 Predicted construction noise scenario 1 – Site establishment and enabling works, NCA1 ground level – Standard hours

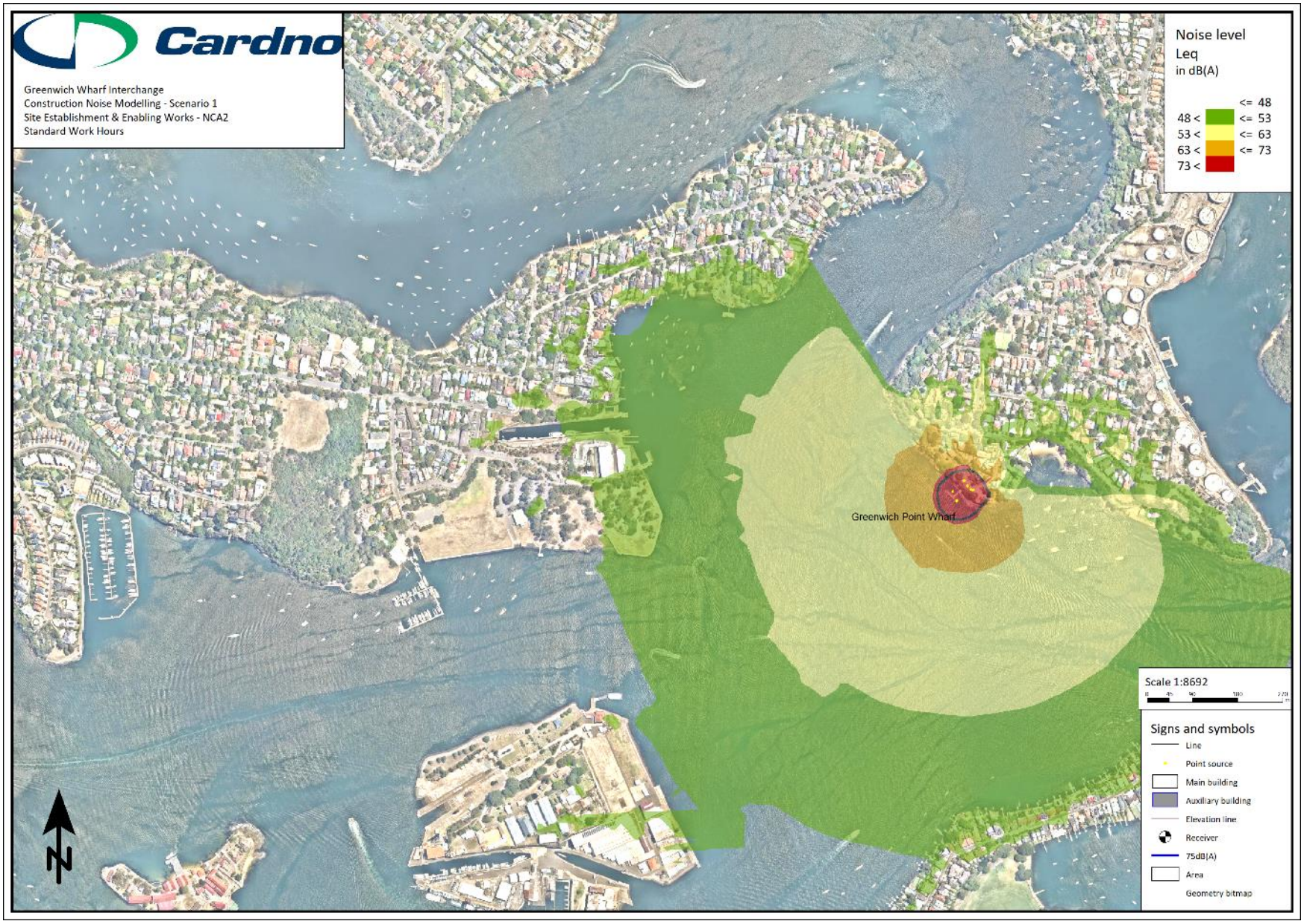


Figure C2 Predicted construction noise scenario 1 – Site establishment and enabling works, NCA2 ground level – standard hours

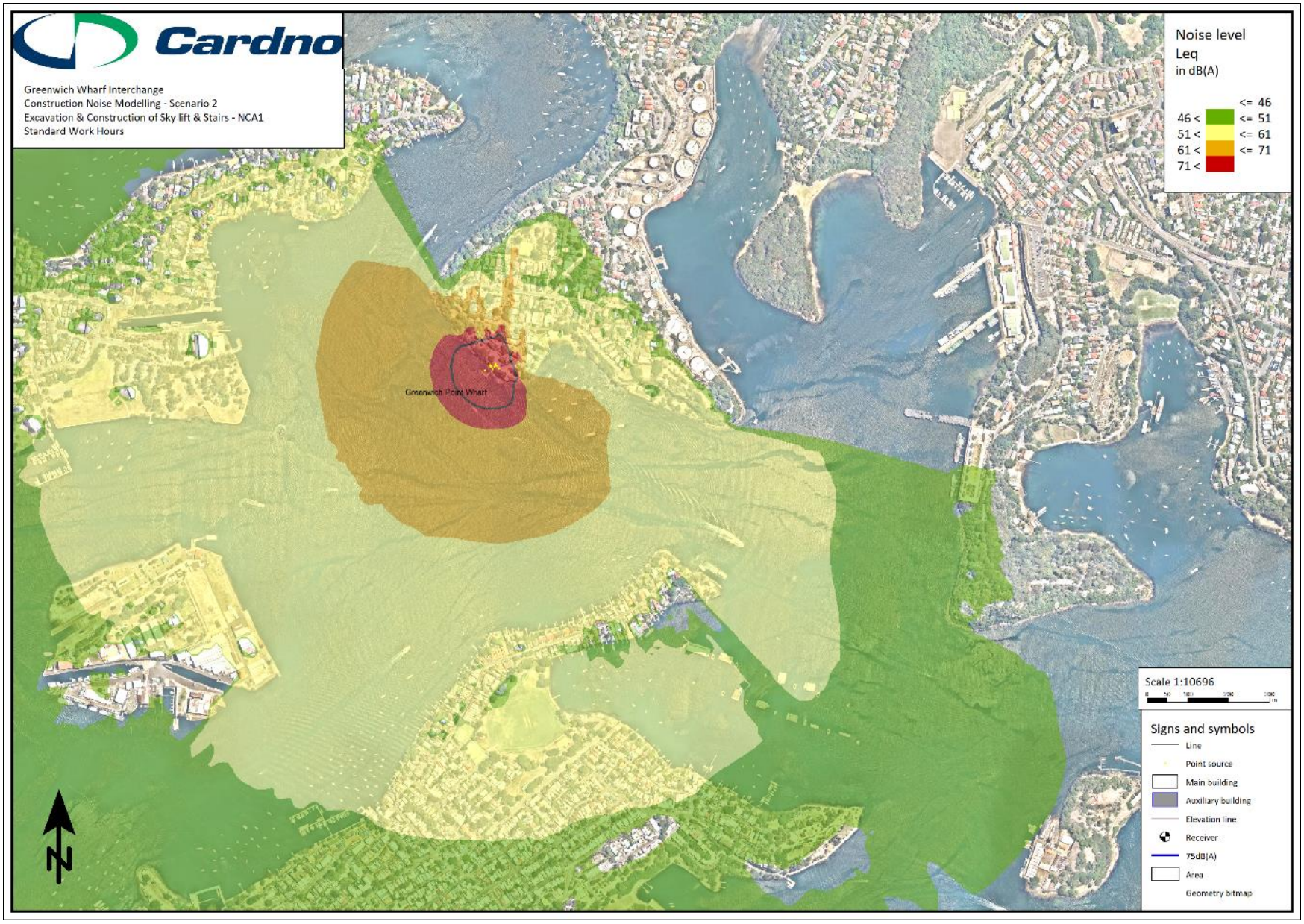


Figure C3 Predicted construction noise scenario 2 – Excavation and construction of skybridge, lift and stairs, NCA1 ground level – Standard hours

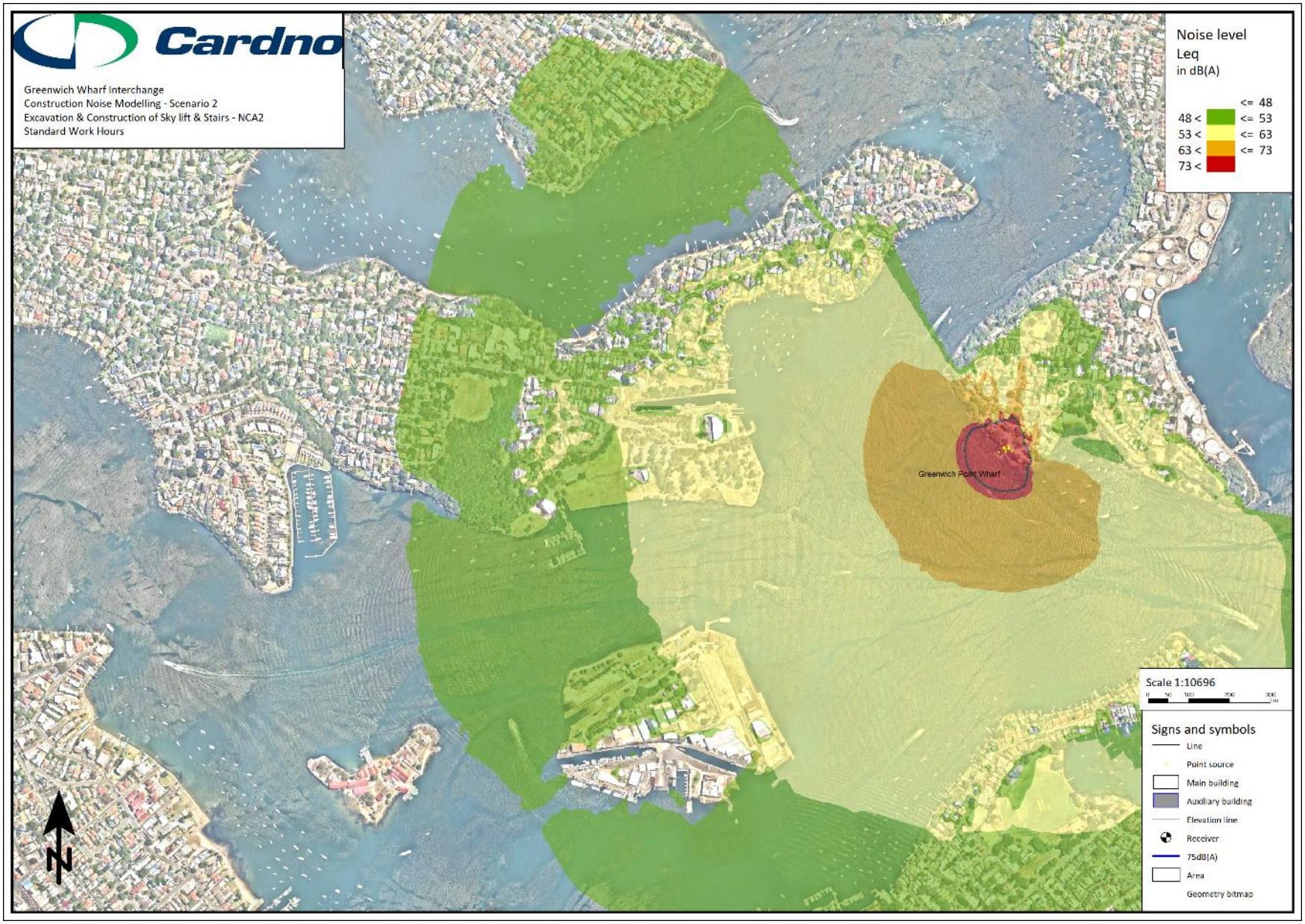


Figure C4 Predicted construction noise Scenario 2 – Excavation and construction of skybridge, lift and stairs, NCA2 ground level – Standard hours

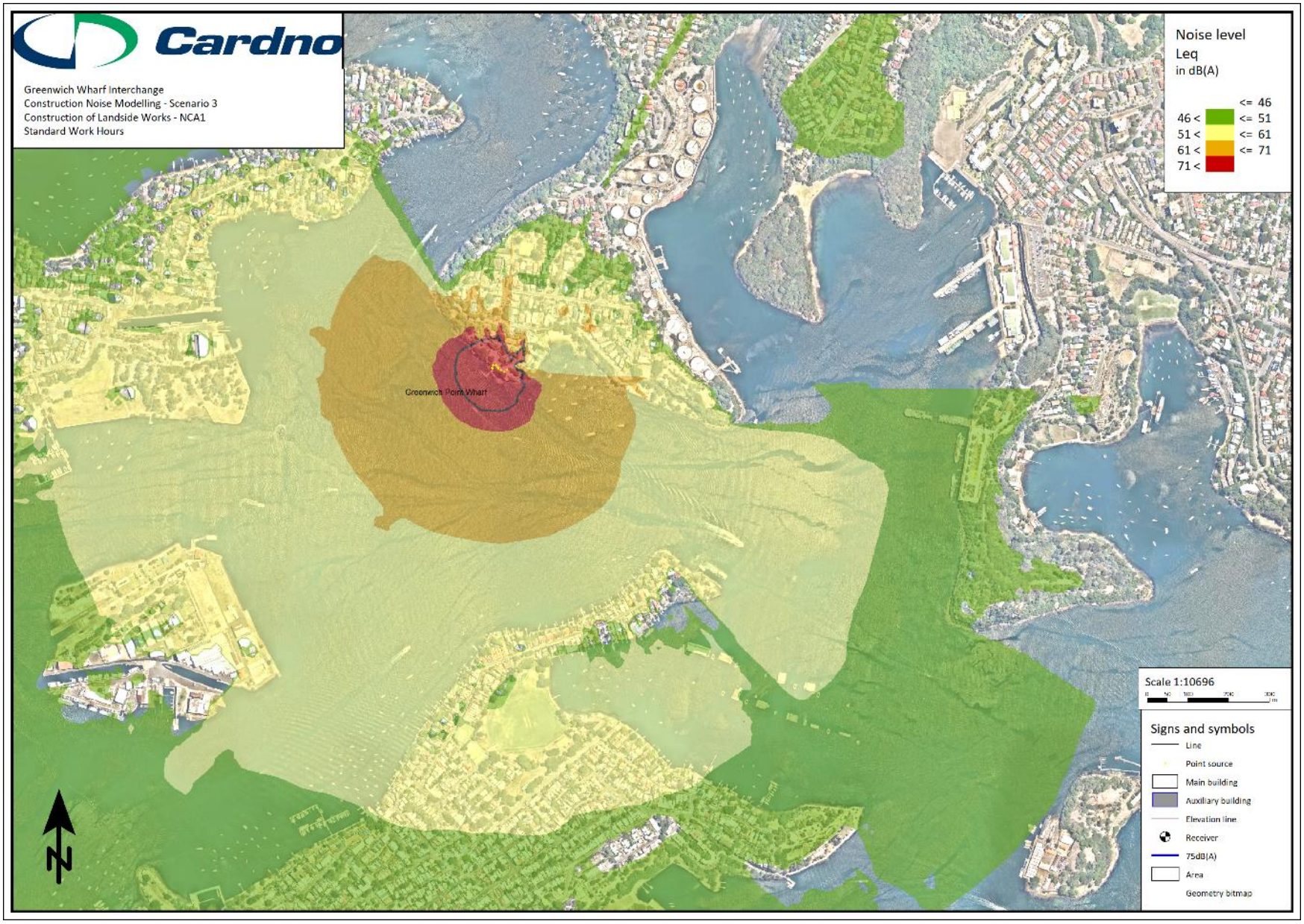


Figure C5 Predicted construction noise Scenario 3 – Construction of landside works, NCA1 ground level – Standard hours

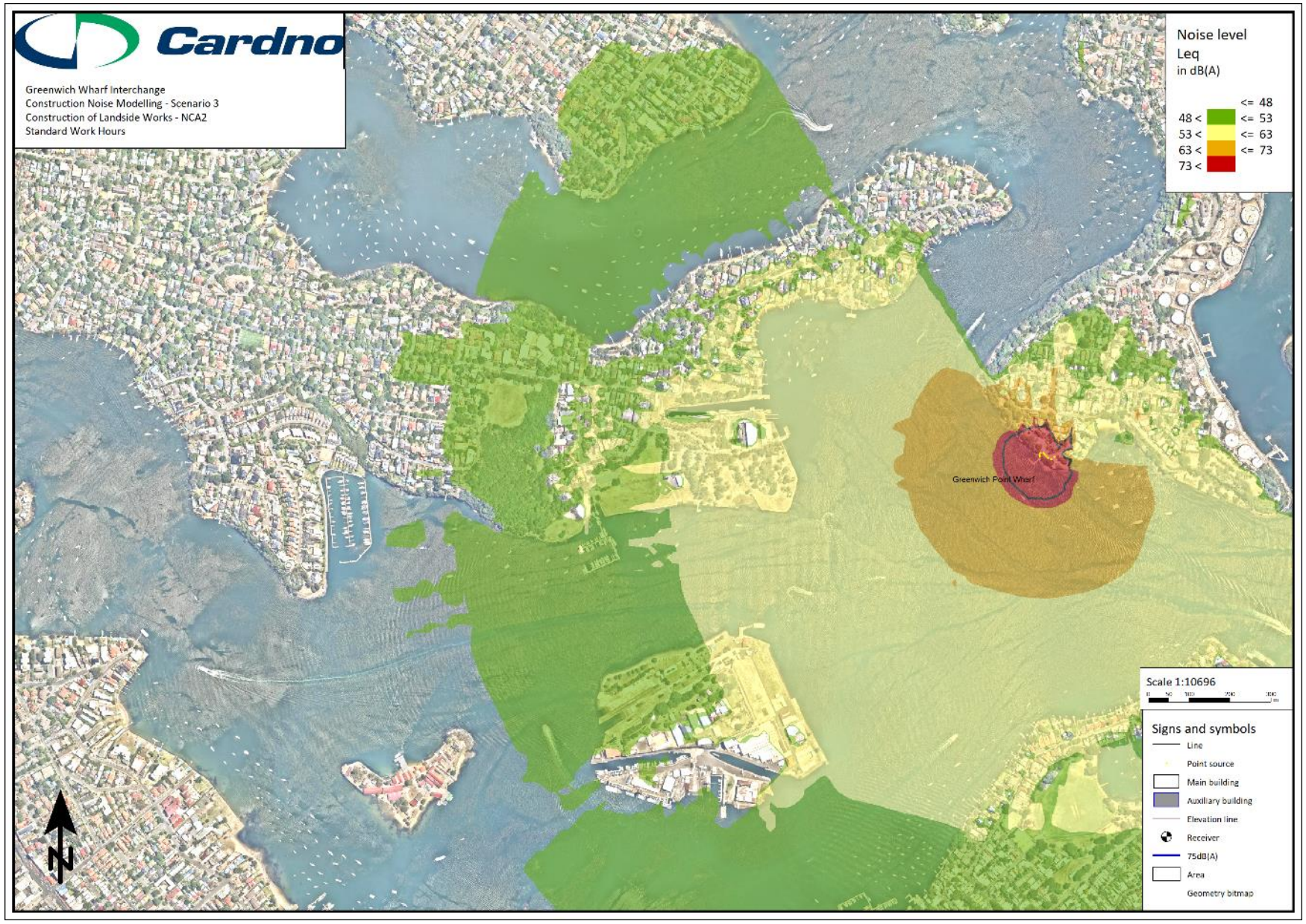


Figure C6 Predicted construction noise scenario 3 – Construction of landside works, NCA2 ground level – Standard hours

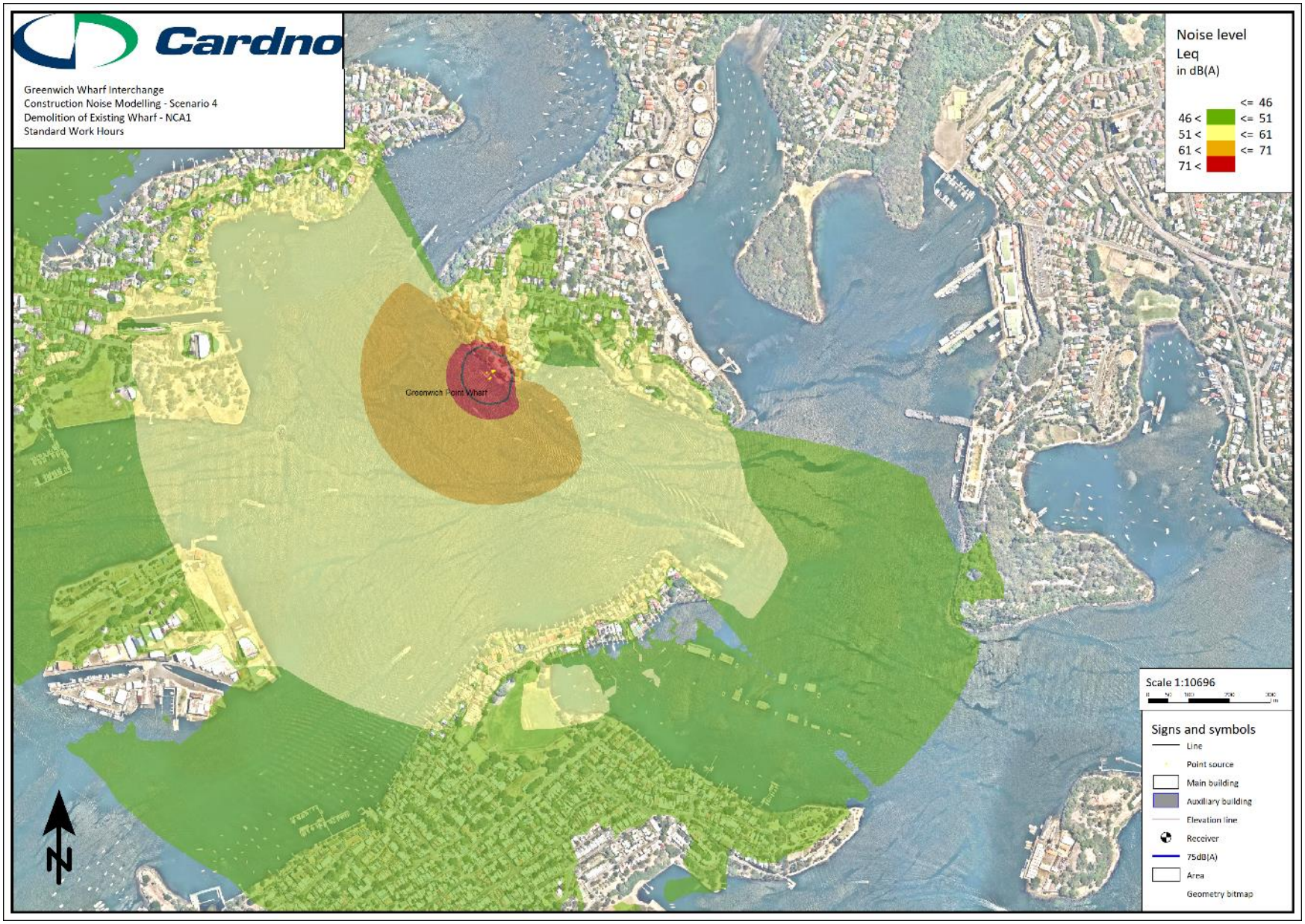


Figure C7 Predicted construction noise Scenario 4 – Demolition of existing wharf, NCA1 ground level – Standard hours

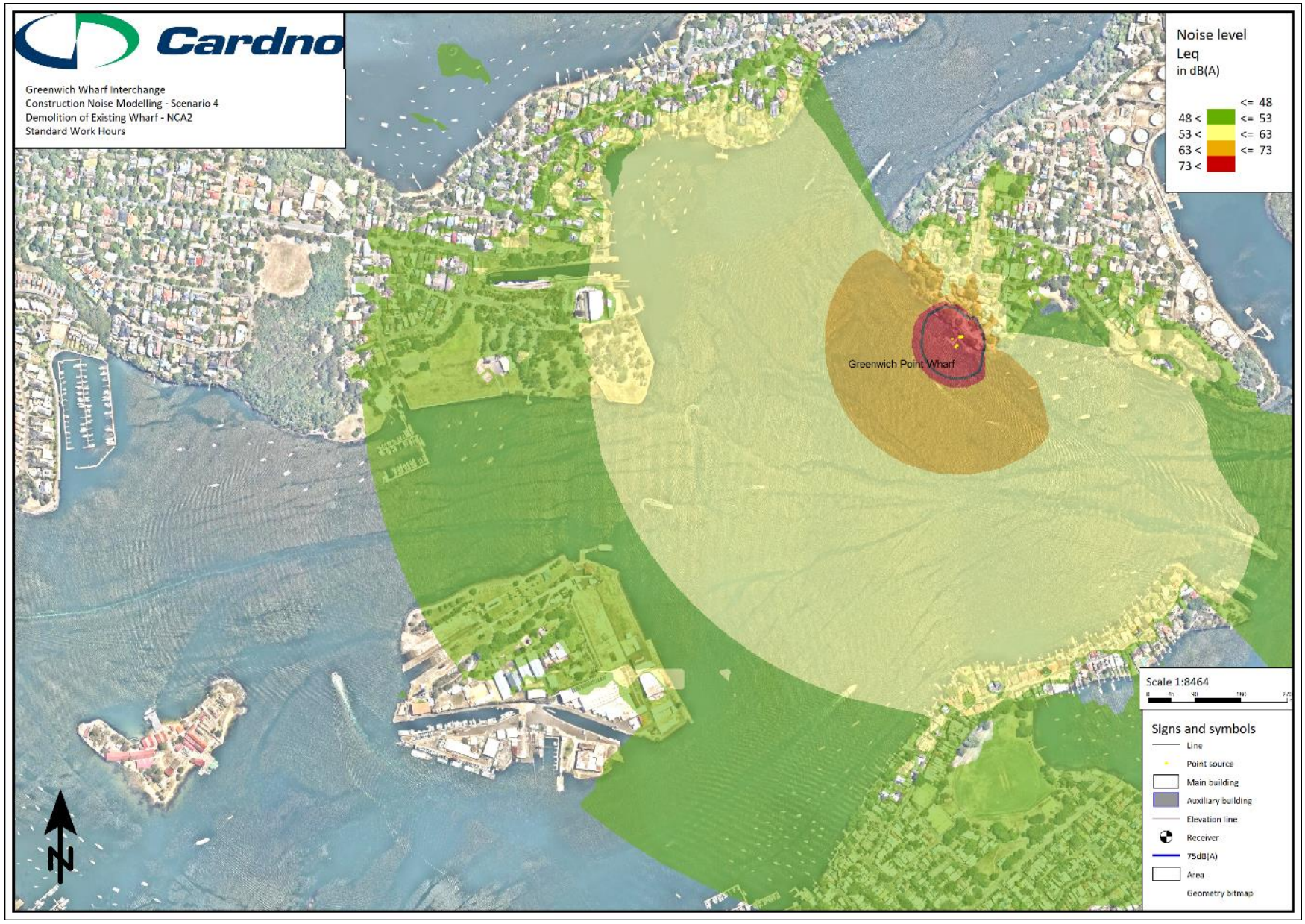


Figure C8 Predicted construction noise Scenario 4 – Demolition of existing wharf, NCA2 ground level – Standard hours

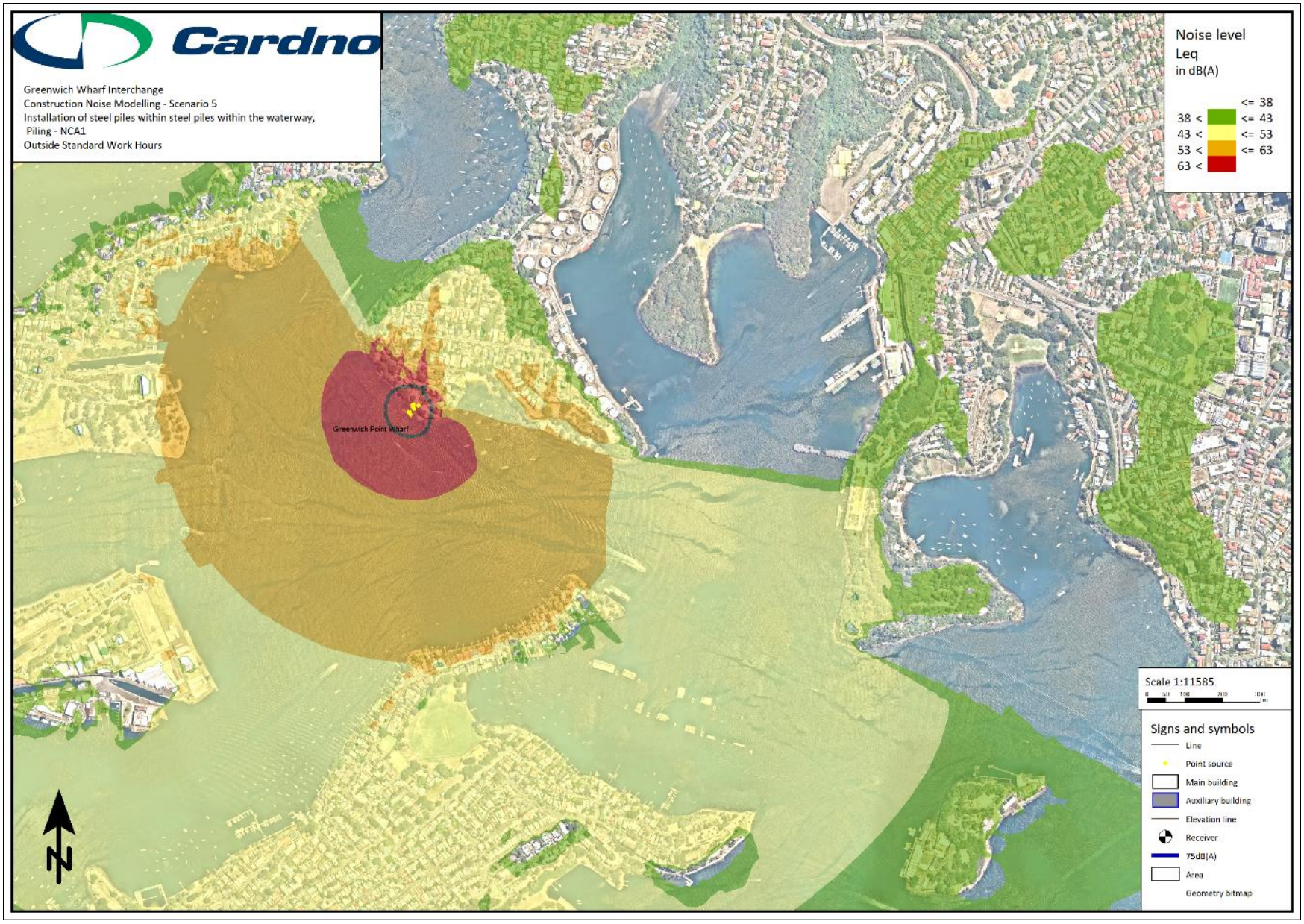


Figure C9 Predicted construction noise Scenario 5 – Installation of steel piles within the waterway, NCA1 ground level – Non-standard hours

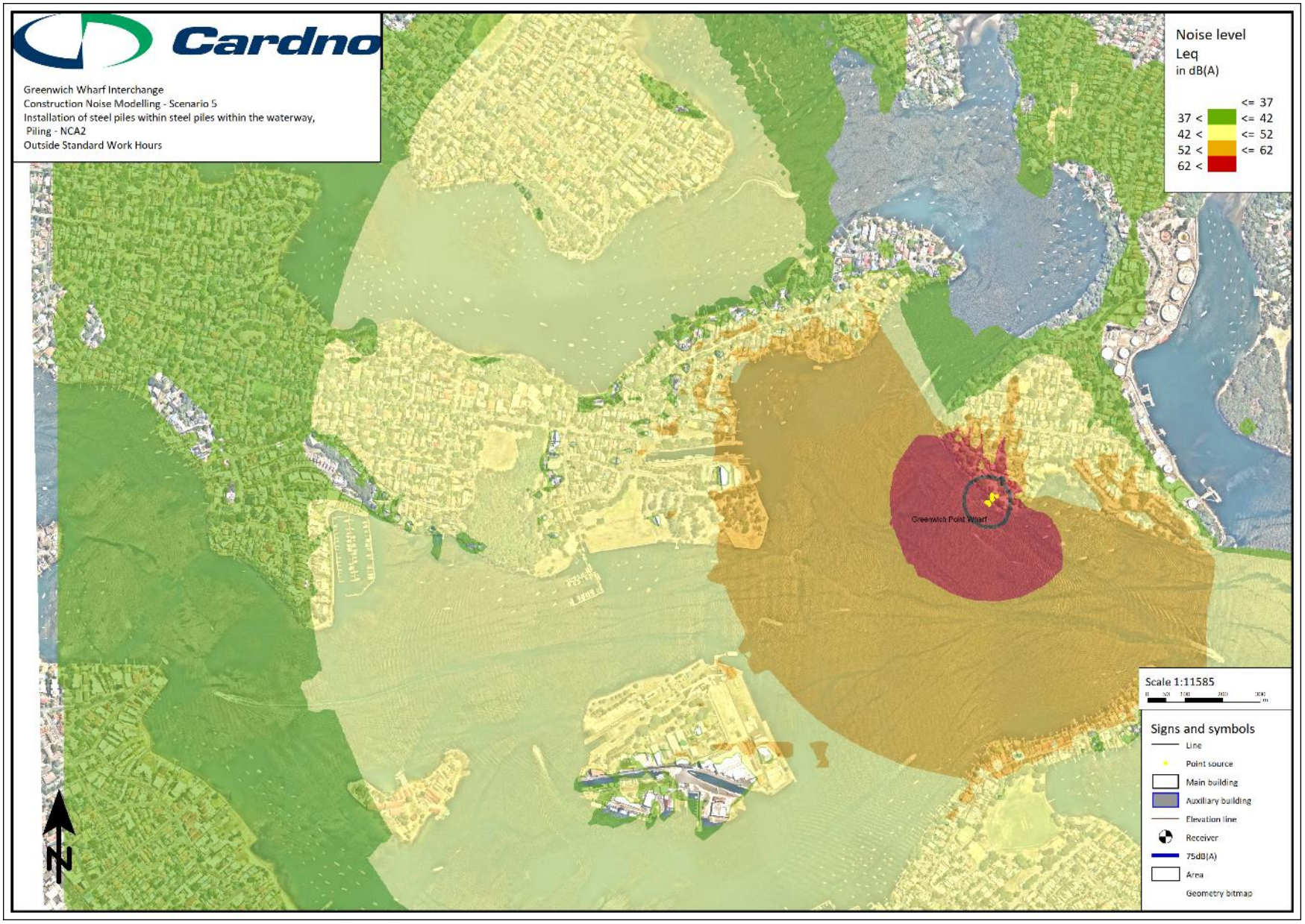


Figure C10 Predicted construction noise Scenario 5 – Installation of steel piles within the waterway, NCA1 ground level – Non-standard hours

Appendix F

Landscape character and visual impact assessment

Landscape Character and Visual Impact Assessment

Greenwich Point Wharf Upgrade

AWE200198

Prepared for
Transport for NSW

30 November 2021

Cardno

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards NSW 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9439 5170

Document Information

Prepared for	Transport for NSW
Project Name	Greenwich Point Wharf Upgrade
File Reference	AWE200198_R406_Rev0_Greenwich Point_LCVIA.docx
Job Reference	AWE200198
Date	30 November 2021
Version Number	Rev 0

Author(s):

Kiera Plumridge	Nadine Page
Environmental Planner	Senior Planner

Approved By:

Nadine Page	
Senior Planner	

Effective Date	30/11/2021
Date Approved	30/11/2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
Rev A	21 April 2021	Draft for client review	Kiera Plumridge	Nadine Page
Rev B	16 September 2021	Draft for client review (incorporating new design)	Nadine Page	Nadine Page
Rev C	11 October 2021	Final draft for client review	Nadine Page	Nadine Page
Rev 0	30 November 2021	Final report	Nadine Page	Nadine Page

© Cardno. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

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.

Table of Contents

Tables

Figures

1 Introduction

Transport for NSW has engaged Cardno (NSW/ACT) Pty Ltd (Cardno) to undertake an environmental assessment to upgrade the Greenwich Point 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 Transport for NSW 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 Transport for NSW as part of the Review of Environmental Factors (REF) for the Greenwich Point 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 vantage 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* (TfNSW, 2020b). The guideline establishes the assessment tasks for a landscape character and visual assessment which are:

- 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 Greenwich Point 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:

- Installation of a new three metre wide by 22 metre long concrete jetty, supported by eight new piles
- Installation of a new, uncovered 18 metre long by 2.5 metre wide gangway to provide access to the new pontoon
- Installation of a new covered steel nine metre by 18 metre pontoon containing a curved zinc roof supported by steel columns, glass weather protection, stainless steel balustrades, seating and information boards. The pontoon would be supported by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of new signage, information boards and opal card readers
- Installation of safety and security features including a help point, lighting, closed circuit television (CCTV) cameras, ladders to the water, a life buoy and tactile ground surface indicators where required
- Removal of the existing waiting shelter, jetty and tidal stairs including associated piles.

2.2.2 Landside design

The land based features of the proposal would include:

- Construction of a 9.8 metre long skybridge from the approximate location of the existing bus shelter on Lower Serpentine Road, connecting the existing footpath to the proposed lift
- Relocation of the existing bus shelter on Lower Serpentine Road approximately three metres to the east to accommodate new skybridge entrance
- Construction of a 12 metre high lift that connects the proposed skybridge to the wharf level. Five metres of the lift would be visible from street level
- Regrading of pavement at street level and wharf level to create the entry/exit points of the skybridge, stairs and lift
- Replacement of the existing non *Disability Discrimination Act 1992* (DDA) compliant stairs with DDA compliant stairs connecting Lower Serpentine Road and the new wharf, near the proposed lift. The new stairs would use part of the existing stair footprint on Lower Serpentine Road, which currently connects Mary Carlson Park to wharf level
- Partial excavation of the embankment to provide room for the new stairs connecting at the western side of the existing bus shelter
- Installation of three bicycle hoops
- Replacement of balustrades and handrail at wharf level
- Electrical work including relocation of existing electrical switchboard cabinet at wharf level, removal of two existing power poles and placing existing electrical overhead wires underground

> Pruning of fig trees to accommodate the new skybridge, stairs and lift

> Retention of the current existing ramp near Greenwich Park connecting road level to the foreshore.

Key features of the proposal including the water-based and land-based features are shown on Figure 2-1.

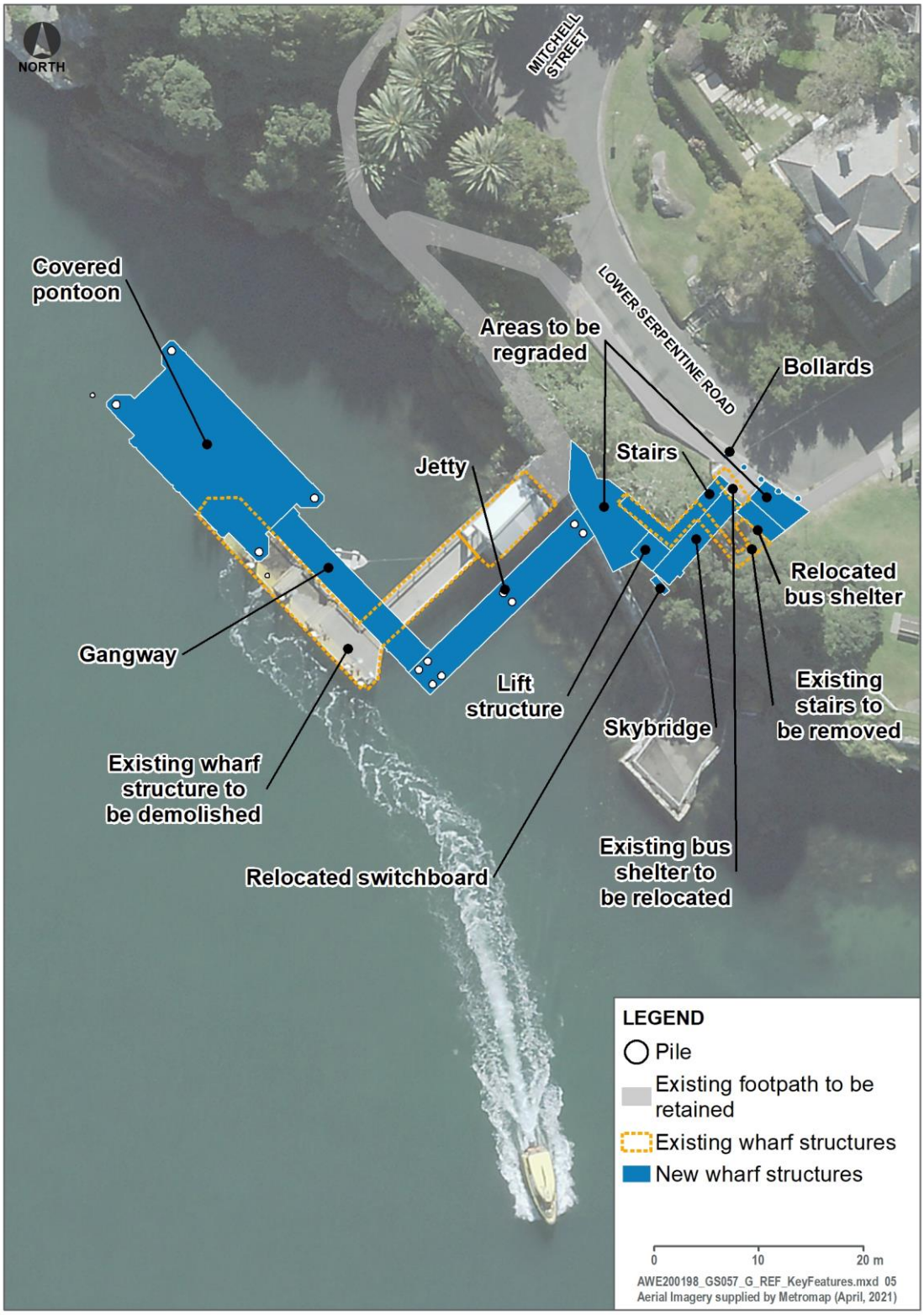


Figure 2-1 Key features of the proposal

2.3 Study area

Figure 2-2 identifies the Study Area of the LCVIA.

Figure 2-2 Study Area (defined by the proposal area)

3 Planning context

3.1 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 W8 Scenic Waters: Passive Use. The objectives of the W8 zone are:

(a) To give preference to unimpeded public access along the intertidal zone, to the visual continuity and significance of the landform and to the ecological value of waters and foreshores,

(b) To allow low-lying private water-dependent development close to shore only where it can be demonstrated that the preferences referred to in objective (a) above are not damaged or impaired in any way, that any proposed structure conforms closely to the shore, that development maximises open and unobstructed waterways and maintains and enhances views to and from waters in this zone,

(c) To restrict development for permanent boat storage and private landing facilities in unsuitable locations,

(d) To allow water-dependent development only where it can be demonstrated that it meets a demonstrated demand and harmonises with the planned character of the locality,

(e) To ensure that the scale and size of development are appropriate to the locality and protect and improve the natural assets and natural and cultural scenic quality of the surrounding area, particularly when viewed from waters in this zone or areas of public access.

Additionally, the Study Area is located within the Foreshores and Waterways Area and Wetland Protection Areas under the Sydney Harbour SREP.

3.2 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 Greenwich Point wharf is identified as Landscape Character Type 9 and the Statement of Character and Intent is as follow:

> *These areas are significant because they contain natural foreshores interspersed with more developed areas and provide a key feature and visual variety to the total landscape. The natural shoreline has significant visual features. However, it is also developed with swimming pools, retained edges and boat sheds. Sections of vegetated skyline have been preserved. The intent is to retain these natural features and only encourage development that is consistent with the scale, design and siting of that which exists.*

An assessment of the performance criteria is provided in Table 3-1.

Table 3-1 Landscape character assessment

Performance Criteria	Comments
It is sited so remaining rock outcrops, cliff lines or vegetated shorelines are protected and not obscured	Rock outcrops and vegetated shorelines are protected and would be minimally impacted by the proposed wharf/pontoon. The stairs and lift structure would impact on and obscure vegetation on the shoreline and rock cliff edge as these are located harbourside.
It is sited to ensure that the continuous line of any natural feature is preserved and remains the dominant feature in the landscape	The proposal would introduce new forms to the existing view (stair and lift) and would interrupt the continuous line of natural features along the steep shoreline. However, this is a minor proportion of the landscape precinct. The wharf facilities would not impact on the landscape.

Performance Criteria	Comments
It is sited and designed to maintain the vegetation cover on the upper slopes and ridgelines	Pruning of fig trees is required to accommodate the lift, stairs and sky bridge. No tree removal is proposed.
Major points and entrances to the bays are preserved in their natural state	The proposal would occur in the same general location of the existing wharf and would not introduce additional impacts to the natural state of major points or entrances to the bays.
Existing character, natural, cultural and heritage features of the islands are retained	While Greenwich Point is not an island (this criteria), it is noted that the vegetated foreshore is significant to the character of the foreshore and Greenwich Conservation Area. The proposal minimises vegetation removal (limited to pruning of fig trees), While the lift structure would be a new element, the design of the wharf structure has been conscious of minimising impacts to heritage items as much as possible.
Colours should match native vegetation as closely as possible with trim colours drawn from natural elements such as tree trunks and stone.	The lift and stair structures would likely be constructed using predominantly glazing, steel and concrete materials. It is recommended the materiality reflect the natural tones of the natural elements of the landscape backdrop.

3.2.2 Lane Cove Local Environmental Plan 2009

The wharf is located within the Lane Cove local government area (LGA). Therefore, consideration of the *Lane Cove Local Environmental Plan 2009* (Lane Cove LEP) is required.

3.2.3 Zoning

The land based portion of the Study Area is zoned as RE1 - Public Recreation, R2 - Low Density Residential and UL- Unzoned land under the Lane Cove LEP as shown on Figure 3-1.

The objectives of the RE1 zone are as follows:

- To enable land to be used for public open space or recreational purposes
- To provide a range of recreational settings and activities and compatible land uses
- To protect and enhance the natural environment for recreational purposes
- To make provision for rights of public access to more foreshore land and to link existing open space areas.

The objectives of the R2 zone are as follows:

- To provide for the housing needs of the community within a low density residential environment
- To enable other land uses that provide facilities or services to meet the day to day needs of residents
- To retain, and where appropriate improve, the existing residential amenity of a detached single family dwelling area
- To encourage new dwelling houses or extensions of existing dwelling houses that are not highly visible when viewed from the Lane Cove River or Parramatta River
- To ensure that landscaping is maintained and enhanced as a major element in the residential environment.

For the UL Unzoned Land consideration must be given to the objectives for development in the zones of the adjoining land.

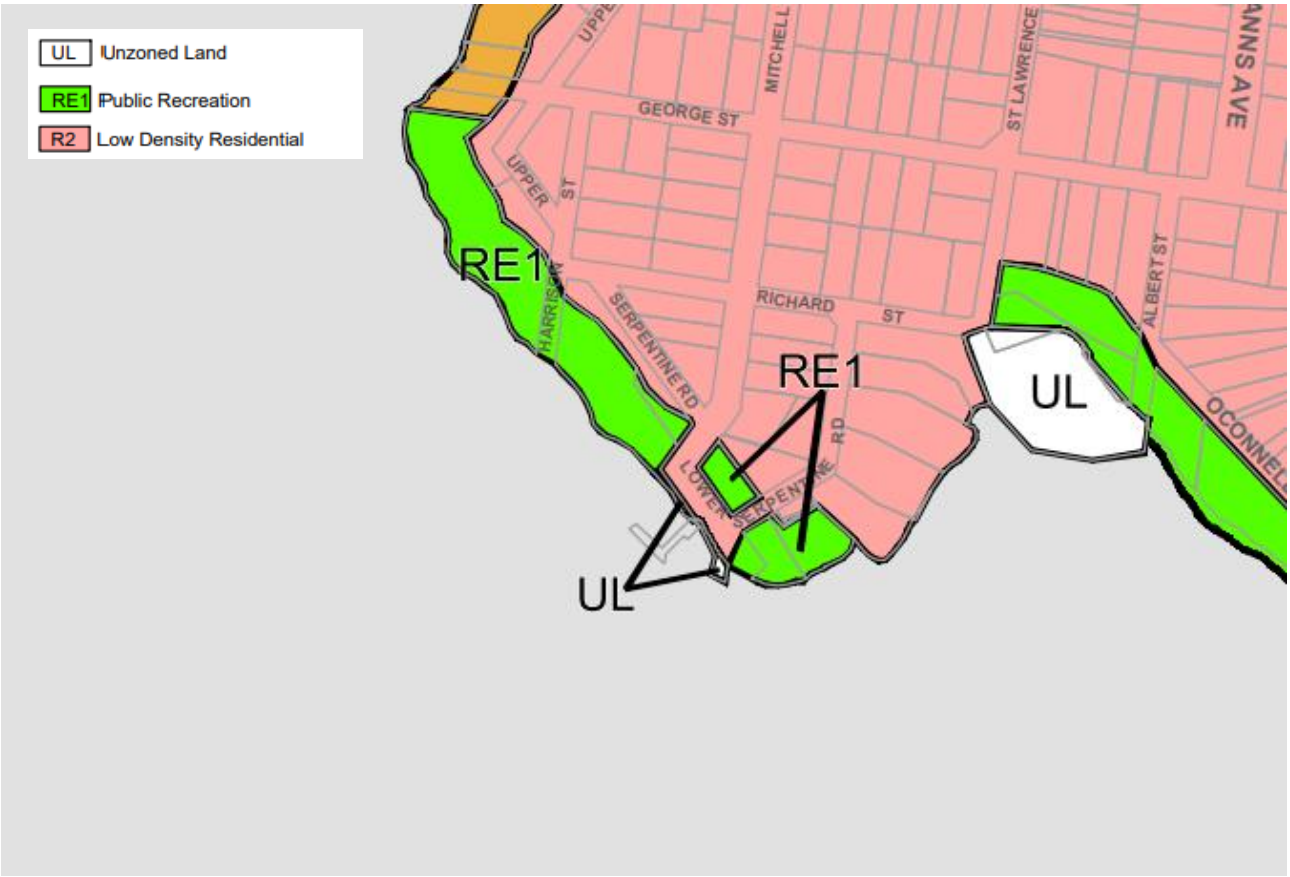


Figure 3-1 Extract *Lane Cove Local Environmental Plan 2009* – Land Zoning Map (Sheet LZN-004)

The proposal would be consistent with the objectives of the above zones and with the adjoining zones that are relevant to landscape character or visual amenity.

3.2.4 Heritage conservation

According to the Lane Cove LEP, the following local heritage items are located within the proposal area:

- Item I130 - Greenwich Point wharf
- Item I64 - Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall), located at Greenwich Point (various streets)
- C1 - Greenwich Conservation Area.

The following local heritage items are also located within 100 metres of the proposal area:

- Item I110 – House, located at 18 Mitchell Street
- Item I111 - Buena Vista, 23 Mitchell Street
- Item I131 - Stone steps to rear of house, located at 36 Serpentine Road
- Item I132 – Stone sea wall, 40 Serpentine Road
- Item I133 - Rockleigh, 44 Serpentine Road.

The locations of the heritage items are shown on Figure 3-2.

Figure 3-2 Extract *Lane Cove Local Environmental Plan 2009* – Heritage Map (Sheet HER-004)

3.2.5 Lane Cove Development Control Plan 2010

The land based works would occur within the locally listed heritage Greenwich Heritage Conservation Area (HCA), which is listed as Locality 5 within Part C – Residential Localities of the Lane Cove Development Control Plan 2010 (Lane Cove DCP).

The locality has the following general objectives:

- Retain and conserve the heritage significance and significant characteristics of the HCA
- Allow removal/alteration of uncharacteristic features that detract from the significance of the HCA
- Retain and conserve heritage items
- Retain the significant landscaped characteristics of the HCA, including the garden setting of residences, enhanced by street planting, grass verges, stone walls and fences, natural features such as the 'live rock' sandstone outcrops, and the exotic and indigenous vegetation that permeates the area
- Encourage the restoration of heritage items that have been unsympathetically altered
- Ensure that development is compatible with the heritage significance and significant characteristics of the HCA. Development should respect the principles contained in The Burra Charter
- The diversity of architectural forms and differentiation of layers of historical development should be recognised in the built fabric of the Conservation Area
- Modern architectural design of high standard is encouraged, provided it is compatible with the traditional forms of the Conservation Area, and it can be demonstrated by a Heritage Impact Statement (HIS) that positive impact will arise in relation to significant elements.

4 Existing context

4.1 Location

Greenwich Point wharf is situated on a peninsula on Sydney Harbour near the confluence of the Lane Cove and Parramatta Rivers. The wharf is accessed from Mitchell Street and Lower Serpentine Road. The location of the wharf is shown in Figure 4-1 and Figure 4-2.

The wharf is situated approximately 4.3 kilometres (by water) and approximately 10.7 kilometres (by road) from the Sydney CBD.

The wharf is situated on the F8 Circular Quay to Cockatoo Island, which provides connections between Circular Quay, Balmain, Birchgrove, Greenwich Point, Woolwich, and Cockatoo Island.

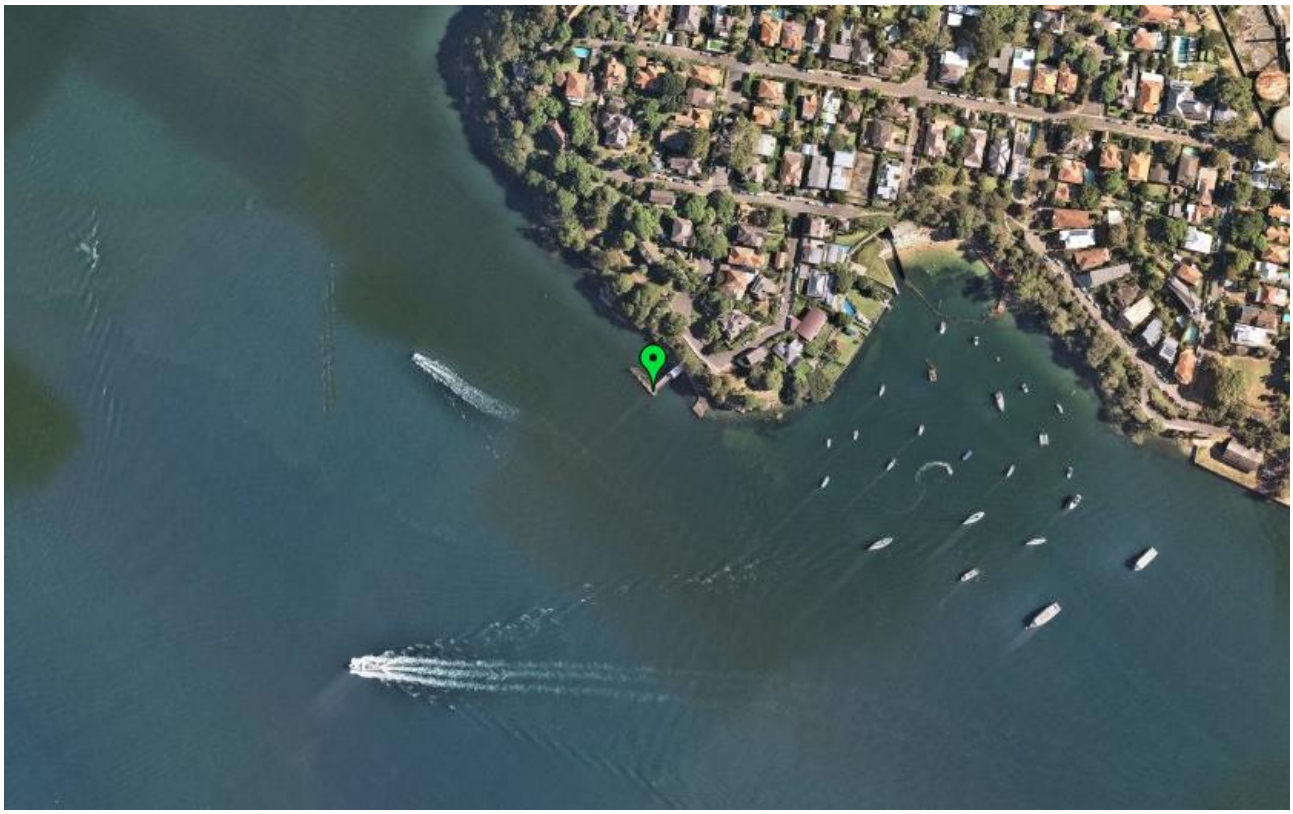


Figure 4-1 Location of Greenwich Point wharf (Source: NearMap)

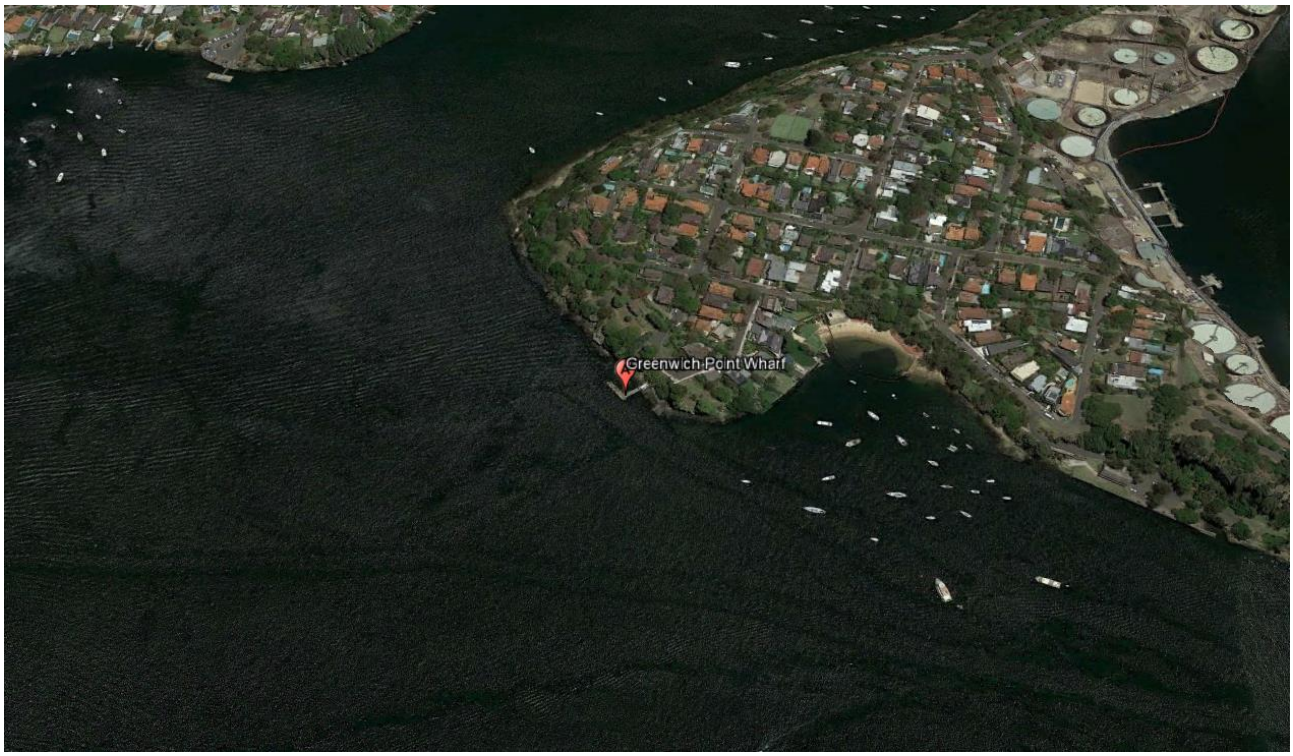


Figure 4-2 Perspective view of Greenwich Point wharf (Source: Google Map)

4.2 Landscape and urban context

The existing Greenwich Point wharf is located immediately south of Lower Serpentine Road, Greenwich, on the peninsula of Greenwich Point on the northern shore of Sydney Harbour. The wharf comprises a jetty structure adjoining the seawall and an access walkway down to a berthing platform which has a single berth on its south-western side, and a waiting area with canopy cover. Paths connect the jetty to the nearest bus stop on Lower Serpentine Road.

Panoramic views are available from this location towards Sydney Harbour and stretch between Woolwich and Birchgrove, and the Sydney CBD beyond. Surrounding visual landscapes include largely vegetated foreshore and recreational areas with residential dwellings interspersed between the mature tree canopies. The historic Cockatoo Island is also visible from Greenwich Point wharf, which sits directly south west of the wharf.

The wharf is surrounded by recreational areas including Greenwich Park and Mary Carlson Park. More broadly, the wharf is located at the end of a wide peninsula with steep grades down to the water. Surrounding land use predominantly comprises of low density detached houses.

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 Greenwich Point 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* (TfNSW, 2020b) 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.*

> *Magnitude refers to the physical scale of the project, how distant it is and the contrast it presents to the existing condition.*

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 Greenwich Point 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 Landscape character impact rating descriptors

Rating	Description
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 Greenwich Point wharf impact, the broader study area has been divided into four 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 Zone	Description *(Adapted from Aurecon, 2019)*	Sensitivity	Magnitude	Landscape Character Impact
Residential slopes	This zone is characterised by a mix of one to two storey residential dwellings. Architectural styles and buildings vary from large federation dwellings, large modern dwellings, Victorian villas to some early cottages with sandstone elements. The terrain generally slopes down from ridgelines to the harbour and Greenwich Point foreshore. Tree lined streets and mature vegetation is interspersed through the residential areas which form a significant part of the appearance of the zone. The land based works would occur within the locally listed heritage Greenwich Conservation Area which has locally significant heritage and landscape characteristics. Low density residential zones are located across the Harbour (Birchgrove to south and Woolwich to the west) comprising waterfront homes on leafy low density properties.	Low to Moderate > The nearby residential zone exhibits a variety of traditional building forms, which generally reflect the historic development of the conservation area. > The proposed upgrades (limited to relocated bus stop, upper part of new lift and stair structure) are located in close proximity to Lower Serpentine Road and would be visible within part of this immediate residential precinct only. The lower parts of the lift and stair structure and wharf infrastructure would not be discernible from the residential areas (similar to existing). > The site would be visible from some residential zones located across the Harbour (Birchgrove and Woolwich) however the distance of these viewpoints to the proposed changes is considered to be negligible to low sensitivity in the landscape.	Low to Moderate > The new wharf facilities would have some impact to the character of the area from the residential dwellings closest to Lower Serpentine Road and Mitchell Street due to additional elements required for accessibility such as the lift and stair structure. > Similar to sensitivity for the residential areas located across the Harbour: the lift and stair structures are relatively increased in magnitude to the existing situation. However the distances viewed toward the site would be relatively imperceptible and hence is a negligible to low rating.	Low to Moderate > The topography from the immediate residential slopes to the wharf location physically separates the proposed design of the lower level covered wharf pontoon and gangway platform and from the residential slopes and residences along Lower Serpentine Road and Mitchell Street. The visibility of the proposed works/structures would be limited to the upper level (lift and stair structure and relocated bus stop) as viewed from the immediate residential zone. While not altering the area's existing character, these are visible new elements. > The proposed works would have negligible to low impact on the landscape character as viewed from the residential zones located across the harbour due to the distance of the viewpoints.

Landscape Character Zone	Description *(Adapted from Aurecon, 2019)*	Sensitivity	Magnitude	Landscape Character Impact
Recreational/vegetated foreshore areas	Grassed recreational spaces and vegetated foreshores are prominent within the landscape character of the area. Large mature trees are evident in the areas which break up the built elements such as the residential slopes from adjoining land uses, such as popular recreational spaces and environmental conservation zones adjacent to the Sydney Harbour. Predominantly located along he foreshore on Greenwich Point on vegetated steeper cliff/foreshore edges. Clarkes Point Reserve to the west across the Harbour is a larger, level recreation area.	Moderate to High > Recreational and vegetated foreshore areas offer significant views of the harbour and provide natural screening for the built up residential and industrial areas around the harbour. > Views to the site: The proposal would be largely located "around the corner" from the majority of foreshore open space on Greenwich Point and therefore would have limited/low or negligible sensitivity and visibility from those areas. The proposed lift structure and slightly relocated bus shelter would have moderate sensitivity and visibility from the western part of the Mary Carlson Park and Greenwich Park. Sensitivity from the foreshore wharf area itself is high. > Low sensitivity from Clarkes Point due to distance.	Moderate to High > The new wharf would have some impact to the character of the immediate recreational and vegetated foreshore due to additional elements required for accessibility such as the prominent covered pontoon and lift and multi-level stair structure at both the upper and lower levels. > Low magnitude rating from Clarke Point Reserve due to distance.	Moderate to High > The visibility of the new wharf structures (land side and water side) are limited as viewed from the recreational/vegetated foreshore areas. The increase in overall size of the wharf infrastructure is a result of the additional elements required for accessibility such as the prominent covered pontoon and lift, and would benefit users of the recreational spaces of Greenwich Point. > Vegetation pruning is required for the lift structure, and would impact on visibility from these immediate recreational and foreshore areas.

Landscape Character Zone	Description *(Adapted from Aurecon, 2019)*	Sensitivity	Magnitude	Landscape Character Impact
Working/heritage working waterfront	Foreshore areas of Sydney Harbour include industrial or previously used industrial areas which reflect Sydney Harbour's historic and continuing use as a working harbour. Woolwich dock, Woolwich marina and Cockatoo Island are within the surrounding landscape character, and these areas reflect an industrial marine character with factory and warehouse buildings and wharf structures. These areas are located to the west of the proposal area across the harbour at some distance.	Low > These working/historic working waterfront areas are identifiably built up areas that consist of multiple large building forms. > The site is visible from these working waterfront sites, however the distance of these viewpoints to the proposed changes is considered to be negligible to low sensitivity in the landscape.	Low > The new wharf would increase in overall size however the materials and structure would be a similar form to the working/heritage working waterfront character zone and other wharves in Sydney Harbour. > Similar to sensitivity rating, the distances viewed toward the proposal would be relatively imperceptible and hence is a negligible to low rating.	Low > The increase in overall size of the wharf is a result of the additional elements required for accessibility such as the prominent covered pontoon and lift, and would benefit users of the recreational spaces and residential areas of Greenwich Point.

Landscape Character Zone	Description *(Adapted from Aurecon, 2019)*	Sensitivity	Magnitude	Landscape Character Impact
Sydney Harbour	Sydney Harbour is a large body of water, which formed from a flooded river estuary. This area of Sydney Harbour is located near the intersection of the Parramatta River and Lane Cove River. 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. Much of the foreshore surrounding the harbour is vegetated recreational areas, residential dwellings, and industrial maritime areas. Visually, parts of the harbour also include moored yachts flanking the foreshores and industrial waterside work areas.	High > The Greenwich Point wharf precinct boasts significant views of Sydney Harbour foreshore areas consisting of iconic landmarks, vegetated reserves and exclusive residencies. > The views to the wharf precinct from the Harbour are also highly sensitive (from close to medium view range).	High > The new wharf would have some impact to the character of the immediate Harbour (water) side due to additional elements and additional scale of structures compared to the existing situation to achieve accessibility and amenity such as the prominent covered pontoon and lift. However, the design and materials would be in character with other existing wharves in the broader locality (e.g. Birchgrove Wharf, Chiswick Wharf, Abbotsford Wharf, and Balmain Wharf) which include a similar design. > The new lift and multi-level stair structure are additional features that would have impact to the character of the area as viewed from the closer parts of the harbour. Lesser so as viewed from afar on the harbour.	High > Sydney Harbour is one of the more scenic harbours in the world and the view from Greenwich Point is of high landscape value. > The new wharf structures would have some impact to the character of Sydney Harbour (from the immediate vicinity only) due to new materials and additional structural elements required for accessibility and patron amenity, compared to the existing more modest historic wharf structures and access footpath.

5.4 Overall sensitivity – moderate to high

The residential LCZ surrounding the wharf is recognised as having local heritage value as the Greenwich Conservation Area consisting generally of single detached dwellings with a traditional architectural form and is considered sensitive to change and new built form. The proposed upgrades (limited to relocated bus stop, upper part of new lift and skybridge) are located in close proximity to Lower Serpentine Road and would be visible within the immediate residential precinct and Mary Carlson Park only. The lower parts of the lift and stair structures and wharf infrastructure would not be discernible from the residential areas (similar to existing). The site is visible from some residential zones located across the Harbour and has low sensitivity.

The recreational/vegetated foreshore area LCZ is also considered to be sensitive within the surrounding landscape character, and the proposed new design would introduce a larger development footprint and new built elements within a highly vegetated foreshore and cliff face than the existing wharf. The new elements would have low visibility and sensitivity from most foreshore and recreational areas but would be highly sensitive within the immediate foreshore wharf area.

Working/historic working waterfronts such as the Woolwich Dock and Cockatoo Island demonstrate Sydney Harbour's present and historic importance as a working harbour. Industrial maritime developments are present on Sydney's foreshore and add to the Harbour's landscape character. These areas are largely developed areas and have a low sensitivity to change given their distance from the site.

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 Greenwich Point wharf consist predominantly of recreational/vegetated foreshore views.

Overall, it is considered that the general sensitivity of the surrounding character zones is moderate to high.

5.5 Overall magnitude – moderate to high

The proposed new wharf is intended to replace the existing Greenwich Point wharf improving accessibility and customer experience. The design would introduce a coordinated palette of materials and an overall 'maritime' feel, however would introduce some larger elements, primarily via the lift, skybridge, new lift, covered pontoon and waiting area.

The magnitude of the proposal is varied depending on the viewpoint within each zone. It is considered to be highest from Lower Serpentine Road and the wharf foreshore and close viewpoints from Sydney Harbour due to the relatively increased scale including new structures. The overall magnitude for the landscape character is considered moderate to high, having regard to the aforementioned immediate precincts and lower more distant and/or less visible viewpoints.

5.6 Overall landscape character impact – moderate to high

Given the sensitivity of the locality within the Greenwich Conservation Area and the significance of the vegetated foreshore reserve to the character of Greenwich Point peninsula, the sensitivity of the landscape character is considered moderate to high. The concept design would introduce larger built elements into the foreshore area and as such the magnitude of the concept design is also considered moderate to high.

It is considered that the overall landscape character impact of the proposed Greenwich Point wharf is therefore assessed to be moderate to high.

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) defines 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 Greenwich Point 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

Rating	Description
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.
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.

Rating	Description
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 Greenwich Point 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

Rating	Description
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 Transport for NSW, viewpoints within a reasonable distance and visual catchment of the Greenwich Point wharf have been identified. Figure 6-1 outlines the position and direction of the key viewpoints that are likely to be impacted by the proposal.

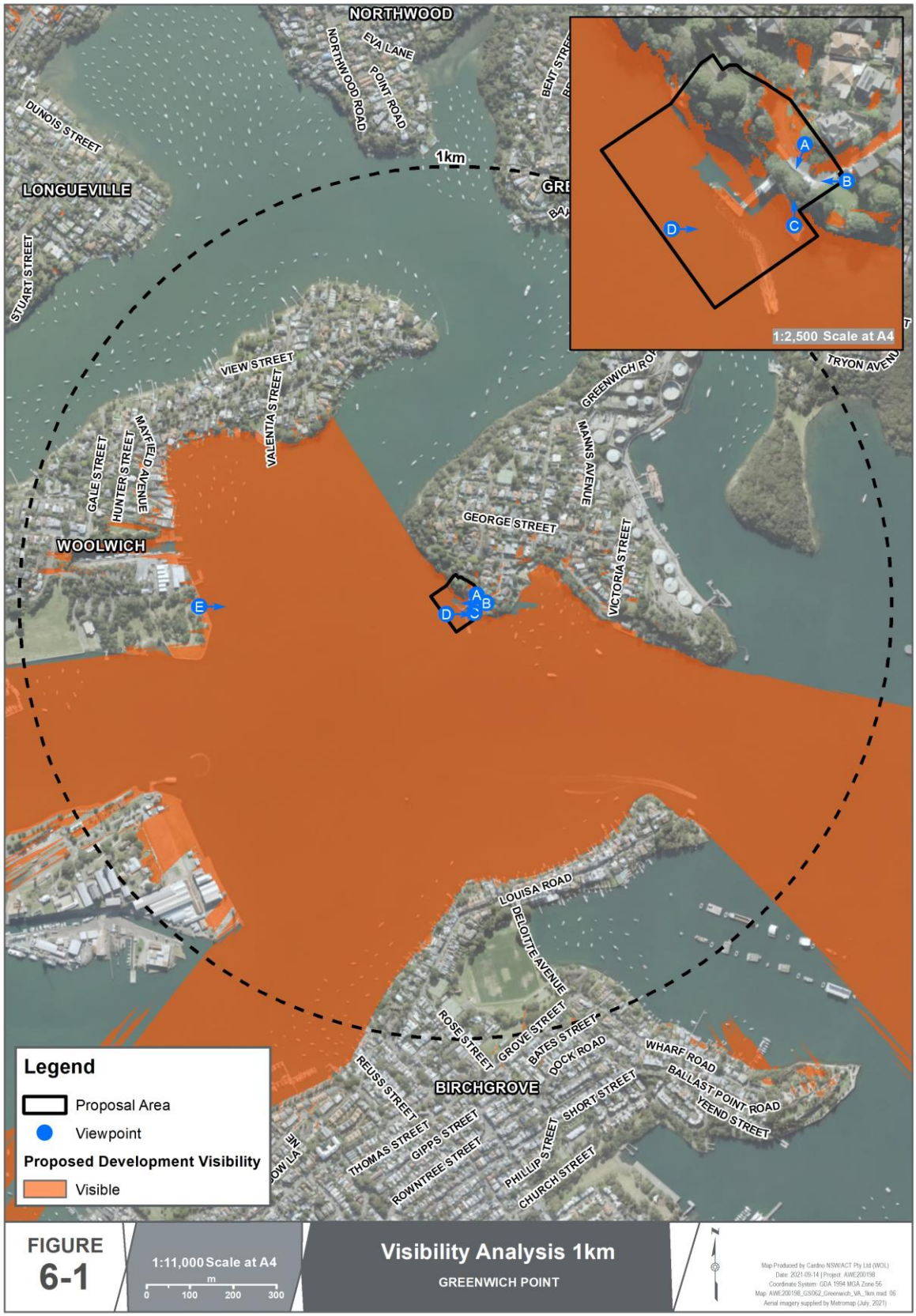


Figure 6-1 Visibility analysis and key viewpoints

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 proposal. The zones are categorised as follow:

- Foreground zone (FZ): 0 – 250 metres from the viewer
- Middle ground zone (MZ): 250 – 500 metres from the viewer
- Background zone (BZ): 500 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 Greenwich Point wharf. Photomontages in the broader study area have been prepared from the following five viewpoints:

- Viewpoint A – Lower Serpentine Road (18 Mitchell Street) looking south toward wharf
- Viewpoint B – Mary Carlson Park (eastern side) looking toward wharf
- Viewpoint C – Historic wharf and jetty looking north west toward wharf
- Viewpoint D – Sydney Harbour looking north east toward wharf
- Viewpoint E – Clarkes Point, Woolwich – looking east toward wharf.

Figure 6-2 to Figure 6-10 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 – Lower Serpentine Road looking south toward wharf

Figure 6-2 Viewpoint A – existing view (Source: Urbaine, 2021)

Figure 6-3 Viewpoint A – photomontage (Source: Urbaine, 2021)

6.2.7.1.2 Viewpoint A - description

Viewpoint A is located at the public recreation area in front of the residence of 18 Mitchell Street looking south toward the wharf, with viewpoints extending towards Cockatoo Island and Clarke's Point Reserve across Sydney Harbour. This viewpoint captures mature vegetation of the foreshore. The bus stop shelter already exists at this location but would be relocated slightly to the east.

6.2.7.1.3 Viewpoint A – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Relocated bus stop, lift, skybridge,	H	M	FZ	H-M	Viewpoint A is representative of a close perspective from the public street and a public recreation area in front of the residence at 18 Mitchell Street looking south towards the proposal site. The sensitivity of Viewpoint A is high for the following reasons: > The central location of the wharf complex in the view and close proximity to the wharf > Highly sensitive elevated views of Sydney Harbour > Vegetated foreshore is prominent from this view which is within Greenwich Conservation Area. The magnitude of impact on the view of the new wharf complex is considered moderate as the proposal would introduce a new form to the existing view in front of Sydney Harbour which is highly sensitive to change. However this is moderated by mature vegetation and topography from the residential slopes, and that the harbour is still visible, and only partially obscured by the proposed structures.

6.2.7.2 Viewpoint B – From eastern side of Mary Carlson Park looking toward wharf site

Figure 6-4 Viewpoint B – existing view (Source: Urbaine, 2021)

Figure 6-5 Viewpoint B – photomontage (Source: Urbaine, 2021)

6.2.7.2.2 Viewpoint B - description

Viewpoint B is located at the eastern side of Mary Carlson Park which is located at the foreshore clifftop end of Greenwich Point and is also bounded by Lower Serpentine Road and a residence fronting that road (No. 36). The small park contains bench seating and picnic tables and has excellent panoramic views of Sydney Harbour, including distant toward the Sydney city. The view also includes the existing bus shelter (to be relocated) and the mature vegetation of the foreshore. The existing wharf facilities are otherwise not visible from this viewpoint.

6.2.7.2.3 Viewpoint B – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Relocated bus stop, lift, skybridge,	M	M	FZ	M	Viewpoint B is very similar to Viewpoint A. The sensitivity of Viewpoint B is moderate for the following reasons: > The new elements of the wharf complex in the view is limited to the skybridge balustrade and lift structure (noting the bus shelter to be slightly relocated will partly screen). > Highly sensitive elevated views of Sydney Harbour > Vegetated foreshore is prominent from this view which is within Greenwich Conservation Area. The magnitude of impact on the view of the new wharf complex is considered moderate as the proposal would introduce a new form to the existing view in front of Sydney Harbour which is highly sensitive to change. However this is moderated by mature vegetation and topography from the residential slopes, and that the harbour is still visible, and only partially obscured by the proposed structures.

6.2.7.3 Viewpoint C – From historic wharf platform looking north west toward existing and proposed wharf site

Figure 6-6 Viewpoint C – existing view (Source: Urbaine, 2021)

Figure 6-7 Viewpoint C – photomontage (Source: Urbaine, 2021)

6.2.7.3.2 Viewpoint C - description

Viewpoint C is located at the end of the historic wharf and jetty location (local heritage Item I64) to the south east of the existing wharf. The view includes the existing covered waiting area, the walkway, Sydney Harbour, and the mature vegetation of the foreshore, with distant views of Woolwich.

6.2.7.3.3 Viewpoint C – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Lift and skybridge, jetty, gangway, covered pontoon	H	M-H	FZ	M-H	Viewpoint C is representative of close perspective views from the end of the historic wharf of the new infrastructure associated with the wharf upgrade proposal. The sensitivity of Viewpoint C is high for the following reasons: > The central location of the heritage-listed wharf complex in the view and close proximity to the wharf, These structures have historic character > Highly sensitive quality views of Sydney Harbour > Vegetated foreshore is prominent from this view which is within Greenwich Conservation Area > Distant views of Woolwich, including historic Woolwich Dock and Parklands. While the new (waterside) wharf structures do not have a much larger bulk or scale than the existing wharf infrastructure, the magnitude of impact on the view of the new wharf complex is considered medium to high. This is because the proposal would introduce a new form with new materials that would replace a heritage listed structure which are closer to this viewpoint. From this viewpoint the lift structure in particular would be a new and visible element (and would involve some pruning of the fig trees). While the lift structure would be prominent, it would have some visual screening from existing trees on the vegetated foreshore cliff landscape in the immediate locality.

6.2.7.4 Viewpoint D – Sydney Harbour looking north-east toward wharf

Figure 6-8 Viewpoint D – existing view (Source: Urbaine, 2021)

Figure 6-9 Viewpoint D – photomontage (Source: Urbaine, 2021)

6.2.7.4.2 Viewpoint D - description

Viewpoint D is located in Sydney Harbour, approaching the wharf from the south looking north east. The viewpoint includes the vegetated landscape of the Greenwich Point foreground, including elevated dwellings and vegetation, in addition to the historic wharf, with more distant harbour, foreshore (Balls Head) and City/Harbour Bridge views to the east.

6.2.7.4.3 Viewpoint D – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Lift, gangway, skybridge and stair structure, covered pontoon	H	H	FZ	H	Viewpoint D is representative of close perspective views from Sydney Harbour of the new infrastructure associated with the wharf upgrade proposal. The sensitivity of Viewpoint D is high for the following reasons: > The central and elevated location of the wharf infrastructure (primarily the lift, stair structure and skybridge) in the view. The proposed wharf structure would replace the heritage-listed wharf structure (with a historic theme/character). > Vegetated foreshore is prominent from this view which is within Greenwich Conservation Area. The magnitude of impact on the view of the new wharf complex is considered high as the proposal would introduce a new form to the existing view of Greenwich Conservation Area which is highly sensitive to change. The historic wharf would be removed and replaced with modern structures with differing materiality.

6.2.7.5 Viewpoint E - Clarke's Point Reserve, Woolwich looking east toward wharf

Figure 6-10 Viewpoint E – existing view (Aurecon, 2019)

6.2.7.5.2 Viewpoint E - description

Viewpoint E is located at Clarke's Point Reserve at Woolwich, looking directly to the east toward Greenwich Point (approximate distance away 600 metres). The viewpoint includes the vegetated landscape of the Greenwich Point foreshore and Balls Head, and the skylines of Waverton and North Sydney and the distant Harbour Bridge.

6.2.7.5.3 Viewpoint E – visual impact assessment

Visible Elements	Sensitivity	Magnitude	Distance Zone	Overall Rating	Comment
Lift, gangway, skybridge and stair structure, covered pontoon	L	L	BZ	L	Viewpoint E is from the foreshore parkland and is also representative of impacts from other foreshore areas within the visual catchment of the site (e.g. residences at nearby Woolwich and Birchgrove to the south). The sensitivity of Viewpoint E is low as the structures are/would be visible, but would remain minor in the overall landscape/vistal (albeit a high quality one). The magnitude of impact on the view of the new wharf complex is also considered to be low as the distance of the viewpoint and scale of the proposed new elements. These elements, despite some reduction in vegetation (extent to be confirmed) would be relatively imperceptible from this viewpoint.

6.3 Overall visual impact assessment – moderate to high

The overall visual impact of the proposed concept design for Greenwich Point wharf, is considered moderate to high 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 lift and skybridge would be new built elements visible from sensitive locations in particular from the adjacent Lower Serpentine Road (and heritage listed residential properties opposite) and the elevated foreshore park (Mary Carlson Park). However the other new structures would be largely screened from this view as they are located beyond and below the steep cliff to the foreshore. All existing trees would be retained, although some pruning of existing vegetation would be required to accommodate the lift and stairs and skybridge.

The heritage-listed existing wharf (to be demolished) and vegetated foreshore is significant to the character of the foreshore and Greenwich Conservation Area, and the proposal would therefore impact on this area. From the waterside (as viewed from lower cliff and harbour), the magnitude of impact on the view of the new wharf complex is considered medium to high. While the on-water wharf structures do not have a significantly larger bulk or scale than the existing wharf infrastructure, the new form and modern materials would replace the 'low key' heritage character structures. The impact of the new skybridge, stairs and lift would be reduced by partially sitting within the sandstone shelf/rock face tying the design to its landscape and retaining existing trees. While some vegetation would require pruning of branches, the retention of vegetation would assist to screen and/or ameliorate the visual impact. However, the lift structure in particular would be a new and highly visible element in the landscape.

7 Summary of urban design concept and mitigation strategy

7.1 Summary of urban design concept and mitigation strategy

The proposed upgrade to Greenwich Point 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 wharf facilities have been designed to maximise amenity and are in keeping with the existing landscape environment (landside and waterside areas and immediate surroundings). The design does not require removal of any trees, with some pruning only required to accommodate the structures.

The main source of impact of the proposal on landscape character and visual quality would be the construction of the landward lift, and adjacent skybridge and stair structure. The waterside structures (covered gangway and pontoon), while increased in footprint to the existing facilities, are considered to have an appropriate visual impact and would exist as appropriate low scale maritime infrastructure consistent with other harbour wharves. The waterside structures have limited visibility from the upper street and residences due to topography and existing vegetation screening, and hence would have a lesser scale impact. The proposal would have low visibility and landscape impacts from more distant viewpoints, including residential areas and parkland further across the harbour (e.g. Birchgrove and Woolwich).

The following measures are recommended to mitigate the impacts of the landward structures as viewed from closer viewpoints: the Lower Serpentine Road precinct, the wharf itself, and from the harbour:

- Use of colours that blend in to the landscape (as viewed from the harbour) and that complement the materiality of the cliff face (e.g. sandstone and landscaping etc) should be considered
- Incorporate landscaping elements, which can also ameliorate impacts of these structures
- Painting of the concrete or steel construction for the lift and stair structure, the visible sides of tread/risers could be painted darker colours to blend into the harbour cliff
- Frame materials on lift structure should be black or dark grey/green to blend in, and should not be white, light or shiny steel which would reflect sunlight and increase prominence
- Consideration of tinted and less reflective glazing for the lift structure is also recommended rather than light and highly reflective clear panels.

With these measures in place we consider that the wharf upgrade design would contribute toward a high quality new built element in the local landscape that would be consistent with the values of its visual and landscape environment, while providing an accessible wharf facility.

7.2 Conclusion

The assessment of the impacts of the proposed Greenwich Point wharf upgrades and associated access infrastructure on local landscape and visual quality has been carried out in accordance with the following Transport for NSW 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 Greenwich Point wharf, replacing the existing wharf, is considered to be high to moderate on the surrounding character zones as proposed design including the lift, covered pontoon, and skybridge/stairway would introduce large and visually significant built elements to the vegetated foreshore setting. The proposal occurs adjacent to, and within, the Greenwich Conservation Area which increases sensitivity of the landscape.

The overall visual impact of the proposed concept design for Greenwich Point wharf, is considered moderate to high 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, most views contain close or distant views of sensitive items such as Sydney Harbour and Greenwich Conservation Area. While existing trees on the vegetated foreshore (to be retained) provide some visual screening, the new

design introduces additional built form primarily from the lift, covered pontoon, and skybridge which would be new and visible elements.

The assessment has found that the proposal would have an acceptable impact on landscape and visual quality when viewed from Sydney Harbour (within close proximity) and from its foreshore. The proposal would have negligible to low visibility from other viewpoints, including residential areas and parkland further across the harbour. It is considered that with regard to visual and landscape impacts the proposal is worthy of support.

8 References

Aurecon (2019) *Preliminary Landscape Character and Visual Impact Assessment. Ferry Wharf Upgrade Project. Greenwich Wharf Interchange.* Aurecon Australasia Pty Ltd, July 2019.

TfNSW (2020a) *Beyond the Pavement: urban design approach and procedures for road and maritime infrastructure planning, design and construction.* Transport for NSW, August 2020.

TfNSW (2020b) *Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Practice Note EIA-NO4*. Transport for NSW, August 2020.

Appendix G

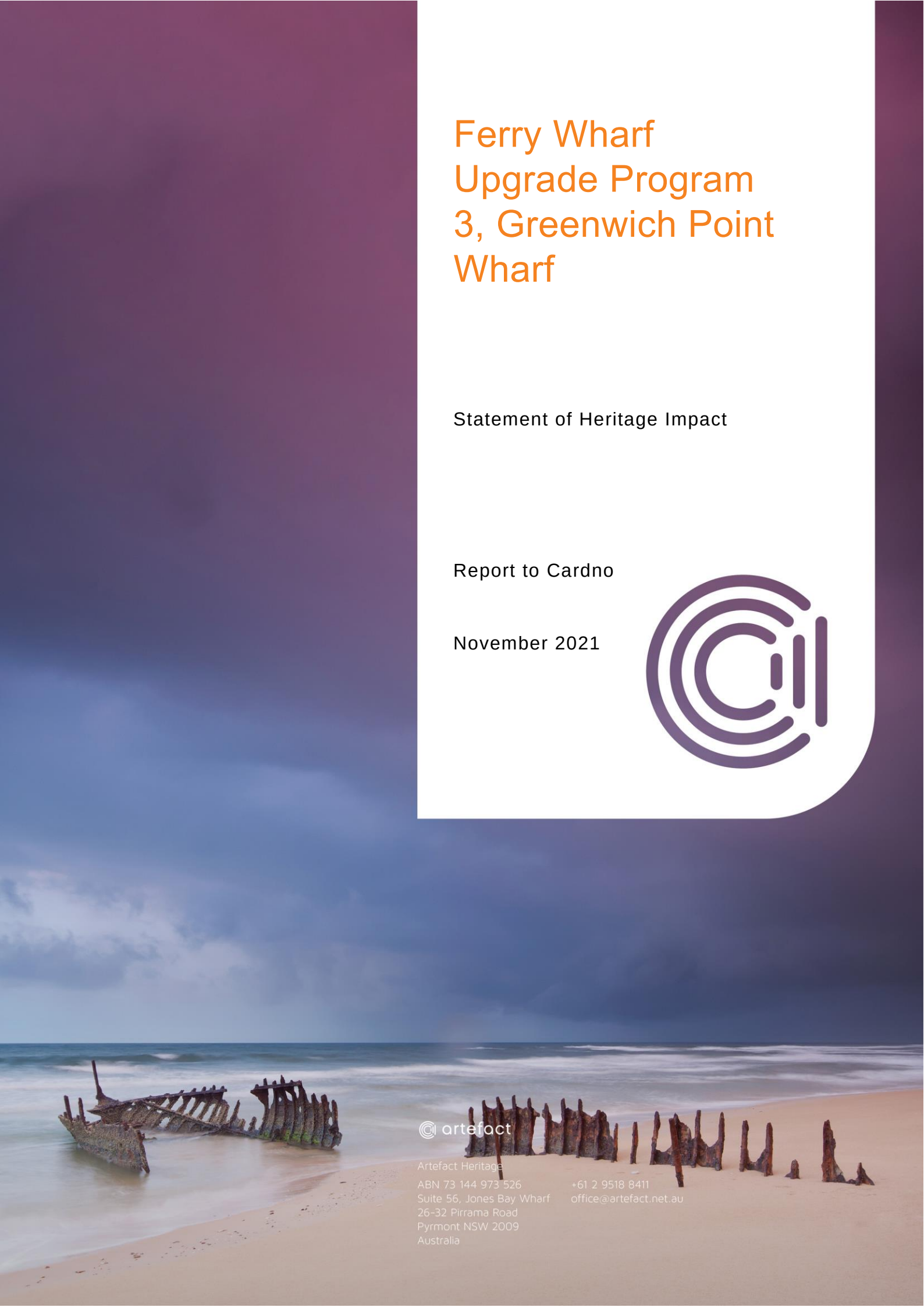
Statement of heritage impact

Ferry Wharf Upgrade Program 3, Greenwich Point Wharf

Statement of Heritage Impact

Report to Cardno

November 2021



artefact

Artefact Heritage
ABN 73 144 973 526
Suite 56, Jones Bay Wharf
26-32 Pirrama Road
Pyrmont NSW 2009
Australia

+61 2 9518 8411
office@artefact.net.au

Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
1	21/04/2021	Josh Symons	Josh Symons	21/04/2021	First draft
2	22/04/2021	Josh Symons	Josh Symons	22/04/2021	Second draft
3	12/10/2021	Jayden van Beek	Jayden van Beek	12/10/2021	Third draft
4	29/11/2021	Jayden van Beek	Jayden van Beek	29/11/2021	Final

Last saved:	29/11/2021
File name:	FWUP3 Seven Wharves Upgrade – Greenwich Point Wharf SoHI Nov2021
Project name:	Ferry Wharf Upgrade Program, Seven Wharves
Author:	Olivia Turner, Jayden van Beek, Josh Symons
Project manager:	Jayden van Beek
Project number:	20035
Name of organisation:	Artefact Heritage
Document version:	Final

© Artefact Heritage Services

This document is and shall remain the property of Artefact Heritage Services. This document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer: Artefact Heritage Services has completed this document in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the document content or for any purpose other than that for which it was intended.

EXECUTIVE SUMMARY

Transport for New South Wales (Transport for NSW - formerly Roads and Maritime Services) is proposing to upgrade Greenwich Point Wharf as part of Ferry Wharf Upgrade Program 3 (FWUP3). FWUP3 is a sub-program under 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 which do not currently provide equitable access to all ferry services and as such do not meet the *Disability Standards for Accessible Public Transport* 2002 (DSAPT) or *Disability Discrimination Act 1992* (DDA) requirements. As part of FWUP3, Cardno, on behalf of Transport for NSW, is preparing a Review of Environmental Factors (REF) for each wharf upgrade.

Artefact Heritage have been engaged by Cardno, on behalf of Transport for NSW, to prepare a Statement of Heritage Impact (SoHI) to assess the potential impacts to listed heritage items and potential archaeological remains as a result of the proposed FWUP3 works at Greenwich Wharf. This report identifies 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 Greenwich Point Wharf compliant with the requirements of the DDA
- The proposal area is located within the curtilage of one heritage item listed on the Roads and Maritime Section 170 (s170) Heritage and Conservation Register and three heritage items listed on the Lane Cove Local Environmental Plan (LEP) 2009:
    - Greenwich Point Wharf (State Heritage Inventory [SHI] no. 4920084, LEP no. I130)
    - Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall) [LEP no. I64)
    - Greenwich Conservation Area (LEP no. C1)
- The proposal area is located adjacent to the curtilages of three heritage items listed on the Lane Cove LEP 2009:
    - House (LEP no. I110)
    - House (LEP no. I111)
    - Stone steps to rear of house (LEP no. I131)
    - Stone sea wall (LEP no. I132)
- The visual buffer zone for the construction site also includes:
    - One heritage item listed on the World Heritage List (WHL):
        - Australian Convict Sites (Reference ID 1306)
    - One heritage item listed on the National Heritage List (NHL):
        - Cockatoo Island (Place ID 105928)
    - Three heritage item listed on the Commonwealth Heritage List (CHL):

        - Woolwich Dock (Place ID 105244)
        - Cockatoo Island Industrial Conservation Area (Place ID 105262)
        - Biloela Group (Place ID 105263)
    - One heritage item listed on the State Heritage Register (SHR):
        - Raywell (SHR no. 00093)
        - Railway electricity tunnel under Sydney Harbour (SHR no. 01231)
    - Three items listed on s170 Heritage and Conservation Registers:
        - Valentia Street Wharf and Waiting Shed (Roads and Maritime s170 SHI no. 4920086)
        - Long Nose Point (Birchgrove) Wharf Site and Shelter (Roads and Maritime s170 SHI no. 4920086)
        - Sydney Harbour (Balmain to Greenwich) Railway Electricity Tunnel (RailCorp s170 SHI no. 5062542).
    - Four heritage items listed on the Lane Cove LEP 2009, nine heritage items listed on the Hunters Hill LEP 2012 and thirteen heritage items listed on the Leichardt LEP 2013
    - Five heritage items listed on the *Sydney Regional Environmental Plan (SREP) [Sydney Harbour Catchment] 2005*
- The proposed works would result in moderate direct and visual impacts to Greenwich Point Wharf (SHI no. 4920084, LEP no. I130). However, because a replacement wharf would be built the ongoing operation of a commuter wharf in this location would be maintained (which is a key heritage value associated with the item), and therefore the overall heritage values of the item would be retained. As a result, the proposal would not result in Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) being delisted from the Roads and Maritime s170 Heritage and Conservation Register or the Lane Cove LEP 2009
- The SHI entry for Greenwich Point Wharf (SHI no. 4920084) states that 'the form and fabric of the wharf are not key attributes of its significance and can be changed'[1]
- The proposed works would not impact the overall significance of the other heritage items within and adjacent to the proposal area, or the heritage items within the visual buffer zone
- Impacts to heritage items listed on the WHL, NHL and CHL as a result of the proposal would be limited to negligible visual impacts. As a result, a referral to the Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is not required
- A preliminary archaeological assessment has determined that the proposal area has nil to low potential to contain non-significant archaeological remains associated with Phase 1 (1788-1830s: Early settlement in Greenwich), and low to moderate potential to contain locally significant archaeological remains associated with Phase 2 (1830s-1992: Greenwich Point Wharf ferry services), including evidence of former road surfaces and streetscape elements, and evidence of the former Greenwich Point Wharf. The archaeological remains would likely be limited to evidence

[1] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'. *State Heritage Inventory.* Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=4920084

of former 'works' and the proposal footprint is unlikely to contain significant 'relics' as defined by the Heritage Act

- Only a small area of low archaeological potential associated with Phase 2, consisting of evidence of former road surfaces or streetscape elements, is located within the proposal footprint itself. Based on the preliminary archaeological assessment, it has been assessed that excavations associated with the proposal would result in negligible impacts to potential archaeological remains of local significance associated with Phase 2
- The preliminary archaeological assessment has found that these potential archaeological remains are expected to be limited to archaeological 'works'. As a result, the proposed works are unlikely to impact significant 'relics' and therefore an exception under Section 139 (4) of the *Heritage Act 1977* (Heritage Act) would not be required
- 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
Greenwich Point Wharf	Moderate	Neutral	Moderate	Neutral
Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall)	Minor	Negligible	Negligible	Negligible
Greenwich Conservation Area	Negligible	Negligible	Negligible	Neutral
House	Neutral	Negligible	Negligible	Neutral
House	Neutral	Neutral	Negligible	Neutral
Stone steps to rear of house	Neutral	Neutral	Neutral	Neutral
Stone sea wall	Neutral	Neutral	Neutral	Neutral
Australian Convict Sites (Cockatoo Island)	Neutral	Neutral	Negligible	Neutral
Biloela Group	Neutral	Neutral	Negligible	Neutral
Greenwich Baths	Neutral	Neutral	Neutral	Neutral
Rockleigh	Neutral	Neutral	Neutral	Neutral
Railway electricity tunnel	Neutral	Neutral	Neutral	Neutral
Site of bond store, wharf and quarry	Neutral	Neutral	Neutral	Neutral
House, 'Cora Lyn'	Neutral	Neutral	Negligible	Neutral
Valentia Street Wharf and Waiting Shed	Neutral	Neutral	Negligible	Neutral
Hunters Hill Conservation Area No 1—The Peninsula	Neutral	Neutral	Negligible	Neutral

Heritage Item	Direct	Potential direct	Indirect (visual)	Archaeological
House, 'Drayton', formerly ' Valentin'	Neutral	Neutral	Negligible	Neutral
House, 'Verdelais'	Neutral	Neutral	Negligible	Neutral
Stone walls	Neutral	Neutral	Negligible	Neutral
Woolwich Dock	Neutral	Neutral	Negligible	Neutral
Site of precision woodware factory	Neutral	Neutral	Negligible	Neutral
Clarkes Point Reserve	Neutral	Neutral	Negligible	Neutral
Raywell	Neutral	Neutral	Negligible	Neutral
Railway electricity tunnel under Sydney Harbour	Neutral	Neutral	Neutral	Neutral
Long Nose Point (Birchgrove) Wharf Site and Shelter	Neutral	Neutral	Negligible	Neutral
Iron Cove Heritage Conservation Area	Neutral	Neutral	Negligible	Neutral
Birchgrove and Ballast Point Road Heritage Conservation Area	Neutral	Neutral	Negligible	Neutral
House, 'Leopoldville', including interiors	Neutral	Neutral	Negligible	Neutral
House, 'Logan Brae', including interiors	Neutral	Neutral	Negligible	Neutral
House, 'The Anchorage', including interiors	Neutral	Neutral	Negligible	Neutral
House, 'Douglas', including interiors	Neutral	Neutral	Negligible	Neutral
Boat sheds only, Louisa Road	Neutral	Neutral	Negligible	Neutral
Cove Street Wharf	Neutral	Neutral	Negligible	Neutral
Aboriginal middens and rock shelter	Neutral	Neutral	Negligible	Neutral
Aboriginal middens and rock shelter	Neutral	Neutral	Negligible	Neutral
Aboriginal middens and rock shelter	Neutral	Neutral	Negligible	Neutral
Yurulbin Park	Neutral	Neutral	Negligible	Neutral
Aboriginal midden and rock shelter	Neutral	Neutral	Negligible	Neutral

Management and mitigation measures

The following mitigation measures should be enacted to minimise heritage impacts:

- Following the construction of the new wharf, the SHI description and heritage curtilage for Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) must be updated to reflect its location and condition
- Because the extant wharf structure within Greenwich Point Wharf (SHI no. 4920084) would be demolished, Heritage NSW, DPC must be notified in accordance with s170A (1c) of the Heritage Act. A copy of this report should be submitted to Heritage NSW, DPC for their records
- Because the proposal would result in impacts to Greenwich Point Wharf (LEP no. I130) that will be 'more than minor or inconsequential', consultation with Lane Cove Council must be undertaken prior to impacts occurring in accordance with Part 2, Division 1 (Section 14) of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP). A copy of this report should be submitted to Lane Cove 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 Greenwich Point Wharf
- It is not recommended that fabric of the shelter is salvaged for reuse/interpretation due to the fact that the shelter fabric dates to 1992 has no identified significance values on its own
- In accordance with the heritage controls identified in Part B.9 (9.1 Heritage Items and Conservation Area) of the Lane Cove Development Control Plan (DCP) 2010, a photographic archival recording of Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) and the area impacted by the proposal must be undertaken prior to impacts to record the current setting of the wharf and Greenwich Conservation Area (LEP no. C1). The photographic archival recording would be prepared in accordance with the following guideline:
    - *Photographic Recording of Heritage Items Using Film or Digital Capture* (NSW Heritage Office 2006)
- Based on the findings of the preliminary archaeological assessment, the proposed works would be managed under the Roads and Maritime Unexpected Heritage Item Procedure 2015. Under this procedure:
    - If archaeological 'works' such as evidence of former road surfaces or streetscape elements 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 design changes result in additional earthworks and impacts to potential archaeological remains associated with the former Greenwich Point Wharf to the south-east of the extant wharf, further archaeological assessment and management would be required. This may include undertaking a maritime archaeological assessment 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 heritage items within 41m of the proposal area. However, to further minimise the risk of vibration impacts the following mitigation measures should be implemented:
    - Determine safe working limits based on proposed plant, and where possible, the smallest plant able to carry out required work should be utilised to minimise potential impacts. Where works are proposed within the safe working limits for the heritage structures, specialist advice must be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works will potentially result in impacts to heritage structures
    - A vibration monitoring plan is to be prepared as part of the Construction Noise and Vibration Management Plan and implemented to confirm vibration levels prior to construction commencement. Where exceedances are recorded, works should be modified in consultation with the identified specialist to reduce vibration levels
- Regular inspections of the construction activities and work areas are to be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology to confirm the integrity of the heritage items. Assessment and monitoring of vibration impacts are to 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 heritage items, they must not be attached with permanent fixings. They should be removable without causing damage. Bees wax may be a suitable attachment method
- Care must be taken during the removal of the waiting shelter and underlying concrete landing to minimise damage to the sandstone sea wall during the removal of the concrete. A hydraulic hammer should not be used to separate the concrete from the face of the sea wall to reduce the risk of damaging the sandstone blocks. Any impacted sections of the sea wall must be made good, and if necessary, damaged sandstone blocks must be replaced with like-for-like sandstone
- 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.

CONTENTS

FIGURES

TABLES

1.0 INTRODUCTION

1.1 Project background

1.1.1 Transport Access Program

The Transport Access Program (TAP) is a Transport for NSW initiative to provide a better experience for public transport customers by delivering accessible, modern, secure and integrated transport infrastructure.

1.1.2 Ferry Wharf Upgrade Program

Transport for NSW (formerly Roads and Maritime Services) 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)[2] 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 equitable 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 Greenwich Point 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.

[2] The DSAPT is an instrument of the *Disability Discrimination Act 1992 (the Act) (Commonwealth).*

1.2 Project location

For the purposes this assessment, the proposal area of the Greenwich Point Wharf has been defined as the broader construction area around the project footprint which includes the site compounds and barge locations in the water around the existing wharf. The proposal footprint is defined as the physical footprint of the proposed works (Figure 1).

The proposal area includes the Greenwich Point Wharf, at Lower Serpentine Road, within the suburb of Greenwich. A portion of Lower Serpentine Road is also within the proposal area. The proposal area is located at the south end of Greenwich Point and extends into Parramatta River near its confluence with Lane Cove River. The proposal area is located within the Lane Cove Council Local Government Area (Lane Cove LGA), within the Country of Cumberland and the Parish of Willoughby.

In addition to the proposal area, a visual buffer zone including the surrounding area of Parramatta River and Lane Cove River has been assessed for visual impacts associated with the proposed works at Greenwich Point 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 Greenwich Point Wharf as part of the TAP.

- Installation of a new four metre wide by 22m long concrete jetty, supported by eight new piles
- Installation of a new, uncovered 18m long by 2.5m wide gangway to provide access to the new pontoon
- Installation of a new covered steel nine metre by 18m pontoon containing a curved zinc roof supported by steel columns, glass weather protection, stainless steel balustrades, seating and information boards. The pontoon would be supported by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of new signage, information boards and opal card readers
- Installation of safety and security features including a help point, lighting, closed circuit television (CCTV) cameras, ladders to the water, a life buoy and tactile ground surface indicators where required

Removal of the existing waiting shelter, jetty and tidal stairs including associated piles.

- The land-based features of the proposal would include:
- Construction of a 9.8m long skybridge from the approximate location of the existing bus shelter on Lower Serpentine Road, connecting the existing footpath to the proposed lift
- Relocation of the existing bus shelter on Lower Serpentine Road approximately three metres to the east to accommodate new skybridge entrance
- Construction of a 12m high lift that connects the proposed skybridge to the wharf level. Five metres of the lift would be visible from street level

- Regrading of pavement at street level and wharf level to create the entry/exit points of the skybridge, stairs and lift
- Construction of new DDA compliant stairs connecting Lower Serpentine Road and the new wharf, near the proposed lift. The new stairs would use part of the existing stair footprint on Lower Serpentine Road, which currently connects Mary Carlson Park to wharf level
- Removal of the existing non DDA compliant stairs
- Partial excavation of the embankment to provide room for the new stairs connecting at the western side of the existing bus shelter
- Installation of three bicycle hoops
- Replacement of balustrades and handrail at wharf level
- Electrical work including relocation of existing electrical switchboard cabinet at wharf level, removal of two existing power poles and placing existing electrical overhead wires underground
- Pruning of fig trees and surrounding shrubbery for construction of the new skybridge, stairs and lift.
- Retention of the current existing ramp near Greenwich Park connecting road level to foreshore.

The proposal area and key features of the proposal are illustrated in Figure 45.

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*.[3] 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*.[4] 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.

[3] 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.
[4] NSW Heritage Council, "Archaeological Assessment Guidelines," in *NSW Heritage Manual* (New South Wales: Heritage Office, 1996).

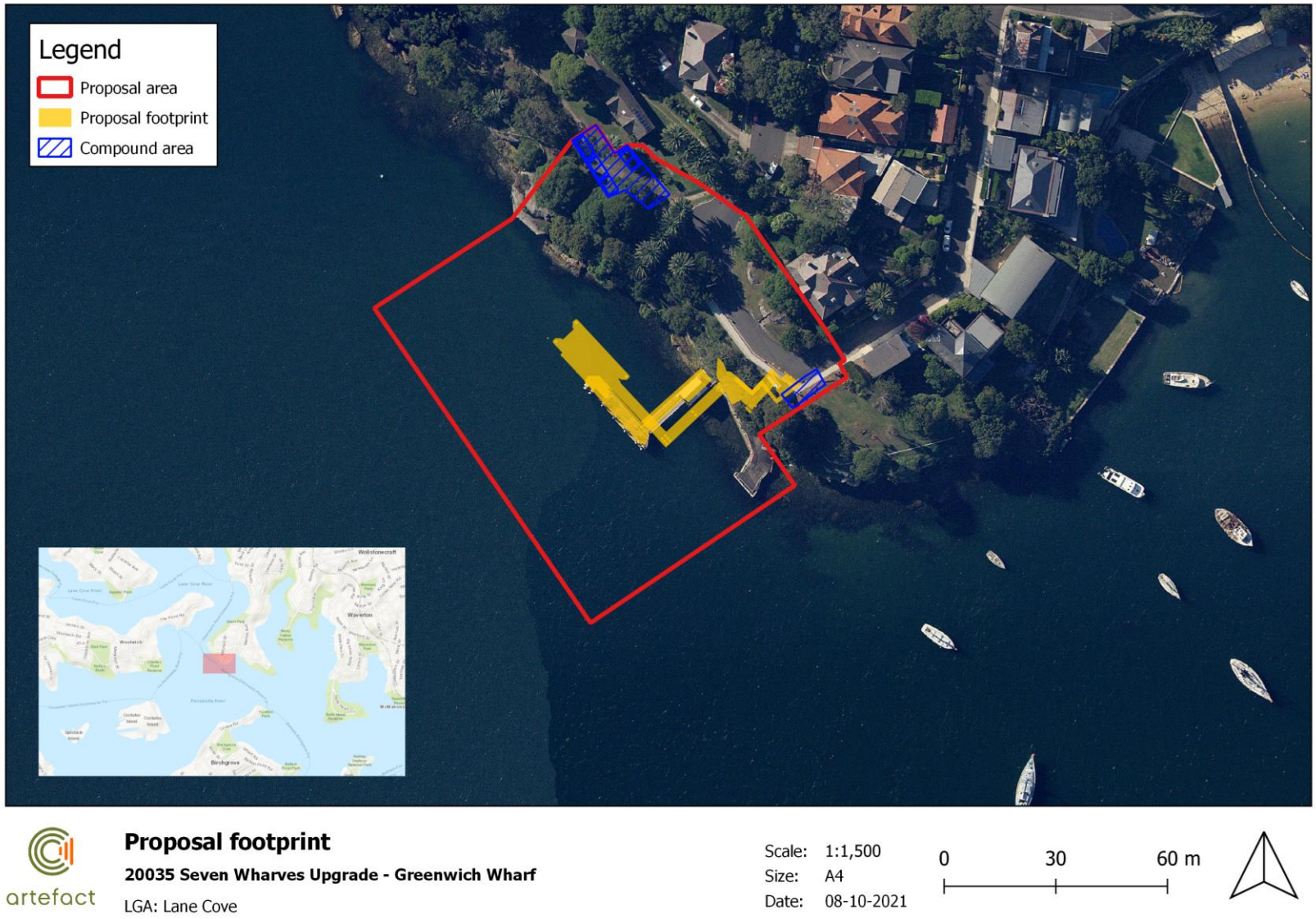


Figure 1: Location of the construction and proposal footprints

Figure 2: Proposal footprint and proposal area (provided by Cardno)

Figure 3: Location of the proposal area and the wider visual buffer zone

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 objector precinct, means significance to an area in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.[5]

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.

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

[5] This section is an extract based on the Heritage Office Assessing Significance for Historical Archaeological Sites and Relics 2009:6.

- 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.[6] 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.

Table 2: Terminology for assessing the magnitude of heritage impact

Magnitude	Definition
Major	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. These actions cannot be fully mitigated
Moderate	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. The impacts arising from such actions may be able to be partially mitigated
Minor	Actions that would results in the slight alteration of heritage buildings, archaeological resources, or the setting of an historical item. The impacts arising from such actions can usually be mitigated
Negligible	Actions that would results in very minor changes to heritage items
Neutral	Actions that would have no heritage impact

1.4.3 Assessment of visual impacts and potential direct impacts

Heritage items that are located within one kilometre of the proposal area 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.[7] As part of this, a visibility analysis has been undertaken and sightlines to and from the proposal 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.

[6] Including the document *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties*, ICOMOS, January 2011.
[7] Cardno, 'Landscape Character and Visual Impact Assessment: Greenwich Point Wharf Upgrade'. Report to Transport for NSW, 2021.

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.

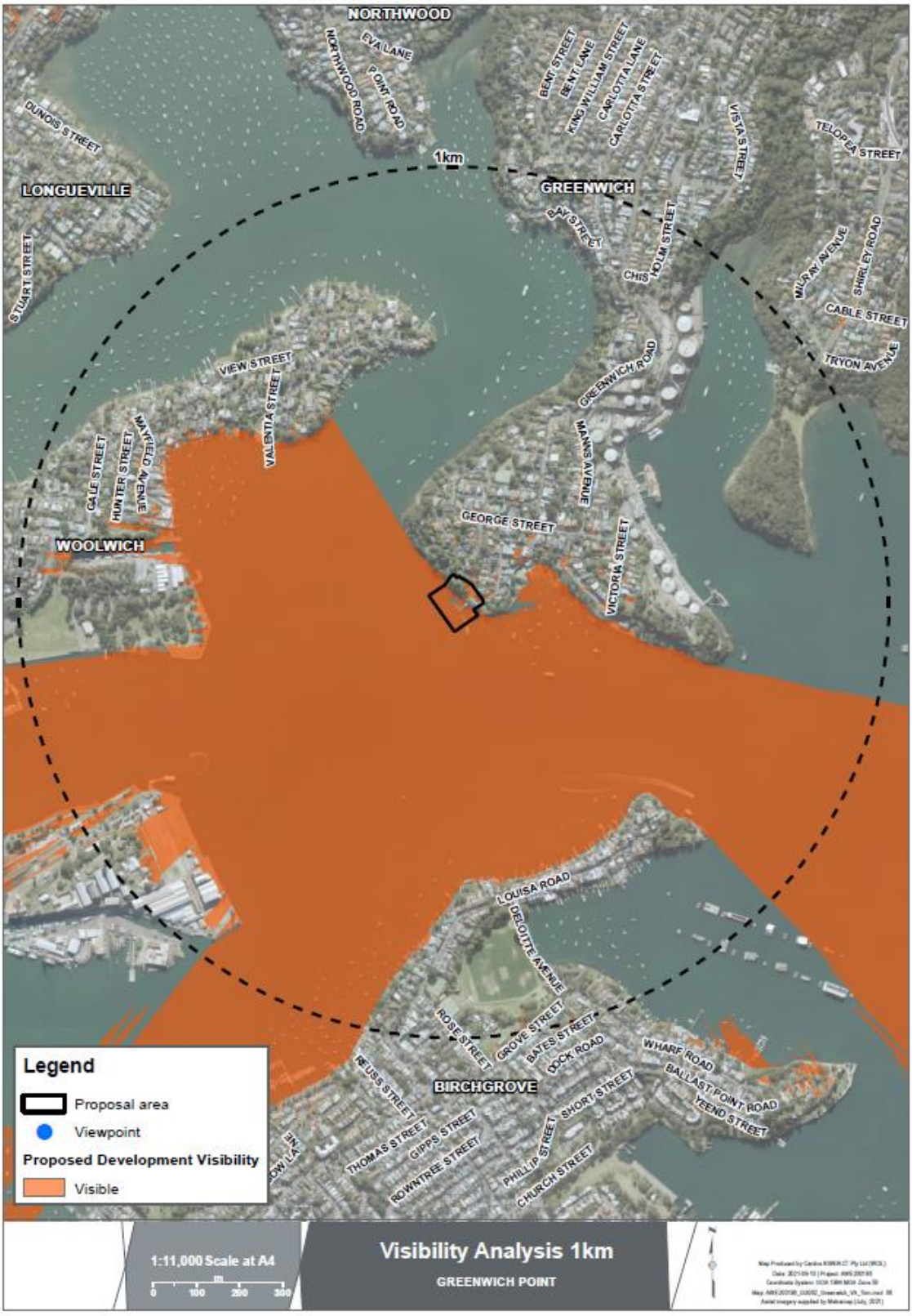


Figure 4: Visibility analysis prepared by Cardno (provided by Cardno 2021[8]

[8] Cardno, 'Landscape Character and Visual Impact Assessment: Greenwich Point Wharf Upgrade'.

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:[9]

- Foreground zone (FZ): Heritage items within 200m of the proposal area
- Middle ground zone (MZ): Heritage items within 200 – 500m of the proposal area
- Background zone (BZ): Heritage items more than 500m from the proposal area.

1.4.4 Assessment of potential direct impacts

In order to assess potential direct impacts, the guidelines provided in the 2016 Roads and Maritime *Construction Noise and Vibration Guideline* are followed.[10] The strategy provides recommendations on the minimum safe working distances from heritage items when utilising vibration intensive plant in order to avoid cosmetic damage. These recommended minimum working distances are provided in Table 3 below.

Table 3: Recommended minimum working distances from vibration intensive plant[11]

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

[9] Cardno, 'Landscape Character and Visual Impact Assessment: Greenwich Point Wharf Upgrade'.
[10] Roads and Maritime, 'Construction Noise and Vibration Guideline'. Roads and Maritime, 2016. 71.
[11] Roads and Maritime, 'Construction Noise and Vibration Guideline'.

The primary vibration intensive items proposed to be used at Greenwich Point Wharf are a 7.5t vibratory roller for the footpath works and pile boring for the wharf piling. An indicative minimum working distance of 41m is recommended for the 7.5t vibratory roller and 40m is recommended for the pile boring. As a result, for the purposes of this SoHI it is assumed that any heritage within 41m of the proposal area would potentially be subject to vibrational impacts as a result of the proposal. It is assumed that any heritage items located more than 45m from the edge of the proposal area would likely be located at a sufficient distance that vibrations resulting from the proposed works would not cause structural damage.

1.4.5 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 proposal area. These guidelines incorporate the aspects of cultural heritage value identified in the *Burra Charter*. The Heritage Council also issued the 1996 *Archaeological Assessment Guidelines*[12] and the Heritage Branch (now Heritage NSW, 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.

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

[12] NSW Heritage Council, "Archaeological Assessment Guidelines".
[13] NSW Heritage Branch, *Assessing Significance for Historical Archaeological Sites and 'Relics'*.

Grading	Justification
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

1.4.6 Archaeological significance

The *NSW Heritage Manual* provides the framework for the significance assessment of the proposal area. 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*.[14] 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)

[14] 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.

1.4.7 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 proposal area, which have views to and from the proposal area. 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 from the proposal area 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 Olivia Turner (Heritage Consultant) and Jayden van Beek (Senior Associate), with management input and review by Josh Symons (Technical Director) and Sandra Wallace (Managing Director).

2.0 STATUTORY CONTEXT

2.1 Introduction

There are several items of State and Commonwealth legislation that are relevant to the current study. A summary of these Acts and the potential legislative implications follow.

Heritage listed items within and 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 (s170) Heritage and Conservation Registers
- Shipwreck Register
- Lane Cove Local Environmental Plan (LEP) 2009
- Hunters Hill LEP 2012
- Leichardt 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 proposal area listed on the WHL, NHL or CHL.

There is one item listed on the WHL within the visual buffer zone.

- Australian Convict Sites (Reference ID 1306)

There is one item listed on the NHL within the visual buffer zone.

- Cockatoo Island (Place ID 105928)

There are three items listed on the CHL within the visual buffer zone:

- Woolwich Dock (Place ID 105244)
- Cockatoo Island Industrial Conservation Area (Place ID 105262)
- Biloela Group (Place ID 105263)

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 proposal area 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. S170 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).*[15]

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:

[15] Heritage Branch, Department of Planning 2009. *Assessing Significance for Archaeological Sites and 'Relics'*, p. 7.

- 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 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*[16] 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 proposal area listed on the SHR.

There are two heritage items listed on the SHR within the visual buffer zone:

- Raywell (SHR no. 00093)
- Railway electricity tunnel under Sydney Harbour (SHR no. 01231).

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.

[16] Heritage Council of New South Wales, 2009. *Standard Exemptions for Works Requiring Heritage Council Approval.*

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 proposal area listed on the Shipwreck Register. There are no items within the visual buffer zone listed on the Shipwreck Register.

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. 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 is one item within or in the immediate vicinity of the proposal area listed on s170 heritage and conservation registers:

- Greenwich Point Ferry Wharf Site (Roads and Maritime s170 Heritage and Conservation Register SHI no. 4920084).

There are three s170 items listed on s170 heritage and conservation registers in the visual buffer zone:

- Valentia Street Wharf and Waiting Shed (Roads and Maritime s170 Heritage and Conservation Register SHI no. 4920086)
- Long Nose Point (Birchgrove) Wharf Site and Shelter (Roads and Maritime s170 Heritage and Conservation Register SHI no. 4920097)
- Sydney Harbour (Balmain to Greenwich) Railway Electricity Tunnel (RailCorp s170 Heritage and Conservation Register SHI no. 5062542).

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 proposal area falls within the boundaries of the Lane Cove LGA. Schedule 5 of the Lane Cove LEP 2009 includes a list of items/sites of heritage significance within the Lane Cove LGA.

2.5.1 Lane Cove Local Environmental Plan 2009

Heritage items listed on the Lane Cove LEP 2009 are managed in accordance with the provisions of Section 5.10 Heritage Conservation of this LEP. Under Clause 5 of this section of Lane Cove LEP 2009:

---

*1) **Objectives** The objectives of this clause are as follows—*

(a) to conserve the environmental heritage of Lane Cove,

(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 seven heritage items listed on the Lane Cove LEP 2009 that are located within or in the immediate vicinity of the proposal area:

- Greenwich Point Wharf (LEP no. I130)
- Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall) [LEP no. I64)
- Greenwich Conservation Area (LEP no. C1)
- House (LEP no. I110)
- House (LEP no. I111)
- Stone steps to rear of house (LEP no. I131)
- Stone sea wall (LEP no. I132).

There are four heritage items and conservation areas listed on the Lane Cove LEP 2009 within the visual buffer zone, nine heritage items and conservation areas listed on the Hunters Hill LEP 2012 within the visual buffer zone, and thirteen heritage items and conservation areas listed on the Leichardt LEP 2013 (Table 6).

2.5.2 Development Control Plan

The Lane Cove DCP 2010 is a supporting document that compliments the provisions contained within the Lane Cove LEP 2009 and provides specific design detail in regard to sympathetic development on, or in the vicinity of, items listed on Schedule 5 of the Lane Cove LEP 2009.

Part B.9: Heritage of the DCP 2010 outlines the following general controls for undertaking developments involving heritage items within the Lane Cove LGA:

9.1 Heritage Items and the Conservation Area

a) Ensure that new additions to heritage buildings are appropriate to the scale of the heritage item.

9.2 Adaptive reuse of heritage items

a) A conservation architect is to be part of the design team for any Development Application (DA) for the adaptive re-use, additions and/or alterations to a heritage item.

9.3 Development in the vicinity of heritage items

a) A Heritage Impact Statement is to be prepared as part of any DA for development "in the vicinity of a heritage item".

Part C of the DCP 2010 also provides specific guidance for undertaking developments within special residential areas, including the Greenwich Heritage Conservation Area. Regarding Locality 5 – Greenwich Heritage Conservation Area, Part C of the DCP 2010 states that:

The overall objectives are:

1 Retain and conserve the heritage significance and significant characteristics of the HCA.

2 Allow removal/alteration of uncharacteristic features that detract from the significance of the HCA.

3 Retain and conserve heritage items.

4 Retain the significant landscaped characteristics of the HCA, including the garden setting of residences, enhanced by street planting, grass verges, stone walls and fences, natural features such as the 'live rock' sandstone outcrops, and the exotic and indigenous vegetation that permeates the area.

5 Encourage the restoration of heritage items that have been unsympathetically altered.

6 Ensure that development is compatible with the heritage significance and significant characteristics of the HCA. Development should respect the principles contained in The Burra Charter.

7 The diversity of architectural forms and differentiation of layers of historical development should be recognised in the built fabric of the Conservation Area.

8 Modern architectural design of high standard is encouraged, provided it is compatible with the traditional forms of the Conservation Area, and it can be demonstrated by HIS that positive impact will arise in relation to significant elements.

2.6 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

There are five heritage items within the visual buffer zone listed on the *Sydney Regional Environmental Plan (SREP) [Sydney Harbour Catchment] 2005* Schedule 4 Part 1. The plan outlines development in relation to heritage under Part 2 and Part 5; and identifies heritage items under Schedule 4.

- Cockatoo Island (item no. 1)
- Balmain to Greenwich Tunnel, including docking facilities and service buildings (item no. 4)
- Long Nose Point Wharf (item no. 5)
- Boat sheds only, Louisa Road (item no. 6)
- Cove Street Wharf (item no. 9).

2.7 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.[17]

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

[17] ISEPP Clause 14. Accessed 19 October 2020. http://www7.austlii.edu.au/cgi-bin/viewdoc/au/legis/nsw/consol_reg/sepp2007541/s14.html.

- Taken into consideration any response to the notice that is received from the council within 21 days after the notice is given.

2.8 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)
- State Environmental Planning Policy (SEPP) No. 56 – Sydney Harbour Foreshores and Tributaries.

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.

The aim of *SEPP No. 56 – Sydney Harbour Foreshores and Tributaries* was to co-ordinate the planning and development of land comprising the foreshores of Sydney Harbour and its tributaries. The policy was repealed on 16 December 2005 by Clause 5 of the *State Environmental Planning Policy (Major Projects) Amendment (Luna Park Site) Policy 2005 (851)*.

2.9 Heritage registers search

A search of all relevant registers was undertaken on 20 September 2021. The results are displayed below in Table 6. Heritage items within and near the proposal area are shaded grey. 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 in close proximity to the proposal area

Item	Address	Significance	Listing	Distance from proposal area
Greenwich Point Wharf	Serpentine Road, Greenwich	Local	Roads and Maritime s170 SHI no. 4920084 Lane Cove LEP 2009 no. I130	Within
Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall)	Greenwich Point (various streets)	Local	Lane Cove LEP 2009 no. I64	Within
Greenwich Conservation Area	Greenwich	Local	Lane Cove LEP 2009 no. C1	Within
House	18 Mitchell Street, Greenwich	Local	Lane Cove LEP 2009 no. I110	Adjacent
House	23 Mitchell Street, Greenwich	Local	Lane Cove LEP 2009 no. I111	Adjacent
Stone steps to rear of house	36 Serpentine Road, Greenwich	Local	Lane Cove LEP 2009 no. I131	Adjacent
Stone sea wall	40 Serpentine Road, Greenwich	Local	Lane Cove LEP 2009 no. I132	40m north-east
Australian Convict Sites (Cockatoo Island)	Cockatoo Island	World	WHL ID 1306 NHL ID 105928 CHL ID 105262 SREP RNE ID 1827 SEPP	Visual buffer zone (735m south-west)
Biloela Group	Cockatoo Island	National	NHL ID 105263 RNE ID 1859	Visual buffer zone (900m south-west)
Greenwich Baths	Albert Street, Parramatta River	Local	Lane Cove LEP 2009 no. I1	Visual buffer zone (120m north-east)
Railway electricity tunnel	Greenwich Point to Birchgrove, Greenwich	Local	Lane Cove LEP 2009 no. I63	Visual buffer zone (320m south-east)
Rockleigh	44 Serpentine Road, Greenwich	Local	Lane Cove LEP 2009 no. I133	Visual buffer zone (75m north-east)
Site of bond store, wharf and quarry	Manns Point Reserve, Prospect Street, Greenwich	Local	Lane Cove LEP 2009 no. A9	Visual buffer zone (300m east)
House, ‘Cora Lyn’	41–43 The Point Road, Woolwich	Local	Hunter’s Hill LEP 2012 no. I318 RNE ID 2822	Visual buffer zone (500m north-west)

Item	Address	Significance	Listing	Distance from proposal area
Valentia Street Wharf and Waiting Shed	Valentia Street, Woolwich	Local	Roads and Maritime s170 SHI no. 4920086 Hunter's Hill LEP 2012 no. I427	Visual buffer zone (515m north-west)
Hunters Hill Conservation Area No 1—The Peninsula	Woolwich	Local	Hunter's Hill LEP 2012 no. C1	Visual buffer zone (515m west)
House, 'Drayton', formerly 'Valentin'	25 The Point Road, Woolwich	Local	Hunter's Hill LEP 2012 no. I313	Visual buffer zone (630m north-west)
House, 'Verdelais'	9 Hunter Street, Woolwich	Local	Hunter's Hill LEP 2012 no. I181 RNE ID 2763	Visual buffer zone (665m north-west)
Stone walls	Woolwich	Local	Hunter's Hill LEP 2012 no. I287	Visual buffer zone (840m west)
Woolwich Dock	Clarke Road and Gale Street, Woolwich	National	CHL ID 105244 Hunter's Hill LEP 2012 no. I92 SREP SEPP RNTA RNE ID 2651	Visual buffer zone (590m west)
Site of precision woodware factory	Woolwich Road, opposite Pier Hotel, Woolwich	Local	Hunter's Hill LEP 2012 no. I418	Visual buffer zone (575m west)
Clarkes Point Reserve	Clarkes Point, Woolwich	Local	Hunter's Hill LEP 2012 no. I93	Visual buffer zone (530m west)
Raywell	144 Louisa Road, Birchgrove	State	SHR no. 00093 Leichardt LEP 2013 no. 830	Visual buffer zone (595m south-east)
Railway electricity tunnel under Sydney Harbour	146A and 146B Louisa Road	State	SHR no. 01231 RailCorp s170 SHI no. 5062542 Leichardt LEP 2013 no. A2 RNTA	Visual buffer zone (640m south-east)
Long Nose Point (Birchgrove) Wharf Site and Shelter	125 Louisa Rd, Birchgrove	Local	Maritime s170 SHI no. 4920097 SREP	Visual buffer zone (660m south-east)
Iron Cove Heritage Conservation Area	Iron Cove, Birchgrove	Local	Leichardt LEP 2013 no. C6	Visual buffer zone (950m south)
Birchgrove and Ballast Point Road Heritage Conservation Area	Birchgrove	Local	Leichardt LEP 2013 no. C8	Visual buffer zone (580m south)

Item	Address	Significance	Listing	Distance from proposal area
House, 'Leopoldville', including interiors	14 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 547	Visual buffer zone (810m south)
House, 'Logan Brae', including interiors	24 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 548	Visual buffer zone (765m south)
House, 'The Anchorage', including interiors	44 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 549	Visual buffer zone (700m south)
House, 'Douglas', including interiors	76 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 552	Visual buffer zone (580m south)
Boat sheds only, Louisa Road	Robinsons Point, Birchgrove	Local	SREP	Visual buffer zone (580m south)
Cove Street Wharf	Cove Street Reserve, Birchgrove	Local	SREP	Visual buffer zone (900m south-west)
Aboriginal middens and rock shelter	7 Numa Street, Birchgrove	Local	Leichardt LEP 2013 no. A6	Visual buffer zone (580m south)
Aboriginal middens and rock shelter	9 Numa Street, Birchgrove	Local	Leichardt LEP 2013 no. A7	Visual buffer zone (570m south-east)
Aboriginal middens and rock shelter	Numa Street (public reserve), Birchgrove	Local	Leichardt LEP 2013 no. A8	Visual buffer zone (590m south-east)
Yurulbin Park	Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. I555 RNTA	Visual buffer zone (660m south-east)
Aboriginal midden and rock shelter	144 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. A4	Visual buffer zone (580m south-east)

Figure 5: Heritage listings within and in close proximity to the proposal area

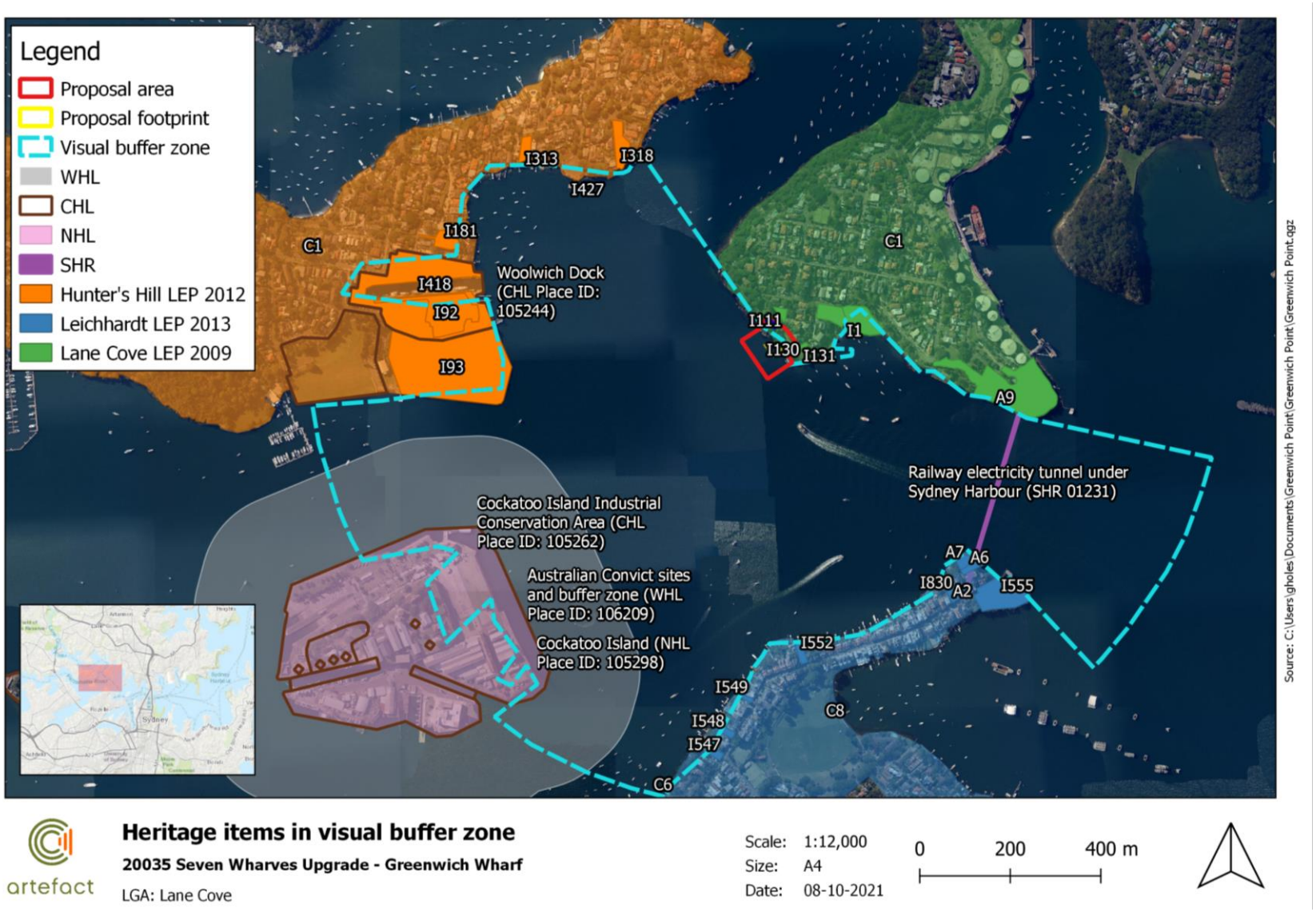


Figure 6: Heritage items within the visual buffer zone

3.0 HISTORICAL CONTEXT

3.1 Early non-Aboriginal settlement in Greenwich Point

3.1.1 Early settlement in Greenwich

Greenwich is the traditional land of the Cammeraygal people. For thousands of years, they cared for and cultivated the local coastal ecosystem and its rich resources.[18] With the onset of European settlement, Greenwich was explored but not settled until the early decades of the nineteenth century. Greenwich was officially designated as within the Parish of Willoughby, County of Cumberland. The first land grant within the area which was to become Greenwich was made in 1794 to convict Samuel Lightfoot.[19] This was in fact one of the earliest grants in the local area.[20]

Other significant early grants in the area included the 150-acre grant to William Gore in 1813, located to the north in what is now the suburb of Gore Hill.[21] Gore created a track through his grant to Gore Cove as a means of transporting his goods to market, and it was this road that later became the main thoroughfare of Greenwich Road. Amaziah Green was granted 5 acres to the east of Gore Cove in 1834 (transferred to his son George in 1837), and James Chisolm was granted a 20-acre block in the same year on Balls Head Bay (later Greenwich). By 1837, the majority of land on the Greenwich peninsula had been officially granted to a selection of settlers.

3.1.2 Growth of the village of Greenwich

Industry emerged with the gradual settlement of Greenwich from the 1830s onwards, with landowners finding the area particularly suitable for the boat and shipbuilding trades.[22] These trades emerged logically following the clearing of the land and the carrying out of timber getting which fed into not only the shipbuilding industry but also the general construction in and around the peninsula. The overwhelming majority of grantees and owners in the mid nineteenth century were themselves shipbuilders or involved in the trade of vessels. Originally known as the Village of St Lawrence, the name Greenwich emerged for the fledgling township as a result of the grand Georgian residence erected for George Green, sometime after 1837 and before 1853, but likely during the 1840s.[23] He named this residence ‘Greenwich House’.

Ferry services were established in the late 1830s and early 1840s but did not become regular until the 1850s. As the primary means of transport to and from the peninsula, Greenwich thus grew around the wharves which serviced it.[24] Accordingly, development was denser on Greenwich Point than in the upper portion of Greenwich deeper inland. This portion of Greenwich remained largely uncleared bushland with some access routes until the final decades of the twentieth century which saw slow and gradual development. At the same time, the current street layout of Greenwich Point appears to have been well-established from the time of its early subdivision in 1859. Mitchell Street, George Street,

[18] Prudence Macleod, 2008. ‘Greenwich’. *Dictionary of Sydney*. Accessed online 14 April 2021, https://dictionaryofsydney.org/entry/greenwich.
[19] Macleod, 2008. ‘Greenwich’. *Dictionary of Sydney*.
[20] Judy Washington, 1992. ‘A brief history of Lane Cove’. Accessed online 14 April 2021, http://www.lanecove.nsw.gov.au/Community/AboutLaneCove/Pages/History.aspx.
[21] Washington, 1992. ‘A brief history of Lane Cove’.
[22] Washington, 1992. ‘A brief history of Lane Cove’; Macleod, 2008. ‘Greenwich’. *Dictionary of Sydney*.
[23] Macleod, 2008. ‘Greenwich’. *Dictionary of Sydney*.
[24] John May, 2015. ‘A Short History of Greenwich Community Association 1944-2014’. p2.

Serpentine Road, Richard Street, O'Connell Street, Albert Street and St Lawrence Street (formerly St Leonard's Street) were all in their current locations and alignment.[25]

The growth of Greenwich alongside other local centres lead to the formation of local government in the Lane Cove area in 1865, when the area was proclaimed part of the Borough of North Willoughby. In 1876, Lane Cove was divided into a series of wards were illustrative of the further growth and need for proper administration of these towns.[26]

The pace of development saw a marked uptick with improved transport connections to the area through a regular ferry service in place by the 1870s, and better roads including Gordon Road/Lane Cove Road (now Pacific Highway) by the 1880s. Subdivision of Upper Greenwich arose as the area was increasingly seen as a desirable residential suburb providing proximate access to the city, rather than a large expanse of coastal land ripe for industry. Such subdivisions included the Seldon Estate of 1882 and the Greendale Park Estate of 1885.[27] Significant early residences in Upper Greenwich were erected at this time, including wine and spirit merchant William Tulloch's 'Airlie', First Mayor of Lane Cove Jeremiah Roberts 'Coolabah,' and alderman John St Vincent Welch's 'Y-Berth'.[28]

Despite the speed with which land was purchased in the 1880s, development throughout Greenwich was still paced and not instant. Dairies became a feature of the unfolding landscape in upper Greenwich in particular as well as farms.[29] Meanwhile, the already more populated Greenwich Point was a well-formed township by the 1880s, with all the amenities the population required in a school, church, general store, post office and commercial stores by this time.[30] Alongside the increased interest in the area came the connection of the suburb to city utilities such as water in the 1890s through the installation of wrought iron mains across Lane Cove River and connection to nearby reservoirs in Ryde and Chatswood.[31] Sewerage connections however, came much later in the 1930s as in other parts of the North Shore.

An interesting description of the suburb in *The Mosman Mail* in 1904 describes the town of Greenwich as 'almost a terra incognita, except to those who live on its healthy heights'.[32] The article details the development of the area at that point in time – including post and telegraph office, a church, stores, and several fine houses. The article notes that all applications for hotel licenses had been rejected.it also describes the ferry wharf and the view it gives 'of the many large industries that send smoke to the skies from almost every point on the waters', and the accommodation of these workers in boarding houses around the foreshore area.

Travel by ferry and road remained the main sources of transport through the area into the twentieth century, with a tram to Gore Hill introduced in 1900 and the North Shore Railway to St Leonards in the 1890s, increasing the general connectivity of the broader area. This network is illustrated in Figure 7. A significant piece of infrastructure, the Sydney Harbour Tunnel which contained the electrical services for the local rail and tramlines, was erected from Birchgrove to Greenwich over 1910s-1920s, opening in 1924. Roads such as Greenwich Road were also upgraded with Littonite around 1920.[33]

[25] Lane Cove Library, 2016. 'Lane Cove Streets'. Accessed online 14 April /2021, http://lanecovestreets.wikifoundry.com/page/Greenwich.
[26] Washington, 1992. 'A brief history of Lane Cove'.
[27] Macleod, 2008. 'Greenwich'. *Dictionary of Sydney*.
[28] Macleod, 2008. 'Greenwich'. *Dictionary of Sydney*.
[29] Washington, 1992. 'A brief history of Lane Cove'.
[30] Washington, 1992. 'A brief history of Lane Cove'.
[31] Washington, 1992. 'A brief history of Lane Cove'.
[32] *The Mosman Mail,* 'Greenwich,' 30 April 1904, Page 7. Accessed online 16 April 2021, https://trove.nla.gov.au/newspaper/article/247007740.
[33] Image of Greenwich Road, Greenwich from 'Littonite roads in Sydney' collection held by the State Library of New South Wales. Accessed online 14 April 2021, https://archival.sl.nsw.gov.au/Details/archive/110038327.

In line with the growth of the suburb as a residential area in the last decades of the nineteenth century into the turn of the century, a significant piece of community infrastructure was located to the north-east of wharf site in 1916, being the Greenwich Baths. [34] Despite resistance from the local community who did not in fact want the baths at the time, the baths flourished into an important local meeting place and site of leisure, with a clubhouse established in the 1930s as the home of the local swimming club. The baths still exist today and are the only example of their type in the Lane Cove area.[35]

As ship and boat building industries moved out around the turn of the century, new industries such as bitumen refinement (through the Patent Ashphaltum Company) and petrol importation and distribution (through the Shell Transport and Trading Company) moved into the area on the water frontages. As early as 1903, the predecessor of Shell Co, John Fell and Company Limited, had established their oil refinery business on the Greenwich Point Peninsula, north-east of the subject site, as illustrated in Figure 8.[36]

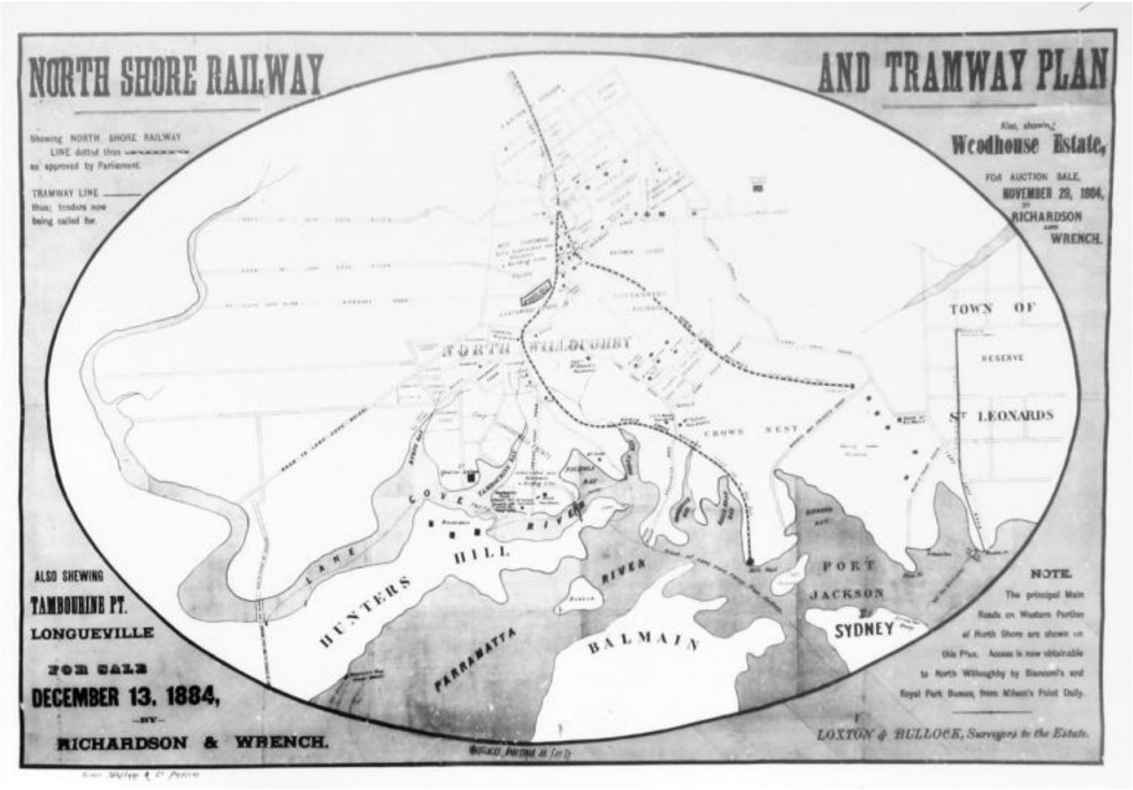


Figure 7: Plan illustrating wider North Shore transport connections around Greenwich in c1880-1890. Source: Willoughby City Library

[34] The Daily Telegraph, '100 years of Greenwich Bath Time,' Marie Hogg, 19 January 2016.
[35] The Daily Telegraph, '100 years of Greenwich Bath Time,' Marie Hogg, 19 January 2016.
[36] Washington, 1992. 'A brief history of Lane Cove'.

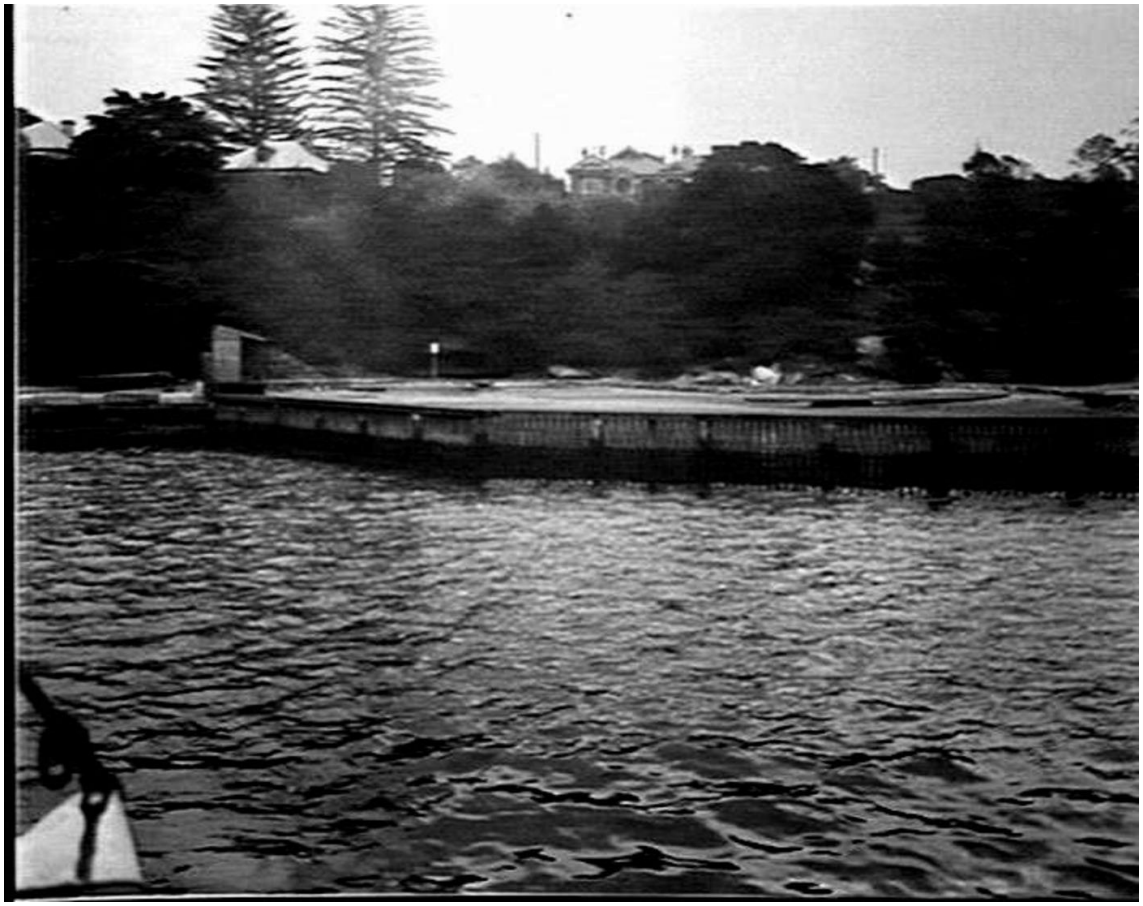


Figure 8: A swimming bath at Greenwich, n.d. Source: SLNSW

Imagery and maps of Greenwich show the continued taking up and development of land, with the northern upper portion of Greenwich increasingly developed over the early twentieth century as seen in Figure 9 and Figure 10. The presence of industry is clear along the north-eastern water frontage of Greenwich Point (Figure 11). Following the opening of the Harbour Bridge in the 1930s, interest and development in Greenwich boomed as the area became much more accessible, with the growth in the demand leading to improved services such as bus services in the area.[37] Community organisations like the Greenwich Community Association grew out of this changing landscape and demography, to represent and advocate for their community.

The present appearance of Greenwich is that of a predominately residential suburb with a small retail offering and several leisure and sporting clubs. Industry still occupies the north-eastern half of Greenwich Point, as seen in the continued presence of tanks and associated offices and infrastructure.

[37] May, 2015. 'A Short History of Greenwich Community Association', p2.

Figure 9: Shell storage depot taken for installation manager Mr. Laing, Greenwich Point. (1964). Source: SLNSW

Figure 10: 'Greenwich nr [sic] Sydney,' 1905. Source: National Museum of Australia

Figure 11: Greenwich Point & Berry Island, c1930s aerial photograph, with the proposal area out of frame to the left. Source: SLNSW

3.2 The North Shore ferries

3.2.1 Sydney ferries

Sydney Harbour and Parramatta River have been a crucial part of Sydney's lifestyle, transportation and industry since the beginning of colonial settlement in NSW. 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. 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 and along Parramatta River, which were 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).[38] 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

[38] Wotherspoon, G., 2008. 'Ferries'. *Dictionary of Sydney*. Accessed online 14 October 2020, https://dictionaryofsydney.org/entry/ferries.

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.[39]

In 1861 the North Shore Ferry Company was established and operated the first commuter-style ferry across the harbour and Parramatta River.[40] At the time there were less than 1000 people living in the North Sydney area, however, as the Harbour Bridge had not been constructed rail or vehicular transportation were not available, and so ferry was the only available transportation method during this period. The establishment of the ferry service contributed to the growth of the North Shore suburbs including Greenwich. Early ferries on the harbour were purpose-built steam paddlers, many of which were constructed at Morts Dock in Balmain in the early 1900s.[41] 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.

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.[42] Vehicular ferries had also been common throughout the early twentieth century, however these services were entirely eradicated following the opening of the harbour Bridge.[43] 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.[44]

Following financial hardship among private ferry operators in the mid-1900s, many of the ferry services were acquired by the State Government in 1951. In the 1980s several new ferries were constructed at Newcastle, reopening the local shipbuilding industry.

3.2.2 Greenwich Point ferry service

Due to the undeveloped road system in the local area which resulted in water being the main access route, the establishment of wharves was an early and important priority for the settlement of the Greenwich area. An 1840 map of the Village of Greenwich (Figure 12) by Mr Bemi, Surveyor, shows three wharves in the area along Parramatta River, being: a government wharf off James Street (now shortened and known as Harrison Street); the St Laurence Street Government wharf, off St Lawrence Street (near the later location of the Greenwich Baths); and a Public Ferry Wharf, representing the original public ferry on Greenwich Point, off Albert Street (to the east of the later location of the Greenwich Baths). The approximate site of the present wharf is shown to have been divided into lots at that time, prior to its acquisition for use as a wharf site.

[39] 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.
[40] Wotherspoon, 2008. 'Ferries'. *Dictionary of Sydney.*
[41] 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.
[42] Wotherspoon, 2008. 'Ferries'. *Dictionary of Sydney.*
[43] Wotherspoon, 2008. 'Ferries'. *Dictionary of Sydney.*
[44] Australian National Maritime Museum, 2018. 'The Manly Ferry'.

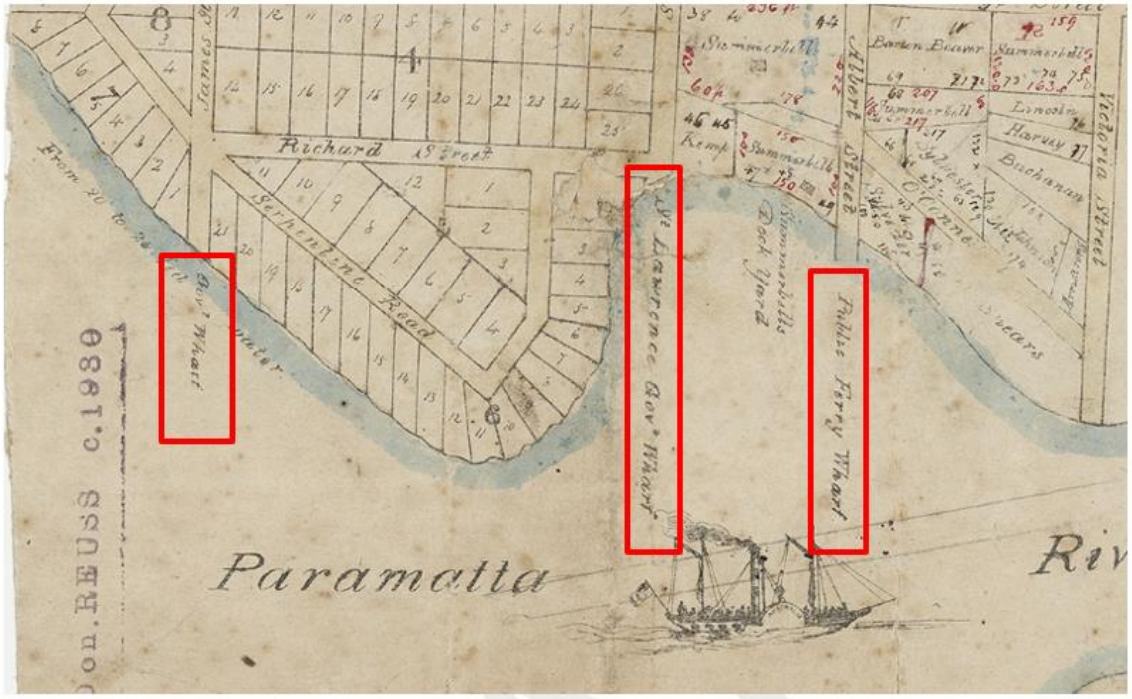


Figure 12: Village of Greenwich / Mr Bemi, surveyor, 1840. Source: SLNSW

The first ferry service established in Greenwich therefore relates to the Public Ferry Wharf depicted in the 1840 map, located at the end of Albert Street.[45] Evidence of the operation of this wharf dates back to 1838, but the service ultimately failed in both its attempts in 1838 and 1841 respectively, being short-lived due to the small population of the area.[46] An 1841 advertisement in The Australian indicates the extent of the service at that time – with the Greenwich Ferry leaving the Balmain Ferry House at 6am, 8am and 4pm, and returning 6:30am, 9:30am and 6:00pm. The cost of the journey was sixpence in each direction.[47] Though short-lived, it was used as a marketing tool for the sale of property on the point, such as Mr Stubb's sale of 84 allotments of the well-known 'Marian Village of Greenwich'.[48]

The Greenwich Point Wharf was then erected to the south-east, at the southernmost point of the Greenwich Peninsula, in the late 1840s or early 1850s when Didier Numa Joubert established a successful regular ferry service in the area (Figure 13).[49]. Joubert was a pioneer of the Hunters Hill area and following the coming of local government to that area, became its first mayor.[50] This determined the length of Joubert's service, which operated from Circular Quay, servicing Greenwich Point, travelling to Hunter's Hill via the Parramatta River (Figure 14). This regular ferry service played an important role in opening up the area and making it more viable for residential occupation through the provision of this public service. Likewise, residents became largely dependent on the service to commute to Circular Quay, and up Parramatta River to Hunter's Hill as the service offered.

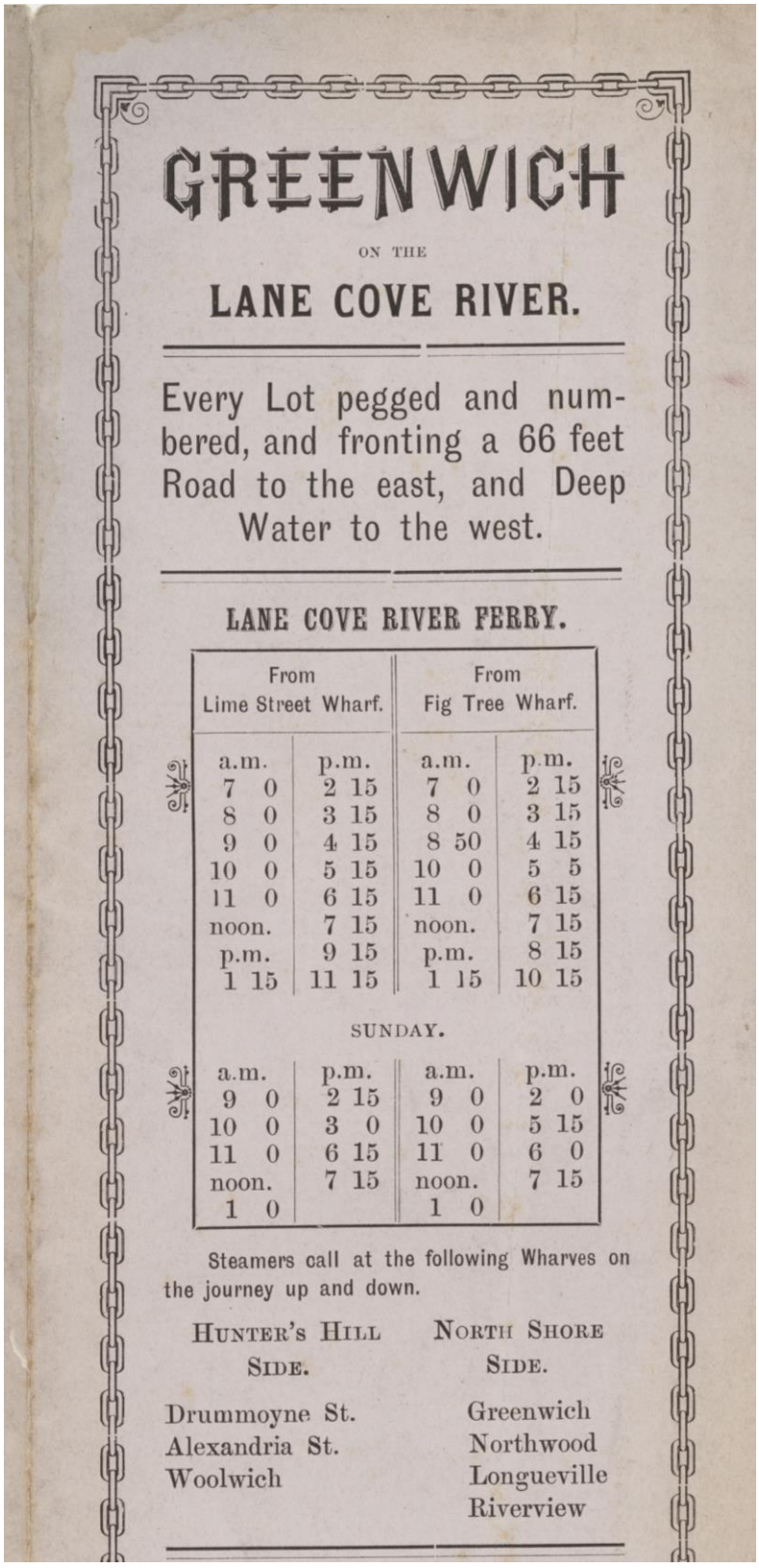
[45] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.
[46] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.
[47] *The Australian,* 'Notice,' Thu 18 February 1941. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/36850539.
[48] *Sydney Morning Herald,* 'Greenwich,' Mon 14 June 1841. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/12869592.
[49] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.
[50] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.

In the 1890s, owing to the success and popularity of the ferry service, a new St Leonards Wharf stop was established off Bay Street (Figure 15).[51] This stop later became known as the Greenwich Ferry Wharf, as opposed to the Greenwich Point Ferry Wharf contained in the proposal area. It represents another layer of the traditional ferry service in the area, and a very important part of the history of infrastructure and transport in the Greenwich area.[52]

The wharf erected for Joubert's service appears to have remained in that location, although it appears to have been rebuilt and modified over time. Figure 16 to Figure 20 illustrate the continuous location of the ferry wharf from 1859 to the mid-twentieth century. It is known that the wharf was extended in 1876, and it was likely partially rebuilt in January 1880 and in the 1940s.[53] Information states the old wharf was rebuilt in the 1940s in timber deck and piles, but it is assumed this relates to the actual jetty of the wharf itself, as the extant fabric of the former wharf is a substantial stone construction.[54] Repairs were also undertaken in 1926, to the dismay of the community who were not given prior notice of the wharf closure to make alternate transport arrangements.[55] The sandstone pier of this wharf is still present today and is identified as the 'former wharf' within the proposal area, but to the east of the actual proposal footprint.

Figure 13: Greenwich Pier, Sydney. Undated, but given as c1880s. Source: Kerry Collection, SLNSW

[51] Heritage NSW, DCP. 'Bay Street, Greenwich Ferry Wharf Site. *State Heritage Inventory*. Accessed online 15 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID= 4920083.
[52] Heritage NSW, DCP. 'Bay Street, Greenwich Ferry Wharf Site'.
[53] *Sydney Morning Herald,* 'Borough Councils,' Sat 15 Jan 1876. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/13366276; *Sydney Morning Herald,* 'Wharf at Greenwich Point,' 31 January 1880. Accessed online 16 April 2021, https://trove.nla.gov.au/newspaper/article/13449920.
[54] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.
[55] Evening News, 'Not playing the game,' Tue 9 March 1926. Accessed online 16 April 2021, https://trove.nla.gov.au/newspaper/article/117291956.



GREENWICH

ON THE

LANE COVE RIVER.

Every Lot pegged and numbered, and fronting a 66 feet Road to the east, and Deep Water to the west.

LANE COVE RIVER FERRY.

From Lime Street Wharf.		From Fig Tree Wharf.	
a.m.	p.m.	a.m.	p.m.
7 0	2 15	7 0	2 15
8 0	3 15	8 0	3 15
9 0	4 15	8 50	4 15
10 0	5 15	10 0	5 5
11 0	6 15	11 0	6 15
noon.	7 15	noon.	7 15
p.m.	9 15	p.m.	8 15
1 15	11 15	1 15	10 15
SUNDAY.			
a.m.	p.m.	a.m.	p.m.
9 0	2 15	9 0	2 0
10 0	3 0	10 0	5 15
11 0	6 15	11 0	6 0
noon.	7 15	noon.	7 15
1 0		1 0	

Steamers call at the following Wharves on the journey up and down.

Hunter's Hill Side.	North Shore Side.
Drummoyne St.	Greenwich
Alexandria St.	Northwood
Woolwich	Longueville
	Riverview

Figure 14: 'Greenwich - Lane Cove River' 1885 Ferry Service Schedule in Greenwich subdivision plans collection. Source: SLNSW

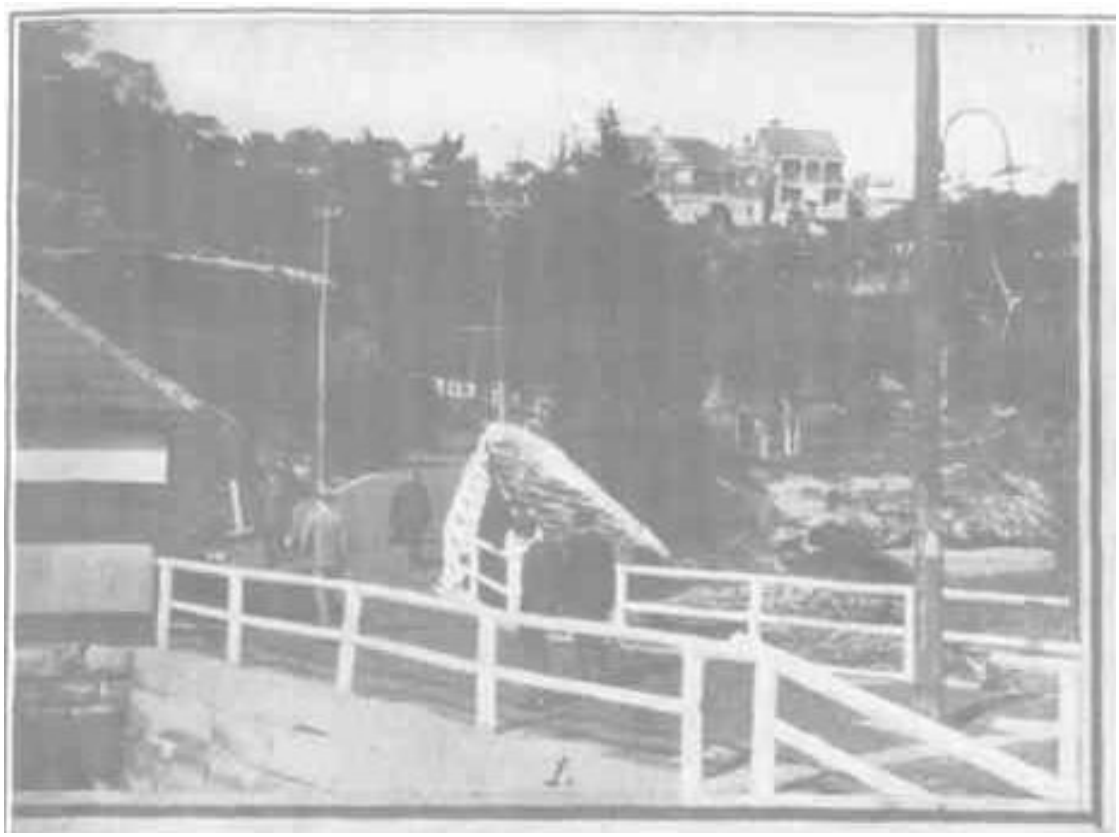


Figure 15: 'Landing at Bay Street, Greenwich,' (St Leonard's Wharf at Bay Street, Greenwich) in 'A Trip on the Lane Cove Steamer,' from *The Australasian,* Sat 5 August 1922.

Figure 16: c1859 'Town of Greenwich' map from collection 'Subdivision plans of the North Shore, Sydney, approximately 1859'. Location of the proposal area shown in red. Soruce: SLNSW

Figure 17: 1888 map excerpt from Certificate of title 882-112. Location of the proposal area shown in red. Source: LPI NSW

Figure 18: Excerpt of location plan showing ferry wharf, from 'Subdivision of Mrs. Ffrench's Estate, Greenwich, Torrens title, 1894'. Location of the proposal area shown in red. Source: SLNSW

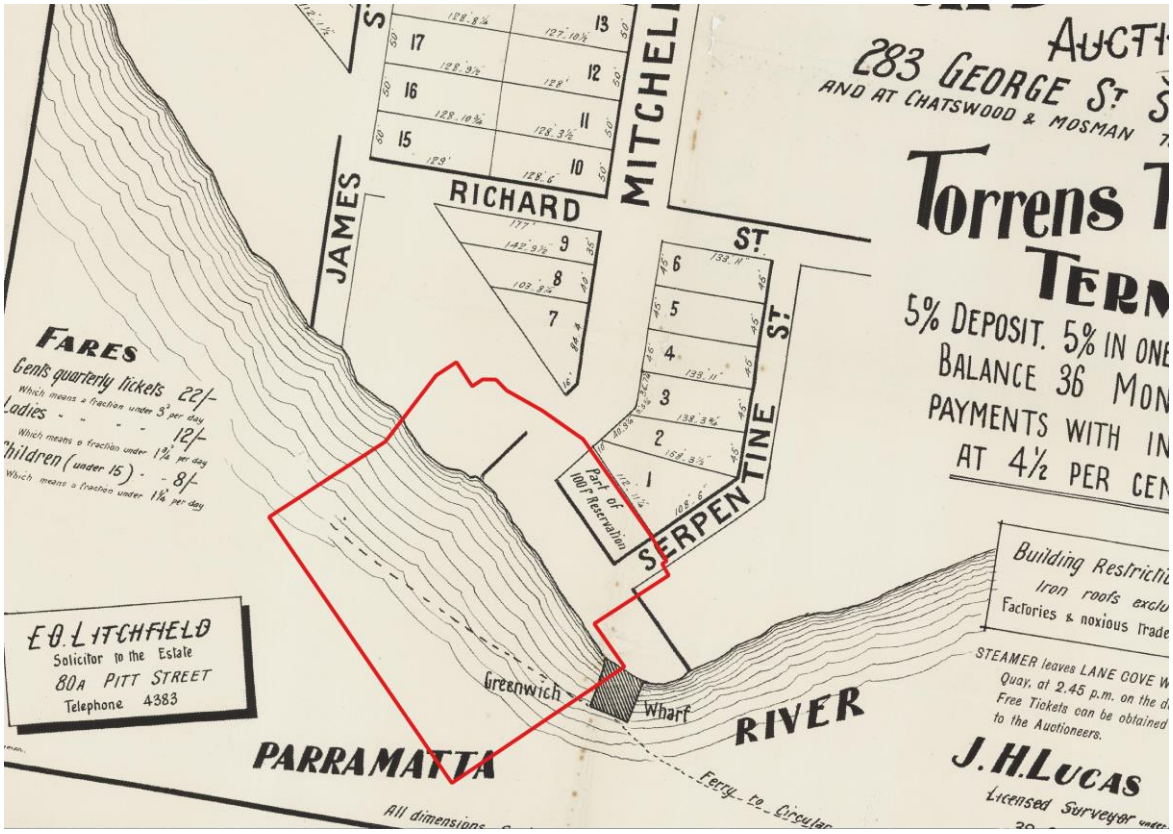


Figure 19: Excerpt of 'Greenwich Point Estate - Church St, Mitchell St, James St, (Sept 1905)'. Location of the proposal area shown in red. Source: SLNSW

Figure 20: 1943 aerial photograph showing the former wharf, pontoons, and waiting shelter. Location of the proposal area shown in red. Source: SIX Maps

Figure 21: Lane Cove River from St Leonards Point Estate, Greenwich, 1904.' Source: Willoughby City Library

The ferry service thrived into the twentieth century (Figure 21), changing hands numerous times, being operated by the Woolwich and Greenwich Steam Ferry Company from at least the 1890s to the early 1900s.[56] The wharfage was later acquired by government. In 1908 and again in 1927, Balmain Council also proposed the creation of a vehicular ferry service between Greenwich and Balmain.[57] However, this service does not appear to have come to fruition. It would appear the costs of the proposal were two prohibitive, and that there were issues in coordination between the councils.[58]

Owing to this popularity, a waiting room appears to have been constructed after tenders were called for the erection of the structure on Greenwich Point Wharf in January 1914.[59] It was extant by the time of the Municipality of Lane Cove council elections in November 1922, when it was advertised as a polling place (Figure 22).[60]

In the 1960s, the Greenwich Community Association lobbied Council to upgrade the ramp which provided access Greenwich Point Wharf with steps due to the difficulty of access in particular tidal and weather conditions.[61] Council replaced the ramp with steps in 1968.

[56] Sydney Morning Herald, 'New South Wales,' Thu 17 Jan 1895. Accessed online 15/04/2021 at: https://trove.nla.gov.au/newspaper/article/13995329/1368037.
[57] *Evening News,* 'Balmain and Greenwich Ferry,' Mon 12 October 1908. Accessed online 15/04/2021 at: https://trove.nla.gov.au/newspaper/article/113766000?
[58] *The Daily Telegraph,* 'Balmain to Greenwich – New Ferry Service Proposal,' Wed 11 May 1927. Accessed online 15/04/2021 at: https://trove.nla.gov.au/newspaper/article/245747944.
[59] *The Daily Telegraph,* 'Municipal Council of Lane Cove,' 10 January 1914, Page 22. Accessed online 15/04/2021 at: https://trove.nla.gov.au/newspaper/article/239015251.
[60] *Sunday Times, '*The Council of the Municipality of Lane Cove,' 26 November 1922, Page 4. Accessed online 15/04/2021 at: https://trove.nla.gov.au/newspaper/article/128210557.
[61] May, 2015. 'A Short History of Greenwich Community Association', p15.

In the 1980s, the remains of the early waiting shed on the old wharf were modified to form the waiting shed structure depicted in photographs from that time (Figure 23 and Figure 24). During this period, the relocation of the wharf was proposed and supported by the community and organisations like the Greenwich Community Association. In 1981, the former wharf was functionally replaced with the present concrete and steel pile wharf to the west.[62] This wharf also contains a small waiting shed, which was constructed in 1992. Prior to this, the old waiting shed was still used on the old wharf in poor weather conditions, although by 1991 it appears to have been in poor condition (Figure 25). Likely as a result of the poor condition of the waiting shelter, Council decided in 1992 to demolish the old shelter and construct a new shelter on the new wharf.[63]

Figure 22: 'Greenwich Pt Wharf, Parramatta River, with collier PELAW MAIN, postcard.' c1920-1929. Source: City of Sydney Archives

[62] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.
[63] May, 2015. 'A Short History of Greenwich Community Association', p31.

Figure 23: A 1987 view when identified for heritage listing. Source: Lane Cove Council via SHI

Figure 24: 'Ferry KARINGAL leaves Greenwich.' (1983) Source: Graeme Andrews Working Harbour Photograph Collection, City of Sydney archives.

Figure 25: Close up of the Greenwich Point Wharf showing the deteriorated condition (window glass no longer present). Source: Sydney & Middle Harbours Heritage Study, GML, 1991.

4.0 SITE INSPECTION

4.1 Introduction

A site inspection was conducted on 2 March 2021 by Jayden van Beek from Artefact Heritage and the FWUP3 Greenwich Point 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

Greenwich Point Wharf is located at the south end of Lower Serpentine Road and Greenwich Point in the suburb of Greenwich. The wharf is situated on Parramatta River near its confluence with Lane Cover River. Lower Serpentine Road is situated at the top of a sandstone escarpment with the wharf located at the base of the escarpment (Figure 26). The wharf is accessed from the road by an asphalted pathway that slopes down to the wharf from the north-west (Figure 27 and Figure 28), or by a set of concrete steps next to the extant bus shelter along the road. There are numerous trees along the edge of Greenwich Point that partially screen the wharf from view from the road (Figure 29). There is also a series of palm trees planted near the west side of Lower Serpentine Road next to the access path to the wharf. To the south-east of the road is Mary Carlson Park and to the north-west is Greenwich Park. There is no evidence of remnant sandstone streetscape elements along the south end of Lower Serpentine Road (Figure 30).

The pathway leading down to the wharf features a sandstone sea wall and white pipe railing (Figure 26). Greenwich Point Wharf extends out from the pathway and consists of a concrete landing and open ramp supported by steel piles (Figure 31 to Figure 33). Access to the ferries is via concrete tidal steps at the end of the ramp, and at the time of the site inspection the lowest steps were submerged (Figure 34). A rectangular timber waiting shelter is present on the concrete landing adjacent to the pathway (Figure 35 to Figure 37). The wharf has clear views looking out onto Parramatta River towards Cockatoo Island to the south-west, and the adjacent suburbs of Birchgrove to the south-east and Woolwich to the west (Figure 38 to Figure 40). The rectangular sandstone pier of the former Greenwich Wharf is located about 20m to the south-east of the current wharf (Figure 41).

In addition to the heritage listed wharf, there are several heritage listed houses at the south end of Greenwich Point. These include the grand ‘Toora’ residence and ‘Buena Vista’ located on Mitchell Street (Figure 42 and Figure 43). Because of the vegetation along Greenwich Point these buildings do not have clear views towards the wharf.

Figure 26: North-east view of the wharf at the base of the escarpment looking up towards Lower Serpentine Road

Figure 27: South view of the wharf from the top of the path leading down to it

Figure 28: South-east view of the path leading down to the wharf

Figure 29: South-west view of the wharf from Lower Serpentine Road obstructed by trees

Figure 30: South-east view of Lower Serpentine Road, with no sandstone elements present

Figure 31: South view of the Greenwich Point Wharf in use

Figure 32: North-west view of the concrete wharf landing attached to the sandstone sea wall

Figure 33: South-west view of the wharf ramp to the tidal steps

Figure 34: North-west view of the tidal steps

Figure 35: South-west view of the ferry shelter from the path

Figure 36: North-east view of the ferry shelter from the wharf ramp

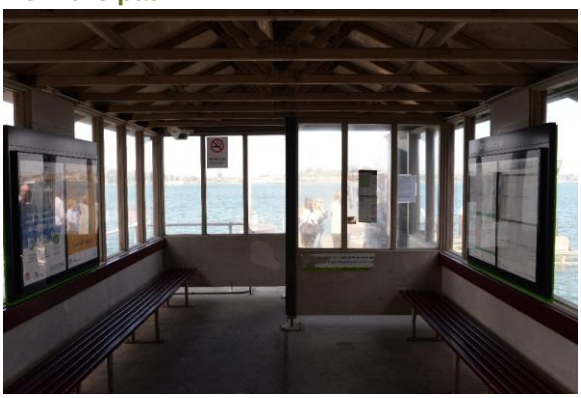


Figure 37: South-west interior view of the ferry shelter

Figure 38: South-west view towards Cockatoo Island from the wharf

Figure 39: West view towards Woolwich from the wharf

Figure 40: South-east view towards Birchgrove from the wharf

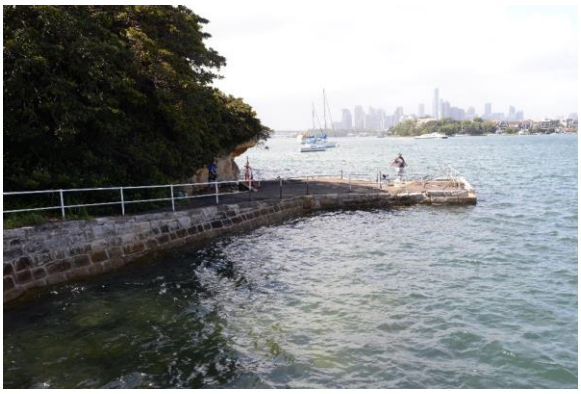


Figure 41: South-east view of the remnant sandstone pier of the former wharf

Figure 42: West view of 'Toora', House (LEP no. I110), from Lower Serpentine Road

Figure 43: North-west view of 'Buena Vista', House (LEP no. I111), from Mitchell Street

5.0 HERITAGE SIGNIFICANCE

5.1 Introduction

This section outlines the significance assessments and statements of significance for the listed heritage items within the proposal area. The significance of the heritage items has been assessed against the NSW heritage significance criteria outlined in Table 5. Statements of significance have been provided for the heritage items identified in Table 6 as being in the immediate vicinity of the proposal area. 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 Greenwich Point Wharf (SHI no. 4920084, LEP no. I130)

5.2.1 Significance assessment

The SHI entries for Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) do not contain a complete significance assessment for the item.[64] As a result, additional significance assessment has been prepared by Artefact Heritage as part of this SoHI and is detailed in Table 7.

Table 7: Significance assessment for Greenwich Point Wharf (SHI no. 4920084, LEP no. I130)

Criterion	Explanation
A – Historical Significance	*Greenwich Point Ferry Wharf is one of the original commuter ferry wharves on the North Shore and has been in continuous use for this purpose since the 1870s. It forms part of the historic infrastructure around which the suburb of Greenwich has developed. The location and on-going operation of commuter ferry wharves has been a significant influence on the roads, public transport and urban development of the North Shore of Sydney Harbour since the 1850s.* **Greenwich Point Wharf has local significance under this criterion**
B – Associative Significance	*Greenwich Point ferry wharf is associated with the early Parramatta River ferry services.* **Greenwich Point Wharf has local significance under this criterion**
C – Aesthetic or Technical Significance	*Greenwich Point Ferry Wharf is one of the original commuter ferry wharves on the North Shore and has been in continuous use for this purpose since the 1870s. It forms part of the historic infrastructure around which the suburb of Greenwich has developed. The location and on-going operation of commuter ferry wharves has been a significant influence on the roads, public transport and urban development of the North Shore of Sydney Harbour since the 1850s.* **Greenwich Point Wharf has local significance under this criterion**
D – Social Significance	The Greenwich Point Wharf may be of interest to residents and history groups within the Lane Cove area. Although the current wharf is not the original Greenwich Point Wharf, it is part of a passenger service that has continuously operated from this location since the 1870s and has served as an important transportation route for residents. The wharf may contribute to residents understanding and sense of place. **Greenwich Point Wharf has local significance under this criterion**

[64] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.

Criterion	Explanation
E – Research Potential	The structure of the wharf does not provide unique information that is not available from other sources and as a result has no research potential. **Greenwich Point Wharf does not reach the threshold of local significance under this criterion**
F – Rarity	*Greenwich Point Ferry Wharf is one of the few ferry wharf sites in Sydney Harbour retaining evidence of generations of wharf structures.* **Greenwich Point Wharf has local significance under this criterion**
G – Representativeness	*Greenwich Point Ferry Wharf is representative of traditional peninsula ferry wharves around Sydney Harbour and its role in the early development of the locality is representative of north shore wharves further east.* **Greenwich Point Wharf has local significance under this criterion**

5.2.2 Statement of significance

Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI entry for Greenwich Point Wharf (SHI no. 4920084, LEP no. I130):

> Greenwich Point Ferry Wharf has been a local transport facility since the 1870s and, as one of several ferry wharves around the Greenwich peninsula, forms part of the historic infrastructure around which the suburb has developed. It is representative of traditional peninsula ferry wharves around Sydney Harbour and, as with other North Shore wharves further east, representative of the early development of the locality that relied upon water transport. The wharf contains the formation and remnants of the earlier late nineteenth/early twentieth century wharf.
>
> The significance of the wharf is contained in its location, its relationship to associated transport routes and any physical evidence that demonstrates its history of use, such as the stone pier.[65]

5.2.3 Recommended management

In addition to the significance assessment and statement of significance above, the SHI entry for Greenwich Point Wharf (SHI no. 4920084) also outlines a series of recommended management measures for the heritage items. These recommended management measures are outlined below:

- *The wharf should be retained and conserved as a ferry wharf*
- *Any alterations and additions should be in accordance with the significance of the wharf site and its relative tolerance for change*

[65] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.

- *The form and fabric of the wharf are not key attributes of its significance and can be changed, as required, to maintain its current function: the cross-harbour passenger ferry activity*
- *The seawall and original stone pier behind the wharf contains evidence of multiple changes over time and, although structural and other reasons may require further alterations to the wall and pier in the future, it should not be altered for aesthetic reasons alone*
- *The wharf waiting shelter provides opportunities for interpretation of the history and significance of the wharf, the ferry system and other heritage elements within their visual catchment which should be explored and developed.*[66]

5.3 Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall) [LEP no. I64]

5.3.1 Significance assessment

The SHI entry for Streetscape elements (LEP no. I64) does not contain a significance assessment for the item.[67] 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 Streetscape elements (LEP no. I64)

Criterion	Explanation
A – Historical Significance	The streetscape elements in Greenwich Point reflect early street planning of the local area, which followed and incorporated the natural land form. The remaining elements are associated with the expansion of residential development in Greenwich Point during the nineteenth century, which required new roadways and paths to accommodate new development and facilitate access through the area. **Streetscape Elements has local significance under this criterion**
B – Associative Significance	The streetscape elements in Greenwich Point do not have a strong association with any individuals or groups that are significant to the development of the local area. **Streetscape Elements does not reach the threshold of local significance under this criterion**
C – Aesthetic or Technical Significance	The streetscape elements in Greenwich Point are remnant remains of the roads and pathways within Greenwich Point that have been shaped by the natural topography of the area. The streetscape elements reflect the ways in which residents and councils utilised the natural landforms and materials in the early street planning. The surviving streetscape elements, which are spread across Greenwich Point, contribute to the visual character of the local area. **Streetscape Elements has local significance under this criterion**

[66] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.
[67] Heritage NSW, DCP, 2010b. 'Streetscape Elements (Sandstone Steps, Outcrops, Kerbing and Retaining Wall)'. *State Heritage Inventory.* Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920071.

Criterion	Explanation
D – Social Significance	The remnant streetscape elements are associated with the historical development of Greenwich Point and contribute to the visual character of the area. As a result, they may be of some social significance to the local community. **Streetscape Elements may have local significance under this criterion**
E – Research Potential	The streetscape elements are unlikely to have research potential as they are unlikely to provide information regarding construction techniques or streetscape planning that is not available from other sources. **Streetscape Elements does not reach the threshold of local significance under this criterion**
F – Rarity	Remnant streetscape elements from the nineteenth century such as sandstone kerbing, steps and retaining walls are not considered to be rare and are relatively common across Sydney. **Streetscape Elements does not reach the threshold of local significance under this criterion**
G – Representativeness	The remnant streetscape elements are representative of early street planning in Greenwich Point during the nineteenth century. Several sections of the streetscape elements appear to be largely unmodified and hold high integrity. **Streetscape Elements has local significance under this criterion**

5.3.2 Statement of significance

Streetscape elements (LEP no. I64) is of local heritage significance.

The following statement of significance has been extracted, and edited where relevant, from the SHI entry for the Streetscape elements (LEP no. I64):

> *Surviving examples of early suburban street planning incorporating the natural land form.*[68]

5.4 Greenwich Conservation Area (LEP no. C1)

5.4.1 Significance assessment

The SHI entry for Greenwich Conservation Area (LEP no. C1) does not contain a significance assessment for the item.[69] As a result, a significance assessment has been prepared by Artefact Heritage as part of this SoHI and is detailed in Table 9.

[68] Heritage NSW, DCP, 2010b. 'Streetscape Elements (Sandstone Steps, Outcrops, Kerbing and Retaining Wall)'.
[69] Heritage NSW, DCP, 2010c. 'Greenwich Conservation Area'. *State Heritage Inventory.* Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920240.

Table 9: Significance Assessment for Greenwich Conservation Area (LEP no. C1)

Criterion	Explanation
A – Historical Significance	The conservation area is reflective of the development of Greenwich Point during the nineteenth and twentieth centuries. **Greenwich Conservation Area has local significance under this criterion**
B – Associative Significance	The conservation area does not have a strong or special association with the works of any individuals or groups who are significant for their contribution to the history of the local area. **Greenwich Conservation Area does not reach the threshold of local significance under this criterion**
C – Aesthetic or Technical Significance	The heritage values of the conservation area are primarily associated with its aesthetic qualities. This includes the scale, form and variety of the residential dwellings, which reflect the development of the area over time and the social mix of people it accommodated, as well as the relationship with the natural harbourside setting of the area, including views out over Balls Head Bay, Parramatta River, and Lane Cove River. **Greenwich Conservation Area has local significance under this criterion**
D – Social Significance	The conservation area is reflective of the development of Greenwich Point during the nineteenth and twentieth centuries, and the variety of the buildings is reflective of the social mix of people it accommodated. The setting of the conservation area, including both the built form and the natural landscape, is strongly tied to its heritage values and likely contributes to the local community's sense of place. As a result, the conservation area is likely to be of social significance to the local community. **Greenwich Conservation Area has local significance under this criterion**
E – Research Potential	The form and fabric of the conservation area are unlikely to provide information regarding construction techniques or town planning that is not available from other sources. **Greenwich Conservation Area does not reach the threshold of local significance under this criterion**
F – Rarity	Harbourside conservation areas with construction dating to the nineteenth century are not considered to be rare in Sydney. Other nearby examples of harbourside conservation areas include Birchgrove and Ballast Point Road Heritage Conservation Area (LEP no. C8) in Leichhardt and Hunters Hill Conservation Area No 2 - The Peninsula (LEP no. C1) in Hunters Hill. **Greenwich Conservation Area does not reach the threshold of local significance under this criterion**
G – Representativeness	The conservation area is representative of the development of Greenwich Point during the nineteenth and twentieth centuries, as reflected through the variety of its structures. It is also representative of harbourside settlement along Parramatta River during this period. **Greenwich Conservation Area has local significance under this criterion**

5.4.2 Statement of significance

Greenwich Conservation Area (LEP no. C1) is of local heritage significance.

The SHI entry for Greenwich Conservation Area (LEP no. C1) does not contain a statement of significance for the item.[70] As a result, the following statement of significance has been extracted, in full, from the Lane Cove heritage study inventory sheets:

> *Greenwich Point clearly demonstrates its developmental history from the first non-convict residential settlement in Lane Cove and through all subsequent stages. The variety of its housing illustrates the social mix it accommodated. It is of aesthetic significance because of the domestic scale of its buildings, and the relationship of buildings to topography and for its water views.*[71]

5.5 House (LEP no. I110)

5.5.1 Statement of significance

House (LEP no. I110) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI entry for House (LEP no. I110):

> *The grandest harbourside residence belonging to the development of Greenwich and Lane Cove as a suburban harbourside area. Fine residence in scale, design and architectural design.*[72]

5.6 House (LEP no. I111)

5.6.1 Statement of significance

House (LEP no. I111) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI entry for House (LEP no. I111):

> *A substantial harbourside residence of similar ilk to 18 Mitchell Street and one of a number of large suburban harbourside residences built at the Pint at this period.*[73]

[70] Heritage NSW, DCP, 2010c. 'Greenwich Conservation Area'.
[71] Robert Moore, Penelope Pike and Lester Tropman & Associates, 1987. 'Municipality of Lane Cove heritage study: [inventory sheets]'. Accessed online 12 April 2021, http://heritagensw.intersearch.com.au/heritagenswjspui/handle/1/2010.
[72] Heritage NSW, DCP, 2010d. 'House'. *State Heritage Inventory.* Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920135.
[73] Heritage NSW, DCP, 2010e. 'House'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920137.

5.7 Stone steps to rear of house (LEP no. I131)

5.7.1 Statement of significance

Stone steps to rear of house (LEP no. I131) is of local heritage significance.

The following statement of significance has been extracted, in full, from the SHI entry for Stone steps to rear of house (LEP no. I131):

> *Set of stone steps and remnant paths leading to the waterfront are evidence of Greenwich Point's earliest period of development as a small maritime settlement with waterfront activity.*[74]

5.8 Stone sea wall (LEP no. I132)

5.8.1 Statement of significance

Stone sea wall (LEP no. I132) is of local heritage significance.

The SHI entry for Stone sea wall (LEP no. I132) does not contain a statement of significance for the item.[75] As a result, the following statement of significance has been extracted, in full, from the Lane Cove heritage study inventory sheets:

> *Picturesque timber Victorian harbourside cottage with waterfront associations, retaining its original stone sea wall. One of the earliest residences at the Point, built by a family involved in the maritime activity of the Point.*[76]

[74] Heritage NSW, DCP, 2010f. 'Stone Steps To Rear of House'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920185.
[75] Heritage NSW, DCP, 2010g. 'Stone sea wall'. *State Heritage Inventory*. Accessed online 20 September 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920239.
[76] Robert Moore, Penelope Pike and Lester Tropman & Associates, 1987. 'Municipality of Lane Cove heritage study: [inventory sheets]'. Accessed online 20 September 2021, http://heritagensw.intersearch.com.au/heritagenswjspui/handle/1/2010.

6.0 PRELMINARY ARCHAEOLOGICAL ASSESSMENT

6.1 Introduction

This section provides a preliminary discussion of the proposal area'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 proposal area.

Areas of potential significant archaeological remains are illustrated in Figure 44.

6.2 Land use summary

Non-Aboriginal occupation and development around the proposal area has been divided into three general phases of historical activity, which are summarised below.

6.2.1 Phase 1 (1788-1830s): Early settlement in Greenwich

Phase 1 consisted of the initial exploration of the area and the provision of grants to early settlers. From the 1830s a boat and shipbuilding industry grew in the area and some land clearing was undertaken. However, this was not centred around the proposal area and there are no structures known to have been built within the proposal area during this period.

6.2.2 Phase 2 (1830s-1992): Greenwich Point Wharf ferry services

Phase 2 saw the establishment of a ferry service and wharf at Greenwich Point. The wharf consisted of a sandstone pier and timber pontoon situated at the end of the pathway leading down from Lower Serpentine Road and was the second wharf established in Greenwich after the failed wharf at the end of Albert Street. The wharf was constructed in the late 1840s or early 1850s and continued to be used until the extant wharf was constructed in the 1980s. A small waiting shed had also been constructed on the pier by the early 1920s which continued to be used during bad weather until 1992. Historical records and photographs indicate that the pier, wharf and waiting room were all modified over time, with the wharf being extended in 1876 and partially rebuilt in the 1940s, and the pier was formalised sometime between the 1880s and early 1920s with the sandstone sea wall that is present today. The former wharf, of which only the sandstone pier is still extent, was located on the eastern edge of the proposal area.

The establishment of the ferry wharf at Greenwich Point also influenced the street layout of the area, as the wharf served as one of the main transport routes to and from Greenwich Point. By the 1840s the layout of the nearby streets largely resembled the current road alignments. Over time these roads were upgraded and formalised. They were likely dirt tracks initially before being formalised with sandstone kerbing, gutters and a possible sandstone surface during the later part of the nineteenth century, as evident by the remnant sandstone Streetscape Elements (LEP no. I64). The roads were then asphalted during the twentieth century.

6.2.3 Phase 3 (1992-present): Current Greenwich Point Wharf

The current Greenwich Point Wharf was constructed in 1981, and in 1992 the old shelter on the former wharf was demolished and a new waiting shelter was built on the current wharf. These structures are still extant today and as a result there are no archaeological remains associated with them.

6.3 Preliminary assessment of archaeological potential

A preliminary assessment of the archaeological potential of each is outlined below. As there are no archaeological remains associated with Phase 3 it is not discussed in this section.

6.3.1 Phase 1 (1788-1830s): Early settlement in Greenwich

Historical records do not attest to the presence of built structures within the proposal area, and it is unlikely that undocumented structures would be present within the proposal area. While some 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 (1830s-1992): Greenwich Point Wharf ferry services

Potential archaeological remains associated with Phase 2 may include evidence of the former Greenwich Point Wharf. The remnant sandstone pier of the former wharf is located 20m south-east of the current wharf. However, the timber pontoons of the former wharf are no longer visible, the former waiting shelter has been removed, and historical records and photographs indicate that the pier itself has been modified over time. Archaeological remains associated with these could include evidence of underwater timber posts, evidence of the footings of the waiting shelter or former waiting shelters underneath the current asphalt surface, or evidence of the modification of the pier. Overall, there is **moderate** potential for archaeological remains of the former wharf to be present within the proposal area. It is noted though that the area of archaeological potential associated with the former wharf is located along the eastern edge of the proposal area and does not extend into the proposal footprint.

By the 1840s roadways to the wharf had been established and during Phase 2 these were formalised into the current street alignments. Prior to being asphalted the roads would have likely featured more substantial sandstone elements, such as kerbing, gutters and a possible sandstone road surface, as indicated by Streetscape Elements (LEP no. I64). As a result, there is archaeological potential for remnant sandstone streetscape elements within the proposal area around Lower Serpentine Road. However, it was noted during the site inspection that no remnant sandstone streetscape elements were visible along the footpath on the south side of the road. This suggests that the remnant sandstone elements have potentially been removed by successive road upgrades and maintenance on Lower Serpentine Road. As a result, there is **low** potential for archaeological remains associated with former road surfaces and streetscape elements.

Overall, there is **low to moderate** potential for archaeological remains associated with Phase 2 to be present within the proposal area. However, only a small area of lower archaeological potential is within the proposal footprint itself.

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 exploration and settlement in the area. However, there is no documentary evidence to suggest that the proposal area was developed during this period. 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 Greenwich 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 Greenwich Point Wharf and remnant streetscape elements. Archaeological remains of these developments would be directly associated with the locally significant Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) and Streetscape Elements (LEP no. I64), and would therefore be significant for their historical, social and representativeness heritage values. The potential archaeological remains would be significant for their association with the development of transportation routes in Greenwich and the development of the local area. These elements are part of the development of the Greenwich Point Wharf which has continued to provide ferry access to Greenwich since the nineteenth century.

Overall, the preliminary archaeological assessment has identified that the proposal area has potential to contain archaeological remains of local significance associated with the development of the former Greenwich Point Wharf and the surrounding streetscape. 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 proposal area 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 for the overall proposal area is provided in Table 10. Areas of archaeological significance are illustrated in Figure 44.

Table 10: Summary of archaeological potential and significance

Phase	Potential Remains	Potential	Significance
Phase 1 (1788-1830s)	Evidence of informal land use, land clearance and isolated artefacts	Nil to low	Would not reach the threshold of local significance
Phase 2 (1830s-1992)	Evidence of the former Greenwich Point Wharf, including timber piles, timber planks, post holes and timber posts, and modifications to the pier	Moderate	Local (works)
	Evidence of the initial establishment of Lower Serpentine Road, such as former gravelled or sandstone road surfaces, kerbing and drainage, and postholes	Low	Local (works)
Phase 3 (c.1992-present)	Nil	Nil	N/a

Figure 44: Areas of significant potential archaeological remains

7.0 PROPOSED WORKS

7.1 Introduction

This section describes the main design features of the proposal and outlines the associated construction activities at Greenwich Point Wharf.

7.2 The proposal

7.2.1 Major water-based features

7.2.1.1 Pontoon

The pontoon is a rectangular steel floating structure 18m long and 9m wide and used as both a ferry boarding and waiting area. The pontoon is orientated parallel to the shoreline and aligns to the navigation channel. This alignment would enable the seaward side of the pontoon to be used as sweep berth. To assist with ferry movements at the wharf, pivot piles are provided at each end of the pontoon berth face. Battery powered flashing navigation lights would be provided on the pivot piles to assist in vessel navigation and to prevent collision in the event of poor visibility of the wharf.

Fenders are provided along the berth face of the pontoon. The fender units would comprise 500mm outer diameter cylindrical fenders with steel fender panels that are 2000mm above the pontoon deck level. Timber walers would span between fender units; the walers would assist with lateral forces and reduce the likelihood of the vessels accidently contacting the side of the fenders and the pontoon. Pontoon mounted 20t bollards are provided for ferry mooring lines. The berthing and mooring loads are ultimately resisted by the four pontoon guide piles, which also act to restrain the pontoon.

The pontoon would be fitted with a glass screen and curved zinc roof structure, supported by steel columns fixed to the pontoon deck providing weather protection for the centrally located seating. The pontoon is also fitted with steel handrails.

A services pod comprising items such as waste bins, information screens, data/electrical cabinet; would be located at the north east end of the pontoon.

Installation of safety and security facilities including lighting, CCTV, ladders to the water, a life buoy and tactile floor treatments would be placed on the pontoon.

7.2.1.2 Gangway

The gangway is an 18m long and 2.5m wide aluminium structure connecting the fixed jetty structure to the pontoon. The gangway gradient would vary according to the tides to be almost horizontal at high tide, and to be a maximum of 1-in-14 for 80 per cent of the tide levels.

7.2.1.3 Jetty

The new jetty would be located approximately six metres east of the existing jetty. The new jetty would extend out from the lift and stairs platform and would consist of concrete deck supported by a concrete headstock on steel piles. The new jetty would be about three metres wide and 22m long. The deck level would account for future sea level rise. The seaward side of the jetty would be built to provide support for the gangway to provide access to the pontoon.

7.2.2 Major land-based features

7.2.2.1 Street-scape

Access to the upgraded Greenwich Point wharf would be via Lower Serpentine Road at the approximate location of the existing bus shelter. This entry point would require the relocation of the existing bus shelter approximately three metres east and would be positioned in front of the access to the existing stairs. This area would require regrading to keep the new bus shelter at the same level as the proposed skybridge and new stairs.

7.2.2.2 Pedestrian access

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

- Proposed DDA compliant skybridge with lift
- New DDA compliant stairs that shares a similar footprint to the lower section of the existing stairs.

The existing non DDA compliant ramp would still provide access from street level to the new wharf.

7.2.2.3 Skybridge

A skybridge would be required to bridge the horizontal distance between the existing pedestrian footpath on Lower Serpentine Road and bottom landing at wharf level.

The skybridge would launch from the location of the existing bus shelter, and interface with the lift at the other side of the escarpment. The skybridge would be approximately 9.8m long and two metres wide.

7.2.2.4 Lift

A through lift configuration is proposed which would allow a person in a wheelchair to enter and exit the lift without the need to reverse or perform manoeuvres. The height of the lift shaft from bottom of pit to top of roof is 12.9m, with approximately five metres of that length visible from street level. From water level the lift shaft would appear as approximately 11.3m tall.

Both doors of the lift would include a glass canopy cover to protect waiting users from inclement weather. Furthermore, the top lift door at skybridge level would be further protected from wind and rain with the inclusion of a glass screen located at the end of the skybridge adjacent the lift door.

Lift shaft finishes are to be considered during detail design that minimise visual impact, are durable, easily maintainable, suitable for a marine environment and promote good CPTED outcomes.

7.2.2.5 Stairs

Access via stairs would form the main route for transitioning between street level and the wharf. The existing stairs do not comply DDA or NCC standards. However, the existing stairs provide a pre-prepared footprint to navigate down the escarpment.

The replacement stairs would be partially constructed within the footprint of the existing stairs. To satisfy the required headroom clearances and relieve potential safety issues, the new stairs would continue straight toward street level (as opposed to turning east as the existing stair does) at the intersection of the skybridge. This is to ensure pedestrians do not need to cross under the skybridge resulting in the issues stated above. This would result in the new stairs reaching street level on the western site of the existing bus shelter, requiring a small section of the embankment to be excavated. The remaining unused segment of the existing stairs would be removed, and appropriate landscaping added.

The staircase would contain four flights of 1.2m wide stairs, with a total step count of 41.

7.2.2.6 Cyclist facilities

It is proposed that three bicycle parking hoops be installed with their location to be determined during the detailed design.

7.2.2.7 Bus facilities

The existing bus shelter would be relocated approximately three metres to the east and would be adjacent to Mary Carlson Park and the existing stair access.

7.2.3 Supporting infrastructure

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

- Opal fixed location readers (tap on/off machines) to be relocated at the entrance to the wharf
- Safety and security lighting in the pontoon waiting area
- Passenger information boards, notices, and (electronic and display board) timetables
- Safety ladders around the walkway and wharf pontoon
- Concealed 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

7.2.4.1 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 11.

7.2.4.2 Earthworks

Earthworks during construction of the land based elements would include:

- Excavation of the cliff face (overburden and rock) to provide a stable platform for the lift and staircase
- Backfilling of area following removal of existing stairs to match surrounding surface
- Excavation for electrical cables
- Earthwork for construction of pavement and kerbs.

A small amount of riverbed sediment would be disturbed during the piling work and demolition of the existing wharf; however, no sediment would be removed.

Table 11: Planned construction activities

Activity	Associated work
Site establishment and enabling works	• Establishment of a temporary fenced compound area (erect site offices, amenities and plant/material storage areas etc.) on the land. The compound area would be located in Greenwich Park • Establishment of a temporary fenced material storage area at the proposed bus shelter location and a small portion of Mary Carlson Park • Site entry and exit points would be established for the construction work site • 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 • The lower area at wharf level would be closed to the public throughout the duration of works • Tree protection would be implemented to minimise damage to trees in proximity to the construction area • Mature Fig tree to be pruned to allow for access prior to start of main works • Removal of two power poles and the main switchboard cabinets
Excavation for stairs	• A 6 tonne excavator would be used for excavation of the stairs • Excavation of the upper stairs and rock can be performed from the upper level after the existing bus shelter has been removed • Excavation of the lower stairs can be performed on the lower level with a small hammer attachment prior to the lift pit excavation • Rock saws would be required to cut through harder rock to minimise vibrations • Replacement of the existing street drainage pipe to the side of the existing stairs may require additional excavation into the rock for the new alignment of the pipes
Excavation for lift pit and walls	• Rock adjacent to existing staircase to be removed for lift pit excavation • Rock should be cut with a rock saw attachment to reduce the vibration into the rock mass • Excavation of the lift pit by 6 tonne excavator but perimeter should be sawed or core drilled to reduce hammering and any effect on the cliff face above it • Rockbolts and shotcrete would be installed progressively as required • 3 tonne site dumper to be used for spoil removal from the wharf level to the site compound
Installation of new services	• New electrical conduits to be installed from the power pole on Lower Serpentine Road footpath to the location of the new main switchboard cabinet at the wharf level prior to the new stairs being cast • New stormwater drainage pipe to be diverted around the location of the lift pit and its upper retaining walls

Activity	Associated work
Construction of lift pit, lift tower, skybridge and walls	• Construct concrete base slab, lift pit and gantry abutment. Concrete would be placed by boom pump on Lower Serpentine Road • The lift tower (prefabricated steel with glazing), lift car, stairs and skybridge would be lifted by a large mobile crane located in Lower Serpentine Road. These operations would block traffic along Lower Serpentine Road for periods of several hours • Access scaffold would be required for fitting the glazing and for installing the lift track system • Crane would need to lift at approximately 20 metre radius to install lift structure. Existing power pole and wires to remain, must be kept clear of during lifting operations • A small anchor rig would be required to drill the rock anchors below the base slab • Waterproofing with injection grouting may be required to ensure a dry excavation for forming up the concrete pour • The concrete deck would be poured in situ with edge protection in place before the skybridge beams are lifted in place
Construction of new stairs and wharf level area	• The new stairs would be cast in situ • The wharf level slab would require excavation and care would be required not to damage the sandstone seawall • Cliff face to be inspected for weak areas
Construction of land side works	Landside infrastructure would involve the modification of footpaths and bus infrastructure
Demolition of the existing Greenwich Point 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 would travel to the site from the off-site facility. One barge would be fitted with a crane (about 12 metres high). When on-site it would be anchored by four points but would reposition around the site during the work, as required • The existing shelter, wharf furniture, fixed tidal structure and jetty decking would be cut away from the piles and loaded onto a barge by crane to be transported to an appropriately approved and licensed facility for reuse and/or disposal • The existing steel and timber piles would be removed by vibratory methods. If a pile is unable to be extracted by vibratory methods, it would be cut off level with the harbour bed. Divers would cut the pile at the seabed level using appropriate underwater equipment. Piles would be transported by barge to an appropriately approved and licensed facility for reuse and/or disposal

Installation of steel piles within the waterway	• Steel locator piles for the pontoon would be installed into bedrock. These piles would be transported by barge to the site from the off-site facility
	• Construct pile foundation systems in bedrock as follows:
	  ○ Pre-drilling into rock
	  ○ Positioning steel pile casing with crane mounted driving unit and piling guide
	  ○ Driving or vibrating the steel pile casings into position
	  ○ Cutting the steal pile casings to length and backfilling with concrete

Activity	Associated work
Installation of the pontoon and gangway	• Lifting and placement of components for the new wharf would be carried out using a barge mounted crane • The new pontoon structure would be constructed at an off-site facility and floated to site. The pontoon would be secured to the locator piles and packing plates used to trim the plan position • The new gangway would be fabricated at an off-site facility and floated to site by barge. The gangway would be lifted into position a large barge mounted crane • Finishing works completed (architectural, services, handrails, etc)
Installation of new or improved facilities	• Provision for new electronic ticketing machines • Installation of bicycle hoops • Installation of way-finding signage • Re-landscaping of the construction areas
Site clean-up	• The site would be cleaned up and restored to its previous state • Sedimentation controls and temporary structures would be removed • Any construction areas would be re-landscaped

Key features of the proposal are illustrated in Figure 45 and virtual renders of the design are illustrated in Figure 46 to Figure 48.

7.2.5 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. A temporary site compound (erect site offices, amenities and plant/material storage areas etc.) would be located in Greenwich Park and Mary Carlson Park (Figure 2).

7.2.6 Public utility adjustment

The proposal would require removal of the two existing power poles and associated cables and fixtures and the existing electrical switchboard within the proposal footprint. New electrical conduits would be run underground from the existing power pole adjacent to the Lower Serpentine Road footpath to the location of the new main switchboard cabinet at the lower level.

Power would be reticulated under the gangway to the pontoon in marine-grade stainless steel conduits. Flexible stainless-steel conduits would be used at the gangway connection to the landside and to the pontoon. A new distribution board would be installed in the electrical switch room within the service pod. All lighting and power circuits as well as other electrical loads on the gangway and the new pontoon would be supplied from the new distribution board.

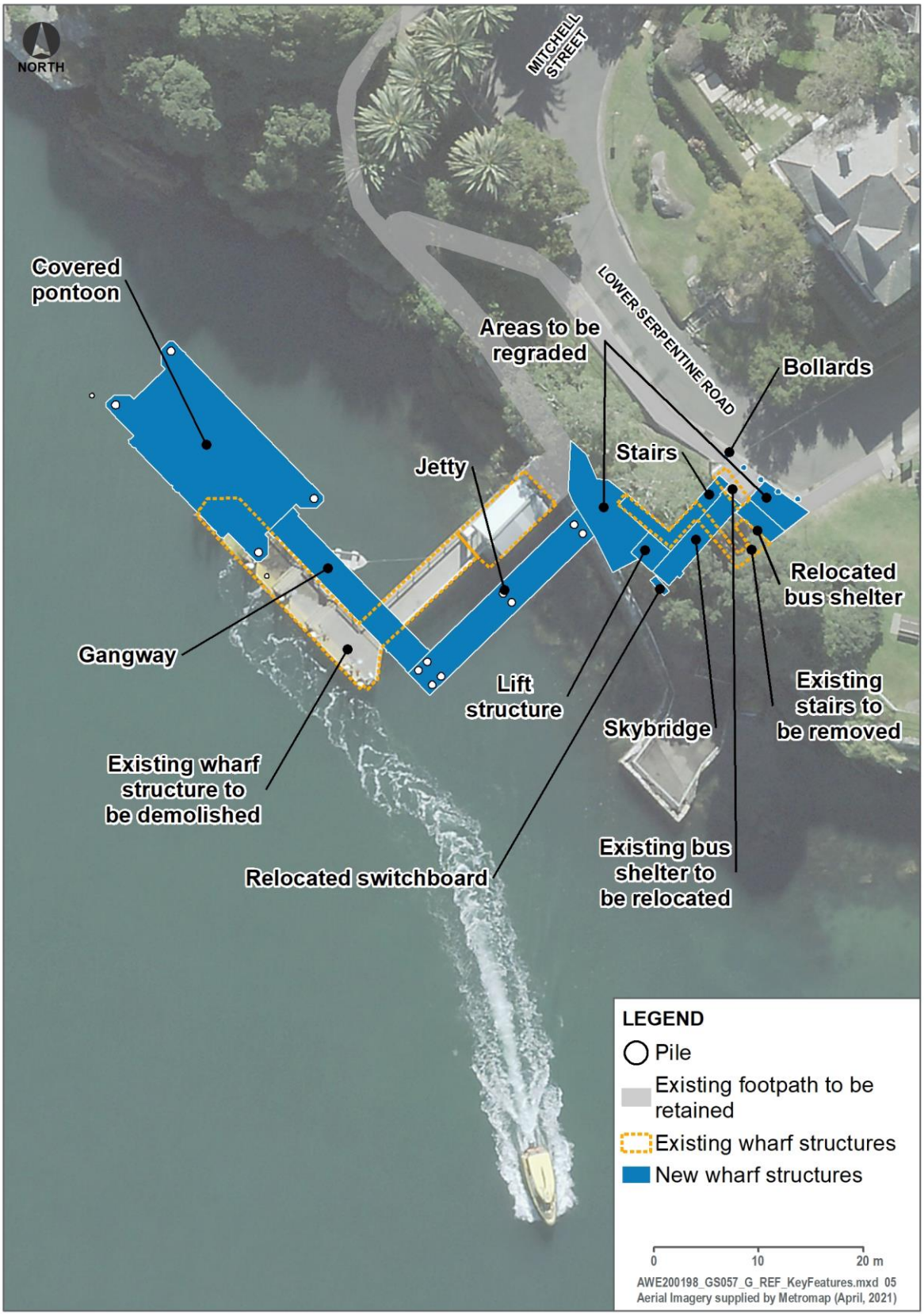


Figure 45: Key features of the proposal (provided by Cardno)

Figure 46: View of proposal from the water looking north-east (provided by Transport for NSW)

Figure 47: View of the proposal from the former nineteenth century wharf looking north-west (provided by Transport for NSW)

Figure 48: View of proposal looking south from Lower Serpentine Road (provided by Transport for NSW)

8.0 HERITAGE IMPACT ASSESSMENT

8.1 Introduction

This section provides an assessment of the impacts that the proposal would have on heritage items near the proposal area. For items identified in Table 6 as being within or in close proximity to the proposal area, assessments are provided of direct, potential direct and indirect (visual) impacts. For heritage items within the visual buffer zone, only indirect (visual) impacts have been considered.

8.2 Greenwich Point Wharf (SHI no. 4920084, LEP no. I130)

8.2.1 Direct and potential direct (physical) heritage impacts

The proposal includes the demolition of the extant Greenwich Point Wharf and the construction of a replacement wharf in roughly the same location and orientation. This would result in the removal of the current structure associated with Greenwich Point Wharf (SHI no. 4920084, LEP no. I130). This represents a major modification of the current heritage item, and without the construction of a replacement wharf this would result in the heritage item being delisted. However, the significance assessment for Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) notes that the heritage values of the site are primarily associated with its location and continuous use of the site as a ferry wharf service since the mid to late nineteenth century. Furthermore, as identified in Section 5.2.3 the listing for the heritage item states that 'The form and fabric of the wharf are not key attributes of its significance and can be changed, as required, to maintain its current function'.[77] It is also noted that the extant wharf itself is not the original wharf and was only constructed in 1981.

As a result, although the extant wharf would be demolished which would result in a major temporary impact, the construction of a new wharf would maintain the continuous provision of ferry services that is associated with the significance of the wharf site. This would mitigate the long-term impact of the proposal and allow the heritage values of Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) to be retained with the new development, as outlined in Table 12.

Table 12: Impact to heritage values of Greenwich Point Wharf (SHI no. 4920084, LEP no. I130)

Criterion	Explanation	Outcome
A	*Greenwich Point Ferry Wharf is one of the original commuter ferry wharves on the North Shore and has been in continuous use for this purpose since the 1870s. It forms part of the historic infrastructure around which the suburb of Greenwich has developed. The location and on-going operation of commuter ferry wharves has been a significant influence on the roads, public transport and urban development of the North Shore of Sydney Harbour since the 1850s.*	It is noted that the extant wharf is not the original wharf and the significance is associated with the continuous operation of a ferry wharf in this location. The construction of a new wharf will allow for the continued provision of ferry services at Greenwich Point. The influence of the wharves on the development of public transport routes is still present through the alignment of the nearby roads. Outcome: Heritage value under this criterion would be retained
B	*Greenwich Point ferry wharf is associated with the early Parramatta River ferry services.*	The site would continue to be associated with ferry services on Parramatta River. Outcome: Heritage value under this criterion would be retained

[77] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'.

Criterion	Explanation	Outcome
C	*Greenwich Point Ferry Wharf is one of the original commuter ferry wharves on the North Shore and has been in continuous use for this purpose since the 1870s. It forms part of the historic infrastructure around which the suburb of Greenwich has developed. The location and on-going operation of commuter ferry wharves has been a significant influence on the roads, public transport and urban development of the North Shore of Sydney Harbour since the 1850s.*	Noted that the extant wharf is not the original wharf. The construction of a new wharf will ensure that the site is still aesthetically associated with the provision of ferry services. Outcome: Heritage value under this criterion would be retained
D	The Greenwich Point Wharf may be of interest to residents and history groups within the Lane Cove area. Although the current wharf is not the original Greenwich Point Wharf, it is part of a passenger service that has continuously operated from this location since the 1870s and has served as an important transportation route for residents. The wharf may contribute to residents understanding and sense of place.	The construction of a new wharf will allow the continued provision of passenger ferry services from this location and will continue to serve as a transportation route for residents. This heritage value could be reinforced through the provision of heritage interpretation to document the history of the site and enable greater public engagement. Outcome: Heritage value under this criterion would be retained
F	*Greenwich Point Ferry Wharf is one of the few ferry wharf sites in Sydney Harbour retaining evidence of generations of wharf structures.*	Evidence of the earlier generation of the wharf (located to the south-east of the extant wharf) would not be altered. Outcome: Heritage value under this criterion would be retained
G	*Greenwich Point Ferry Wharf is representative of traditional peninsula ferry wharves around Sydney Harbour and its role in the early development of the locality is representative of north shore wharves further east.*	It is noted again that the extant wharf is not the original wharf. The development of the area is represented through the continued use of the site as a ferry service, including upgrades to the wharves over time to serve the community. Outcome: Heritage value under this criterion would be retained

Because the extant wharf structure would be removed, there would be no potential direct impact to Greenwich Point Wharf (SHI no. 4920084, LEP no. I130).

Overall, the proposed works would result in a **moderate** direct and **neutral** potential direct impact to Greenwich Point Wharf (SHI no. 4920084, LEP no. I130), however, the overall heritage values of the heritage item would be largely retained, and Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) would not be delisted.

8.2.2 Indirect (visual) heritage impacts

The proposal would result in the demolition of the extant wharf. This would remove the present wharf infrastructure which is associated with the aesthetic heritage values of the site as an ongoing commuter ferry wharf. This would represent a major temporary modification of the current setting of Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) in the time between the demolition of the extant wharf and the construction of the new one.

However, the heritage listing for the item notes that the form of the wharf is not a key component of its significance, and a new wharf would be built adjacent to the current one. As a result, the key aesthetical element of the item's significance, the continued presence of a wharf at Greenwich Point,

would be largely maintained. The proposal would introduce new visually intrusive elements such as the lift and skybridge, however, the wharf itself has been designed to be small in size and feature a low height to reduce the visual impact on the setting of the area. The wharf has also been designed to respond to existing visual cues on the river by using lightweight materials, simple lines, and muted colours. The design of the wharf is consistent with other wharves in Sydney, including nearby wharves such as Woolwich Ferry Wharf (Valentia Street Wharf) and Birchgrove Ferry Wharf (formerly Longnose Point Ferry Wharf), and views looking out and from Parramatta River would be largely unaffected. Furthermore, views to the location of the former generation of wharves to the south-east would be.

Overall, the proposed works would result in a **moderate** visual impact to Greenwich Point Wharf (SHI no. 4920084, LEP no. I130), however, the overall aesthetic heritage values of the heritage item would be largely retained.

8.3 Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall) [LEP no. I64]

8.3.1 Direct and potential direct (physical heritage impacts)

Although the Streetscape Elements (LEP no. I64) extends into the proposal area, only a very small portion of the heritage item is within the proposal footprint itself. No evidence of sandstone streetscape elements was visible on Lower Serpentine Road during the site inspection (as they have potentially been previously removed), therefore, it is unlikely that any direct impacts to the heritage item would occur as a result of the proposed footpath works including the regrading, relocation of the bus shelter and installation of the stairs. The proposed works would include the removal of the existing concrete stairs down to the wharf; however, these are not part of the heritage of the item and therefore the removal of the stairs would not impact significant fabric.

The main portion of the heritage item that may be impacted by the proposed works is the sandstone sea wall that is present along the edge of the path providing access from Lower Serpentine Road to the extant and former wharf. The sea wall would not be directly impacted by the lift and skybridge which are set back from the edge of the wall, and it is not expected to be directly impacted by the gangway which has been designed to sit on top of the wall rather than set into it. It is also expected that that the new handrails would be set back far enough from the edge of the sea wall that they would not be drilled into the sandstone blocks.

The sea wall does however continue behind the extant wharf, and as a result the removal of the wharf, particularly the concrete landing that is connected to the path, may cause impacts to the adjacent section of the sea wall. Although it is not expected to result in the removal of multiple sandstone blocks from the sea wall, the removal of the concrete landing may damage several of the blocks where the concrete is attached. This would cause localised impacts to the sea wall. The impacted section would be relatively small compared to the overall size of the heritage item however, and it is expected that if care is taken and mitigation measures are implemented, then the direct impacts would largely be limited to surface damage. Furthermore, the nearby sandstone pier of the original wharf to the south-east, which is associated with the significance of Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) but is within the curtilage of Streetscape Elements (LEP no. I64), would not be directly impacted. As a result, the impact to the overall heritage item would be minor in nature.

The proposed works would be located within the curtilage of Streetscape Elements (LEP no. I64) and therefore the vibrations associated with the proposed works could result in potential direct impacts. In particular, the proposed piling is located within 5m of the significant sandstone sea wall along the water's edge. This could potentially cause blocks within the sea wall to be displaced or could cause

blocks to crack. However, only a small number of piles are required and the sea wall is a robust feature that appears to be in good condition, therefore, it is unlikely that the relatively minor works would cause substantial structural issues. 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 **minor** direct and **negligible** potential direct impact to Streetscape Elements (LEP no. I64).

8.3.2 Indirect (visual) heritage impacts

The construction of a new wharf and items such as the lift and skybridge would introduce new visually intrusive elements within sight of the Streetscape Elements (LEP no. I64). However, the new elements would primarily only be visible from the portion of the heritage item at the south end of Greenwich Point, and the vegetation in the area will help to partially screen some of these elements from view. The wharf itself has also been designed to reduce visual impacts through the size and height of the wharf and the use of lightweight materials, simple lines, and muted colours. The new wharf would not obstruct views from the water towards the sandstone sea wall more than the extant wharf already does and would not obstruct views towards the sandstone pier of the former wharf. The new handrails would also be visually consistent with the existing handrails along the edge of the sea wall. Direct impacts to the sandstone sea wall however, such as surface damage to the sandstone blocks from the removal of the extant concrete landing, would visually impact the sea wall. However, as this section of the sea wall is normally obstructed from view by the extant wharf, the visual impact caused by any surface damage would be largely offset by exposing the currently covered sandstone. As a result, the overall visual impact to the heritage item would be minimal.

Overall, the proposed works would result in a **negligible** visual impact to Streetscape Elements (LEP no. I64).

8.4 Greenwich Conservation Area (LEP no. C1)

8.4.1 Direct and potential direct (physical) heritage impacts

The main works associated with the proposal is the demolition of the extant wharf. However, the wharf is not within the curtilage of Greenwich Conservation Area (LEP no. C1) and therefore is not considered to be significant fabric associated with the conservation area. As a result, the removal of the extant wharf would not result in direct impacts to the conservation area. Works within the curtilage of the conservation area would consist of minor footpath works, the relocation of the extant bus shelter, the removal of the existing concrete stairs, and the construction of the lift and skybridge. The footpath, bus shelter and concrete stairs are not considered to be significant fabric within the conservation area though, and while some vegetation would be trimmed to install the lift and skybridge, no trees would be removed. As a result, the direct impact to fabric that contributes to the significance of Greenwich Conservation Area (LEP no. C1) would be minimal.

The proposed works would be undertaken within the vicinity of remnant streetscape elements (discussed in 8.3), built heritage items (discussed in Section 8.5, Section 8.6 and Section 8.7), and other buildings. These elements are located within Greenwich Conservation Area (LEP no. C1) and contribute to its significance. They are located within the minimum safe working distance for cosmetic damage and as a result the vibrations associated with the proposed works could result in potential direct impacts. However, the land-based scope of works is relatively minor in nature and is unlikely to produce substantial vibrations, and the majority of the built structures are situated further back from the proposed works. Furthermore, the affected area of the conservation area is only a very small part relative to the overall size of Greenwich Conservation Area (LEP no. C1). 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 **negligible** direct and **negligible** potential direct impact to Greenwich Conservation Area (LEP no. C1).

8.4.2 Indirect (visual) heritage impacts

Part of the aesthetical significance of Greenwich Conservation Area (LEP no. C1) is its harbourside setting and its views looking out over Parramatta River. Although the extant wharf is not part of the conservation area, the removal and replacement of the wharf would modify part of the harbourside setting and river views within the conservation area. The construction of new elements such as the lift and skybridge would also introduce new visually intrusive elements into the conservation area. However, the impacts would be limited to a very small portion of the overall conservation area, and the changes would generally only be visible from the southern end of Lower Serpentine Road. Only a small area of vegetation would be pruned, and more visually prominent trees such as the Fig trees in Mary Carlson Park would not be impacted. The remaining vegetation would help to partially screen the new elements from view within the local setting.

The new wharf has been designed to be small in size and feature a low height to reduce the visual impact on the setting of the area, and to respond to existing visual cues on the river by using lightweight materials, simple lines, and muted colours. The design would be consistent with other nearby wharves on Parramatta River, and because the wharf is set at a lower elevation than the conservation area on Lower Serpentine Road, views looking out to Parramatta River would be largely unaffected. 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 Greenwich Conservation Area (LEP no. C1).

8.5 House (LEP no. I110)

8.5.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of House (LEP no. I110). As a result, there would be no direct impacts to the heritage item. House (LEP no. I110) is located 15-20m north-east of the nearest proposed work, consisting of the regarding of the footpath along Lower Serpentine Road and the relocation of the bus shelter, and 30m from the proposed piling for the gangway piles. As a result, House (LEP no. I110) would be located within the minimum safe working distance for cosmetic damage and the vibrations associated with the proposed works could result in potential direct impacts. However, the land-based scope of works is relatively minor in nature and is unlikely to produce substantial vibrations, and the structure is located towards the edge of the minimum safe working distance from the piling. As a result, it is expected that any potential direct impacts resulting from vibrations would be minimal.

Overall, the proposed works would result in **neutral** direct and **negligible** potential direct impact to House (LEP no. I110).

8.5.2 Indirect (visual) heritage impacts

The proposal involves the replacement of the current Greenwich Point Wharf with a new one in roughly the same location. Views to and from the House (LEP no. I110) and the extant wharf are already largely obstructed by trees between the road and the wharf and as a result views towards the new wharf would also be largely obstructed (Figure 48). A new lift and skybridge would be constructed at the edge of the road which would introduce a new visually intrusive element. However, only the top portion of the lift shaft and skybridge would be visible, and they would be partially

obstructed by the extant vegetation. As a result, the visual impacts to the heritage item would be minimal.

Overall, the proposed works would result in a **negligible** visual impact to House (LEP no. I110).

8.6 House (LEP no. I111)

8.6.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of House (LEP no. I111). As a result, there would be no direct impacts to the heritage item. House (LEP no. I111) is located 15m north-east of the proposed compound, however it is located 50-55m from the nearest proposed work, consisting of the footpath works and skybridge and lift construction on Lower Serpentine Road. As a result, House (LEP no. I110) would be located outside the minimum safe working distance for cosmetic damage and the vibrations associated with the proposed works are unlikely to result in potential direct impacts.

Overall, the proposed works would result in **neutral** direct and **neutral** potential direct impact to House (LEP no. I111).

8.6.2 Indirect (visual) heritage impacts

Views to and from the House (LEP no. I111) and the extant wharf are already largely obstructed by trees between the road and the wharf and as a result views towards the new wharf would also be largely obstructed (Figure 48). Views towards the new lift shaft and skybridge would similarly be largely obstructed by the extant vegetation. As a result, the visual impacts to the heritage item would be minimal.

Overall, the proposed works would result in a **negligible** visual impact to House (LEP no. I111).

8.7 Stone steps to rear of house (LEP no. I131)

8.7.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of the Stone steps to rear of house (LEP no. I131). As a result, there would be no direct impacts to the heritage item.

The curtilage of the heritage item consists of the house located at 36 Serpentine Road, Greenwich. However, the house itself is not an element of significance and the stone steps appear to be located outside of the heritage curtilage. Based on the inventory sheet descriptions and historical photographs of the stone steps, the steps appear to be located on the waterfront about 25-30m south-east of the heritage curtilage. The stone steps are likely situated near a portion of the Streetscapes elements (LEP no. I64) which is located along the waterfront. This area is located about 45-50m south-east from the nearest proposed work, consisting of the footpath works on Lower Serpentine Road. As a result, the stone steps themselves are located outside the minimum safe working distance for cosmetic damage. Therefore, the vibrations associated with the proposed works are unlikely to result in potential direct impacts to the heritage item.

Overall, the proposed works would result in **neutral** direct and **neutral** potential direct impact to Stone steps to rear of house (LEP no. I131).

8.7.2 Indirect (visual) heritage impacts

Due to the topography of the landscape and the extant vegetation, there are no clear sightlines between the stone steps and the proposed works. Therefore, there would be no visual impact to the significant element of the heritage item.

Overall, the proposed works would result in a **neutral** visual impact to Stone steps to rear of house (LEP no. I131).

8.8 Stone sea wall (LEP no. I132)

8.8.1 Direct and potential direct (physical) heritage impacts

The proposed works are located outside of the curtilage of the Stone sea wall (LEP no. I132). As a result, there would be no direct impacts to the heritage item.

The curtilage of the heritage item includes the house located at 40 Serpentine Road, Greenwich, which is located 40m from the proposal area. However, the house itself appears to be a more modern development as it does not match the description of the item provided in the Lane Cove heritage study inventory sheets.[78] Because of this the house is not considered to be an element of significance. The sea wall is located at the rear of the property and is about 65-75m south-east from the nearest proposed work, consisting of the footpath works on Lower Serpentine Road. As a result, the stone sea wall itself is located outside the minimum safe working distance for cosmetic damage. Therefore, the vibrations associated with the proposed works are unlikely to result in potential direct impacts to the heritage item.

Overall, the proposed works would result in **neutral** direct and **neutral** potential direct impact to Stone sea wall (LEP no. I132).

8.8.2 Indirect (visual) heritage impacts

Due to the topography of the landscape and the extant vegetation, there are no clear sightlines between the stone sea wall and the proposed works. Therefore, there would be no visual impact to the significant element of the heritage item.

Overall, the proposed works would result in a **neutral** visual impact to Stone sea wall (LEP no. I132).

8.9 Visual impacts to heritage items in the foreground zone

Individual visual impact assessments have been prepared for the heritage items within the FZ due to their closer proximity to the proposed works. As these heritage items are all located outside of the minimum recommended distance for avoiding cosmetic damage (Table 3). However, there would be no direct or potential direct impacts.

8.9.1 Greenwich Baths (LEP no. I1)

8.9.1.1 Indirect (visual) heritage impacts

Greenwich Baths (LEP no. I1) is located about 120m north-east of the proposal area. Due to the topography of the landscape, the surrounding buildings, and the extant vegetation there are no clear

[78] Robert Moore, Penelope Pike and Lester Tropman & Associates, 1987. 'Municipality of Lane Cove heritage study: [inventory sheets]'. Accessed online 20 September 2021, http://heritagensw.intersearch.com.au/heritagenswjspui/handle/1/2010.

sightlines between Greenwich Baths and the proposed works. Therefore, there would be no visual impact to the significant element of the heritage item.

Overall, the proposed works would result in a **neutral** visual impact to Greenwich Baths (LEP no. I1).

8.9.2 Rockleigh (LEP no. I133)

8.9.2.1 Indirect (visual) heritage impacts

Rockleigh (LEP no. I133) is located about 75m north-east of the proposal area and has views to the edge of the proposal area. Despite this however, it is expected that views to the developments on Lower Serpentine Road, including the lift shaft and the skybridge, would be obstructed by the road alignment, the surrounding houses, the topography of the landscape, and the extant vegetation at the proposed location of the lift. Therefore, there would be no visual impact to the significant element of the heritage item.

Overall, the proposed works would result in a **neutral** visual impact to Rockleigh (LEP no. I133).

8.10 Visual impacts to heritage items in the middle ground and background zones

This section provides a visual impact assessment for the heritage items located within the MZ and BZ of the visual buffer zone. Only two of the identified heritage items are within the MZ (located 200-500m from the proposal area). The remaining 27 items are within the BZ (located 500m or more from the proposal area). The items within the MZ and BZ are listed in Table 13.

Table 13: Heritage items within the MZ and BZ of the visual buffer zone

Item	Address	Significance	Listing	Distance from proposal area
Australian Convict Sites (Cockatoo Island)	Cockatoo Island	World	WHL ID 1306 NHL ID 105928 CHL ID 105262 RNE ID 1827 SEPP SREP	Visual buffer zone (735m south-west)
Biloela Group	Cockatoo Island	National	NHL ID 105263 RNE ID 1859	Visual buffer zone (900m south-west)
Railway electricity tunnel	Greenwich Point to Birchgrove, Greenwich	Local	Lane Cove LEP 2009 no. I63	Visual buffer zone (320m south-east)
Site of bond store, wharf and quarry	Manns Point Reserve, Prospect Street, Greenwich	Local	Lane Cove LEP 2009 no. A9	Visual buffer zone (300m east)
House, ‘Cora Lyn’	41–43 The Point Road, Woolwich	Local	Hunter’s Hill LEP 2012 no. I318 RNE ID 2822	Visual buffer zone (500m north-west)
Valentia Street Wharf and Waiting Shed	Valentia Street, Woolwich	Local	Roads and Maritime s170 SHI no. 4920086 Hunter’s Hill LEP 2012 no. I427	Visual buffer zone (515m north-west)

Item	Address	Significance	Listing	Distance from proposal area
Hunters Hill Conservation Area No 1—The Peninsula	Woolwich	Local	Hunter's Hill LEP 2012 no. C1	Visual buffer zone (515m west)
House, 'Drayton', formerly 'Valentin'	25 The Point Road, Woolwich	Local	Hunter's Hill LEP 2012 no. I313	Visual buffer zone (630m north-west)
House, 'Verdelais'	9 Hunter Street, Woolwich	Local	Hunter's Hill LEP 2012 no. I181 RNE ID 2763	Visual buffer zone (665m north-west)
Stone walls	Woolwich	Local	Hunter's Hill LEP 2012 no. I287	Visual buffer zone (840m west)
Woolwich Dock	Clarke Road and Gale Street, Woolwich	National	CHL ID 105244 Hunter's Hill LEP 2012 no. I92 SEPP SREP RNTA RNE ID 2651	Visual buffer zone (590m west)
Site of precision woodware factory	Woolwich Road, opposite Pier Hotel, Woolwich	Local	Hunter's Hill LEP 2012 no. I418	Visual buffer zone (575m west)
Clarkes Point Reserve	Clarkes Point, Woolwich	Local	Hunter's Hill LEP 2012 no. I93	Visual buffer zone (530m west)
Raywell	144 Louisa Road, Birchgrove	State	SHR no. 00093 Leichardt LEP 2013 no. 830	Visual buffer zone (595m south-east)
Railway electricity tunnel under Sydney Harbour	146A and 146B Louisa Road	State	SHR no. 01231 RailCorp s170 SHI no. 5062542 Leichardt LEP 2013 no. A2 RNTA	Visual buffer zone (640m south-east)
Long Nose Point (Birchgrove) Wharf Site and Shelter	125 Louisa Rd, Birchgrove	Local	Maritime s170 SHI no. 4920097 SREP	Visual buffer zone (660m south-east)
Iron Cove Heritage Conservation Area	Iron Cove, Birchgrove	Local	Leichardt LEP 2013 no. C6	Visual buffer zone (950m south)
Birchgrove and Ballast Point Road Heritage Conservation Area	Birchgrove	Local	Leichardt LEP 2013 no. C8	Visual buffer zone (580m south)
House, 'Leopoldville', including interiors	14 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 547	Visual buffer zone (810m south)
House, 'Logan Brae', including interiors	24 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 548	Visual buffer zone (765m south)

Item	Address	Significance	Listing	Distance from proposal area
House, 'The Anchorage', including interiors	44 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 549	Visual buffer zone (700m south)
House, 'Douglas', including interiors	76 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. 552	Visual buffer zone (580m south)
Boat sheds only, Louisa Road	Robinsons Point, Birchgrove	Local	SREP	Visual buffer zone (580m south)
Cove Street Wharf	Cove Street Reserve, Birchgrove	Local	SREP	Visual buffer zone (900m south-west)
Aboriginal middens and rock shelter	7 Numa Street, Birchgrove	Local	Leichardt LEP 2013 no. A6	Visual buffer zone (580m south)
Aboriginal middens and rock shelter	9 Numa Street, Birchgrove	Local	Leichardt LEP 2013 no. A7	Visual buffer zone (570m south-east)
Aboriginal middens and rock shelter	Numa Street (public reserve), Birchgrove	Local	Leichardt LEP 2013 no. A8	Visual buffer zone (590m south-east)
Yurulbin Park	Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. I555 RNTA	Visual buffer zone (660m south-east)
Aboriginal midden and rock shelter	144 Louisa Road, Birchgrove	Local	Leichardt LEP 2013 no. A4	Visual buffer zone (580m south-east)

The proposed upgrade of the Greenwich Point Wharf would introduce new intrusive elements, primarily consisting of the new wharf, lift shaft and skybridge, within sight of most of the heritage items listed above which have views to and from the proposal area. However, while direct sightlines are present to and from most of these heritage items, they are located at a sufficient distance that the wharf would not interrupt prominent views and would generally only be partially visible in the background. The wharf and associated elements have been designed to be less obtrusive through the use of lightweight and consistent materials, simple lines, and muted colours. Renders of the proposed design show that the low height of the proposed wharf would enable the retention of views between Greenwich Point and these heritage items.

The new wharf would be consistent with the historical use of the area and other nearby wharves on Parramatta River, and views to the wharf would be mostly comparable to views to the extant wharf. At Cockatoo Island (WHL ID 1306) the new wharf would only be visible from the eastern portion of the island. Some views of the lift shift, primarily from the north-west and south-east, would be partially obscured by the existing vegetation along Greenwich Point, and other elements of the proposed works on Lower Serpentine Road such as the footpath works would be low to the ground and blocked from view at that distance by the vegetation.

Overall, the proposed works would result in a **negligible** visual impact to most of the heritage items listed in Table 13.

The proposed works would result in a **neutral** visual impact to the Railway electricity tunnel under Sydney Harbour (SHR no. 01231, SHI no. 5062542) and Railway electricity tunnel (LEP no. I63) however, because the tunnels are located under the harbour/below ground and are not visible from the proposal area. The proposed works would also result in a **neutral** visual impact to Site of bond store, wharf and quarry (LEP no. A9). Although the heritage item has views towards the proposal area and there may be negligible temporary visual impacts during construction, the heritage item does not have views towards the wharf itself due to the surrounding landscape. Therefore, there would be no permanent visual impacts to Site of bond store, wharf and quarry (LEP no. A9).

8.11 Impacts to archaeological resources

The proposed works within the proposal area would require limited earthworks including piling work, which is expected to disturb a small amount of seabed, excavations for the installation of the stairs, lift pit and associated electrical cables, and shallow excavation for the regrading of the footpath and bollard installation. Based on the preliminary archaeological assessment, however, only the minor excavations within the footpath area on Lower Serpentine Road would be located in proximity to areas of archaeological potential. Excavations within the footpath would be located within an area assessed as having low potential to contain locally significant archaeological remains of former road surfaces and streetscape elements. These archaeological remains would be associated with Streetscape Elements (LEP no. I64). However, the area has likely been disturbed by previous road upgrades and maintenance works, and the footpath works would be minor in nature. As a result, if archaeological remains of former road surfaces and streetscape elements are present, it is expected that any impact to them would be **negligible**.

The SHI listing for Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) notes that the site has good archaeological potential.[79] However, the archaeological potential is associated with the former Greenwich Wharf rather than the extant wharf. Although it has been assessed that there is moderate archaeological potential of local significance associated with the former Greenwich Point Wharf, the potential archaeological remains are located outside of the proposal footprint. As a result, there would be **nil** impacts to archaeological remains associated with the former wharf.

Overall, it is assessed that the proposed works would result in **nil to negligible** 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 proposal area would likely be limited to ‘works’. As a result, the proposed works would not result in impacts to significant archaeological ‘relics’.

8.12 Summary of impacts to heritage items

A summary of impacts to relevant heritage items is provided in Table 14.

[79] Heritage NSW, DCP, 2010a. ‘Greenwich Point Ferry Wharf Site’.

Table 14: Summary of impacts to heritage items

Heritage Item	Direct	Potential direct	Indirect (visual)	Archaeological
Greenwich Point Wharf	Moderate	Neutral	Moderate	Neutral
Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall)	Minor	Negligible	Negligible	Negligible
Greenwich Conservation Area	Negligible	Negligible	Negligible	Neutral
House	Neutral	Negligible	Negligible	Neutral
House	Neutral	Neutral	Negligible	Neutral
Stone steps to rear of house	Neutral	Neutral	Neutral	Neutral
Stone sea wall	Neutral	Neutral	Neutral	Neutral
Australian Convict Sites (Cockatoo Island)	Neutral	Neutral	Negligible	Neutral
Biloela Group	Neutral	Neutral	Negligible	Neutral
Greenwich Baths	Neutral	Neutral	Neutral	Neutral
Rockleigh	Neutral	Neutral	Neutral	Neutral
Railway electricity tunnel	Neutral	Neutral	Neutral	Neutral
Site of bond store, wharf and quarry	Neutral	Neutral	Neutral	Neutral
House, ‘Cora Lyn’	Neutral	Neutral	Negligible	Neutral
Valentia Street Wharf and Waiting Shed	Neutral	Neutral	Negligible	Neutral
Hunters Hill Conservation Area No 1—The Peninsula	Neutral	Neutral	Negligible	Neutral
House, ‘Drayton’, formerly ‘ Valentin’	Neutral	Neutral	Negligible	Neutral
House, ‘Verdelais’	Neutral	Neutral	Negligible	Neutral
Stone walls	Neutral	Neutral	Negligible	Neutral
Woolwich Dock	Neutral	Neutral	Negligible	Neutral
Site of precision woodware factory	Neutral	Neutral	Negligible	Neutral
Clarkes Point Reserve	Neutral	Neutral	Negligible	Neutral
Raywell	Neutral	Neutral	Negligible	Neutral
Railway electricity tunnel under Sydney Harbour	Neutral	Neutral	Neutral	Neutral
Long Nose Point (Birchgrove) Wharf Site and Shelter	Neutral	Neutral	Negligible	Neutral

Heritage Item	Direct	Potential direct	Indirect (visual)	Archaeological
Iron Cove Heritage Conservation Area	Neutral	Neutral	Negligible	Neutral
Birchgrove and Ballast Point Road Heritage Conservation Area	Neutral	Neutral	Negligible	Neutral
House, 'Leopoldville', including interiors	Neutral	Neutral	Negligible	Neutral
House, 'Logan Brae', including interiors	Neutral	Neutral	Negligible	Neutral
House, 'The Anchorage', including interiors	Neutral	Neutral	Negligible	Neutral
House, 'Douglas', including interiors	Neutral	Neutral	Negligible	Neutral
Boat sheds only, Louisa Road	Neutral	Neutral	Negligible	Neutral
Cove Street Wharf	Neutral	Neutral	Negligible	Neutral
Aboriginal middens and rock shelter	Neutral	Neutral	Negligible	Neutral
Aboriginal middens and rock shelter	Neutral	Neutral	Negligible	Neutral
Aboriginal middens and rock shelter	Neutral	Neutral	Negligible	Neutral
Yurulbin Park	Neutral	Neutral	Negligible	Neutral
Aboriginal midden and rock shelter	Neutral	Neutral	Negligible	Neutral

8.13 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 proposal area?	The proposed works would result in moderate impacts to Greenwich Point Wharf (SHI no. 4920084, LEP no. I130). However, it has been noted that the form and fabric of the extant wharf are not significant, and by constructing a new wharf the heritage values of the heritage item would be respected and retained. As a result, the heritage item would not be delisted. The proposal would largely avoid impacts to significant fabric associated with the other nearby heritage items, and would not impact potential archaeological remains associated with the former wharf. The upgrading of Greenwich Point Wharf would introduce new intrusive visual elements in the area. However, the wharf would maintain its historical use within the area, and the wharf has been designed to

Development	Discussion
	respond to existing visual cues on the river. As a result, the harbourside setting of Greenwich Conservation Area (LEP no. C1) and views out over Parramatta River would be largely unaffected. The proposal would allow for greater accessibility and appreciation of the area by providing DDA compliant access
What aspects of the Proposal could have a detrimental impact on the heritage significance of the proposal area?	The proposal would involve the demolition of the current Greenwich Point Wharf which would result in moderate direct and visual impact to Greenwich Point Wharf (SHI no. 4920084, LEP no. I130). However, by constructing a new wharf the heritage values of the item would be retained and the item would not be delisted. The removal of the concrete wharf landing may also result in damage to the sandstone sea wall that is part of Streetscape Elements (LEP no. I64). However, if the concrete landing is carefully removed it is expected that impacts to the sandstone sea wall would largely be limited to minor surface damage to the sandstone blocks. Vibrations associated with the proposed works have the potential to result in structural impacts to the sandstone sea wall and pier listed as part of Streetscape Elements (LEP no. I64), and the heritage listed building House (LEP no. I110). However, the risk of potential indirect impacts could be largely mitigated through control measures. The proposed works are necessary to make Greenwich Point Wharf DDA compliant. The proposed works would introduce new intrusive visual elements in the vicinity of listed heritage items. However, the new wharf has been designed to reduce visual impacts through the use of lightweight and consistent materials, simple lines, and muted colours. The wharf would be visually consistent with those found at other Sydney ferry wharves on Parramatta River, and views to the wharf, lift and skybridge would be partially screened by existing trees along Greenwich Point. As a result, views out over Parramatta River would be largely consistent with the current setting and the proposed would generally have minimal visual impact to the listed heritage items in the area. The proposal would also result in a negligible visual impact to several items within the 1-kilometre visual buffer zone, including the WHL listed Cockatoo Island (Reference ID 1306). However, these items are all located within the BZ and therefore any visual impact on the overall setting of these items would be minimal and would not affect their overall heritage significance
Have more sympathetic options been considered and discounted?	Two options were assessed as part of the original concept design for Greenwich Point Wharf. Option 1 proposed a new pontoon and gangway with access via lift and stairs, while Option 2 proposed a new pontoon and gangway with access via a switchback ramp. Both options resulted in the demolition of the extant wharf, however, Option 2 would have resulted in the removal of a larger number of trees, would have resulted in a greater visual impact, and would have provided a less direct access route to the new wharf. A further three options were considered as part of an amendment report for the Greenwich Point Wharf concept design.[80] Option 1 proposed a full height lift and stairs to link Lower Serpentine Road to the proposed wharf, but relocated compared to original concept design location so as to improve visual amenity. Option 2 proposed ramp access only (same as Option 2 from the original concept design). Option 3 proposed lift and ramp access to the new wharf, but with a reduced lift height to improve visual amenity. As a result of the consideration of compliance, advantages, and disadvantages of all three options, Option 1 (full height lift and stairs) was selected as the preferred option. The final refinement

[80] GHD, 2021. Greenwich Point Wharf Interchange: Concept Design Report – Amendment 1. Report prepared for TfNSW.

Development	Discussion
	of Option 1 has also considered alternative design elements such as maintaining the existing stair alignment from street level, alternative locations for the skybridge and new wharf gangway, and the option for new stairs. The option of retaining the wharf waiting shelter for re-use and inclusion in site interpretation, as recommended as part of the management for Greenwich Point Wharf (SHI no. 4920084) that is outlined in the s170 SHI sheet for the item, has also been considered.[81] However, it has been determined that this option is not feasible due to the close proximity of the proposed wharf to the waiting shelter

[81] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'. *State Heritage Inventory.* Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=4920084.

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 Greenwich Point Wharf compliant with the requirements of the DDA
- The proposal area is located within the curtilage of one heritage item listed on the Roads and Maritime s170 Heritage and Conservation Register and three heritage items listed on the Lane Cove LEP 2009:
    - Greenwich Point Wharf (SHI no. 4920084, LEP no. I130)
    - Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall) [LEP no. I64)
    - Greenwich Conservation Area (LEP no. C1)
- The proposal area is located adjacent to the curtilages of three heritage items listed on the Lane Cove LEP 2009:
    - House (LEP no. I110)
    - House (LEP no. I111)
    - Stone steps to rear of house (LEP no. I131)
    - Stone sea wall (LEP no. I132)
- The visual buffer zone for the construction site also includes:
    - One heritage item listed on the WHL:
        - Australian Convict Sites (Reference ID 1306)
    - One heritage item listed on the NHL:
        - Cockatoo Island (Place ID 105928)
    - Three heritage item listed on the CHL:
        - Woolwich Dock (Place ID 105244)
        - Cockatoo Island Industrial Conservation Area (Place ID 105262)
        - Biloela Group (Place ID 105263)
    - One heritage item listed on the SHR:
        - Raywell (SHR no. 00093)
        - Railway electricity tunnel under Sydney Harbour (SHR no. 01231)
    - Three items listed on s170 Heritage and Conservation Registers:
        - Valentia Street Wharf and Waiting Shed (Roads and Maritime s170 SHI no. 4920086)
        - Long Nose Point (Birchgrove) Wharf Site and Shelter (Roads and Maritime s170 SHI no. 4920086)
        - Sydney Harbour (Balmain to Greenwich) Railway Electricity Tunnel (RailCorp s170 SHI no. 5062542).

  - Four heritage items listed on the Lane Cove LEP 2009, nine heritage items listed on the Hunters Hill LEP 2012 and thirteen heritage items listed on the Leichardt LEP 2013
  - Five heritage items listed on the SREP [Sydney Harbour Catchment]
- The proposed works would result in moderate direct and visual impacts to Greenwich Point Wharf (SHI no. 4920084, LEP no. I130). However, because a replacement wharf would be built the ongoing operation of a commuter wharf in this location would be maintained (which is a key heritage value associated with the item), and therefore the overall heritage values of the item would be retained. As a result, the proposal would not result in Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) being delisted from the Roads and Maritime s170 Heritage and Conservation Register or the Lane Cove LEP 2009
- The SHI entry for Greenwich Point Wharf (SHI no. 4920084) states that 'the form and fabric of the wharf are not key attributes of its significance and can be changed'[82]
- The proposed works would not impact the overall significance of the other heritage items within and adjacent to the proposal area, or the heritage items within the visual buffer zone
- Impacts to heritage items listed on the WHL, NHL and CHL as a result of the proposal would be limited to negligible visual impacts. As a result, a referral to the Minister for the Environment under the EPBC Act is not required
- A preliminary archaeological assessment has determined that the proposal area has nil to low potential to contain non-significant archaeological remains associated with Phase 1 (1788-1830s: Early settlement in Greenwich), and low to moderate potential to contain locally significant archaeological remains associated with Phase 2 (1830s-1992: Greenwich Point Wharf ferry services), including evidence of former road surfaces and streetscape elements, and evidence of the former Greenwich Point Wharf. The archaeological remains would likely be limited to evidence of former 'works' and the proposal footprint is unlikely to contain significant 'relics' as defined by the Heritage Act
- Only a small area of low archaeological potential associated with Phase 2, consisting of evidence of former road surfaces or streetscape elements, is located within the proposal footprint itself. Based on the preliminary archaeological assessment, it has been assessed that excavations associated with the proposal would result in negligible impacts to potential archaeological remains of local significance associated with Phase 2
- The preliminary archaeological assessment has found that these potential archaeological remains are expected to be limited to archaeological 'works'. As a result, the proposed works are unlikely to impact significant 'relics' and therefore an exception under Section 139 (4) of the Heritage Act would not be required
- The impact on the identified heritage items resulting from the proposed works are summarised in Table 14.

[82] Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'. *State Heritage Inventory.* Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=4920084

9.2 Management and mitigation measures

The following mitigation measures should be enacted to minimise heritage impacts:

- Following the construction of the new wharf, the SHI description and heritage curtilage for Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) must be updated to reflect its location and condition
- Because the extant wharf structure within Greenwich Point Wharf (SHI no. 4920084) would be demolished, Heritage NSW, DPC must be notified in accordance with s170A (1c) of the Heritage Act. A copy of this report should be submitted to Heritage NSW, DPC for their records
- Because the proposal would result in impacts to Greenwich Point Wharf (LEP no. I130) that will be 'more than minor or inconsequential', consultation with Lane Cove Council must be undertaken prior to impacts occurring in accordance with Part 2, Division 1 (Section 14) of ISEPP. A copy of this report should be submitted to Lane Cove 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 Greenwich Point Wharf
- It is not recommended that fabric of the shelter is salvaged for reuse/interpretation due to the fact that the shelter fabric dates to 1992 has no identified significance values on its own
- In accordance with the heritage controls identified in Part B.9 (9.1 Heritage Items and Conservation Area) of the Lane Cove Development Control Plan (DCP) 2010, a photographic archival recording of Greenwich Point Wharf (SHI no. 4920084, LEP no. I130) and the area impacted by the proposal must be undertaken prior to impacts to record the current setting of the wharf and Greenwich Conservation Area (LEP no. C1) The photographic archival recording would be prepared in accordance with the following guideline:
    - *Photographic Recording of Heritage Items Using Film or Digital Capture* (NSW Heritage Office 2006)
- Based on the findings of the preliminary archaeological assessment, the proposed works would be managed under the Roads and Maritime Unexpected Heritage Item Procedure 2015. Under this procedure:
    - If archaeological 'works' such as evidence of former road surfaces or streetscape elements 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 design changes result in additional earthworks and impacts to potential archaeological remains associated with the former Greenwich Point Wharf to the south-east of the extant wharf, further

archaeological assessment and management would be required. This may include undertaking a maritime archaeological assessment 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 heritage items within 41m of the proposal area. However, to further minimise the risk of vibration impacts the following mitigation measures should be implemented:
    - Determine safe working limits based on proposed plant, and where possible, the smallest plant able to carry out required work should be utilised to minimise potential impacts. Where works are proposed within the safe working limits for the heritage structures, specialist advice must be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works will potentially result in impacts to heritage structures
    - A vibration monitoring plan is to be prepared as part of the Construction Noise and Vibration Management Plan and implemented to confirm vibration levels prior to construction commencement. Where exceedances are recorded, works should be modified in consultation with the identified specialist to reduce vibration levels
- Regular inspections of the construction activities and work areas are to be undertaken by structural engineers and any other required specialist to monitor and review the construction methodology to confirm the integrity of the heritage items. Assessment and monitoring of vibration impacts are to 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 heritage items, they must not be attached with permanent fixings. They should be removable without causing damage. Bees wax may be a suitable attachment method
- Care must be taken during the removal of the waiting shelter and underlying concrete landing to minimise damage to the sandstone sea wall during the removal of the concrete. A hydraulic hammer should not be used to separate the concrete from the face of the sea wall to reduce the risk of damaging the sandstone blocks. Any impacted sections of the sea wall must be made good, and if necessary, damaged sandstone blocks must be replaced with like-for-like sandstone
- 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.

10.0 REFERENCES

The Australian, 'Notice,' Thu 18 February 1941. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/36850539.

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.

The Daily Telegraph, 'Municipal Council of Lane Cove,' 10 January 1914, Page 22. Accessed online 15April 2021 https://trove.nla.gov.au/newspaper/article/239015251.

The Daily Telegraph, 'Balmain to Greenwich – New Ferry Service Proposal,' Wed 11 May 1927. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/245747944.

Evening News, 'Balmain and Greenwich Ferry,' Mon 12 October 1908. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/113766000?

Evening News, 'Not playing the game,' Tue 9 March 1926. Accessed online 16 April 2021, https://trove.nla.gov.au/newspaper/article/117291956.

Heritage NSW, DCP, 2010a. 'Greenwich Point Ferry Wharf Site'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=4920084.

Heritage NSW, DCP, 2010b. 'Streetscape Elements (Sandstone Steps, Outcrops, Kerbing and Retaining Wall)'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920071.

Heritage NSW, DCP, 2010c. 'Greenwich Conservation Area'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920240.

Heritage NSW, DCP, 2010d. 'House'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920135.

Heritage NSW, DCP, 2010e. 'House'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920137.

Heritage NSW, DCP, 2010f. 'Stone Steps To Rear of House'. *State Heritage Inventory*. Accessed online 12 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920185.

Heritage NSW, DCP, 2010g. 'Stone sea wall'. *State Heritage Inventory*. Accessed online 20 September 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID=1920239.

Heritage NSW, DCP. 'Bay Street, Greenwich Ferry Wharf Site. *State Heritage Inventory*. Accessed online 15 April 2021, https://apps.environment.nsw.gov.au/dpcheritageapp/ViewHeritageItemDetails.aspx?ID= 4920083.

Hogg, Marie, '100 years of Greenwich Bath Time,' *The Daily Telegraph*, 19 January 2016.

Karskens, G., 2014. 'Harbour life: tracing early Sydney's watery history.' *The Conversation.* Accessed online 15 April 2021, http://theconversation.com/harbour-life-tracing-early-sydneys-watery-history-21892.

Lane Cove Library, 2016. 'Lane Cove Streets'. Accessed online 14 April 2021, http://lanecovestreets.wikifoundry.com/page/Greenwich.

Macleod, P., 2008. 'Greenwich. *Dictionary of Sydney*. Accessed online 14 April 2021, https://dictionaryofsydney.org/entry/greenwich.

May, J., 2015. 'A Short History of Greenwich Community Association 1944-2014'.

The Mosman Mail, 'Greenwich,' 30 April 1904, Page 7. Accessed online 16 April 2021, https://trove.nla.gov.au/newspaper/article/247007740.

*Sunday Times, '*The Council of the Municipality of Lane Cove,' 26 November 1922, Page 4. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/128210557.

Sydney Morning Herald, 'Greenwich,' Mon 14 June 1841. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/12869592.

Sydney Morning Herald, 'Borough Councils,' Sat 15 Jan 1876. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/13366276.

Sydney Morning Herald, 'Wharf at Greenwich Point,' 31 January 1880. Accessed online 16 April 2021, https://trove.nla.gov.au/newspaper/article/13449920.

Sydney Morning Herald, 'New South Wales,' Thu 17 Jan 1895. Accessed online 15 April 2021, https://trove.nla.gov.au/newspaper/article/13995329/1368037.

Washington, Judy 'A brief history of Lane Cove,' 1992. Accessed online 14 April 2021, http://www.lanecove.nsw.gov.au/Community/AboutLaneCove/Pages/History.aspx.

Wotherspoon, G., 2008. 'Ferries.' *Dictionary of Sydney*. Accessed online 14 April 2021, https://dictionaryofsydney.org/entry/ferries.

artefact

Artefact Heritage

ABN 73 144 973 526
Suite 56, Jones Bay Wharf
26-32 Pirrama Road
Pyrmont NSW 2009 Australia

+61 2 9518 8411
office@artefact.net.au
www.artefact.net.au

Appendix H

Procedure for Aboriginal cultural heritage consultation and investigation clearance letter

23 March 2021

Bob Rimac
Project Manager
Transport for NSW

Dear Bob,

Preliminary assessment results for Greenwich Wharf Upgrade 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 (see attached), 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 (AHIMS sites 45-6-1037 and 45-6-3049).
- The AHIMS search did not indicate the presence of any Aboriginal objects or places within the proposed works area.
- The study area does 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 Transport for NSW procedure, however the cultural heritage potential of the study area appears to be reduced due to past disturbance in the form of construction of the existing wharf.
- All site personnel are to be made aware of the nearby AHIMS sites mentioned above in the form of Aboriginal site awareness during induction.

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 Con Lambous 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 Transport for NSW *Unexpected Heritage Items Procedure*.

Transport for NSW

Level 3, 27 Argyle Street Parramatta NSW 2150
T 0428 683 845 **| E** lee.davison@transport.nsw.gov.au

For further assistance in this matter do not hesitate to contact me.

Yours sincerely

Lee Davison
Aboriginal Cultural Heritage Officer

Appendix I

Socio-economic impact assessment

Socio-economic Impact Assessment

Greenwich Point Wharf Upgrade

AWE200198

Prepared for
Transport for NSW

30 November 2021

Cardno®

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards NSW 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9439 5170

Author(s):

Name: Naveena Wijesekara
Job title: Environmental Advisor

Approved By:

Name: Belinda Crichton
Job title: Principal - Environment

Document Information

Prepared for	Transport for NSW
Project Name	Greenwich Point Wharf Upgrade
File Reference	AWE200198_R407_Rev0_GreenwichPoint_SEIA.docx
Job Reference	AWE200198
Date	30 November 2021
Version Number	Rev 0
Effective Date	30/11/2021
Date Approved	30/11/2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
Rev A	16 April 2021	Draft for client review	Naveena Wijesekara	Tanja Mackenzie
Rev B	17 September 2021	Draft for client review (incorporating new design)	Naveena Wijesekara	Belinda Crichton
Rev C	11 October 2021	Final draft for client review	Naveena Wijesekara	Belinda Crichton
Rev 0	30 November 2021	Final report	Naveena Wijesekara	Belinda Crichton

© Cardno. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

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.

Table of Contents

Tables

Figures

1 Introduction

1.1 Overview

Transport for NSW proposes to upgrade the wharf interchange at Greenwich Point (the proposal) as part of the NSW Government's Transport Access Program (TAP). The 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.

1.1.1 Proposal description

Greenwich Point wharf is in the Lane Cove local government area (LGA) and is located on the southern peninsula of the suburb of Greenwich. It is about 4.3 kilometres (by water) and 9.8 kilometres (by road) from the Sydney CBD. Greenwich Point wharf is surrounded by residences (primarily large water front homes) and is accessed via Lane Cove Council's footpath from Lower Serpentine Road. Greenwich Baths (a popular public ocean swimming location) is located nearby and travel between the baths and wharf is possible for pedestrians along the waterfront via Mary Carlson Park. Figure 1-1 and Figure 1-2 show the regional and local setting respectively.

The F8 Circular Quay to Cockatoo Island route services Greenwich Point wharf, and has relatively low patronage compared to neighbouring wharves.

The existing wharf at Greenwich Point includes a set of tidal steps for ferries to berth, a concrete jetty connecting the wharf to land and a small waiting shelter for passengers at the end of the wharf.

The proposal is to upgrade the Greenwich Point wharf as part of the TAP.

The water based features of the proposal would include:

- Installation of a new three metre wide by 22 metre long concrete jetty, supported by eight new piles
- Installation of a new, uncovered 18 metre long by 2.5 metre wide gangway to provide access to the new pontoon
- Installation of a new covered steel nine metre by 18 metre pontoon containing a curved zinc roof supported by steel columns, glass weather protection, stainless steel balustrades, seating and information boards. The pontoon would be supported by four new piles, with one pivot pile (to assist with berthing) provided at either end of the pontoon (two in total)
- Installation of new signage, information boards and Opal card readers
- Installation of safety and security features including a help point, lighting, closed circuit television (CCTV) cameras, ladders to the water, a life buoy and tactile ground surface indicators where required
- Removal of the existing waiting shelter, jetty and tidal stairs including associated piles.

The land based features of the proposal would include:

- Construction of a 9.8 metre long skybridge from the approximate location of the existing bus shelter on Lower Serpentine Road, connecting the existing footpath to the proposed lift
- Relocation of the existing bus shelter on Lower Serpentine Road approximately three metres to the east to accommodate new skybridge entrance
- Construction of a 12 metre high lift that connects the proposed skybridge to the wharf level. Five metres of the lift would be visible from street level
- Regrading of pavement at street level and wharf level to create the entry/exit points of the skybridge, stairs and lift
- Replacement of the existing non *Disability Discrimination Act 1992* (DDA) compliant stairs with DDA compliant stairs connecting Lower Serpentine Road and the new wharf, near the proposed lift. The new

stairs would use part of the existing stair footprint on Lower Serpentine Road, which currently connects Mary Carlson Park to wharf level

- Partial excavation of the embankment to provide room for the new stairs connecting at the western side of the existing bus shelter
- Installation of three bicycle hoops
- Replacement of balustrades and handrail at wharf level
- Electrical work including relocation of existing electrical switchboard cabinet at wharf level, removal of two existing power poles and placing existing electrical overhead wires underground
- Pruning of fig trees to accommodate the new skybridge, stairs and lift
- Retention of the current existing ramp near Greenwich Park connecting road level to the foreshore.

The key features of the proposal are shown in Figure 1-3. Chapter 3 of the Greenwich Point wharf Upgrade REF report describes the proposal in more detail.

The proposal would be constructed over a period of up to six months (weather and maritime conditions permitting) starting in late 2022. During construction the wharf would be closed.

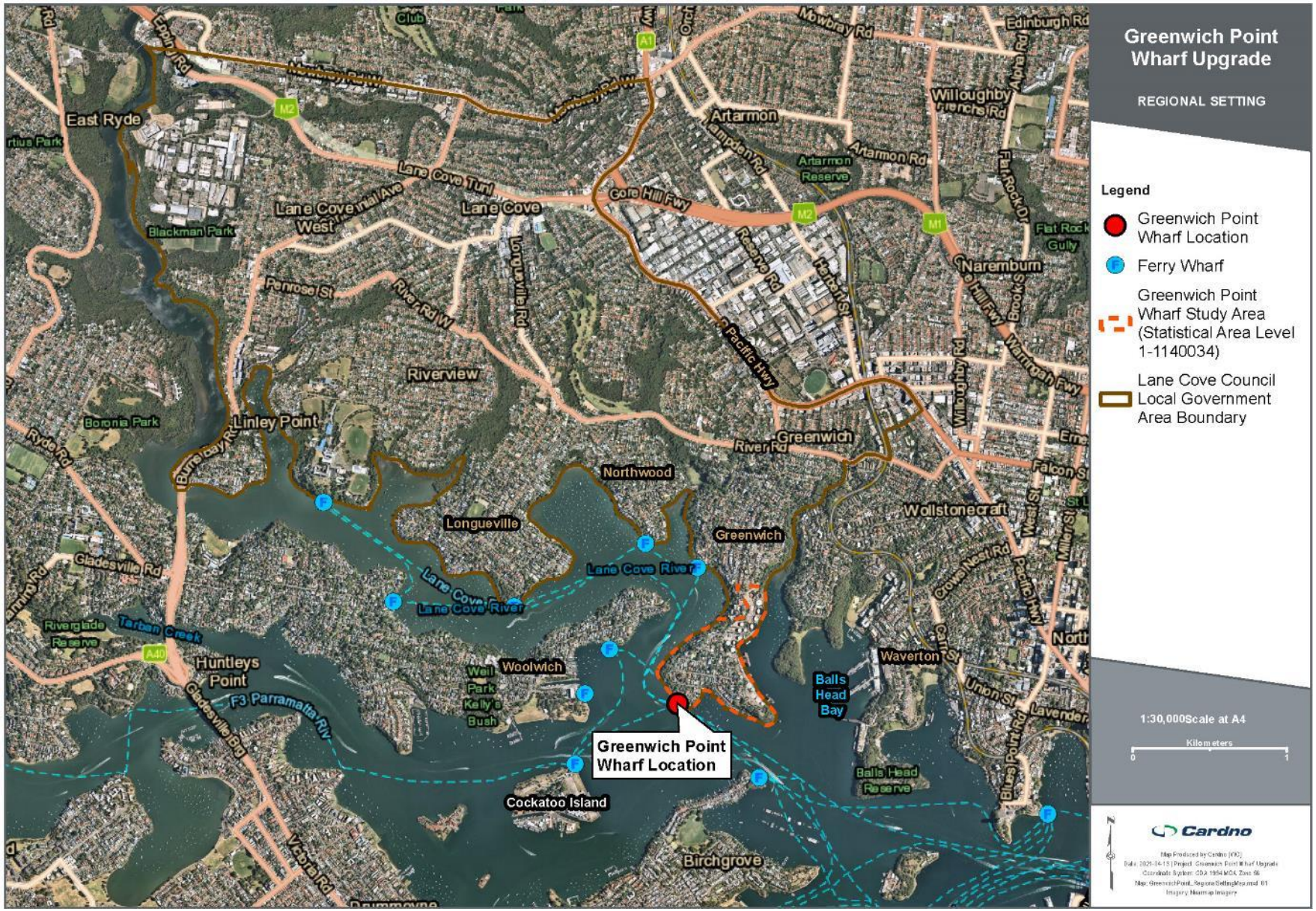


Figure 1-1 Regional setting of the Greenwich Point wharf

Figure 1-2 Greenwich Point wharf location and local setting

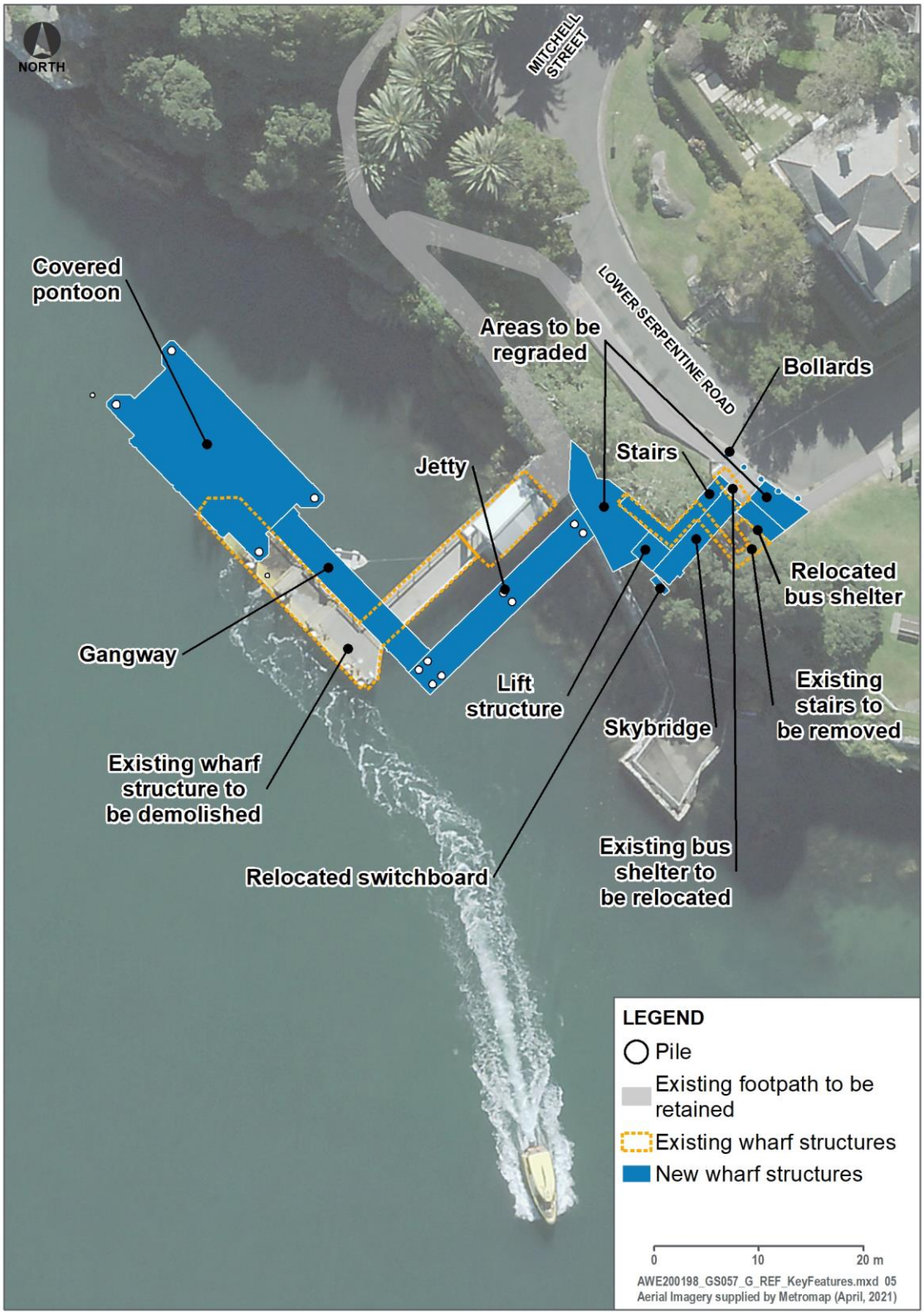


Figure 1-3 Key features of the proposal

Figure 1-4 Greenwich Point wharf visualisation of the proposal (Source: Urbaine, 2021)

1.2 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 *Environmental Impact Assessment Practice Note (EIA-N05) – Socio-economic assessment* (TfNSW, 2020a).

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.

1.3 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: Legislative and policy framework – 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 5: Potential impacts – provides an assessment of the potential socio-economic benefits and impacts of the proposal
- Section 6: Safeguards and management measures – outlines the safeguards and management measures for potential socioeconomic impacts resulting from the proposal
- Section 7: Conclusion – provides a conclusion of the findings in the socio-economic assessment
- Section 8: References.

2 Methodology

This SEIA assesses the socio-economic impact of the proposal in accordance with *Environmental Impact Assessment Practice Note (EIA-N05) – Socio-economic assessment* (TfNSW, 2020a). 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 Statistical Area Level 1-1140034, hereafter 'study area', has been selected to represent the study area for this assessment. Statistical Area Level 1-1140034 is the main catchment area for the Greenwich Point wharf and Greenwich Road connects the peninsula to the mainland.

In practice it is clear that there are several scales of potential impact, ranging from the immediate impact to Greenwich Point ferry wharf users, businesses around the wharf, the Lane Cove LGA, or to the broader Chatswood - Lane Cove 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 Lane Cove LGA, including local government policies and strategies:
  - Disability Inclusion Action Plan (DIAP) (Lane Cove Council, 2017)
  - Lane Cove Local Environmental Plan 2009 (Lane Cove LEP)
  - Lane Cove Social Plan 2010-2014: Meeting the Needs of Our Community (Lane Cove Council, 2010a)
  - Lane Cove People with Disability. Social Plan 2010–2014 (Lane Cove Council, 2010b)
  - Liveable Lane Cove 2035: Community Strategic Plan Adopted 18 June 2018 (Lane Cove Council, 2018)
  - Delivery Program 2020-22 and Operational Plan 2020-21 June 2020 (Lane Cove Council, 2020)
- Greater Sydney Harbour Estuary Coastal Management Program Scoping Study (BMT, 2018)
- Greenwich Point Wharf Upgrade Concept Design (Aurecon, 2019) and Concept Design Amendment (GHD, 2021)
- 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 Nearmap, 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 impact assessment: Greenwich Point Wharf Upgrade (Cardno, 2021a)
- Noise and vibration impact assessment: Greenwich Point Wharf Upgrade (Cardno, 2021b)
- Statement of heritage impact: Greenwich Point Wharf Upgrade (Artefact, 2021)
- Greenwich Point Wharf – Ferry Wharf Upgrade Program TAP 3 – Communications and Stakeholder Engagement Plan 2021 (Cardno, 2021c).

2.3 Scope

Scoping for the proposal was undertaken in accordance with the practice note (EIA-N05) (TfNSW, 2020a) 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

The methodology for evaluating significance of the proposal impacts is adopted from the practice note (TfNSW, 2020a).

The proposal has the potential to affect road and recreational 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 potential impacts. 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.

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, residents, etc. The levels of sensitivity are set out in Table 2-2.

Table 2-1 Levels of sensitivity

Sensitivity	Definition
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

The significance of an impact will depend on the magnitude of the impact, such as the scale and intensity of the types of works, spatial extent, duration and scope of the proposal including how it will be constructed and operated. The spatial extent is the geographical area affected which may be local, suburb, regional, State, etc. The duration can be short, medium or long-term, or relate to hours of works, frequency of occurrence, etc. The levels of magnitude are set out in Table 2-1.

Table 2-2 Levels of magnitude

Magnitude	Definition
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.

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 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 the impact is to be assigned under that heading. Where sub-issues are needed under ‘community values’, each sub-issue is 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 a factor of both the level of sensitivity and magnitude.

Table 2-3 Level of significance

Sensitivity	Magnitude			
	High	Moderate	Low	Negligible
High	High	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

Consultation was undertaken on the proposal's concept design. The community and key stakeholders were invited to provide feedback on the proposed works in April and May 2021. Community members and stakeholders are encouraged to provide feedback, leave comments and make submissions via phone, email, or via the online project portal and survey.

As part of the community consultation program, a four-page community update was distributed to residents and businesses in the wharf area. Two community drop in sessions were be held in Mary Carlson Park on the 18 and 22 April 2021.

Transport for NSW has modified the concept design for the upgrade following consideration of community feedback received during exhibition. The updated design has been assessed in this SEIA. Further community consultation will be undertaken during exhibition of the REF.

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 Central Business District (CBD) is identified as the metropolitan centre of Eastern Harbour City, where Greenwich Point wharf is located. 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 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	'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.' '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.'
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	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: > 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	'Mixed-use neighbourhoods close to centres and public transport improve the opportunity for people to walk and cycle to schools, local shops and services.' 'Physical, social and spatial accessibility is important across all ages and abilities and is a key part of planning for a female-friendly region. A region that is female-friendly applies the principles of Crime Prevention Through Environmental Design and is safer and more accessible for all people. Places and transport designed to be accessible by all people, and homes that can be easily adapted to

	house older people and people with a disability, are increasingly required as the population grows and demographics change.'
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 Greenwich Point wharf is increasing and the demand for the ferry services are higher, necessitating the upgrade of the wharf infrastructure
- Upgrading Greenwich Point 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, facilitating 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 (TfNSW, 2015). The focus of the program is improving access to the transport network for less mobile passengers. As a result, the former 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 Greenwich 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 Greenwich Point 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" (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 accordance with the TAP.

This proposal responds to this plan by improving and modernising infrastructure and responding to efficiencies by creating accessible pathways.

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 Greenwich Point wharf, and improving the capacity of the ferry network.

3.2 Lane Cove Council

Lane Cove Council strategic plans relevant to the proposal are discussed in Table 3-2.

Table 3-2 Lane Cove Council strategic plans relevant to the proposal

Strategy / Plans	Description
Liveable Lane Cove: Community Strategic Plan 2035 (Lane Cove Council, 2018)	Liveable Lane Cove 2035 is the Council's Community Strategic Plan that outlines the long term vision and aspirations of the local community and the council. Liveable Lane Cove; 2035 is comprised of goals, objectives and strategies across six planning themes - our society, our built environment, our natural environment, our culture, our local economy and our council. > Our Society - Main objectives include: community connections, community health and wellbeing, community services and facilities, recreation, education, community safety > Our Built Environment – Main objectives include: sustainable development, housing, assets, infrastructure and public domain, transport and mobility, parking, traffic > Our Natural Environment- Main objectives include: environmental protection, urban forest, bushland, waterways > Our Culture - Main objectives include: creative expression, cultural places, celebrating cultural identity > Our Local Economy – Main objectives include: supporting local businesses, developing business precincts, sustainable business practices > Our Council - Main objectives include: governance, best value, quality service, communication and engagement, workforce As part of this process Lane Cove Council developed the Delivery Program and Operational Plan which outline the specific actions to be undertaken by Lane Cove Council over the next three years to achieve the goals and objectives set out in Liveable Lane Cove: 2035. The budget to support these actions has also been adopted.
Delivery Program 2020-22 and Operational Plan 2020-21(Lane Cove Council, 2020)	The Delivery Program 2020-22 and Operational Plan 2020-21 provides performance measures against progress towards the goals and objectives of Council's Community Strategic Plan, "Liveable Lane Cove: 2035". The Delivery Program shows the integration between the strategies in 'Liveable Lane Cove', the actions in the Delivery Program (incorporating the Operational Plan) and how they will be achieved with the resourcing strategies.
Disability Inclusion Action Plan (DIAP) (Lane Cove Council, 2017)	The DIAP addresses four key areas that have been nominated by people with disability as being of primary importance in creating an inclusive community: > Developing positive community attitudes and behaviours > Creating liveable communities > Supporting access to meaningful employment > Improving access to services through better systems and processes. The DIAP allows Council to review its practices and programs and to identify the possible sources of discrimination (intentional or unintentional) against people with a disability. In doing so, Council can remove barriers to access for people with disabilities and have practical actions to further improve its services and facilities which allows residents, visitors and workers with disabilities to move about our community and to access services and facilities with ease and dignity. Council adopted its DDA Action Plan in March 2007. The DIAP has been also been lodged with the Human Rights and Equal Opportunity Commission.
Lane Cove Social Plan 2010-2014 (Lane Cove Council, 2010a)	The Social Plan was adopted by Council in March 2010. The Lane Cove Social Plan aims to: > Take account of existing and future social needs of communities > Design strategies to respond to, and plan for, current or projected needs > Identify current and emerging social issues, and support the development and articulation of Council's approach to these issues > Increase the capacity of government, community agencies, business and individuals to plan, adopt and implement strategies to take account of human social needs.

Strategy / Plans	Description
	The Plans cover the following target groups: People with Disabilities, People from Culturally and Linguistically Diverse Backgrounds, Children, Youth, Seniors, and Women. In relation to Aboriginal Australians, due to the dispersion of Aboriginal people across northern Sydney, agreement was reached between the eleven Northern Sydney Councils to conduct the Aboriginal Social Plan on a regional basis. The Northern Sydney Aboriginal Social Plan was adopted by Lane Cove Council on 5 February 2007 and a work plan has been developed to implement its recommendations.
Lane Cove People with Disability. Social Plan 2010–2014 (Lane Cove Council, 2010b)	This Plan provides an overview of the needs of people with a disability in Lane Cove and includes a demographic overview, mapping of available services, and a number of recommendations to address identified needs. There are two recommendations identified in the plan along with goals, actions, priority and who's responsible for implementing them: > Recommendation 1 - Removing barriers to service access and community participation goal - Improve access for people with disability to services and participation in community life > Recommendation 2 - Advocating for more services for people with disability goal - Improvement of local services for people with disability.
Sustainability Action Plan 2016-2021 (Lane Cove Council, 2016)	Council's Sustainability Action Plan is a document that provides a framework of goals and actions that can improve sustainability outcomes in our community. Council is committed to working with the community towards implementation of this plan and celebrating its outcomes in the coming years
Lane Cove LEP	Council's LEP is a guide for development over the next 20 years in line with the Greater Sydney Commission's Greater Sydney Region Plan and North District Plan. The LEP came into force on 19 February 2010.
Development Control Plan (DCP)	The DCP supports the LEP in providing detailed development controls such as landscaped area, car spaces and building scale. The DCP contains twenty two parts, including attachments, which came into force on 22 February 2010.

The proposal supports the priorities and actions sets out in Lane Cove Council's strategic plans by improving and modernising Greenwich Point wharf infrastructure and making the wharf accessible to people with limited mobility. The proposal supports Lane Cove Council's plans by reducing barriers to provide people with disabilities improved opportunities to be fully engaged in community life.

4 Existing 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 Statistical Area Level 1-1140034 have been used (identified in section 2.1), and statistics of Lane Cove LGA provided for the purpose of comparison.

4.1 Overview of the regional and local socio-economic context

4.1.1 Regional context

The proposal is located within the Lane Cove LGA, which is about 1,050 hectares in size. In the 2016 Census, there were 36,051 people in the LGA. Of these, 49 per cent were male and 51 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 Lane Cove LGA was 36 years. Children aged 0-19 years made up 23.7 per cent of the population and people aged 65 years and over made up 13.7 per cent of the population. The Lane Cove LGA is predominantly a residential area, with commercial and mixed-use areas located along the arterial roads. About 52 per cent of housing is low-medium density flats. Townhouses, separate houses and terrace houses made up of 48 per cent. There were 20,181 people who reported being in the labour force and of these 65.8 per cent were employed full time, 25.8 per cent were employed part-time and 4.4 per cent were unemployed.

4.1.2 Study Area

The Statistical Area Level 1-1140034, has been selected to represent the study area for this assessment (Figure 1-1). The study area is about 32 hectares and is the main catchment area for the Greenwich Point wharf. It is located in the suburb of Greenwich and Greenwich Road connects the peninsula to the mainland.

4.2 Population and demography

A demographic profile for the study area and the Lane Cove LGA (Table 4-1) was developed based on a review of ABS Census Data (2016).

Table 4-1 Demographic and social characteristics of the study area (Source: ABS, 2016)

Sub-category	Indicator	Study area (Statistical Area Level 1-1140034)	Lane Cove LGA
Population size	Population Total	499	36,051
	Male	238 (47.6%)	17,733 (49.2%)
	Female	262 (52.4%)	18,313 (50.8%)
Age	Babies and pre-schoolers (0-4)	4.9%	6.7%
	Primary and secondary schoolers (5-19)	19.2%	17.0%
	Tertiary education and independence (20-24)	7.8%	5.6%
	Young workforce (25-34)	3.1%	17.4%
	Parents, homebuilders and main workforce (35-54)	23.9%	29.3%
	Older workers and pre-retirees (55-64)	16.3%	10.2%
	Empty nesters and retirees (65-74)	15.4%	7.5%
	Seniors (75-84)	7.2%	4%
	Elderly aged (85 and over)	2.3%	2.2%
	Median age of persons	48	36
Average household size		2.9	2.5

Sub-category	Indicator	Study area (Statistical Area Level 1-1140034)	Lane Cove LGA
Cultural Diversity	Aboriginal and Torres Strait Islander population	0.0%	0.3%
	Proportion of people who speak a language other than English at home	12.4%	31.5%
	Top three languages other than English spoken at home	Cantonese, Spanish and Mandarin	Mandarin, Cantonese and Spanish
People with disability	People with need for assistance (percentage of the total population)	n/a	3%
Dwelling Structures	Separate house	89.6%	42.3%
	Semi-detached, row or terrace house, townhouse etc	6.5%	5.5%
	Flat or apartment	3.9%	51.6%
	Other dwelling	0%	0.1%
Tenure Type	Median mortgage repayment (per month)	$3,467	$2,600
	Median rent (per week)	$882	$520
	Home owners (outright)	60.3%	29.9%
	Home owners (with a mortgage)	29.5%	32.6%
	Renters	10.3%	34.9%
Primary methods of travel to work	People who travelled to work by public transport	27.1%	31.5%
	People who travelled to work by car as driver or passenger	49.6%	49.3%
	Walked only	n/a	4.4%
	Worked at home	12.1%	5.5%
	Ferry as the primary method of travel to work	9.5%	0.4%
	Train as the primary method of travel to work	7.3%	6.3%
	Bus as the primary method of travel to work	n/a	18.5%
People who use multiple methods to travel to work	Combination of train and ferry as method of travel to work	n/a	0.05%
	Combination of bus and ferry as method of travel to work	n/a	0.03%

n/a – data not available for the statistical level

4.2.2 Population and growth

At the time of the 2016 Census, the study area had an estimated residential population of about 499 people, of these 48 per cent were male and 52 per cent were female. There were no recorded Aboriginal and/or Torres Strait Islander people. The study area experienced a six per cent population growth between 2011 and 2016. This is lower than the rate of population growth in the Lane Cove LGA (14 per cent) and Greater Sydney (10 per cent) for the same period.

The 2019 projections indicate that the population of Lane Cove LGA is estimated to increase by 11,650 people between 2016 and 2041, from 37,700 to 49,350 (DPIE, 2019). Population gains are largely driven by natural change, with only a modest number of people moving to the area. The working age population (aged 15-64) is estimated to increase by 25,650 in 2016 to 32,050 in 2041 – a change of 6,400. The number of children aged 14 and under is estimated to change by 1,800 children, from 6,950 in 2016 to 8,750 in 2041. The number of people aged 65 and over is estimated to increase from 5,050 in 2016 to 8,550 by 2041 - a change of 3,500 (DPIE, 2019).

4.2.3 Age

In 2016 the median age of the study area population was 48 years. In 2016, the 'parents, homebuilders and main workforce' age service group represented the highest proportion of people (24 per cent) in the study area, which is consistent with the study area median age. The data showed a similar trend for Lane Cove LGA and NSW. However, in 2016 the study area had the lowest 'young workforce' group (three per cent) when compared with Lane Cove LGA and the whole of NSW. The study area had a considerably high proportion of 'older workers and pre-retirees', 'empty nesters and retirees' and 'seniors' groups (16 per cent, 15 per cent and seven per cent respectively) compared with Lane Cove LGA and NSW state in 2016.

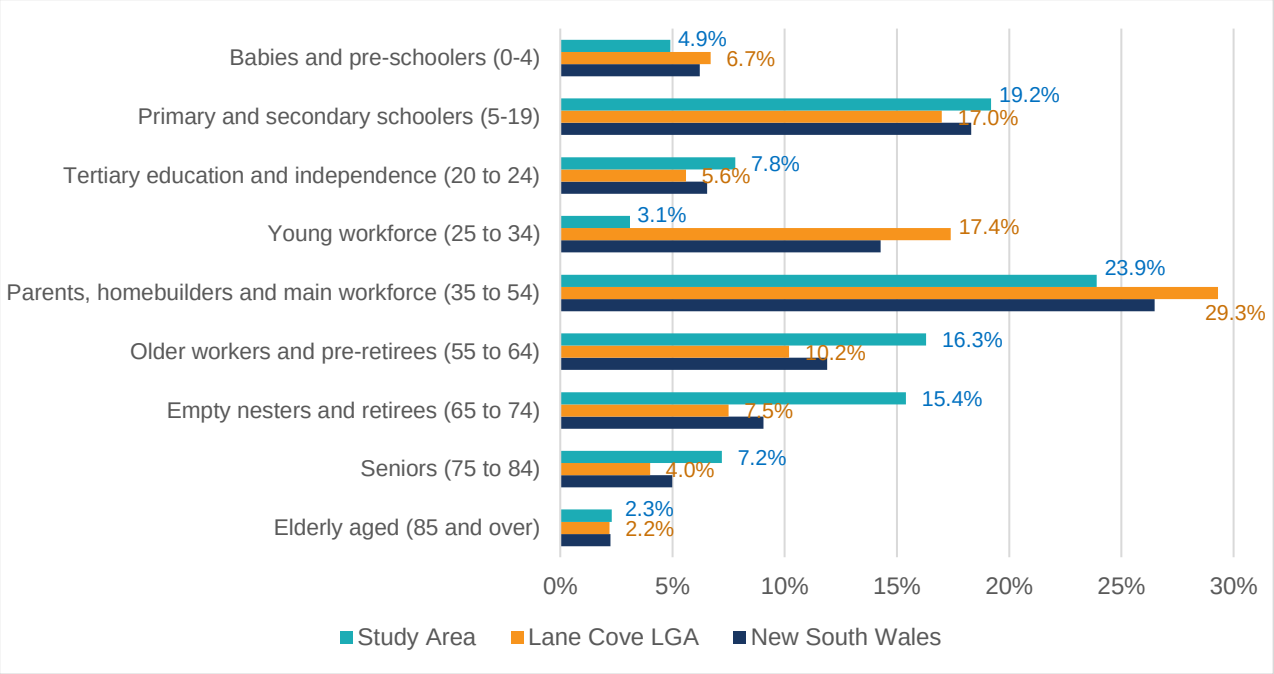


Figure 4-1 Age distribution of population in the study area, compared with Lane Cove LGA and NSW in 2016 (Source: ABS, 2016)

4.2.4 Cultural diversity

Most of the residents in the study area were born in Australia (73 per cent) with the majority of the remaining population born in England, New Zealand, South Africa, the United States of America and China (excludes Hong Kong, Macau and Taiwan). The study area is culturally diverse with descendants from various countries. The most common ancestries in the study area were English (25 per cent), Australian (23 per cent), Scottish (11 per cent), Irish (11 per cent) and Chinese (four per cent). About 12 per cent of residents speak another language other than English at home, with other languages including Cantonese, Spanish, Mandarin, Italian and Korean. There is no recorded population of Aboriginal and/or Torres Strait Islander people in the study area.

4.2.5 Families and households

When compared to Lane Cove LGA, the study area had a considerably high proportion of 'couple family with children' at about 51 per cent of families, compared to about 49 per cent in Lane Cove LGA. In 2016, 34 per cent of families in the study area were 'couple families without children'. Of the families in the study area, 12 per cent were 'one parent families' and all of them are female headed households.

4.2.6 Housing

In 2016 the majority of residents of the study area lived in separate houses (90 per cent) and only six per cent lived in semi-detached, row or terrace houses or townhouses. Of the occupied private dwellings, the majority of them consist of four or more bedrooms (63 per cent). About 60 per cent of dwellings in the study area were owned outright, 30 per cent were owned with a mortgage and only 10 per cent were rented.

In 2016 the study area had a much higher rate of home ownership when compared to the Lane Cove LGA. When compared to Lane Cove LGA (70 per cent), the study area had a high percentage of family households (82 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 1,181, 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 1 (study area)	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[a]	Decile[b]	Score[a]	Decile[b]	Score[a]	Decile[b]	Score[a]	Decile[b]	
1140034	1138	10	1181	10	1156	10	1194	10	499

[a] Score - a lower score indicates that an area is relatively disadvantaged compared to an area with a higher score.

[b] Decile - Decile 1 is the most disadvantaged relative to the others.

4.3 Transport and access

The majority of the employed residents in the study area travelled to work by car, either as driver or as passenger (50 per cent), while 27 per cent used public transport (train, ferry, bus, tram/light rail) as at least one of their methods of travel to work. A comparatively high proportion (27 per cent) of study area residents rely on public transport to reach work when compared with Greater Sydney region (20 per cent). About ten per cent use the ferry as the primary method of travel to work.

Travelling to work primarily via bus is not common for residents of the study area as only four per cent of residents use a combination of train and bus services, as compared to Lane Cove LGA (18 percent) and Greater Sydney (six percent).

Greenwich Point wharf is accessible by both the Sydney ferry network and bus route 265. On-road cycling routes and bushwalking tracks are also provided around the foreshore. Transport options servicing the wharf are discussed below.

4.3.1 Ferry network

The Greenwich Point wharf mainly functions as a local wharf due to its proximity to strategic transport corridors and hubs. The wharf is serviced by the F8 Cockatoo Island route and the private Captain Cook Cruise Lane Cove to City ferry route. The F8 travels between Circular Quay and Cockatoo Island via Balmain, Birchgrove, Greenwich Point and Woolwich (refer Figure 4-2).

During weekdays the F8 Circular Quay to Cockatoo Island ferry service stops at Greenwich Point wharf from 6:36 to 00:06. On Saturdays, the ferry service stops at the wharf from 7:06 to 00:06. On Sundays and public holidays, the ferry service stops at the wharf from 9:06 to 21:06.

During weekdays the F8 Cockatoo Island to Circular Quay ferry service stops at Greenwich Point wharf from 6:27 to 23:27. On Saturdays, the ferry service stops at the wharf from 7:27 to 23:27. On Sundays and public holidays, the ferry service stops at the wharf from 9:27 to 20:27.

During the morning and afternoon peak periods F8 ferry services arrive every 30 minutes, with hourly frequency outside the peak. It takes around 16 minutes for the ferry to travel from Greenwich Point wharf to Circular Quay and 20 minutes in the opposite direction (Table 4-3).

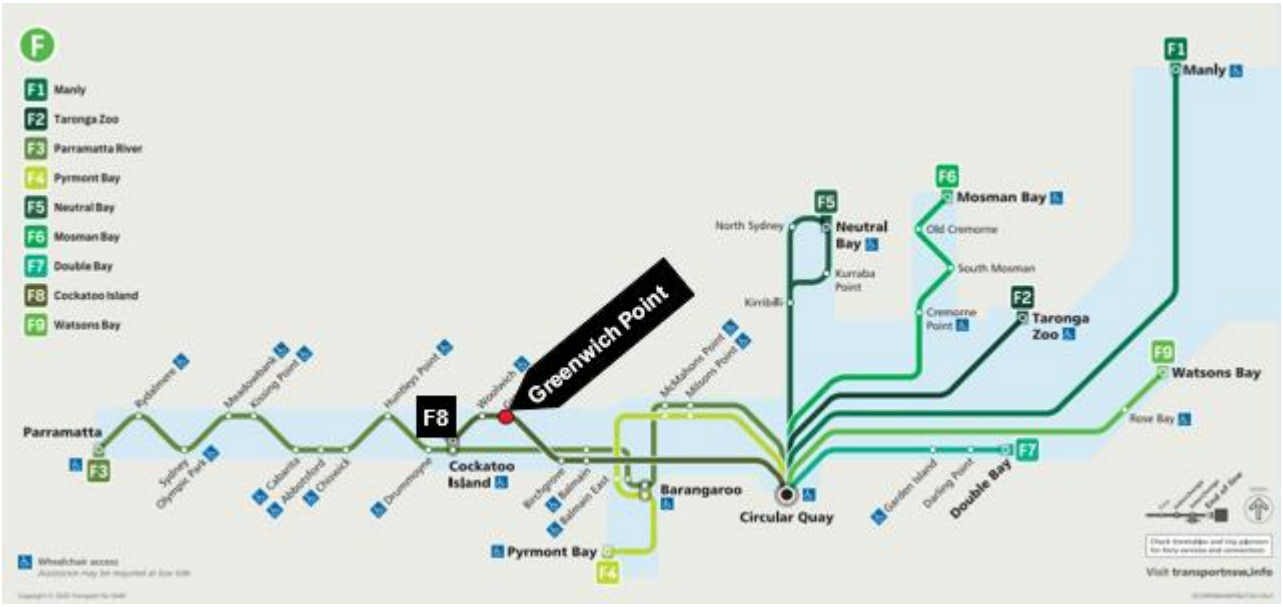


Figure 4-2 Sydney ferries network map with Greenwich Point wharf highlighted (Source: TfNSW, 2020b)

Table 4-3 F8 Cockatoo Island ferry service frequency (Source: TfNSW, 2020b)

Route	Direction	Average frequency (mins)					
		AM peak (7am-9am)	Off peak	PM peak (4pm-6pm)	Saturday	Sunday	Travel
F8 Cockatoo Island	Circular Quay to Greenwich Point	30	60	30	60	60	16
	Greenwich Point to Circular Quay	30	60	30	60	60	20

The Captain Cook Cruise ferry service operates on Monday to Friday during private school term dates. There are total of three Captain Cook Cruise services stopping at Greenwich Point wharf throughout the day: 7:44am and 8:13am in the City to Lane Cove direction and at 4:16pm in the Lane Cove to City direction.

Greenwich Point wharf forms part of Sydney's extensive ferry network (Figure 4-2) which consists of 28 vessels serving eight routes and 39 wharves around Sydney Harbour and along the Parramatta River (TfNSW, 2013).

Around 16 million trips were made on the Sydney ferries network in 2019 (calculated using Opal Ferry Trips) and the Cross Harbour (F4) and Manly (F1) services are the most popular routes. In 2019 passengers made about 609,000 trips on Cockatoo Island service (F8), which represents about four per cent of the total trips made on the ferry network (TfNSW, 2021b).

Around six million trips were made on the entire Sydney ferry network in 2020. This is due to the restrictions and various lockdown measures implemented for the COVID-19 pandemic. The F1 and F4 services remained the most popular routes in 2020, with passengers taking about 1.8 million trips and 1.5 million trips respectively. In 2020, passengers made about 291,000 trips on the Cockatoo Island (F8) ferry service (TfNSW, 2021b).

The 2017 data for the busiest peak hour of the week is provided in 0. 2017 Opal card data indicates the maximum number of boarding and alighting passengers from the wharf per hour over a 10-month period was 117 (refer Table 4-4).

Table 4-4 Peak hour patronage at Greenwich Point wharf in 2017 (Source: Aurecon, 2019)

Peak hour of week – highest average one-hour period Jan-Dec 2017 (day and hour)	2017 patronage / hour			Special events maximum patronage – maximum patronage / hour 2017 (total boarding and alighting)
	Boarding	Alighting	Total	
Friday 8am–9am	11	17	28	117

Future patronage information was estimated 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 potential, which is the patronage considered for the wharf design upgrade (Aurecon, 2019; refer Table 4-5).

Table 4-5 Future patronage forecasted for the Greenwich Point 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
Friday 8am–9am	17	25	42	175

Future ferry services would be considered for wharves where patronage exceeds the vessel capacity on a regular basis. As this is not expected to be the case for Greenwich Point wharf, it is unlikely that there would be more services scheduled for the F8 Cockatoo Island ferry route in future.

4.3.2 Road network

Greenwich Point wharf is located about 1.8 kilometres south of River Road and can be accessed via Greenwich Road and along St Lawrence Street, Mitchell Street and Lower Serpentine Road. Vehicular access terminates at the end of Lower Serpentine Road, at which point ferry users are required to take a set of stairs down a steep cliff face or to take a steep ramp to the ferry wharf. Both Mitchell Street and Lower Serpentine Road have (restricted) kerbside parking, with a 'No stopping' restriction at the Lower Serpentine Road cul-de-sac. The northern verge along the transition between Lower Serpentine Road and Mitchell Street is zoned as 'No Parking' which would allow the brief stopping of vehicles, however the narrow width of the road restricts vehicles from stopping at that verge.

4.3.3 Bus network

The nearest bus stop is located adjacent to the wharf at street level. It is served by the 265 bus which travels from Lane Cove to North Sydney via Greenwich (refer Figure 4-3). In most instances, the bus and ferry services generally align with about eight to 20-minute intervals between the two transport modes. During weekdays the route 265 bus service operates between 6am to 6pm and on Saturdays it operates between 9am to 6pm. There are no bus services on Sunday. The service profile of route 265 is summarised in Table 4-6.

Table 4-6 Frequency of bus services on route 265 (TfNSW, 2021b)

Route	Direction	Average frequency (mins)				
		AM peak (6am-9am)	Off peak	PM peak (3pm-6pm)	Saturday	Sunday
265	Lane Cove to North Sydney	30	60	30	60	n/a
	North Sydney to Lane Cove	30	60	30	60	n/a

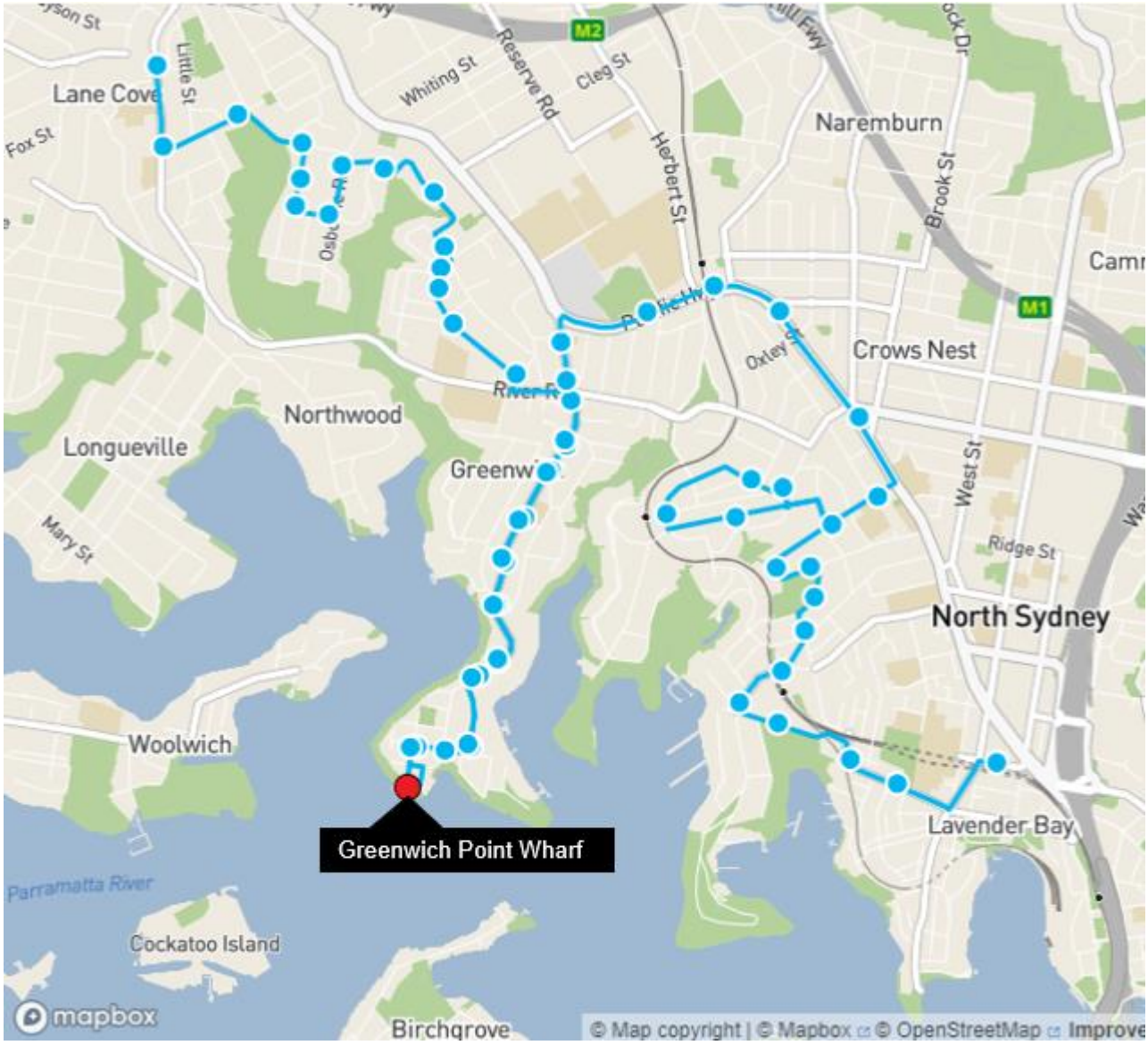


Figure 4-3 Sydney Buses Network – Route 265 (Source: TfNSW webpage https://transportnsw.info/routes/details/sydney-buses-network/265/26265)

4.3.4 Train network

Wollstonecraft station is the closest train station which is located about 1.5 kilometres away from the wharf. Wollstonecraft train station is on the T9 Northern Line which serves Sydney's Inner West and Northern suburbs. The service frequency is about 15 minutes between trains.

St Leonards station is located about 2.5 kilometres away from the wharf and train services to St Leonards station align with the bus route 265 timetable.

4.3.5 Bicycle network

The streets surrounding Greenwich Point wharf are part of the Cammeraygal Loop which is one of six easy-to-follow rides designed by Lane Cove Council (Figure 4-4). The route travels along unmarked local roads. No bicycle hoops or secure lockers are provided at the existing wharf.

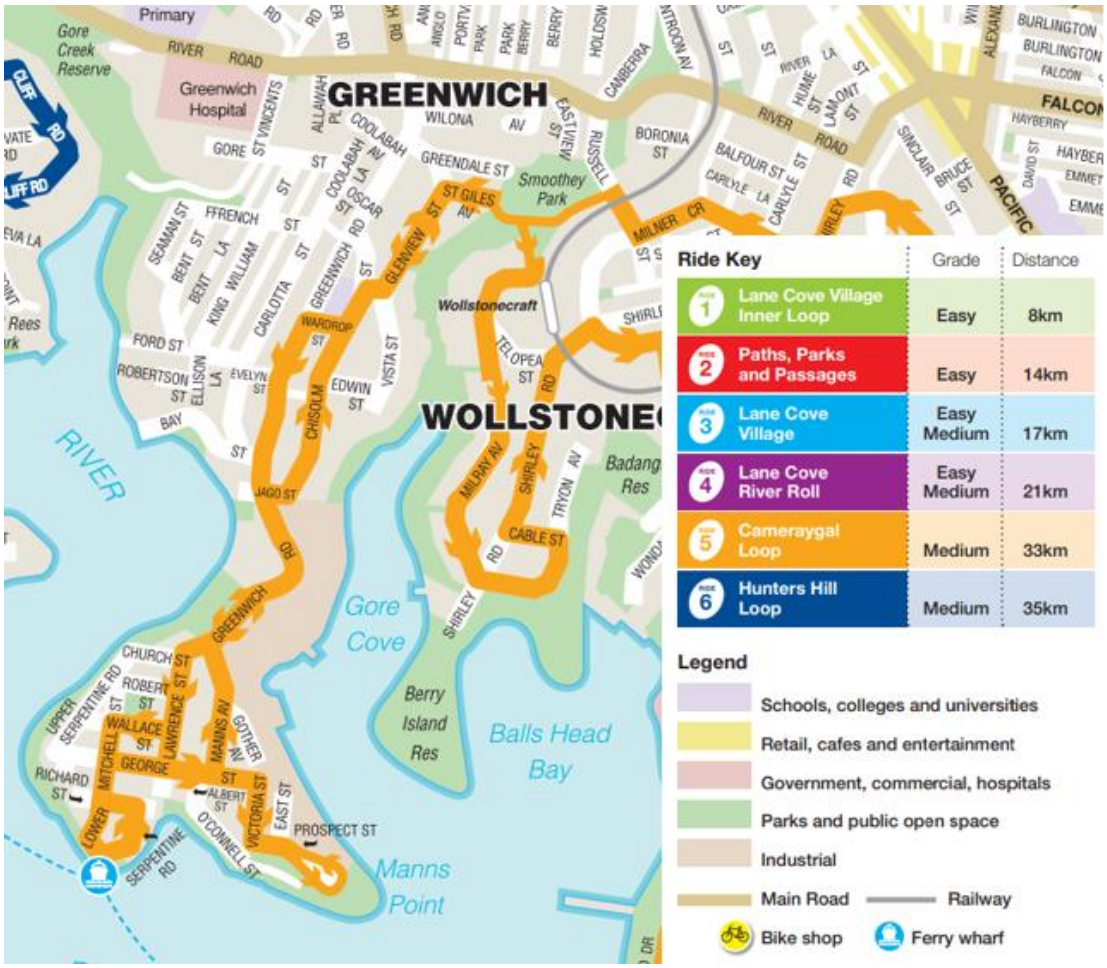


Figure 4-4 Bike routes within Greenwich. (Source: Lane Cove Council webpage: http://ecouncil.lanecove.nsw.gov.au/TRIM/documents_TE/440090408/TRIM_BikeNorth_Riding_LC_Brochure_Website_Friendly_1205113.PDF)

4.3.6 Pedestrian access

Pedestrian access to the wharf is predominantly along Mitchell Street and Lower Serpentine Road. Footpaths alongside these roadways range from 1.5 to two metres in width. Walking access towards the wharf from the road comprises of:

- A set of stairs (1.5 metres wide) down a steep cliff face
- A two-metre wide, 45 metres long ramp with an average gradient of 19 per cent (1:5).

Both methods of access pose difficulties for users with limited mobility (Aurecon, 2019).

4.4 Economic profile

Table 4-7 summarises the employment profile of the study area and Lane Cove LGA.

Table 4-7 Economic profile of the study area (Source: ABS, 2016)

Sub-category	Indicator	Study area	Lane Cove LGA
Income	Median household income (per week)	$3,437	$2,376
	Median personal income (per week)	$1,324	$1,149
Employment	Worked full-time	55.6%	65.8%
	Worked part-time	35.5%	25.8%
	Employed, away from work	5.1%	4.0%
	Unemployed	3.8%	4.4%
	Top three industries of employment	Hospitals (except Psychiatric Hospitals) (6.6%) General Practice Medical Services (6.6%) Other Auxiliary Finance and Investment Services (6%) Legal Services (6%) Accounting Services (6%)	Computer System Design and Related Services (4.8%) Hospitals (except Psychiatric Hospitals) (4.3%) Banking (3.8%)
	Top three professions	Professionals (47.7%) Managers (22%) Clerical and Administrative Workers (14.2%)	Professionals (41.8%) Managers (18.8%) Clerical and Administrative Workers (12.7%)

4.4.2 Income and employment

In 2016 the median weekly household income in the study area was $3,437. This was higher than that for the Lane Cove LGA ($2,376) and Greater Sydney ($1,750).

About 56 per cent of the study area's labour force was employed full-time and about 36 per cent were employed part-time.

Labour force participation (47 per cent) in the study area is slightly lower than the Lane Cove LGA, which is 56 per cent. This correlates with the low percentage of the younger workforce cohort resident in the study area. The most common occupations in the study area include professionals (48 per cent), managers (22 per cent), and clerical and administrative workers (14 per cent). People in the study area mainly worked for hospitals (except Psychiatric Hospitals), general practice medical services and auxiliary finance and investment services, legal services and accounting services.

4.4.3 Local business and services

Greenwich Point wharf is located primarily within a low-density residential area, therefore only a few local businesses are located in close proximity to the proposal (refer Figure 4-5). Local businesses and service providers within 500 metres of the wharf include:

- Greenwich Baths and Café
- Oil refuelling station located within the Working Waterfront Land Zone (IN4)
- Greenwich Tennis Club
- Greenwich Sailing Club.

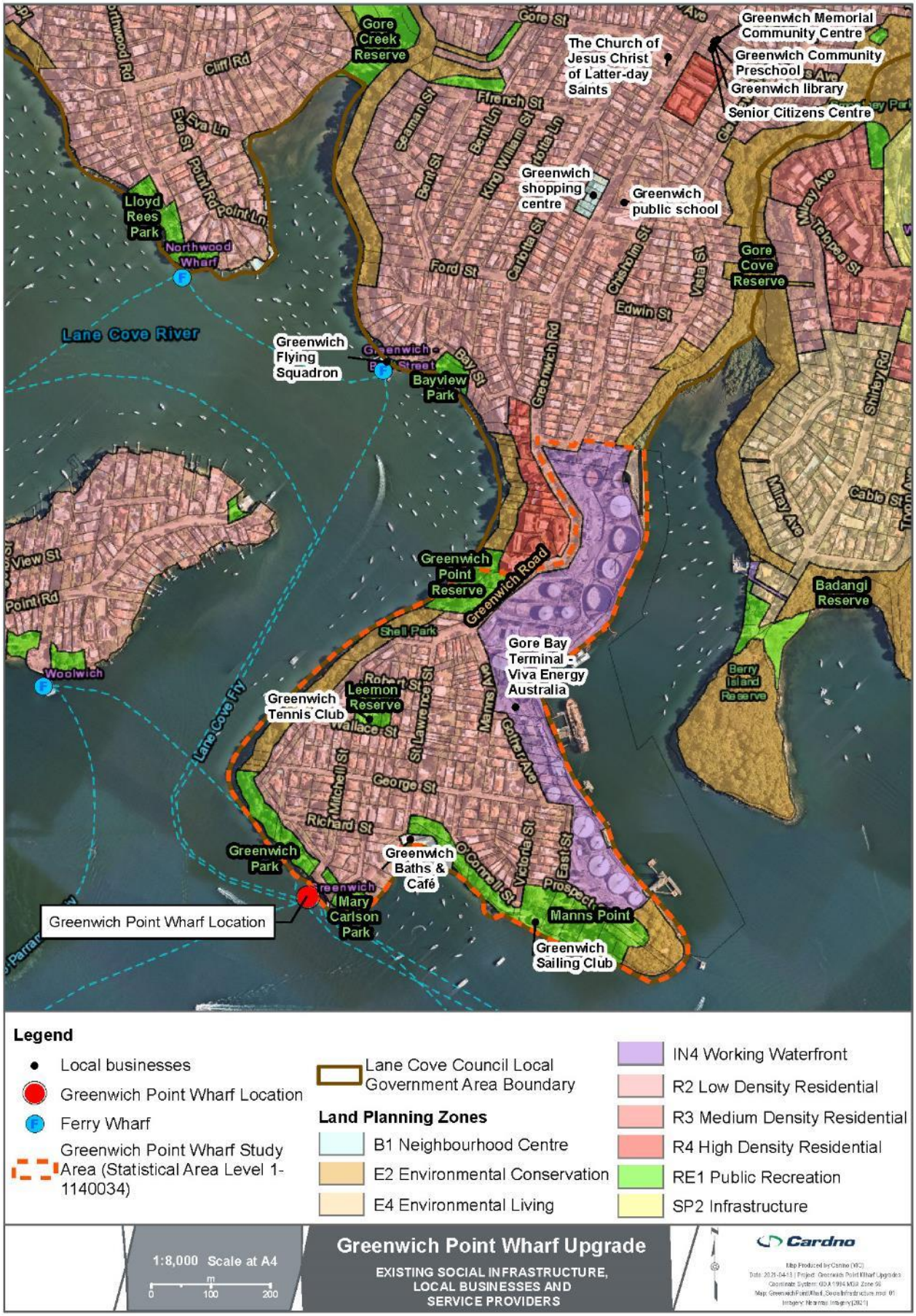


Figure 4-5 Land planning zones, existing social infrastructure, local businesses and service providers within the study area

4.5 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 wellbeing.

Social infrastructure located near the proposal is identified in Figure 4-5 and includes:

- Local parks and recreational areas including:
  - Mary Carlson Park
  - Greenwich Park
  - Leemon Reserve
  - Manns Point
  - Shell Park
  - Greenwich Point Reserve
  - Walking track between Greenwich Point and Shell Park
- Greenwich Baths
- Community infrastructure such as Greenwich shopping centre on Greenwich Road, Greenwich Public School (K-2 campus), The Church of Jesus Christ of Latter-day Saints, KU Greenwich Community Preschool, Greenwich library, Senior Citizens Centre
- Public transport facilities such as bus stops operating in the Greenwich Road, Manns Avenue, George Street, Mitchell Street and Lower Serpentine Road.

4.6 Community values

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

Liveable Lane Cove 2035: Community Strategic Plan (Lane Cove Council, 2018), identifies the values and priorities of the community, as expressed through a range of community engagement activities. Lane Cove community mostly valued the natural environment, village atmosphere, strong community spirit, Lane Cove's location and variety of community services and facilities available.

Lane Cove community is most concerned about the rapidly growing population and the impact this has on local amenity and our environment. The need to manage development through effective controls and appropriate urban design and to have infrastructure in place that has the capacity to keep up with high density growth has been identified as vital.

Other issues that are important to the community include: enhanced engagement, improved connectivity and access to sustainable transportation, access to suitable parking, the protection and expansion of our natural environment, traffic management and safety, and access to sporting and recreational facilities.

4.7 Landscape character and visual amenity

Land use zoning across the study area is mapped in Figure 4-5.

Greenwich Point wharf is situated on a peninsula on Sydney Harbour near the confluence of the Lane Cove and Parramatta Rivers. Greenwich Point has prominent tree coverage which wraps around the peninsula and lines the residential streets. Residential dwellings in the area vary in architectural style, however are generally characteristic of the Greenwich Heritage Conservation Area. Several of these dwellings are visible from the wharf. Existing sandstone and rock outcrops are also visible along the water's edge of Greenwich Point, which is characteristic of the maritime location.

Panoramic views are available from this location towards Sydney Harbour and stretch between Woolwich and Birchgrove, and the Sydney CBD beyond. Surrounding visual landscapes include largely vegetated foreshore and recreational areas, with residential dwellings interspersed between the mature tree canopies. The historic Cockatoo Island is also visible from Greenwich Point wharf, and sits directly south-east of the wharf.

As part of the Landscape character and visual impact assessment (Cardno, 2021a) photomontages were developed to illustrate proposed changes and to determine the likely visual impact generated by the proposed Greenwich Point wharf. Photomontages in the broader study area were prepared from a number of viewpoints including.

- Viewpoint A – Lower Serpentine Road (18 Mitchell Street) looking south toward wharf (Figure 4-6 and Figure 4-7)
- Viewpoint C – Historic wharf and jetty looking north west toward wharf (Figure 4-8 and Figure 4-9)

Viewpoint A is located at the public recreation area in front of the residence of 18 Mitchell Street looking south toward the wharf, with viewpoints extending towards Cockatoo Island and Clarke's Point Reserve across Sydney Harbour. This viewpoint captures the mature vegetation of the foreshore.

Figure 4-6 Viewpoint A – existing view (Source: Urbaine, 2021)

Figure 4-7 Viewpoint A – photomontage (Source: Urbaine, 2021)

Figure 4-8 Viewpoint C – existing view (Source: Urbaine, 2021)

Figure 4-9 Viewpoint C – photomontage (Source: Urbaine, 2021)

4.8 Heritage sites

4.8.1 Aboriginal heritage

A search of the Aboriginal Heritage Information Management System (AHIMS) database on 21 October 2021 revealed two Aboriginal sites recorded within 200 metres of the wharf location as shown in Table 4-8.

Table 4-8 Aboriginal heritage sites within the proposal vicinity

Site ID	Site name	Context	Site features	Distance from the wharf
45-6-1037	Crows Nest; Greenwich Wharf Cave	Closed site	Shelter with art and midden. Includes shell, artefact/s and art (pigment or engraved)	Up to 150 metres*
45-6-3049	Greenwich Path 3 LCC092	Open site	Shell	175 metres

** The location of 45-6-1037 was recorded with Australian Geodetic Datum (AGD) coordinates which are no longer used by contemporary mapping systems. As such, the exact location of the cave could not be confirmed (Aurecon, 2019).*

Stage 1 of the Procedure for Aboriginal cultural heritage consultation and investigation (PACHCI) was completed for the proposed works by Transport for NSW. The preliminary assessment concluded that the proposal is unlikely to harm known Aboriginal objects or places (AHIMS site 45-6-1037).

4.8.2 Non Aboriginal Heritage

Greenwich Point wharf is listed under the Lane Cove LEP as a non-Aboriginal heritage item. The wharf site is also listed on Roads and Maritime s.170 heritage and conservation register.

The State Heritage Register was searched and returned no results of state-significant heritage items near Greenwich Point wharf. There were no items listed as a heritage item in Schedule 4 of *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* within or near the project area.

Schedule 5 of the Lane Cove LEP identified eight local heritage items within 100 metres of the proposal area. Heritage items identified by these searches have been tabulated in Table 4-9. The closest heritage items to the wharf are shown in Figure 4-10.

There are no World, National or Commonwealth heritage items recorded near the proposal.

Table 4-9 Non-Aboriginal heritage sites within the proposal vicinity

Item number	Item name	Address	Distance from proposal area	Listing
I130	Greenwich Point wharf	Serpentine Road	Within proposal area	Heritage Act – s.170 Roads and Maritime heritage register and LEP
I64	Streetscape elements (sandstone steps, outcrops, kerbing and retaining wall)	Greenwich Point (various streets)	Within proposal area	LEP
C1	Greenwich Conservation Area	Greenwich Peninsula South	Within proposal area	LEP
I131	Stone steps to rear of house	36 Serpentine Road	Adjacent, south east	LEP
I110	House	18 Mitchell Street	Adjacent north	LEP
I111	Buena Vista	23 Mitchell Street	Adjacent north west	LEP
I132	Stone sea wall	40 Serpentine Road	40m north-east	LEP
I133	Rockleigh	44 Serpentine Road	75m north east	LEP

These potential heritage impacts are further assessed in section 6.10 and section 6.11 of the REF.

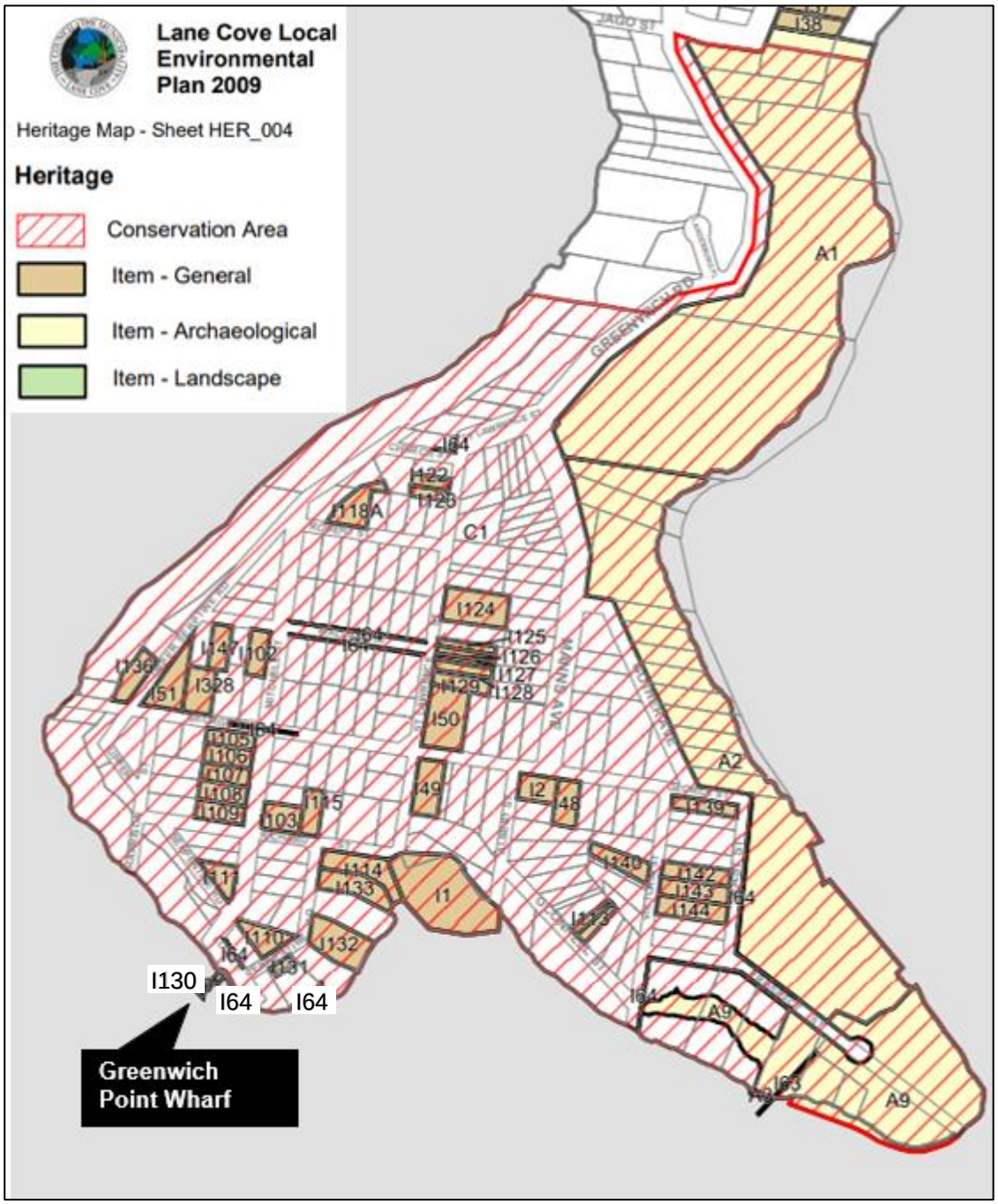


Figure 4-10 Non-aboriginal heritage sites in the study area. Extract from Heritage Map (Sheet HER-004) of the Lane Cove LEP

5 Potential impacts

The proposal has the potential for 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 Greenwich Point 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 six months starting in late 2022. During construction the wharf would be closed.

5.1.1 Transport and access impacts

Existing bus services would be used to support access to Greenwich Point and surrounding areas as bus transport would remain unchanged. Ferry customers travelling to or from the City could catch the existing 265 bus service from St Leonards station as an alternative to using the ferry service during construction, if required. The nearest 265 bus stop is located at the entrance to the wharf on Lower Serpentine Road.

The existing bus service (route 265) has reduced operating hours compared to the ferry service. The bus service generally operates between 6am and 6pm on weekdays, between 9am and 6pm on Saturdays and does not operate on a Sunday or public holidays. However, the F8 ferry service generally operates from 6:30am to 23:30-midnight on weekdays, between 7-7:30am and 23:30-midnight on Saturdays and also operates on Sundays and public holidays. As such, opportunities to provide alternative transport during the construction period would be considered.

Greenwich wharf, which is a private wharf serviced by Captain Cook Cruises, is the closest ferry wharf to Greenwich Point. The Captain Cook Cruises Lane Cove to City ferry service stops at Greenwich wharf and takes about 12 minutes to Circular Quay from Greenwich wharf. Alternatively, customers could use McMahons Point wharf serviced by both F3 Parramatta River and F4 Pyrmont Bay routes.

Closure of Greenwich Point wharf may result in increased travel times for people who would normally use the ferry service in the event they need to use bus services or Wollstonecraft train station, St Leonards train station or a combination of bus and train as an alternative to ferry services. Any disruptions would be managed via notification ahead of construction, and subsequent updates provided to customers.

Although Mitchell Road would remain open, a temporary partial closure of the Mitchell Road / Lower Serpentine Road cul-de-sac may be required during landside construction activities. Any such closures could potentially be undertaken at night to minimise impacts to bus services and property access. The delivery of wharf components would be via the water on a barge and installed by barge mounted crane.

There would be a number of heavy vehicles accessing the proposal site via Greenwich Road during demolition, earthworks, and for installation of the lift and stairs. 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 Greenwich 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 general 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 construction traffic management plan which would be updated as required as the construction activities progress.

A maritime exclusion zone would be required around the proposal area during construction to prevent unauthorised commercial and recreational vessels entering the works area.

The Greenwich Point wharf closures would impact the passengers using the Captain Cook Cruise ferry services from the wharf. Any disruptions would be managed via notification ahead of construction, and subsequent updates provided to customers to seek alternative travel arrangements.

It is expected that these short-term impacts during construction 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, 2021b) identified that for a worst case scenario, construction noise levels are predicted to exceed management levels for 'standard' and 'non-standard' hours for all construction stages at some residential receivers. The most likely source of potential sleep disturbance from outside of standard construction hours works would be from piling proposed during calm sea conditions either late at night or early morning works.

A construction noise and vibration management plan would be prepared prior to construction and implemented throughout the construction period to minimise noise impacts on nearby residents. This management plan would incorporate best practice mitigation measures.

Further details on the potential noise impacts and mitigation measures are detailed in the Noise and Vibration Impact Assessment (Cardno, 2021b) prepared for the proposal.

5.1.3 Heritage impacts

The existing wharf, listed on the Lane Cove LEP and under the s.170 state agency register, would be removed as part of the works.

The proposed works would occur within 100 metres of an additional seven non-Aboriginal heritage items listed on the Lane Cove LEP. All landside works would fall within the Greenwich Conservation Area.

Further details on the potential heritage impacts and mitigation measures are detailed in the Statement of Heritage Impact (Artefact, 2021) prepared for the proposal.

5.1.4 Local amenity

The site compounds would be located in Greenwich Park and Mary Carlson Park (Figure 5-1) and a land exclusion area may also need to be established around the construction area for the safety of people using the park and other recreational users during construction. Pedestrian and cyclist access to the foreshore around Greenwich Park would be restricted, however access to the Greenwich Point to Shell Park walking track would be maintained. As a result, recreational users may potentially be impacted during the construction period. At the end of construction, the exclusion zones would be removed and the area would be landscaped and made accessible again.

Some construction activities may require work to be carried out during early mornings or late at night when the water is calm and the harbour is least busy, a time of day where residents may be more likely to be at home and therefore disrupted by the activities. Construction activities conducted at night-time, or the use of high voltage lighting, may also disrupt nearby residents. The management measures described in Chapter 6 would aim to minimise these impacts on local amenity.

5.1.5 Local businesses

There are no local businesses located within 100 metres of the wharf. However, indirect impacts to local businesses in the broader area may occur due to increased construction traffic, noise, air quality and visual impacts, and a general decline in local amenity. Further consultation with businesses and the community would be undertaken to determine sensitive periods for surrounding businesses and other receivers. This may include consultations with the surrounding businesses to understand their peak hours. The management measures described in Chapter 6 aim to minimise these impacts.

5.1.6 Opportunities

Construction activity also generates regional demand for services such as recruitment agencies, construction companies, suppliers and construction services. Local businesses such as cafes may benefit from the patronage of construction personnel.

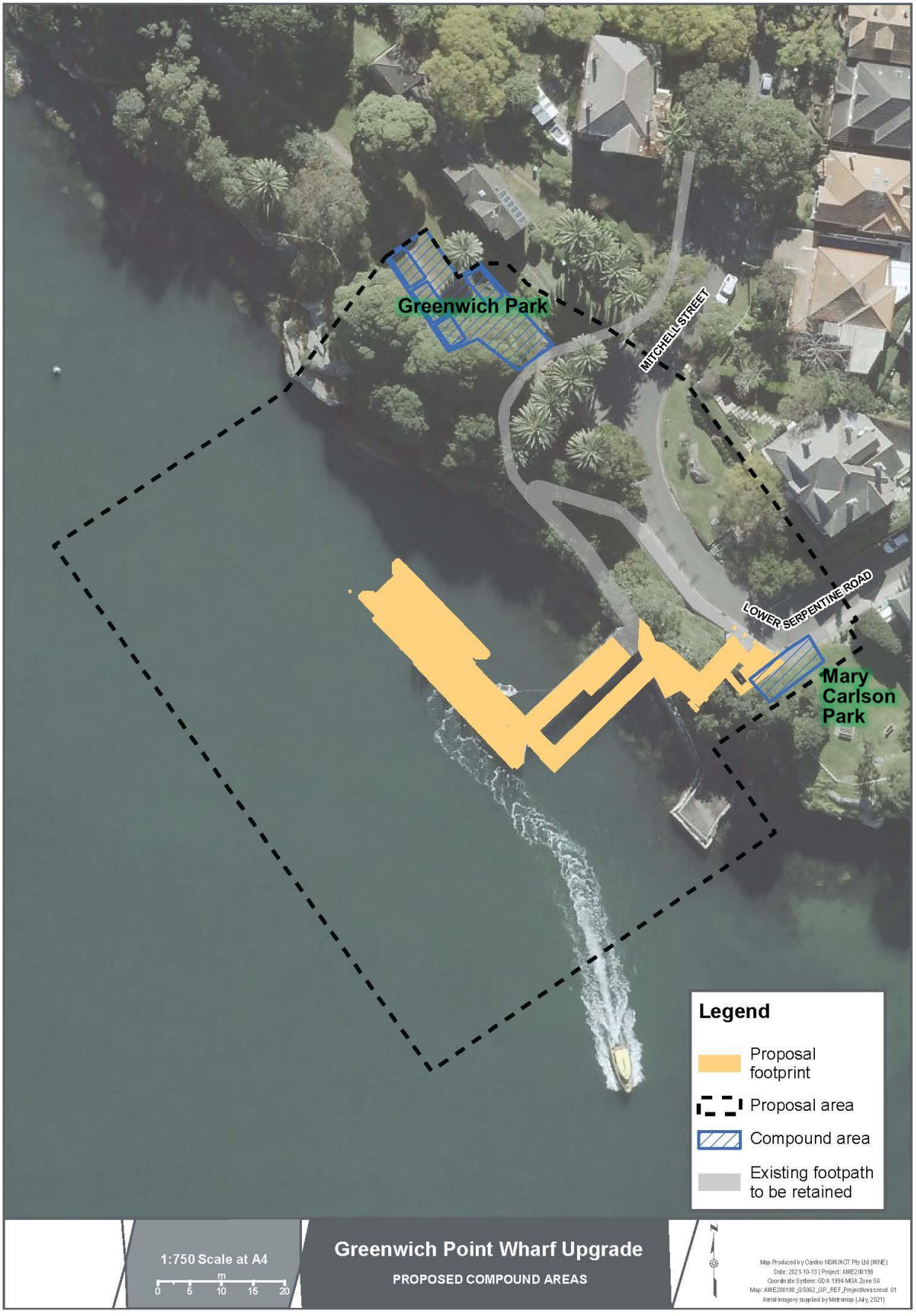


Figure 5-1 Proposed compound areas

5.2 Operational impacts

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

5.2.1 Transport and access

At present Greenwich Point wharf does not provide equitable access to ferry services and it does not meet the DSAPT or DDA requirements. Customers with mobility needs are currently unable to access the wharf. The proposed wharf design on the waterside includes a new DSAPT compliant gangway and covered pontoon. Land-based DSAPT compliant infrastructure includes a path from Lower Serpentine Road to a new 13 metre high lift to take customers between the street and water levels.

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

The landscape character impact of the proposed Greenwich Point wharf (which would replace the existing wharf) on the surrounding character zones is considered to be moderate to high as the proposed lift, covered pontoon and skybridge would introduce new built elements to the vegetated foreshore setting. The proposal occurs adjacent to, and within, the Greenwich Heritage Conservation Area which increases the sensitivity of the landscape.

The overall visual impact of the proposed concept design for Greenwich Point wharf is considered moderate to high 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 lift and skybridge would be new built elements visible from sensitive locations in particular from the adjacent Lower Serpentine Road (and heritage listed residential properties opposite) and the elevated foreshore park (Mary Carlson Park). However the other new structures would be largely screened from this view as they are located beyond and below the steep cliff to the foreshore. All existing trees would be retained, although some pruning of existing vegetation would be required to accommodate the lift and stairs and skybridge.

5.2.3 Local businesses and community

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 waiting area for the security of waiting passengers.

5.3 Significance of impacts

The Table 5-1 summarises the significance of social and economic impacts of the proposal with regard to the factors of sensitivity and magnitude.

Table 5-1 Significance of social and economic impacts

Impact	Stakeholder	Duration	Sensitivity	Magnitude	Level of Significance
Construction impacts					
During the construction phase the wharf would be closed	Local residents	Short-term	Low	Moderate	Moderate-low
Introduction of temporary access restriction, diversions and traffic management controls	Local residents, visitors to Greenwich	Short-term	Negligible	Low	Negligible
Construction-generated noise and vibration	Local residents adjacent to the wharf	Short-term	Moderate	Moderate	Moderate
Reduced amenity during construction	Local residents adjacent to the wharf	Short-term	Low	Low	Low
Reduced patronage of local businesses	Local businesses	Short-term	Low	Low	Low
Operational impacts					
Visual impact of the proposal from the various viewpoints	Local residents, ferry patrons	Medium-term	Moderate	Moderate	Moderate
Improved customer experience of ferry services from the wharf	*Local residents, visitors and local businesses*	*Positive impact*			
Increase access to services, and economic opportunities for locals	*Local residents*	*Positive impact*			

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 will be developed prior to the commencement of construction and will be implemented during construction to provide timely and accurate information to stakeholders. It will include (as a minimum): > Mechanisms to provide details and timing of proposed activities to local community and affected businesses including changes to traffic, public transport services and access > A contact name and telephone number for complaints. The Plan will be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008)	Transport for NSW / Contractor	Pre-construction / Construction
SE2	General Socio-economic impacts	> A webpage and free-call number will be established for enquiries regarding the project, 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 benefits	Investigate opportunities to encourage the Contractor to purchase goods and services locally.	Transport for NSW	Pre-construction / Construction
SE4	Socio-economic benefits	Investigate opportunities to incorporate community health and wellbeing initiatives in the design and construction of the project.	Transport for NSW	Detailed design / Construction
SE5	Land transport and parking	Opportunities to provide alternative transport during the construction period will be considered.	Transport for NSW	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 wharf closure and alternative transport arrangements prior to the commencement of construction. This will include updates to the timetable (online and Opal app) indicating the construction work at the wharf.	Transport for NSW	Pre-construction / construction
T4	Maritime transport	> A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the site. > This zone will be clearly defined to communicate access for other water users.	Contractor	Pre-construction / 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. The TAP is an initiative to deliver modern, safe and accessible transport infrastructure across NSW.

The existing wharf sits at the end of a one way road at the transition between Lower Serpentine Road and Mitchell Street. The wharf is situated between Mary Carlson Park to the east and Greenwich Park to the west. Current access to the wharf requires ferry passengers to traverse a narrow set of stairs or a relatively steep ramp. Customers with mobility needs are currently unable to access Greenwich Point wharf. Transport for NSW are planning to replace the wharf at Greenwich Point to improve accessibility.

The proposed wharf design includes a new DSPAT compliant covered pontoon, gangway, jetty and skybridge connecting the footpath to the lift.

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 other specialist studies prepared for the REF, and the outcomes of community consultation, and proposes the adoption of appropriate mitigation measures for identified impacts.

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. This would include disruption to ferry services from the wharf, disruption to recreational activities conducted around the wharf, and increased local traffic. 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 Lane Cove Council, local businesses, social infrastructure providers and local residents being notified and effectively engaged 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.

8 References

Artefact (2021). Ferry Wharf Upgrade Program 3, Greenwich Point Wharf. Statement of Heritage Impact. Report prepared by Artefact Heritage for Cardno (NSW/ACT) Pty Ltd on behalf of Transport for NSW.

Aurecon (2019). *Ferry Wharf Upgrade Program, Greenwich Point wharf interchange: Concept design report, Roads and Maritime Services*, Prepared by Aurecon Australasia Pty Ltd on behalf of Roads and Maritime Services, July 2019.

Australian Bureau of Statistics (2018). *Socio-Economic Indexes for Areas (SEIFA) 2016*. Available at: https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/2033.0.55.001Main+Features12016?OpenDocument

BMT (2018). *Greater Sydney Harbour Estuary Coastal Management Program Scoping Study*. Developed by BMT, in partnership with the Greater Sydney Local Land Service, Office of Environment and Heritage and City of Sydney. Available at: https://www.sydneycoastalcouncils.com.au/wp-content/uploads/2018/10/Greater-Sydney-Harbour-Coastal-Management-Plan-Scoping-Study.pdf

Cardno (2021a). *Landscape Character and Visual Impact Assessment: Greenwich Point Wharf Upgrade.* Prepared by Cardno (NSW/ACT) Pty Ltd on behalf of Transport for NSW.

Cardno (2021b). *Noise and Vibration Impact Assessment: Greenwich Point Wharf Upgrade.* Prepared by Cardno (NSW/ACT) Pty Ltd on behalf of Transport for NSW.

Cardno (2021c). *Greenwich Point Wharf – Ferry Wharf Upgrade Program TAP 3 – Communications and Stakeholder Engagement Plan 2021.* Prepared by Deborah Metcalf for Cardno (NSW/ACT) Pty Ltd on behalf of Transport for NSW.

DPIE (2019). *Lane Cove Council 2016-2041 Population* Projections. Available at: https://www.planning.nsw.gov.au/-/media/Files/DPE/Factsheets-and-faqs/Research-and-demography/Population-projections/2019-Lane-Cove.pdf Department of Planning, Industry and Environment.

Greater Sydney Commission (2018a). *Greater Sydney Region Plan: A Metropolis of Three Cities*. Available at: https://www.greater.sydney/metropolis-of-three-cities

Greater Sydney Commission (2018b). *Our Greater Sydney 2056: North District Plan.*

GHD (2021). *Greenwich Point Wharf Interchange. Concept Design Report – Amendment 1.* Prepared by GHD on behalf of Transport for NSW, August 2021.

Lane Cove Council (2009). *Lane Cove Local Environmental Plan 2009.* Available at: https://www.legislation.nsw.gov.au/view/html/inforce/current/epi-2010-0049

Lane Cove Council (2010a). *Lane Cove Social Plan 2010-2014: Meeting the Needs of Our Community.* Available at: http://ecouncil.lanecove.nsw.gov.au/TRIM/documents_TE/970907918/TRIM_Lane%20Cove%20Social%20Plan%202010-2014_609425.PDFLane Cove Council (2010b). *Lane Cove People with Disability. Social Plan 2010–2014*. Available at: http://ecouncil.lanecove.nsw.gov.au/TRIM/documents_TE/970907923/TRIM_Lane%20Cove%20People%20with%20Disability%20Social%20Plan%202010-2014_609420.PDF

Lane Cove Council (2016). *Sustainability Action Plan 2016-2021*. Available at: http://lcc-web1.lanecove.nsw.gov.au/flipbook/SustainabilityActionPlan/files/index.html

Lane Cove Council (2017). Disability Inclusion Action Plan - Lane Cove Council - July 2017 - June 2021. Available at: http://ecouncil.lanecove.nsw.gov.au/TRIM/documents_TE/970907931/TRIM_Disability%20Inclusion%20Action%20Plan%20-%20Lane%20Cove%20Council%20-%20July%202017%20-%20June%202021_1214000.PDF

Lane Cove Council (2018). *Liveable Lane Cove 2035: Community Strategic Plan* Adopted 18 June 2018. Available at: http://ecouncil.lanecove.nsw.gov.au/TRIM/documents_TE/440090666/TRIM_ADOPTED%20Community%20Strategic%20Plan%20-%20Liveable%20Lane%20Cove%202035%20-%2018%20June%202018_1257482.PDF

Lane Cove Council (2019). *Riding around Lane Cove*. Available at: http://ecouncil.lanecove.nsw.gov.au/TRIM/documents_TE/440090408/TRIM_BikeNorth_Riding_LC_Brochure_Website_Friendly_1205113.PDF

Lane Cove Council (2020). *Delivery Program 2020-22 and Operational Plan 2020-21* June 2020. Available at: http://ecouncil.lanecove.nsw.gov.au/TRIM/documents_TE/440090621/TRIM_Delivery%20Program%202020-22%20and%20Operational%20Plan%202020-21%20web_1439070.PDF

NSW Government (2012). *NSW Long Term Transport Master Plan*. Available at: https://www.transport.nsw.gov.au/newsroom-and-events/reports-and-publications/nsw-long-term-transport-master-plan

NSW Government (2013). *Sydney's Ferry Future: Modernising Sydney's Ferries*. Available at: https://www.transport.nsw.gov.au/newsroom-and-events/media-releases/sydneys-ferry-future-new-vessels-new-wharves-and-more-services

TfNSW (2013). *Sydney's Ferry Future: Modernising Sydney's Ferries 2013*. Transport for NSW.

TfNSW (2017a). *Sydney Ferries Network map*: https://transportnsw.info/sydney-ferries-network-map. Transport for NSW.

TfNSW (2017b). Disability Inclusion Action Plan 2018–2022. Available at: https://www.transport.nsw.gov.au/system/files/media/documents/2018/tfnsw-disability-inclusion-action-plan-2018-2022.pdf. Transport for NSW.

TfNSW (2020a). *Environmental Impact Assessment Practice Note (EIA-N05): Socio-economic assessment,* Transport for NSW, January 2020.

TfNSW (2020b). Routes and timetables: F8 Circular Quay to Cockatoo Island. Available at: https://transportnsw.info/documents/timetables/93-F8-Cockatoo-Island-20201025.pdf

TfNSW (2021a). Ferry Patronage – A Comparison of Monthly Opal Trips by Line. Available at: https://www.transport.nsw.gov.au/data-and-research/passenger-travel/ferry-patronage/ferry-patronage-monthly-comparison.

TfNSW (2021b). Routes and timetables: Route 265 Lane Cove to North Sydney via Greenwich. Available at https://transportnsw.info/documents/timetables/16-265-Lane-Cove-to-North-Sydney-via-Greenwich-20210419.pdf